Obtaining and Using Data in Practice Improvement

A HANDBOOK FOR HEALTH IT ADVISORS AND PRACTICE FACILITATORS

Agency for Healthcare Research and Quality

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Contents

Introduction

Over the past two decades primary care practices have been encouraged to implement new, evidence-based approaches and advanced models of care to close the quality "chasm" in healthcare. [1] Increasingly, value-based payment programs also tie practice reimbursement to the implementation of processes that are designed to improve quality. [2-4]

External support, particularly practice facilitation, has emerged as a successful method to help practices implement new approaches to improving quality of care [5-10] and advanced primary care models. [11-22] Practice facilitators – also called practice coaches – draw on their skills in engaging and motivating change and improving work processes to help practices improve the quality of care they provide. [23] Agency for Healthcare Research and Quality (AHRQ)-funded EvidenceNOW initiatives have provided evidence of the effectiveness of practice facilitation as well as an increased understanding of the importance of high-quality data for the practice improvement process.

However, practice facilitation is implemented by a variety of different types of organizations, and practice facilitators vary in their background and skills in clinical health information technology (IT). This has led some practice transformation and quality improvement (QI) organizations to develop the role of a health IT-focused coach (or a "Health IT Advisor") as a complementary resource to support practices in their QI and practice transformation efforts. [8, 24] Health IT Advisors are essentially practice coaches who focus on healthcare information technology. For example, they may help a practice look at their EHR reports and data to determine their baseline results around the quality of care they are providing. Or, Health IT Advisors may help practices with data validation around specific quality measures. [25] While some health systems and practices have internal staff that can serve in this role, there is value to having an external health IT coach share the best practices they have learned from working across many practices, with different electronic health records (EHRs) and other health IT platforms, and from addressing a wide variety of issues.

AHRQ has developed extensive resources to support primary care practice facilitation, including a Primary Care Practice Facilitation Curriculum and related Practice Facilitation Training Modules (and the precursor to these materials, the Practice Facilitation Handbook). These resources include information regarding the use of data for QI; however, they contain only limited information about the use of EHRs and other health IT as sources of data for practice improvement and transformation. The current handbook was developed to provide the more in-depth information Health IT Advisors need to effectively support the IT needs of primary care practices as they increasingly engage in QI and practice transformation efforts.

About This Handbook

The authors designed *Obtaining and Using Data in Practice Improvement: A Handbook for Health IT Advisors and Practice Facilitators* to be a resource for the coaches who provide health IT-related assistance for primary care practices to support their QI and practice transformation efforts. The audience for this handbook includes both the health IT-focused coaches who support QI work (who we refer to as "Health IT Advisors") as well as the practice facilitators/coaches who have the necessary background, interest, and skills to provide clinical health IT support. Although the handbook is primarily

intended for external coaches working with primary care practices, we believe the content could also be useful for practice-based staff responsible for addressing health IT needs related to QI.

The handbook assumes readers already have a basic level of comfort with EHR use and with extracting and using electronic data for QI. While the handbook does not cover advanced health IT topics, it does include links to supplementary information in these areas where appropriate. Finally, the handbook does not include practice facilitation information already covered in other resources (described above).

The handbook is organized into nine sections and four appendices:

- **Section 1: Strategies for Health IT Advisors.** This section is a review of general strategies for Health IT Advisors working with practices to promote QI using EHRs and other health IT and includes information about assessing QI practice capacity; different health IT systems that coaches will see in the field; obtaining practice buy-in and engaging leadership; collaborating with practice QI staff; establishing shared QI goals; monitoring adoption and providing feedback; incentivizing QI; establishing data protocols; and understanding policy and legal issues as well as patient attribution and empanelment.
- **Section 2: Working with Electronic Health Records.** This section is a review of foundational concepts for Health IT Advisors working with practice electronic EHRs, including data structures; how workflows impact data; how to assess data quality; best practices for handling EHR data; privacy and security considerations; tips for extracting data and obtaining EHR support; and suggestions for documenting and sharing best practices.
- **Section 3: Clinical Decision Support**. This section provides a review of clinical decision support (CDS) and includes a discussion of CDS applications for QI. Types of CDS commonly found in EHRs and best practices for using CDS in QI work are also discussed.
- **Section 4: Patient Portals and Engagement Technologies.** This section provides a review of patient portals and related patient-engagement tools and their applications for QI, including a discussion of common features of patient portals and how they may be used in practice improvement efforts.
- **Section 5: Incorporating Patient-Generated Data for Quality Improvement.** This section provides an introduction to patient-generated data and applications for QI, including a discussion of the advantages of patient-reported outcomes and patient-generated data; data examples and sources; technical, privacy, and security concerns; patient-reported symptoms and health-related quality of life; electronic health screenings for preventive care; and data collection and use challenges.
- **Section 6: EHR Use Cases for Quality Improvement.** This section serves as a practical guide to using EHR data as a platform for delivering QI interventions, including a diabetes case study and use cases for using EHR data for quality measurement and improving preventive care.
- **Section 7: Beyond the EHR: Alternative Data Sources for Quality Improvement Data.** This section provides a look at how to use claims data and how health IT platforms beyond the EHR (including registries, population health platforms, and health information exchanges [HIEs]) can be used for QI.

- **Section 8: Review of Clinical Quality Measures.** This section provides a comprehensive review of how clinical quality measures (CQMs) are constructed and used to support QI. This includes reviews types of CQMs; finding CQMs for use in QI; the anatomy of a CQM; CQM specifications; a worked-through example of a CQM; and tips for presenting CQM data.
- **Section 9: Review of Risk-Stratification in Primary Care.** This section provides an introduction to risk stratification, including the identification of high-risk patients; a discussion of health and social factors that impact health; diseases and risk-stratification; and other risk-stratification data sources, goals, and barriers.
- **Appendix A: Review of Interoperability and Data Standards.** This supplemental section provides a review of key interoperability concepts and data standards, including components of interoperability, interoperability standards, and information models.
- **Appendix B: Health IT Crosswalk for the Ten Building Blocks for Primary Care.** This supplemental section applies the Ten Building Blocks Model for Practice Transformation to health IT concepts.
- **Appendix C: Example of Data Planning for Quality Improvement.** This supplemental section provides additional tips on data planning for a QI project.
- **Appendix D: Tips on Designing Reports and Data Visualizations.** This supplemental section provides a guide for selecting and designing data presentations and visualizations to communicate findings.

Section 1: Strategies for Health IT Advisors

This section reviews general strategies for working with practices to improve EHR and other data capabilities and to promote ongoing QI. Some of the topics introduced in this section are covered in greater detail in subsequent sections. As a general approach, we recommend that the strategies described here should be employed with the goal of building a true partnership with each practice, rather than providing expert instruction.

1.1 *Assessing Practice Capacity, Motivation, and Interest in Quality Improvement*

A careful assessment of practice data capacity, both broadly and specific to the needs of a QI project, is a crucial initial step. This includes determining the specific EHR version and other data systems in use, the ability of the practice to generate key measures and data, the ability of the practice to produce usable, clean, and accurate data, and the use of data in QI and other practice management activities. Potential delays or barriers in producing data should be identified and addressed as early as possible in the process. Practices can vary widely in their data culture, and the promotion of a practice culture of data-driven process and improvement—in close collaboration with practice staff—should be a primary mission of the Health IT Advisor.

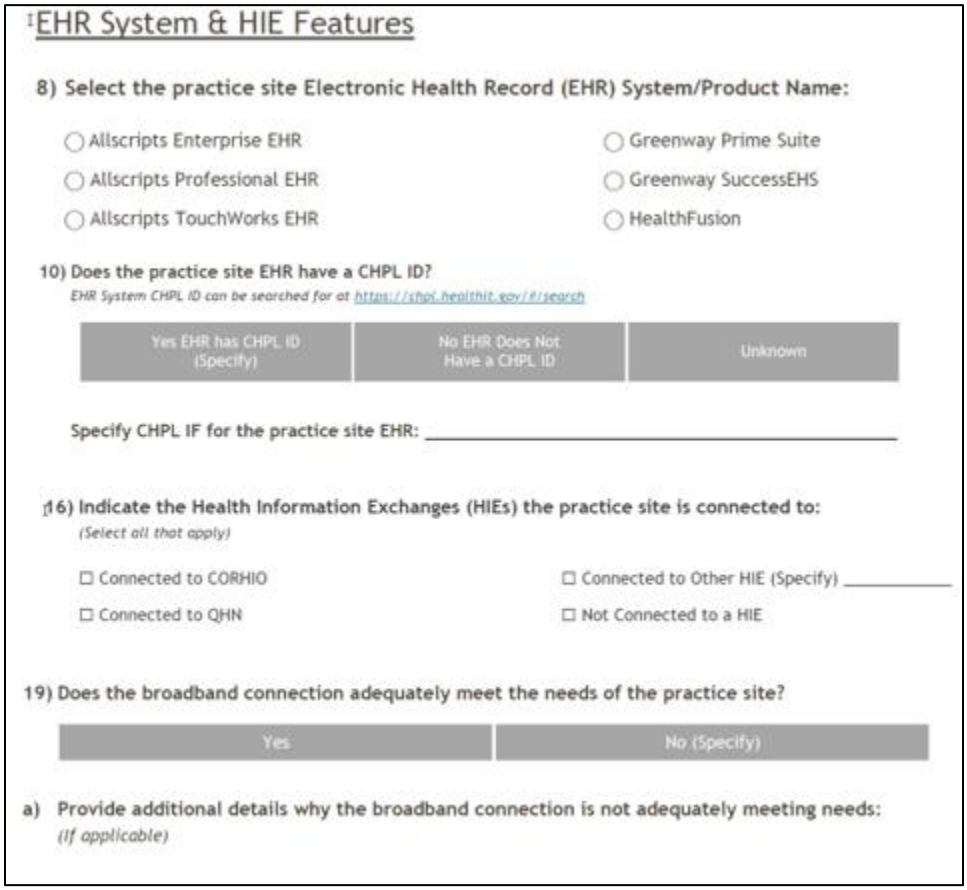
For practices to use data to guide their quality efforts, the data must be accessible, timely, accurate, and trusted. Health IT Advisors can assess these important aspects of a practice's health IT capacity through informal conversations or structured assessments. Section 1.2, Health IT Systems and Platforms, discusses core aspects of clinical health IT that advisors can assess across the practices they serve.

1.2 *Health IT Systems and Platforms*

Health IT Advisors may need to work across dozens of practices and health systems where EHRs and other health IT can vary substantially. By keeping an inventory of key health IT by practice, Health IT Advisors can more quickly spot common barriers and spread useful solutions. Listed below are some examples of important systems and functions that Health IT Advisors can consider documenting for their own information or through a standard questionnaire like the example showed in Exhibit 1.

- EHR system name and version
- Population health software and patient registry tools
- Certified Health IT Products List (CHPL) identification number(s) of health IT systems
- Name and functions of Health Information Exchanges used by the practice
- Adequacy of broadband connectivity, and
- Contact information for IT support and troubleshooting.

Exhibit 1: Sample Health IT Inventory



EHR System & HIE Features

8) Select the practice site Electronic Health Record (EHR) System/Product Name:

- ◯ Allscripts Enterprise EHR
- ◯ Allscripts Professional EHR
- ◯ Allscripts TouchWorks EHR
- ◯ Greenway Prime Suite
- ◯ Greenway SuccessEHS
- ◯ HealthFusion

10) Does the practice site EHR have a CHPL ID?

EHR System CHPL ID can be searched for at https://chpl.healthit.gov/#/search

Yes EHR has CHPL ID (Specify)	No EHR Does Not Have a CHPL ID	Unknown

Specify CHPL IF for the practice site EHR: _____

16) Indicate the Health Information Exchanges (HIEs) the practice site is connected to:

(Select all that apply)

- ☐ Connected to CORHIO
- ☐ Connected to QHN
- ☐ Connected to Other HIE (Specify) _____
- ☐ Not Connected to a HIE

19) Does the broadband connection adequately meet the needs of the practice site?

Yes	No (Specify)

a) Provide additional details why the broadband connection is not adequately meeting needs:

(If applicable)

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Access to Key Reports

Health IT Advisors help practices create and optimize their feedback reports, ensure results satisfy the reporting requirements for external programs, and demonstrate the impact of a practice's internal QI efforts. Key questions to ask include:

- How and when will reports be generated?
- Who has access to the reports?
- Do the numerator and denominator definitions make sense clinically and satisfy the external project specifications?
- How often should reports be updated? Will this time period line up with how fast changes are expected in the project and meet project specifications?
- Does the local QI team trust the results? Do the results line up with the practice's expectations? Are patients included that should not be? Are there patients missing?
- What would make the report more useful for the practice?

Workflows for Reliable Data Capture

Every CQM is made up of smaller key data points. Health IT Advisors need to quickly assess the accuracy and reliability of these core data elements because inaccurate or inconsistent data entry can cause patient care issues and lead to validation concerns in quality reports. The example provided in Exhibit 2 is a simple assessment a Health IT Advisor can use to understand if data is being accurately and regularly recorded in discrete sections of the her (a table that can be filled in and printed can be found here). The table can be modified to only include the elements relevant to any given project, and it can be completed with the practice's improvement teams to highlight workflows in need of attention.

Exhibit 2: EHR Data Assessment Table

EHR Data	Data captured in discrete fields accurately and consistently on all patients	Data captured in discrete fields with accuracy and/or consistency concerns	Data not captured in discrete fields
Patient Linking Number			
Date of Birth			
Gender			
Ethnicity			
Race			
Medications			
Height			
Weight			
Body Mass Index (BMI)			
BMI percentiles (for children)			
BMI follow up plan (for children) – Exercise counseling			
BMI follow up plan (for children) – Nutrition			
Blood pressure – Diastolic			
Blood pressure – Systolic			
Substance abuse screening			
Substance abuse follow up plan			
Anxiety Screening results			
Depression screening for patients 12+ years old			
Maternal depression screening			
Depression follow up plan			
Standardized way to assess risk for child developmental, behavioral, and social delays			
Immunizations			
Colon cancer screening results			
Mammogram results			
Hemoglobin A1C results			

Green	Data captured in discrete fields accurately and consistently on all patients
Yellow	Data captured in discrete fields with accuracy and/or consistency concerns
Red	Data elements not captured in discrete fields

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1.3 *Obtaining Organizational Leadership Buy-in*

Engaging the leadership of a practice and their organizational stakeholders ensures there is a resourced and focused team capable of aligning a practice-wide vision with concrete goals and objectives that the Health IT Advisor can support. This is a key step in any effort to implement evidence-based practice improvements and advanced primary care frameworks.

Leadership introduces the practice to concepts important in improving primary care, enters into value-based payment agreements, creates budgets, determines funding for health IT, allocates time of team members to projects, and sets the stage for the Health IT Advisor in the practice's quality improvement efforts. Within a health system, practice, or system, leaders are critical in getting attention and engagement from the organization's health IT vendors, which can be a major barrier. Leaders exist at all levels in healthcare organizations and primary care practices. Local teams may lack the positional power of system directors and executives but often have the most to gain (or lose) from changes in practice workflows. Understanding how to identify and engage effective formal and informal leaders at all levels of a practice and/or system will help the Health IT Advisor meet improvement objectives. Effective leadership can expedite decision making, provide strategic credibility, and authorize resource allocations.

Dynamic engagement outlasts the one-time pitch. When focusing on implementation, QI data needs, and health IT capabilities, obtaining leadership buy-in should not be a one-time ask. In addition to the recurring funding required for technology licensing, leadership also must regularly invest in team trainings, data extraction, validation, optimization, and reporting to support ongoing data monitoring and quality improvement.

1.4 *Opportunities for Health IT Advisors to Engage Leaders*

A data-driven business case: QI efforts that also improve the financial standing of a practice have a higher likelihood of leadership support and long-term sustainability. Health IT Advisors can help teams compile locally relevant data points to define target populations and capture potential savings or new revenue for a team's proposed interventions.

EXAMPLE:
Practice A was hesitant to shift staff time from other duties to address a growing backlog for patients waiting to be scheduled for internal behavioral health and procedure visits. The Health IT Advisor pulled data on the size of the backlog, the average collections for these visits, and their internal versus industry standards for conversion rate of internal referral to a completed visit. With this data, the team found they could generate over $200,000 of additional revenue per year if a dedicated staff member was assigned to schedule an extra 100 behavioral health and procedure visits each month from this backlog. Sharing this information with leadership lead to hiring a dedicated staff person for this function.

Displaying key data at leadership meetings: Run charts (line charts of data graphed over time; also called run-sequence plots;) and other data visualizations showing data progression over time can be effective tools for orienting leaders to project goals and developing a sense of urgency for making improvements.

EXAMPLE:
Practice B participated in a project to increase the prescribing of statins for patients with diabetes. To increase attention to the project and inform conversations about potential interventions, the Health IT Advisor helped update a monthly run chart showing the proportion of diabetic patients prescribed a statin aggregated at the clinic level and at the provider level. The Health IT Advisor reserved agenda time at the practice's leadership meeting each month to review the data. The team was able to show leadership success in increasing statin prescriptions for this patient population.

Highlighting success: Busy leaders rarely carve out time to celebrate successes in QI projects. Teams do better when they see they are making progress. Rather than waiting until a practice meets their larger goals, Health IT Advisors can support leaders by pointing out positive trends and important data milestones to bolster the sense of accomplishment for the team

EXAMPLE:
As a part of a broader project to integrate behavioral health into primary care, Practice C's leadership team set a goal to screen over 90% of their new mothers for postpartum depression. They spent the first 3 months of the project creating a new documentation module within their EHR to capture this data within the newborn's chart. The Health IT Advisor made a point to congratulate the full clinic team after the first time a screening was properly documented using their new EHR workflow and included leadership in celebrating this achievement.

1.5 *Collaborating with Practice Quality Improvement Staff*

To be successful in QI and practice transformation efforts, you need buy-in from other staff beyond leaders and health-IT-focused employees. This requires a team effort. Health IT Advisors can collaborate with practice staff members and assist in developing a practice support plan that connects the practice's vision for advanced patient care with how they will benefit from multiple projects over time. If a practice has a well-developed QI process already in place, engagement of that team and its leaders will make any efforts easier and more streamlined. If the practice does not have an existing quality improvement team or effort, identification and engagement of potential clinician and staff leaders interested in change and QI will be an important initial part of the effort for the Health IT Advisor.

Once the appropriate practice members have been identified and engaged, work proceeds according to basic QI and change management processes. Throughout, ongoing collaboration with a variety of practice clinicians and staff members will be needed, either through regular team meetings, interactions with individuals, or, generally, both. As an example, to track patents screened positive for unhealthy alcohol use, the Health IT Advisor will need to:

- Learn the clinic's current workflow/process for incorporating a screening tool (this may be in place of other validated tools, or may not yet exist)
- Work with clinicians and staff to select a screening tool
- Coordinate with clinical and operational staff to ensure they are using the screening tool and documenting data in the proper location within the EHR so that it can be counted

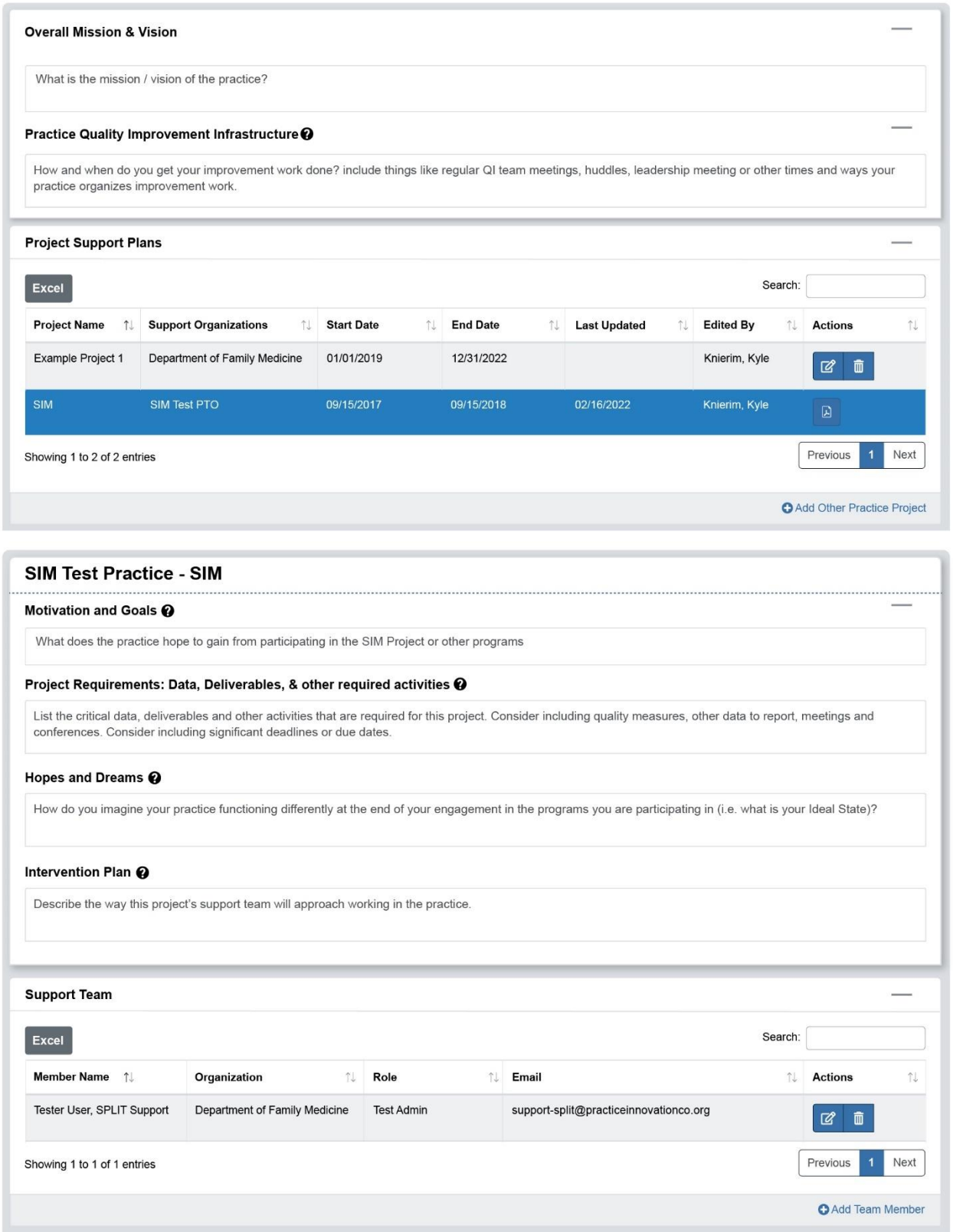
- Assist staff members in developing a process to build and run reports regarding the number of patients screened, and
- Share the reports with clinicians and staff at QI meetings for refinement of ongoing efforts to improve screening.

1.6 *Collaboration to Determine Health IT Needs and Establish Quality Improvement Goals*

Practices may be working with multiple Health IT Advisors, and practice facilitators representing practice transformation efforts, research projects, health system initiatives, health plan payment programs, and other programs or projects. Communication and understanding across various Health IT Advisors and others working with the practice are crucial in coordinating and aligning practice efforts and decreasing the potential for confusion. A shared practice support plan can serve as one way to frame multiple projects in the service of a practice's long-term QI goals. Practices have motivations for working on quality that will outlast any individual project and may involve support from multiple Health IT Advisors and other aligned resources. Understanding and managing the complex and dynamic interplay among individuals, projects, and organizations can often be a source of frustration for Health IT Advisors as well as practice members. Health IT Advisors can use a shared practice support plan to help everyone make sense of QI efforts.

A shared practice support plan starts with a practice's overall mission and vision statement and an outline of their QI resources (Exhibit 3). The shared practice support plan allows QI leaders and Health IT Advisors to explicitly document why a practice decides to participate in QI initiatives, how they see the projects advancing the practice's overall vision, and how the requirements will fit within their current QI infrastructure. For more involved projects, support plans can document project requirements, data expectations, and a coordinated intervention plan that describes ways in which the Health IT Advisor and other support team members will approach working in the practice. Over time, a practice can use this plan to strategically decide on new projects in which to engage and reflect on past experiences to take better advantage of potential project resources.

Exhibit 3. Shared Practice Support Plan



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1.7 *Developing Shared Goals and Action Plans*

Relating closely to the development of a practice support or implementation plan regarding the core content of a particular project, the Health IT Advisor should assist in developing a data quality improvement plan to guide the recording, extraction, cleaning, and reporting of key data related to the project. A simple template for documenting these plans is shown in Exhibit 4, and a template that can be filled in and printed can be found online here. A data quality improvement plan can be developed and monitored:

- With the practice's QI team during regular meetings that include key data personnel from the practice and the Health IT Advisor
- In special meetings with data personnel and other key people from the practice, led by the Health IT Advisor
    - This especially tends to be the case in system practices, where key data personnel may be centralized and not available for regular meetings in the practice. In this case, communications with the Health IT Advisor and the practice QI team are critical to maintaining alignment of plans and expectations.

Key elements of a data quality improvement plan consist of goals that are SMART (SMART Goal Setting): Specific, Measurable, Achievable, Realistic, and Timely. Useful areas of focus for an initial data quality improvement plan include:

- Accurate and consistent capture of core data elements in discrete fields
- Validation of reports and registries, and
- Communicating metrics of success to leadership and care team members.

Data quality improvement plans often contain longer-term ambitions. It is important to help break these plans into smaller, more actionable SMART goals that can be achieved in 1-3 months. SMART goals are good touchpoints to bring up and adjust periodically to keep teams on track with both short-term progress and long-term aims.

Exhibit 4: Data Quality Improvement Plan Goal Setting Form

DATA QUALITY IMPROVEMENT GOALS

- Institute improvement team and feedback and regular check-ins.
- Include those who are involved in creating and using the data.
- Identify goals for data quality improvement related to identified uses and issues.
- Establish measures of success.

Please list your three goals for improving data quality in your practice:

- Make the goals SMART (specific, measureable, attainable, realistic, timely).
- Think of your data elements.
- Consider how to consistently pull reports and validate information relevant to each clinical quality measure (CQM).
- With each goal, be sure to include measure of success.

GOAL 1:

GOAL 2:

GOAL 3:

Graphic adapted with permission from the Practice Innovation Program at the University of Colorado.

Once initial data sources are identified and initial reports developed, a practice can be guided—collaboratively—through steps to assure data accuracy. It is likely that initial reports will contain errors due to erroneous patient attribution, inconsistent data entry into key EHR fields, and a variety of other issues. Careful data cleaning is generally required. Chart audits to verify the accuracy of the data and to determine why it might not be accurate are often very helpful. This entire process takes a great deal of time and varies according to multiple factors, including the type of data being tracked, the EHR or other data source being used, health IT resources within a practice and/or system, and many other variables. [8, 24, 26] In addition, practices often must go through stages of a kind of grief – often including denial and anger – before accepting that the data is a true reflection of the care being provided.

1.8 *Monitoring Practice Adoption and Providing Ongoing Feedback*

Once clean and trustworthy data are obtained, regular data reports can be used to monitor implementation and improvement over time. These reports provide a picture of where the practice is

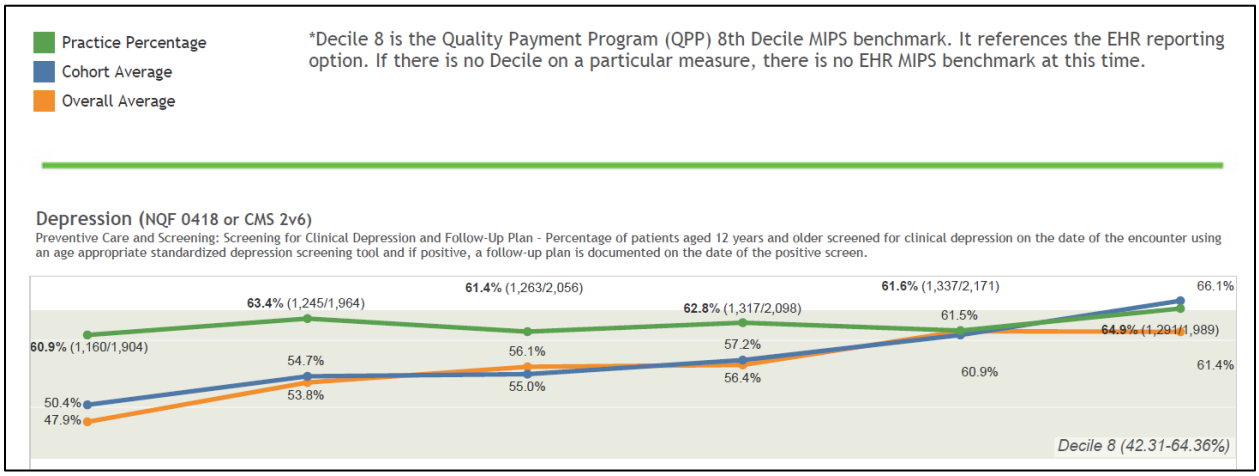
starting and can be reviewed regularly at QI team meetings. Developing a culture of ongoing use of data to inform decision making is a key objective for this type of QI and practice transformation work.

When sharing feedback, keep the following tips in mind:

- **Practices like comparing themselves to others.** People are competitive, and these comparisons can provide a great deal of motivation for change and improvement. Run charts, like the one in Exhibit 5, show performance on CQMs over time. They are a classic example of tools that Health IT Advisors can deliver to practices for ongoing feedback. Adding reference ranges from other practices in a project and national benchmarks if they exist can add context for the practice team as it reflects on its progress.

  Not all measures will have outside reference ranges or benchmarks. In these situations, consider using a control limit chart. Control charts can show how processes change over time and can quickly identify when results change more than expected with random variation in data points. Alternatively, breaking down and comparing data between individual providers can be as motivating as external comparison data.

Exhibit 5: Sample Quarterly Clinical Quality Measure Run Chart with Project and National Benchmarks



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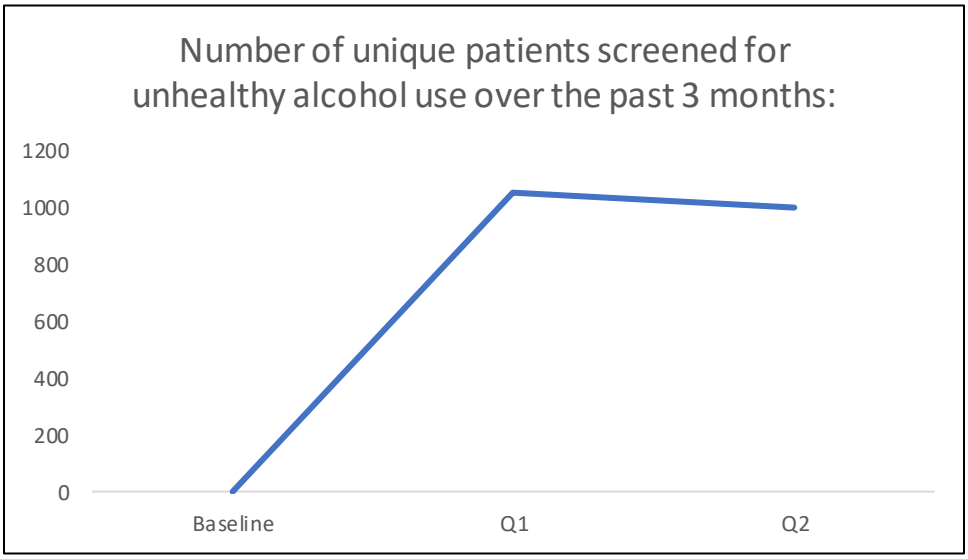
- **The 3% rule of thumb.** The 3% rule of thumb assumes that a successful QI project will produce a sustained 3% absolute improvement in a clinical outcome metric over the course of a 12-month intervention. This principle, developed by quality improvement programs based on experience – and used by the Practice Innovation Program at the University of Colorado – is a quick and easy way to put a practice's QI achievements into perspective. Of course, a Health IT Advisor will need to consider where a practice started (high starting performance may limit how much improvement is possible) and how much control a practice has over the metric (it is easier to change process measures than patient outcomes). Also, process-related measures can sometimes improve more rapidly through improved capture of key data elements. Regardless, the 3% rule is a convenient reference for many QI projects.

- **Stories resonate with staff and providers.** Tables and graphs filled with numbers can motivate analytical team members, but many others find feedback less sterile and more memorable when it is tied to real patient and care team experiences. Health IT Advisors can work with QI teams to share success stories that build momentum or bring up examples of a poor outcome that can develop a sense of urgency for change.

  For example, a Health IT Advisor could use this run chart (Exhibit 6) showing the number of patients screened for unhealthy alcohol use to ask the QI team, "Your data shows a great increase in screening for unhealthy alcohol use; can you think of any of these patients who screened positive that you then went on to connect with resources to help stop drinking?"

Exhibit 6: Sample of a Simple Run Chart



- **Feedback can be used to reinforce good data practices.** Health IT Advisors can draw attention to how the practice advanced their QI agenda by using foundational data skills like validating a report, creating a new patient registry, or training staff on new documentation workflows. This feedback can be brought up at regular QI meetings, by annotating run charts, or when debriefing at the end of a project. Sharing feedback with a larger clinical team as well, beyond QI groups, will promote greater buy-in for future projects.

1.9 *Incentivizing Quality Improvement*

The Health IT Advisor is positioned to translate programmatic benefits and incentives related to quality data systems to practice teams and individuals. Both intrinsic (personal development, belonging, recognition, altruism) and extrinsic (rewards, penalties, compliance) motivators matter when promoting data-driven continuous QI.

What can a Health IT Advisor do to incentivize QI in a practice?

- **Contribute your understanding of programmatic incentives.** Practices look to their Health IT Advisor to answer questions about program requirements. Good Health IT Advisors demonstrate how the practice's health IT strategies and tactics are directly related to achieving success in payment, QI, and other programs. Alignment of practice motivations and incentives

across programs can help the practice make sense of the multiple requirements that are bombarding them and greatly assist in developing coherent action plans moving forward.

- **Build on intrinsic motivators of team members.** This includes autonomy, mastery, belonging, and competition. Foster curiosity in the data. For instance, try asking "Which patients of yours could we help if we focused on this measure?".
- **Engage the patient voice.** Most people in healthcare choose to work in this field to help people and their community live happier, healthier lives. If a practice has a patient and family advisory council, engage them in understanding and supporting the use of data in improving care in the practice.
- **Provide feedback.** Share data in a manner that allows the practice to advance multiple aspects of their existing QI work.
- **Celebrate wins.** Rarely do leaders take time to reflect on and celebrate success. It is easy to gloss over seemingly small health IT wins such as a valid CQM report. Assist the practice in developing a culture where wins are regularly celebrated and rewarded.

1.10 *Establishing Clinical Protocols for EHR Data*

Beyond CQM extraction, cleaning, use, and reporting, practices need clean data and efficient workflows for other uses of their data. This is especially true for practices participating in advanced payment models that incentivize population management, care management, longitudinal tracking of preventive care, and avoidance of unnecessary expenditures. Health IT Advisors can help care teams increase reliability of processes and decrease duplicated effort by ensuring data is thoughtfully embedded within a practice's operating protocols. There still are major deficiencies in clinical health IT systems, but Health IT Advisors can help practices continue to chip away to achieve useful and desirable data resources.

Health IT Advisors have a role in:

- **Promoting reliable and discrete data entry.** While EHRs are rapidly trying to improve their interfaces, many documentation procedures remain so clunky that busy clinical teams often find it easier to simply type their findings in free text fields. But for a data point to flow seamlessly among multiple reports and over time, it needs to be in a discrete, searchable field. With practices new to discrete data entry, consider data that have cross-cutting implications but remain in a practice's control like accurate documentation of repeat blood pressure readings, entry of behavioral health screening results, and recording patient demographics like gender, race, ethnicity, and language preference in a sensitive and affirming manner.
- **Codifying best practices.** Once a team decides on a reliable workflow that involves data entry, Health IT Advisors can help them embed that workflow into policies and training documents. While these documents take an upfront lift to produce, they can make it easier to onboard new members and refresh memories when people fall back into old habits when new priorities inevitably arise. Policies and procedures are important tools to sustain improvements in quality and efficiency.

TIP:
Health IT Advisors can drastically cut down the time it takes to produce policy and training documents by sharing examples from other practices with which they work. Just remember to ask for permission from the example practice first. Ensure that policies and training documents are reviewed and updated on a regular basis, in accordance with an established schedule.

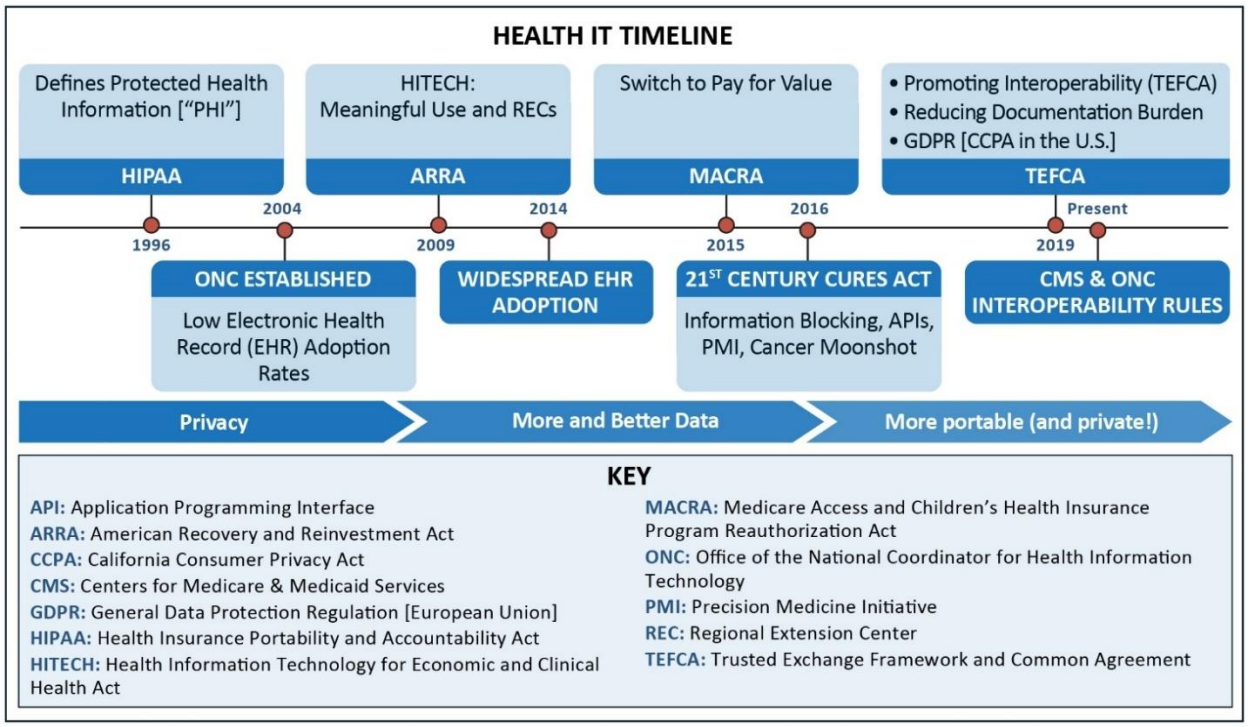
- **Advancing interoperability**. The ecosystem of interoperable health data systems continues to expand. Health information exchanges (HIEs) vary by region, state, EHR platform, and even data type. Health IT Advisors can link practices with organizations and services that provide clean and useful data affordably. While data and reports for some of these purposes are slowly being included in new versions of EHRs, Health IT Advisors can often help practices in navigating this important space through recommending and assisting in the implementation of third-party solutions, such as various types of registries, HIEs, behavioral symptom screening assessments, self-management support platforms, and many others.

TIP:
HIEs are often able to generate reports with lists of a practice's patients admitted, discharged, or transferred (ADT) reports from local hospitals. Managing transitions of care using these ADT reports can be a sustainably reimbursable activity through Medicare and other payers and a key lever for controlling costs in value-based payment programs. The Centers for Medicare & Medicaid Services (CMS) now has a Conditions of Participation (CoP) requirement regarding receiving ADT alerts from hospitals.

1.11 *Understanding Policy Issues*

Federal and state laws have had a dramatic impact on health IT adoption through policies, regulations, and incentive programs. The health IT Timeline in Exhibit 7 shows how key legislative efforts reach back decades and have progressively increased pressure on practices to use data systems to improve health outcomes.

Exhibit 7: Health IT Timeline



Graphic adapted and included with permission from Abel Kho MD, MS, Northwestern University.

Practices often struggle to stay up to date on the shifting (and sometimes conflicting) rules that impact their teams and patients. With a firm understanding of key laws and regulations, Health IT Advisors can help identify when new laws will bring added resources aligned with the practice's QI goals and point out areas needing attention to stay in compliance with new rules. Important information about health IT laws and regulations can be found on the Office of the National Coordinator for Health Information Technology's website ONC | Office of the National Coordinator for Health Information Technology (healthit.gov). Exhibit 8 outlines a few key laws and regulations that impact health IT and the work of Health IT Advisors in practices.

Exhibit 8: Key Health IT Laws and Regulations

Important Health IT Laws and Regulations	Summary	Impact On Health IT Advisors Work
HITECH Act (2009)	Passed in January 2009, as a part of the larger American Recovery and Reinvestment Act, this specified general guidelines for the development and implementation of a "nationwide health information technology infrastructure."[27] Spurred federal government investment to promote the widespread adoption of EHRs that were intended to improve the quality, safety, efficiency, coordination, and equity of healthcare in the US.	Help practices choose or develop EHRs that will meet federal requirements. Focus on reporting on CQMs.

Important Health IT Laws and Regulations	Summary	Impact On Health IT Advisors Work
	Created Meaningful Use, which drove EHR adoption by hospitals and office-based care providers. Also advanced standards in CQMs.	
Medicare Access and CHIP Reauthorization Act (MACRA; 2015)	Adjusted how physicians were paid for their services. Sped the adoption of value-based payment programs that achieve the Triple Aim. Consolidated several QI reporting programs. Authorized the Quality Payment Program, creating the Merit-based Incentive Program and Advanced Alternative Payment Models Tracks 1 and 2.	Continues down path of CQM reporting. Focuses more on electronic CQM (eCQM) reporting through EHR or third-party registry. Moves away from self-reporting metrics from EHR.
Health Insurance Portability and Accountability Act (HIPAA; 1996)	Defined protected information with focus on privacy and security of patient health information. Determines rules around permissible electronic health data exchange.	Focus on Security Risk Analysis. This was started under HIPAA and re-emphasized under the HITECH Act.
Certified Electronic Health Record Technology (CEHRT; 2010)	Rules established within Meaningful Use by the Office of the National Coordinator for Health IT (ONC) defining certified electronic health record technology (CEHRT). This helped standardize many of the requirements that EHR vendors had to follow in designing new EHR systems.	With certified technology, practices have a base-level capability for CQM reporting.
21st Century Cures Act (2016; 2020)	Among other goals, aims to reduce regulatory burdens of using EHR systems and other health IT. Provisions are focused on making progress toward interoperability and ensuring that IT developers do not engage in "information blocking," which is the prevention of or creation of barriers to accessing, sharing, and/or using electronic health data. As part of the "next phase" of the Cures Act, CMS and ONC finalized rules about this in March 2020.	Vendors are increasingly opening their EHR systems to application programming interfaces (APIs) using a platform-agnostic interoperability standard called FHIR®, which has been developed by Health Level Seven International (HL7®).

1.12 *Understanding Legal Issues*

Health IT Advisors will encounter a variety of scenarios that are covered by legal protections of various types. The development of several types of agreements between the Health IT Advisor's organization and a practice and/or its health system will define the relationship between the various organizations, outline the use of data as part of this relationship, and protect the practice, its patients, and the Health IT Advisor. While Health IT Advisors will not generally be responsible for developing agreements between organizations, they need to be aware of key regulations and whether appropriate agreements are in place early in the process of working with a practice.

These agreements and regulations include:

- **Business Associate Agreements.** A business associate agreement, or BAA, is a written document that details how to protect health information when it is shared between two organizations or individuals. It is often required when a Health IT Advisor works for a separate organization from the practice and will need to view protected health information (PHI). For a Health IT Advisor this can include looking at patient information in a practice's EHR for a QI or research project. As outlined by the U.S. Department of Health and Human Services (DHHS), "if a covered entity engages a business associate to help it carry out its healthcare activities and functions, the covered entity must have a written business associate contract or other arrangement with the business associate that establishes specifically what the business associate has been engaged to do and requires the business associate to comply with the Rules' requirements to protect the privacy and security of protected health information." [28] Health IT Advisors should verify if a BAA is needed or in place prior to the beginning of a project. An example of a business associate agreement can be found here: *Model Business Associate Agreement (hhs.gov).*
- **Data Use Agreements.** When Health IT Advisors work on projects with practices from different organizations around specific clinical data or quality measures, a data use agreement (DUA) might be needed. "A data use agreement establishes who is permitted to use and receive the Limited Data Set, and the permitted uses and disclosures of such information by the recipient." [29] The DUA specifies what data will be shared and how that data will be used by partnering organizations. It will also specifically list how the data will be destroyed or returned at the end of a given time period. The Health IT Advisor should be aware of any DUAs prior to starting a project.
- **Institutional Review Board.** Institutional review boards (IRBs) help ensure that human subjects research is conducted in an ethical manner and in compliance with federal and organizational guidelines. Health IT Advisors often work on research projects and therefore need to be aware of how IRB rules impact data covered under research protocols. This data may include clinical data from an EHR, survey data, and interviews that Health IT Advisors participate in for a project. When working on an IRB-approved research study, Health IT Advisors should be aware of the specific descriptions of data gathering and use included in the research protocol and the IRB approval documents. IRBs' role in the protection of human subjects in research is guided by DHHS' "Common Rule." QI research projects that involve human subjects will require IRB review, but not all QI projects require IRB review and approval.

1.13 *Understanding Patient Attribution and Empanelment*

Empanelment and attribution are related concepts differentiated by the source of the allocation of patients, among other factors; some of these are shown in Exhibit 9.

Exhibit 9: Empanelment Versus Attribution

Features of Empanelment	Features of Attribution
• Process a practice uses to identify their "active patients" and to assign those patients to a single provider or care team panel • Foundation for establishing continuity between patient and provider/care teams • Managing panel size is an important step in balancing access to and demand for services • Requires ongoing monitoring as patients change primary care providers, move, or die, and as providers leave practices • Helps define the inclusion criteria of many QI metrics • Used to credit quality outcomes to individual providers and care teams and for programs like CMS Medicare Merit-based Improvement Payment System (MIPS)	• Process insurance companies and other purchasers of group healthcare use to assign patients to a particular provider, practice, or health system; determines payment • Contractual agreement where assigned providers can receive incentives to provide a certain set of services or achieve certain aggregate outcomes • Understanding attribution is a core element of value-based payment programs in which many practices are participating • Changes as people gain and lose insurance, methodologies adjust, and health plan options evolve

Traditionally, the definition of "active patients" includes patients who have sought care at the practice within the last 24 to 36 months, allowing inclusion of some patients who have minimal preventive or chronic healthcare needs. In practices who also have attributed patients, empanelment should also include those patients assigned to the practice by a health plan, even if those patients have never sought care with them.

Health IT Advisors can take certain steps to help practices with traditional empanelment as well as attribution, including:

- Help the team determine an empanelment methodology and workflow and document agreed-upon procedures with key clinicians and staff
- Ensure all active patients are assigned to a provider panel
- Monitor concordance between internal empaneled patients and payer attribution reports
- Help practices follow payer methodologies to reconcile any discrepancies, and
- Explain when CQMs include attributed patients in specifications to avoid confusion among care teams.

Section 2: Working with Electronic Health Records

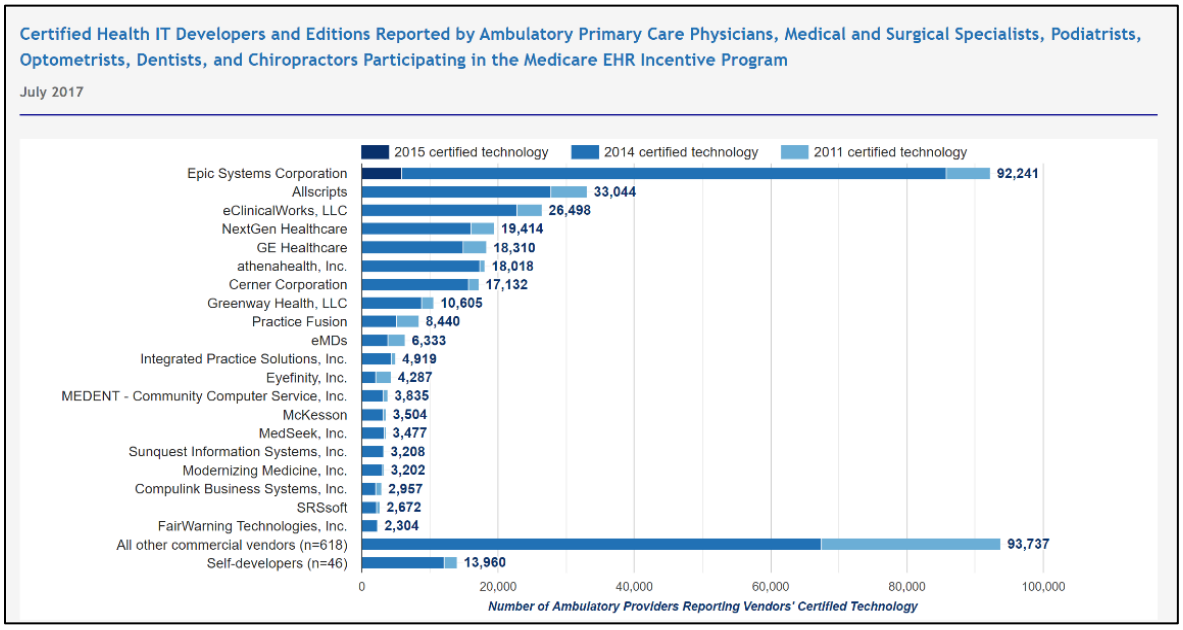
This section of the handbook focuses on the EHR as a tool for QI. Section 7 addresses useful alternative electronic data sources including external electronic registries, population health platforms, and HIEs, and Appendix A covers standards for data exchange, or interoperability, between systems.

The EHR is the most common type of health IT used by healthcare providers in the U.S. To qualify for the CMS Quality Payment Program (QPP) and other government and value-based incentive programs (see Section 7), EHRs must have a current certification with the federal Office of the National Coordinator for Health IT (ONC). The certification criteria specify the minimum technical and functional requirements that an EHR vendor must meet to qualify for the Medicare MIPS,[3] Promoting Interoperability requirements, formerly called "Meaningful Use"). As of 2022, this is the 2015 edition.[30]

In 2022, there were more than 400 unique EHR developers with products listed with the ONC and more than 600 individual EHR products and versions. Exhibit 10 shows the most common IT vendors adopted by ambulatory providers in the U.S. from a survey in 2017, with the majority of providers using products from Epic, Allscripts, eClinicalWorks, GE, athenahealth, and Cerner Corp.[31]

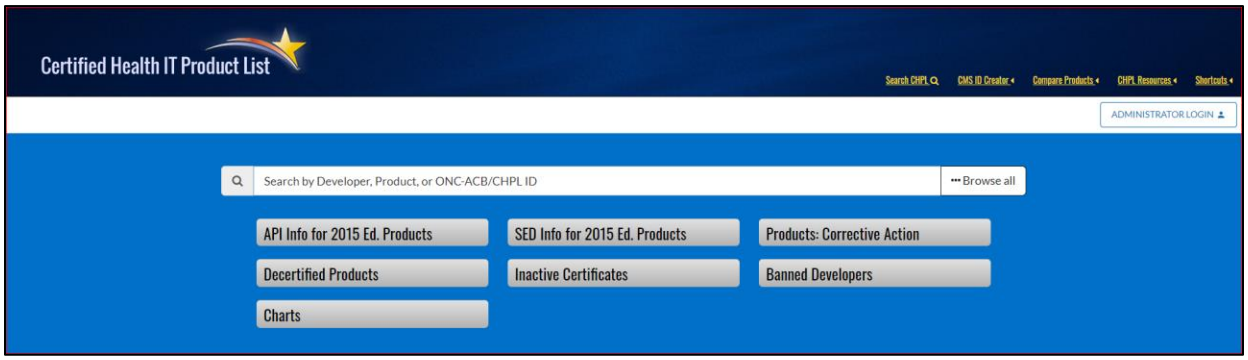
Health IT Advisors may have to work with a number of different EHR systems, and, thus, may have to learn different methodologies to generate data needed for QI or to deliver an intervention based on the EHR a practice has adopted.

Exhibit 10. Certified EHR Technology Used by Ambulatory Providers as of 2017 [32]



TIP:
It is helpful to know what a clinic's EHR capabilities are before beginning a QI project. A quick way to find out is to use the ONC's online Certified Health IT Product List (CHPL) search tool to review the certification status, product conformance, and what quality measures the vendor provides for a given product and version. Be sure to ask for the details regarding the clinic's EHR system (and version, etc.) before conducting this search. A screenshot of the search tool is shown in Exhibit 11.

Exhibit 11: ONC's Certified Health IT Product List Search Tool [33]



EXAMPLE:
You will be working with a small independent practice using an EHR from vendor ABC. They are currently on version 123, which has a current ONC certification. For the project, you will need clinical performance data on the number of patients with controlled diabetes before and after a quality intervention. After looking up the vendor and version on the CHPL, you find that the vendor offers several certified quality measures that could be used for the project. For the project, you decided on "Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%), (CMS 122, NQF 0059)" as a potential metric to use. [34]

The following topics provide an overview of the fundamental concepts and best practices to consider when using an EHR for QI and practice transformation. We begin with a conceptual map of the data an EHR is likely to contain.

2.1 *An Overview of Generic EHR Data Groupings and Elements*

With so many different EHRs, it is difficult to make general statements about how a given product stores and represents the data it collects. There are, however, common design elements and terminology that can guide Health IT Advisors, and many of these terms reflect the common "ancestor" of the EHR: the traditional paper medical record. It is very important to keep in mind the fact that the original function of EHRs was to support billing and payment, and this still affects both EHR development as well as clinician use of these systems.

An EHR has multiple functions. The most obvious is to serve as the primary patient medical record to inform, deliver, and coordinate patient care. However, today's EHRs have evolved to provide some (or all) of the following capabilities:

- Perform scheduling and billing (the original function of most major EHRs!)
- Serve as a primary, organizational medical record
- Deliver clinical decision support
- Provide registries and tools for managing population health
- Provide dashboards for cost and quality analytics
- Qualify for EHR incentive programs
- Support patient engagement and communication
- Support telehealth and virtual visits
- Connect to remote patient management devices
- Provide data for clinical and health services studies, and
- Coordinate care within internal care teams and external care partners.

Trying to meet all of these demands in one technology solution, the EHR, creates challenges for developers, implementers, and users alike. A Health IT Advisor should be prepared for the remarkable diversity of EHR implementations in the field.

Why are EHRs So different From Each Other?

We have come to expect a degree of standardization when using websites, desktop applications, and phone apps. It can be surprising to see how much variability there is in EHR user interfaces, features, technical capabilities, configurations, and workflows. This variability is the results of many factors, including the following:

- A thriving commercial market for EHRs, driven by federal government incentives, which spawned a proliferation in vendors and products
- Federal certification requirements for functionality and design are relatively new (2009)
- Major EHR vendors usually create flexible solutions for broad adoption
- Vendors generally allow extensive site-specific customization during implementation, and
- Users may choose different workflows or user settings within the same product and version.

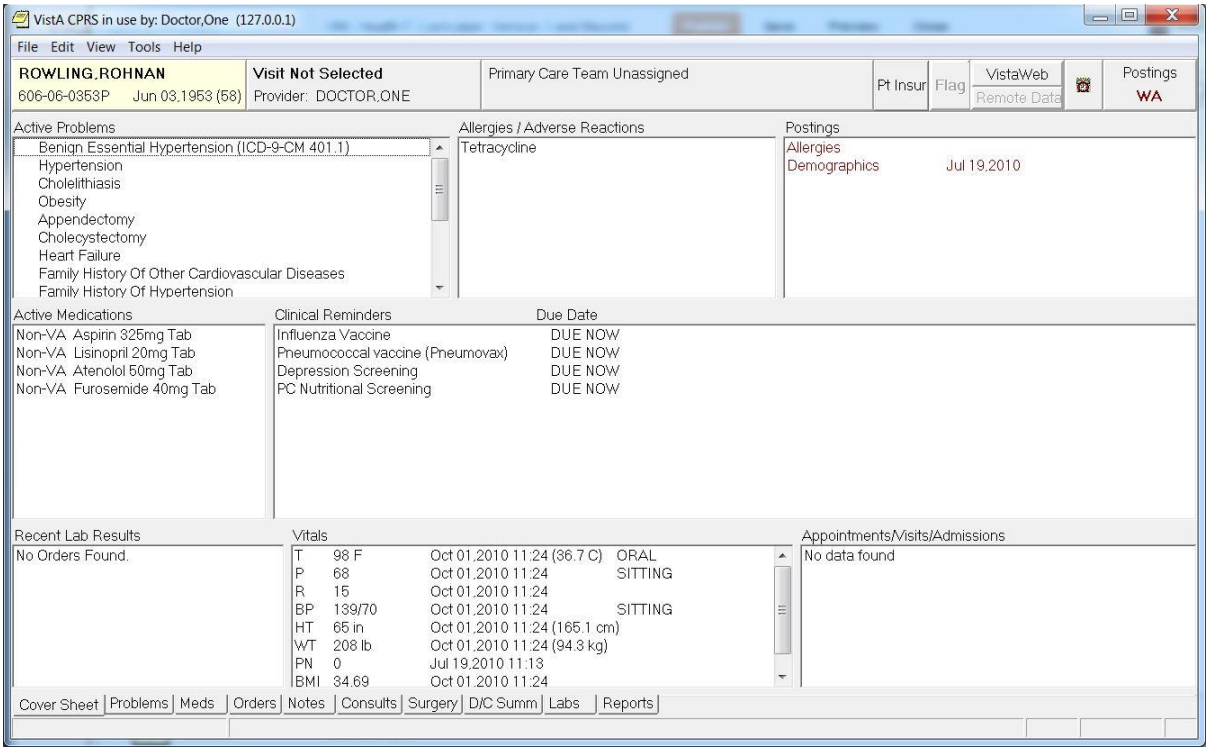
A Conceptual Map of EHR Data

Despite wide variability among EHRs, a Health IT Advisor will find similar groupings of patient information from one system to another. For example, any EHR should provide a place to capture, store, and view current medications, diagnoses or conditions, test results, and many of the other groupings described below. The key differences between EHRs are likely to be: 1) the workflows used to enter and view data (discussed in the next section of the handbook); 2) navigation of screens and layout of displays; 3) vendor terminology; and 4) the potential range of user preferences and custom settings.

EHR screen designs for grouping and presenting data are unique to each system but follow the same general design themes. Below is an example of the VistA EHR developed by the Veterans Administration that illustrates several of the groupings described by the United States Core Data for Interoperability (USCDI) standard.[35] The USCDI is a vendor-neutral model and terminology standard for organizing patient-specific clinical information for exchange with other systems, and will be required going forward

for certification of APIs and EHRs. (The topic of interoperability is covered in Appendix A of the handbook.)

Exhibit 12: Example of a Patient Summary Screen from the U.S. Department of Veterans Affairs' Vista EHR [36]



EXAMPLE:

In comparing EHRs across clinics, you find that the clinical documentation of a patient encounter is called progress note at one clinic, visit note at another, and SOAP note (Subjective, Objective, Assessment, and Plan) at a third. The fourth simply calls it "the chart." Health IT Advisors should use the particular terminology a clinic uses when discussing its data or EHR features. This can sometimes be difficult when working with multiple clinics.

The "conceptual map" we have chosen to provide is a generic grouping of information in an EHR based on a recent specification, mentioned above: United States Core Data for Interoperability (USCDI).[35]

Exhibit 13 shows the major information groupings for draft version 3.0 of the USCDI released in January 2022 (the final version 3.0 of USCDI will be released in the summer of 2022).[35] The important groups to consider for QI are summarized in Exhibit 14 and can be a useful guide to "where to look for…" when encountering a new EHR.

Exhibit 13: Draft USCDI v3 Summary of Data Classes and Data Elements [37]

Allergies and Intolerances
- Substance (Medication)
- Substance (Drug Class)
- Reaction

Assessment and Plan of Treatment
- Assessment and Plan of Treatment
- SDOH Assessment

Care Team Member(s)
- Care Team Member Name
- Care Team Member Identifier
- Care Team Member Role
- Care Team Member Location
- Care Team Member Telecom

Clinical Notes
- Consultation Note
- Discharge Summary Note
- History & Physical
- Procedure Note
- Progress Note

Clinical Tests
- Clinical Test
- Clinical Test Result/Report

Diagnostic Imaging
- Diagnostic Imaging Test
- Diagnostic Imaging Report

Encounter Information
- Encounter Type
- Encounter Diagnosis
- Encounter Time
- Encounter Location
- Encounter Disposition

Goals
- Patient Goals
- SDOH Goals

Health Insurance Information ★
- Coverage Status ★
- Coverage Type ★
- Relationship to Subscriber ★
- Member Identifier ★
- Subscriber Identifier ★
- Group Number ★
- Payer Identifier ★

Health Status ★
- Health Concerns ➡
- Functional Status ★
- Disability Status ★
- Mental Function ★
- Pregnancy Status ★
- Smoking Status ➡

Immunizations
- Immunizations

Laboratory
- Tests
- Values/Results
- Specimen Type ★
- Result Status ★

Medications
- Medications

Patient Demographics
- First Name
- Last Name
- Middle Name (Including middle initial)
- Suffix
- Previous Name
- Date of Birth
- Date of Death ★
- Race
- Ethnicity
- Tribal Affiliation ★
- Sex (Assigned at Birth)
- Sexual Orientation
- Gender Identity
- Preferred Language
- Current Address
- Previous Address
- Phone Number
- Phone Number Type
- Email Address
- Related Person's Name ★
- Related Person's Relationship ★
- Occupation ★
- Occupation Industry ★

Problems
- Problems
- SDOH Problems/Health Concerns
- Date of Diagnosis
- Date of Resolution

Procedures
- Procedures
- SDOH Interventions
- Reason for Referral ★

Provenance
- Author Organization
- Author Time Stamp

Unique Device Identifier(s) for a Patient's Implantable Device(s)
- Unique Device Identifier(s) for a patient's implantable device(s)

Vital Signs
- Systolic blood pressure
- Diastolic blood pressure
- Heart Rate
- Respiratory rate
- Body temperature
- Body height
- Body weight
- Pulse oximetry
- Inhaled oxygen concentration
- BMI Percentile (2 - 20 years)
- Weight-for-length Percentile (Birth - 36 Months)
- Head Occipital-frontal Circumference Percentile (Birth-36 Months)

Key: ★ New Data Class or Element ➡ Data Element Reclassified

Expansion of the USCDI to New Quality Domains

In 2021, the USCDI was expanded to incorporate new data elements for behavioral and social needs and assessments. For example, a new class was added to address social determinants of health (SDOH) and substance use treatment, an important target for QI. A use case for how these data might be used for QI is found in Section 6. In January 2022, a draft version 3 of USCDI was published. The most current specification for the USCDI's data structures and data elements, can be accessed through HealthIT.gov here.

Exhibit 14: EHR Data Groupings Useful for Quality Improvement (USCDI Data Classes)[35]

EHR Data Grouping	Description
Assessment and Plan of Treatment	• Represents a health professional's conclusions and working assumptions that will guide treatment of the patient.
Clinical Notes	• Represents narrative patient data relevant to the respective note types.
Clinical Tests	• Includes non-imaging and non-laboratory tests performed on a patient that results in structured or unstructured (narrative) findings specific to the patient, such as electrocardiogram (ECG), visual acuity exam, macular exam, or graded exercise testing (GXT), to facilitate the diagnosis and management of conditions.
Diagnostic Imaging	• Tests that result in visual images requiring interpretation by a credentialed professional.
Encounter Information	• An episode defined by an interaction between a healthcare provider and the subject of care in which healthcare-related activities take place.
Health Concerns	• Health-related matter that is of interest, importance, or worry to someone who may be the patient, patient's family, or patient's healthcare provider.
Immunizations	• Record of an administration of a vaccination or a record of a vaccination as reported by a patient, a clinician, or another party.
Laboratory	• The name of the analysis of specimens derived from humans which provide information for the diagnosis, prevention, treatment of disease, or assessment of health. • Documented findings of the analysis of a tested specimen. Includes both structured and unstructured (narrative) components.
Medications	• [Prescribed medications]
Patient Demographics	• Current Address • Date of Birth • Email Address • Ethnicity • First Name • Gender Identity • Last Name • Middle Name (including middle initial) • Phone Number • Phone Number Type • Preferred Language • Previous Address • Previous Name • Race • Sex (Assigned at Birth) • Sexual Orientation • Suffix
Problems	• Information about a condition, diagnosis, or other event, situation, issue, or clinical concept that is documented.
Procedures	• An activity that is performed with or on a patient as part of the provision of care.

	-

Identifying EHR Data Elements for Quality Improvement

The USCDI graphic in Exhibit 13 shows the high-level data elements included in each group. For example, the group (or data structure) for vital signs includes finding blood pressure, which is frequently used in measures of clinical quality.

For projects where one or more EHR will be used as a data source, a Health IT Advisor must answer each of the following questions -- even when clinics using the same vendor (see the discussion on variation).

Are the data elements needed to inform the project captured in the EHR?

In an ideal world, the EHR would contain all of the relevant information that a clinic creates, stores, receives, or retrieves on its patients. Sadly, this is rarely the case. Before planning to use EHR data for a QI project, Health IT Advisors must confirm that the needed data elements are there and in a format that can be used.

Because needed data can be entered by typing, dictation, scanning, electronic interfaces, medical devices, or entered by patients on a smartphone or portal, ensuring data consistency and quality is an important function of the Health IT Advisor. Even today, clinical information also continues to be stored in scans or faxes, offline paper files, desktop spreadsheets, or specialized databases.

How are the data elements entered and where are they viewed in the EHR?

The best way to determine *where* needed data elements "live" in the EHR is to observe users entering the information into the EHR. A process for "following the data" is described later in the handbook. It helps to know: What screens are accessed for input? How are these data viewed by clinicians and staff? Can data be viewed for more than one patient at a time?

How are the data elements represented in the EHR?

For QI work, *how* data elements are captured and stored in an EHR is as important as *where*. Electronic data can be represented in an EHR as unstructured, structured, or multimedia, with important implications for extraction and analysis.

Unstructured data includes short or long free text in the form of a result ("See report," "No malignancy noted"), a brief phrase ("Counseled patient on smoking cessation"), or a lengthy narrative ("The patient presents with a…"). Information entered into an EHR as free text can be very difficult to extract and analyze.

Structured data constrains a data element to a predefined format or standardized code list and is the best choice for extracting and analyzing data from an EHR. Structured data is usually entered using picklists, checkboxes, validated numeric fields or dates, yes/no responses (Boolean), or "macros" that generate structured responses from user input, a "dot phrase," or a "smart form."

Multi-media data includes fax and document images, photographs, diagnostic scans, voice or dictation files, and medical device telemetry. Information entered in this form is nearly impossible to extract or analyze without specialized software and equipment. Data needed for a project is often "hidden" in faxes and scanned documents creating challenges for QI (and many other secondary uses).

Can the data elements be extracted through reports, dashboards, or custom queries?

Extracting data from an EHR is challenging. It is important to consider all of the options available for retrieving the data you need, and how the format of the stored information might impact these efforts. As a rule, structured data is much easier to extract and use than unstructured data.

Health IT Advisors can also save time and effort by adapting an EHRs' built-in reports and dashboards instead of requesting (or developing) a EHR custom report or database query. [34]

EXAMPLE 1:

You need to use clinical data from an EHR to measure diabetes control in a sub-population of a clinic's patients. Your project preparation shows that Hemoglobin A1c values are being captured in the EHR as structured data and that a built-in quality measure (Poor A1c Control CMS 122, National Quality Forum (NQF) 0059) will suit your needs. Unfortunately, on closer examination, you find that the built-in quality measure reports all active patients with diabetes and cannot distinguish the subpopulations you are targeting for an intervention.

You might get what you need by merging data from the EHR report with a patient list reflecting your inclusion criteria.

2.2 *The Impact of EHR Workflows on Data for Quality Improvement*

EXAMPLE 2:
In addition to looking at A1c values, you also want to collect the measure for Diabetic Eye Exam (CMS 131, NQF 0055). After being told initially that "these reports are in the EHR," you learn that the practice has been scanning faxed reports into the EHR and not using structured data.

You will find this is a recurring issue. The best option for retrieving data "hidden" in documents or scans is usually to perform a chart audit as discussed below.

For the long term, you will want to encourage and support changes in data-entry workflows to address the problem more directly. In doing this, you will be using an opportunity to improve data practices overall as part of building more robust QI capabilities.

Exhibit 13 is a list of EHR data groupings commonly used in QI projects. Health IT Advisors must understand how local clinic workflows, design of EHRs, and availability of high-quality data will affect a QI project.

EXAMPLE:
You plan to use the CQM for Poor Hemoglobin A1c Control (CMS 122, NQF 0059) built into a clinic's EHR for a project looking at the quality of diabetes care. After pulling data from the EHR's dashboard, you find that the A1c values received as scanned laboratory reports are missing, making the performance rate look worse than it is.

The historical A1c values from the scans may not be available without resorting to a chart audit. However, it is not unusual for a QI project to explicitly include the development of new EHR workflows to improve structured data capture. For example, you might find out if external A1c values can be entered into the EHR to correctly update the quality measure and how much additional work that would be for staff.

Reasons for EHR Workflow Variation

We have seen that EHR workflows can vary widely among clinics and users. Even practices using the same EHR vendor and software version might have significant differences in how they capture, enter, and store patient information. Health IT Advisors will encounter several reasons for this, summarized in Exhibit 15.

Exhibit 15: Common Reasons for EHR Workflow Variation

Reason for EHR Workflow Variation	Example
Individual workflow preferences of clinicians and staff	*"The checkbox is too many clicks; I prefer to type my notes."*
Deeply embedded habits carried over to the EHR	*"We've always done it this way."*
Poorly configured EHR settings or hidden features	*"I didn't know it did that!"*
Inadequate training during and after implementation	*"This is how I was taught to do it."*
Unique circumstances	*"The laboratory only sends us results by fax."*
Regulatory or payer requirements for documentation	*"XYZ insurance will only pay for X if we do this."*
Alternate workflows to "workaround" a bug or missing feature	*"The screen crashes if I try to enter numbers."*
Using data systems outside the EHR	*"We view our patients' discharge summaries in the hospital's EHR using their portal."*

There may be good reasons for a clinic to choose workflows that adversely impact data quality to use for QI. While addressing them may be out of scope for your project, you can mitigate the impact of "alternative" workflows by identifying any data limitations early and incorporating them into the design of the project.

EXAMPLE:
Dr. Smith is one of ten clinicians who are part of a QI project that requires them to enter structured data by clicking a new template in their notes. He refuses to change his workflow. Asking providers to change their workflows, especially if it means more time navigating the EHR ("more clicks") can be difficult. An option is to find a way to deal with the missing data, or negotiate a workflow where staff handles data entry on behalf of the provider.

We will discuss the importance of data governance and quality assessment later in this section of the handbook.

Data Implications for Key EHR workflows

Thomas Bodenheimer identified 23 EHR workflows that Health IT Advisors frequently target for improvement, as shown in Figure 26.7 in Module 26: An Introduction to Electronic Health Records and Meaningful Use of the Primary Care Practice Facilitation Curriculum.[38] Exhibit 16, below, lists how EHR workflows may impact data important to QI work.

Exhibit 16: Data Considerations for 23 Key EHR Workflows

EHR Workflow	Data Considerations
Recording patient demographics	• Are key patient demographics (age, gender, language, race, ethnicity, etc.) recorded consistently and using a standard vocabulary?
Recording vital signs	• Do providers and staff consistently record blood pressure and other vital signs; especially when repeat values or alternate postures are used (sitting, standing, supine BP readings)?
Maintaining an up-to-date problem list	• Are clinicians diligent about maintaining a current problem list by adding, updating, or removing codes when indicated? • Is the problem list a reliable source for assessing current and historical acute or chronic conditions? • Does the problem list use a standard vocabulary for documented diagnoses [international classification of diseases (ICD), systematized nomenclature of medicine (SNOMED)]?
Maintaining an active medication list	• Who in the clinic is responsible for their routine medication reconciliation process to ensure medications are current in the EHR? • Are medications mapped to standard drug codes [national drug code (NDC), RxNorm] or can free text or custom medications/supplements be prescribed? • Is there a consistent process for electronically prescribing medications including: phone orders, refill requests, and controlled substances? • Are paper prescriptions ever used?
Maintaining an active allergy list	• Are patient allergies for food or drugs consistently recorded using a standard vocabulary?
Recording smoking status [and other health screening assessments]	• When and how are screening questions for health risk (smoking), preventive care (depression screening), behavior (alcohol use) and social needs recorded in the EHR? • Are individual questions from health screening assessments captured in the EHR as structured data versus scanning a questionnaire? • Are billing codes used to determine when screening services are delivered or may be overdue?
Providing patients with clinical summaries for each office visit	• Can patient summaries produced by the EHR provide context or detailed data to patients for a QI intervention? • Can paper or electronic care summaries deliver education or self-care interventions? • Do patients have full access to office notes online?
E-prescribing	• Are medications mapped to standard drug codes (NDC, RxNorm)? • Can free text or custom medications/supplements be prescribed?

EHR Workflow	Data Considerations
	• Is there a consistent process for electronically prescribing medications including: phone orders, refill requests, and controlled substances? • Are paper prescriptions ever used?
Checking for drug-drug and drug-allergy interactions [Clinical Decision Support]	• How receptive are prescribers to drug-drug and drug-allergy alerts? This may be a warning sign of alert fatigue making new CDS interventions difficult to implement.
Exchanging electronic information with other sites of care	• How are care summaries and consultation reports received by the clinic? • Are external electronic care summaries incorporated into the patient's chart? • Are paper or faxed summaries scanned or uploaded into the EHR? • How can external data be accessed and extracted from the EHR?
Implementing a decision support rule and tracking compliance with the rule [Clinical Decision Support]	• Has the clinic implemented CDS rules for preventive care reminders or other alerts that could inform or support a QI intervention? • What other forms of CDS could be used to deliver quality interventions (templates, online resources, etc.).
Maintaining systems to protect privacy and security of patient data	• How do workflows for protecting patient data impact the availability and accessibility of key data elements? For example, are paper forms shredded after recording findings in the EHR.
Reporting CQMs to CMS or States	• Has the clinic implemented the EHR workflows needed to accurately and consistently populate quality measure dashboards and reports in the EHR (MIPS, UDS)? • Does the clinic have alternatives to EHR reporting including external registries, population health tools, or access to a health information exchange?
Generating lists of patients for QI or outreach	• What tools and workflows are available for pulling ad hoc lists of patients with specific conditions, visit types, demographics, or other registry criteria?
Providing electronic health education resources	• Does the EHR provide online education resources for patients and caregivers at visits or through the portal that could be used to deliver a QI intervention?
Performing medication reconciliation between care settings	• Does the clinic use a routine medication reconciliation process to ensure medications are current in the EHR?
Generating summary of care record for referrals and transitions	• What are the workflows for sending and receiving patient information when referring or transitioning patients to acute, specialty, or long-term care? • How do processes differ for referrals to internal groups using the same EHR and those external groups using other EHR systems?

EHR Workflow	Data Considerations
	• Are EHR workflows for referrals and transitions consistently used, or are there other ways the clinic requests and tracks them outside of the EHR (fax, an HIE)?
Providing immunization data to regional registries	• Does the clinic routinely update immunizations from outside sources (state registry, pharmacies, other providers)? • Are immunizations mapped to standard codes (CVX, MVX), or can free text vaccines be entered?
Providing surveillance data to public health agencies [Registries]	• Can the clinic identify and report a list of patients with specific conditions based on diagnosis, lab results, symptoms, or other criteria? • Does the EHR provide demographic, disease, or condition-specific patient lists, or registries, that can be used for targeted QI interventions?
Using patient reminders for prevention/chronic care [Clinical Decision Support]	• Has the clinic implemented CDS rules for preventive care reminders or other alerts that could inform or support a QI intervention? • Are there prompts and reminders for routine and follow-up appointment scheduling? • What other forms of CDS could be used to deliver quality interventions (templates, online resources, etc.).
Providing patient access to lab results, problem and medication lists, and allergy information	• What options do patients or caregivers have for accessing their own clinical information in the EHR? • What information can patients or caregivers access using the clinic's portal? • Do portals or other patient engagement tools (voice and text messages, email, mailings) provide options for targeted QI interventions?
Performing drug formulary check	• Do prescribers have access to payer-specific drug lists (or formularies) when they select medications in the EHR?
Entering lab results into EHR	• Do workflows for entering or receiving lab and imaging results populate structured (discrete) or unstructured (text) data elements? • Are lab values mapped to standard LOINC (logical observation identifiers, names, and codes) or SNOMED codes by sending labs or in the EHR?

Source: The 23 EHR workflows described in this table are from a Bodenheimer communication cited in Module 26 of the AHRQ Primary Care Practice Facilitation Curriculum.[39]

Workflow Analysis as a Tool for EHR Data Exploration

Health IT Advisors must know how to observe, document, analyze, and improve clinical workflows to fully understand how data from an EHR can be used in their projects.

A "workflow" is a collection of activities (or tasks) performed to achieve a specific outcome. This outcome might be a physical artifact (filling out a form), an electronic record (documenting findings from a medical examination or laboratory test), or a trigger for additional workflows (a portal reminder prompting a patient to take a home blood pressure reading).

EHR workflows are often observed and mapped as part of a QI project for four main reasons:

- To collect the data needed to design improved work practices
- To better support population health
- To illustrate how clinical processes were done before and after a workflow change or quality intervention, and/or
- To discover how specific data elements are collected, captured, and viewed in a clinic's EHR.

While a how-to guide for conducting workflow analysis using all of the available tools and techniques is beyond the scope of this handbook, we present three practical steps that can use workflow analysis as a tool to identify potential data sources, workflow variations, and identify limitations of data from the EHR.

Step 1: Identify workflows that impact EHR data

The twenty-three workflows in Exhibit 16 are central to collecting, recording, storing, and retrieving data elements that may be useful for QI. Before drawing any conclusions from the data, Health IT Advisors must carefully identify how and where data are acquired (by humans or computers) and the process used to transform real-world information (a blood pressure reading, a lab result, a faxed consult report) into electronic data structures stored in an EHR.

Step 2: Conduct a targeted workflow analysis

The opportunities to study a clinic's use of an EHR will largely depend on how much access the health IT Advisor has to the clinic. Many times, it is not possible to directly observe clinicians and staff as they interact with the EHR, and remote or virtual methods may be necessary. Below are three options.

- **Option 1**: Directly observing important workflows is the best way to understand how clinicians and staff use their EHR. Health IT Advisors can document their findings in brief field notes or jottings, sketches and diagrams, or even audio or video recordings that do not expose PHI.
- **Option 2**: When visiting the clinic is not an option, ask for a virtual demonstration of the workflows you are interested in. Screen-sharing or online collaboration software can be used to virtually interview users.
- **Option 3**: As last resort, a lot can be learned about EHR workflows by collecting forms, screenshots (being careful of PHI), job aids or "cheat sheets," written procedures, or user manuals. Be careful of using proprietary materials provided by vendors without explicit permission.

Remember that variations in workflow are not uncommon even within the same clinic. It is important to ask if an observed workflow is the same for all users and is consistently followed to see if there are workflows that might impact your data or interventions.

Step 3: Analyzing workflows to assess EHR data

The results of a targeted workflow analysis are usually represented by a diagram. This can be a simple flow chart or a swim-lane chart (splitting workflows into lanes for each actor). An experienced process analyst might even use a data flow diagram used by software engineers to illustrate how data travels through a clinic.

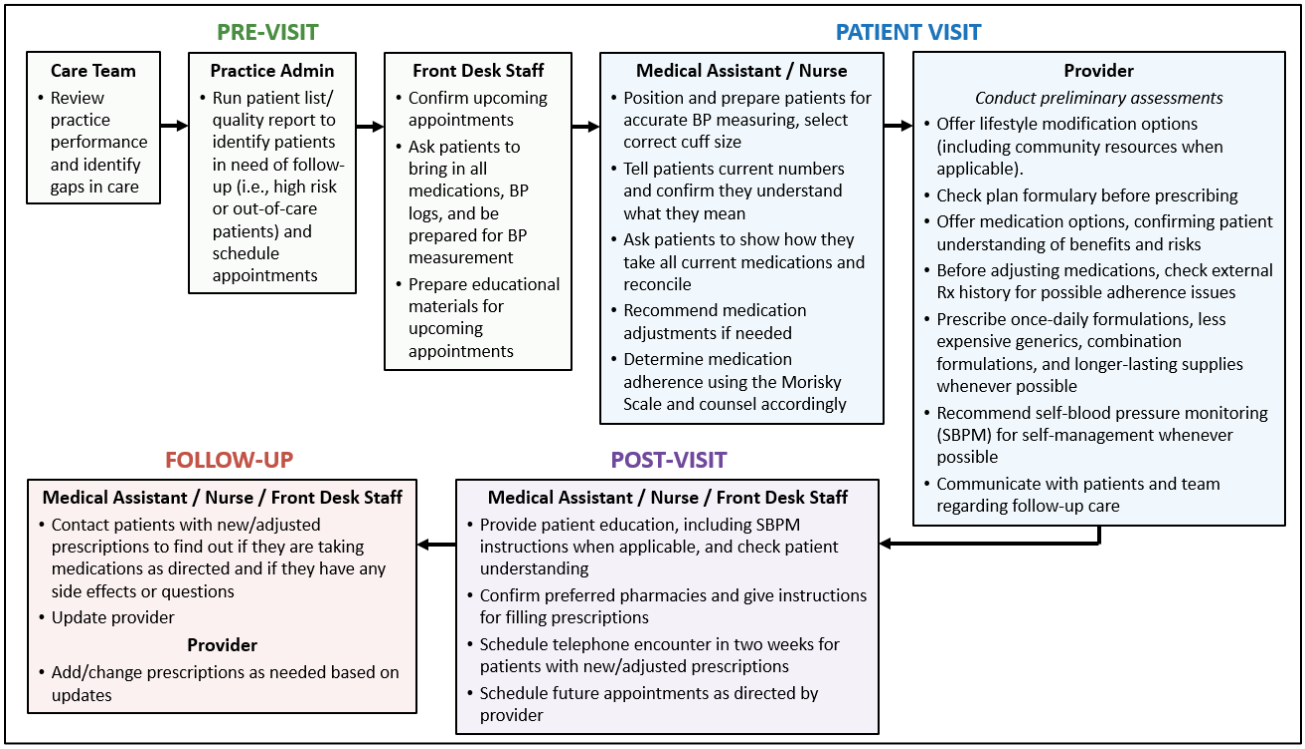
An example of a practice workflow for an office visit for blood pressure control (with care-team roles highlighted) is shown in Exhibit 17. This could be modified for a targeted workflow analysis to focus only on the tasks that directly) or indirectly) impact the data (the box for the medical assistant, in this example).

EXAMPLE:

Given the importance of blood pressure findings from the EHR to your project, you do a targeted workflow analysis to study how blood pressure readings are captured in a telehealth visit. You find that patients or caregivers have the option to enter home readings when they check in to the online appointment and are surprised to see that a free text entry box is used with no validation for a standard reading (e.g., "140/80").

This discovery is a red flag that you will need to take extra care to ensure improperly formatted home blood pressure readings are not distorting the clinic's performance on hypertension control when you extract and analyze the EHR data.

Exhibit 17: Example of a Workflow Diagram for Blood Pressure (BP) Control



Module 10 of Primary Care Practice Facilitation Curriculum provides guidance on how to conduct a workflow analysis and reviews how flowcharts and swim-lane diagrams are constructed, as does the

Practice Facilitation Training Module Process Mapping. AHRQ has also developed a comprehensive toolkit for Health IT workflow analysis with a detailed discussion of workflow tools and techniques.

2.3 *Assessing EHR Data Quality*

A clinic's EHR will often be the best (and sometimes only) option to facilitate QI. Care must be taken, however, to ensure that the quality of underlying data elements is sufficient to accurately measure quality, inform practice transformation, and/or trigger health-IT based interventions.

This section reviews data problems often encountered in QI projects and provides tips to prevent, identify, and address troublesome data you will find in EHRs and other electronic data sources.

Common Problems with EHR Data

Before discussing what can go wrong with EHR data, it may help to consider what "good" data looks like. There are numerous practical and scholarly approaches that define (and even quantify) various aspects of data quality. The ONC model below defines five dimensions of data quality that can serve as a framework to discuss the characteristics of "good" EHR data.[40]

Each of the five dimensions shown in Exhibit 18 should be a prompt for Health IT Advisors to think critically about any EHR data they use in quality work.

Exhibit 18: ONC's Five Quality Dimensions for EHR Data

Data Quality Dimension	Definition
Completeness	Is the truth about a patient present in the EHR?
Correctness	Is an element that is present in the EHR true?
Concordance	Is there agreement between elements in the EHR or between the EHR and another data source?
Currency	Is an element in the EHR a relevant representation of the patient state at a given time?
Plausibility	Does an element in the EHR make sense in light of other knowledge about what the element is measuring?

Consider asking each of these questions as you assess project data:

1. Completeness: Are any needed data missing or incomplete?

Despite our best efforts, healthcare is delivered in multiple places by multiple providers and caregivers. This leads to a fragmented medical record scattered across many instances of electronic (and paper) records used by hospitals, laboratories, specialists, behavioral and community service providers, and other "silos" where health data can be found. Examples of incomplete data include the following:

- Inconsistent user workflows can lead to missing data. *Example:* Not all A1c values are recorded as structured data.
- The clinic does not receive key data elements needed for QI. *Example:* Outside care summaries or specialty reports are not received.
- Needed historical data might pre-date new workflows or system configurations. *Example:* New fields were created for a recent health screening assessment.

2. Correctness: Are the data accurate?

Correct data are not only *accurate (*truly reflecting a real-world patient attribute or finding) but are also captured in the expected data structure and format (see home blood pressure example above). Incorrect data might result from the following:

- Users forget to clear or change default selections from documentation templates or questionnaires.
- Users record data in notes or clinical narratives instead of available structured data. *Example:* A medical assistant types the result of a depression screening in the notes instead of the screening form.
- Expected numeric data, units of measure, or free text are entered with an incorrect format. *Example:* A medical assistant types "Left arm 140 over 80" instead of the expected "140/80" for a blood pressure reading.

3. Concordance: Are the data consistent and in the proper context?

Discordant data can be difficult to detect when looking at raw data in a spreadsheet. Correlating suspicious data might require a manual chart check for corresponding records or to comparing project data with related clinical information. Examples of discordant data include the following.

- Missing or conflicting documentation of key data elements: *Example:* No colonoscopy report exists despite a structured data field indicating that one was done.
- Laboratory values from different sources with different units or analytical methods: *Example:* Lab A reports an A1c .075 versus Lab B that provides the percentage 7.5%.

4. Currency: Are the data in the EHR the most current?

Data currency is usually determined by the dates and times (or "timestamps") attached to a data element. For example, a laboratory result might include when a sample was collected, when a result was reported, and even when a clinician reviewed the result. Here are some examples where data currency may not be obvious.

- Key data elements are pulled forward from previous visits or history. *Example:* The EHR pulls data in the social history section forward to the current record, but the previous data were not confirmed during the visit.
- The EHR data reflects when the element was entered and not when it was first identified. *Example:* When a new diagnosis is added to the problem list, the timestamp reflects today's visit and not when the problem first began ("added date" versus "onset date").
- There may be more recent data available outside of the clinic EHR. *Example*: Tests, referrals, hospital visits, procedures, and referrals may all be missing from the clinic's EHR unless workflows exist to retrieve and incorporate them.

5. Plausibility: Do the data make sense?

A subjective "gut check" can often identify troublesome data. For example, laboratory values outside of the range of human life are an obvious clue that there is an issue with the EHR process for receiving, recording, or reviewing test results. Additional examples of implausible data include the following:

- Numeric values or structured data impossible or incompatible with life. *Example:* A percentage value over 100%.
- Findings that are unusual or inappropriate for a patient's attributes. *Example:* A recorded smoking status on an infant.
- Blatant data inconsistencies in the data. *Example:* A patient both received and declined screening for social needs.
- Data errors introduced during extraction or analysis. *Example:* Data elements are automatically reformatted by a spreadsheet application when the EHR data file is imported.

Techniques for Assessing the Quality of EHR Data

Many techniques have been developed to assess the completeness, correctness, concordance, currency, and plausibility of EHR data.[40] While a review of formal data quality assessment methods is beyond the scope of this handbook, below are some practical tips to ensure that data elements extracted or abstracted from an EHR accurately represent the clinic's quality and performance.

TIP 1: FOLLOW THE DATA

Earlier, we discussed how technical design, configuration, and workflows all affect the presence and reliability of data in an EHR. A simple approach to compensate for all this variation is to directly observe how and where users document the key data elements needed for the project. Although this technique can be done at the same time as a formal workflow analysis, following the data is more focused on how and where specific data elements are captured in the EHR. We refer to this as a targeted workflow analysis (addressed earlier in this section).

TIP 2: INSPECT THE DATA FOR "RED FLAGS"

The quality of EHR data should never be taken for granted. Formal research studies require rigorous protocols and statistical analysis to assess data quality, but QI projects may lack the time, expertise, and resources for this. Below are red flags that can help detect data quality problems:

Missing data often indicates that the clinic's EHR records may not be complete, consistent, or accurate.

Compare the available data elements within the data set for concordance. *Example*: Do all values for laboratory results and vital signs have realistic dates?

For numeric values, calculate the median, mean, and standard deviation to detect outliers or unusual variation. A box-plot can be especially helpful to detect outliers. *Example*: Is a mistyped A1c value of "76%" skewing the sample?

Graph the data on a scatter plot to quickly identify potential gaps or anomalies in the data.

TIP 3: COMPARE EHR DATA WITH A GOLD STANDARD, BENCHMARK, OR ADDITIONAL DATA SOURCES"

When direct access to a clinic's EHR is available, it may be possible to compare supporting documentation within the patient record with the extracted data used for a project. Project data can also be correlated with external data sources. (Also see discussion of this in Section 1.8).

Seek corresponding data from other electronic or paper sources. *Example:* External data sources including health information exchanges and specialty registries may provide data not found in the clinic's EHR.

Use an external performance benchmark from national or quality organizations for similar clinics to find values for comparison.

Compare denominators and numerators from similar measures. *Example:* The denominator for one quality measure could be used as a sample for a manual chart audit for a similar measure.

Search the medical literature for disease prevalence to "gut check" a clinic's population. *Example:* Does the clinic's diabetes or hypertension rate seem reasonable compared to national or regional prevalence data?

TIP 4: ASK THE CLINIC FOR A "GUT CHECK"

Clinics usually have a good subjective idea when their data seems off. Periodic "data checks" can be part of an overall project communication plan to create an opportunity to get another set of eyes on the data. Here are some additional tips:

Be careful not to overwhelm clinics with raw data. The idea is to assess the "reasonableness" of the data you have collected; summary data is generally best for this. *Example:* Share the number of qualifying visits for depression screening with the clinic and not a list of 3,000 non-compliant patients.

Focus on intuitive metrics to share with clinicians and staff. For example, a clinic administrator will know when values for certain visit types or billing codes seem plausible while a quality manager can quickly determine if performance on quality measures seems off.

Follow up on any concerns the clinic may have. It is not unusual for an EHR quality measure to seem "just wrong" before implementing the necessary workflows to populate specific codes according to the vendor's best practices.

EXAMPLE:

Using an EHR's quality dashboard, you retrieve the performance rate for Depression Screening and Follow-up (CMS 2, NQF 418). When the clinic reviews the data, they are shocked and tell you this cannot possibly be right. On investigation, you learn that the EHR is relying on a structured data field to determine whether follow-up was provided on positive screens. The clinic does not use this field, throwing the measure off substantially.

Assessing EHR Data for a Quality Measure

In this extended example, you are helping a primary care clinic improve their annual screening for risky alcohol use. In this example, we have simplified the quality measure for illustration purposes.

The clinic's performance on Screening and Brief Intervention and Referral to Treatment (SBIRT)[41] will use the quality measure for "Unhealthy Alcohol Use: Screening and Brief Counseling" (CMS 431, NQF 2152)[34] that counts eligible patients, screening rates, and whether a qualifying intervention was delivered on a positive screen.

You begin by identifying the data elements needed to generate the quality measure for the project and create a table like that in Exhibit 19 or the Data Collection Plan introduced earlier to explicitly list the data elements needed to satisfy the measure and make note of any potential questions or concerns. You have confirmed that resources are available to generate an EHR extraction file with the data you need.

Exhibit 19: Data Components of the SBIRT Quality Measure (CMS 431, NQF 2152)

Data Component	Elements	Further Considerations
How many patients were eligible for SBIRT screening?	• Patient age (Integer) • Encounter code for visit [current procedural terminology (CPT)] • Excluding diagnoses (ICD-10) • Patient refused screening (Yes/No)	How is "eligibility" is defined and what inclusion and exclusion criteria will be used to select patients?
How many eligible patients received SBIRT screening?	• SBIRT given? (Yes/No) • SBIRT date and time • SBIRT tool used (List of assessments)	Of those eligible, who received screening, when, and what assessments were used [Alcohol Use Disorders Identification Test (AUDIT), Alcohol Use Disorders Identification Test-Consumption (AUDIT-C), CRAFFT].
How many SBIRT screens were "positive"?	• Result of SBIRT screen (Positive/Negative) • Additional assessments (Type, Score)	What constitutes a "Positive" for the assessment tools being used? How are the screening results represented in the EHR?
How many "positive" screens resulted in a brief intervention?	• Was an intervention given? (Yes/No) • Intervention date/time • Type of intervention (List of interventions) • Was this a qualifying intervention (Yes/No)	How many patients received a qualifying intervention, when, and what type (counseling, a referral, or medication).

The following are more specific steps to take in putting the tips above into practice:

Step 1: Follow the data

- Do a targeted workflow analysis to determine if, when, and how the required data elements are collected and entered in the EHR. Tips for observing workflows are discussed in Section 2.2.
- Map the required data elements for the quality measure to the information in the EHR by observing users or reviewing screen shots (being careful to protect PHI!)

Step 2: Inspect the data for "red flags": Inspect the extracted data file for potential issues, asking the following questions:

- Are the data adequate to determine each patient's eligibility for a SBIRT screen?
- Does the total number of eligible patients pass a "gut check"?
- Are there gaps or coding issues with the encounter codes exported to the file?
- Are there any outliers or obvious format errors in dates, numeric data, or coded values?
- Are coded values for screening assessment and interventions what is expected?
- Are dates and times associated with SBIRT screening and follow-up realistic?

Step 3: Compare EHR data with a gold standard, benchmark, or additional data sources

- Finding appropriate comparison data in this example could be difficult. Some options to consider include the following:
  - Confirm the patient age distribution against known values for the clinic
  - Find a reasonable benchmark for a "typical" number of patients eligible for screening
  - Make sure screening tools, scoring criteria, and risk interpretation are consistent with a validated assessment tool.

Example: You find that data for the AUDIT, an assessment used to score risky alcohol use, are included in the data set, but the questions and scoring found in the EHR do not match the validated assessment. How can this be best addressed?

Step 4: Ask the clinic for a "gut check"

- To avoid overloading clinic staff, a "gut check" for this example might include the following:
  - A preview of the performance rate for a short measurement period
  - The total number of eligible visits; does this track with the total visits during that period?
  - A chart showing frequency of specific intervention types; is it realistic that all of these services were delivered?

Conclusion

The wide adoption of EHRs by medical practices has created a wealth of data that can be used to support QI projects. Knowing where to start begins early in the project and the implications of poor-quality data must be clearly understood and addressed. While not all projects will require all of these steps, Health IT Advisors must always ensure data quality before using any EHR data for a project.

2.4 *Core Principles for Handling EHR Data*

Health IT Advisors have a legal and ethical obligation to follow best practices when handling data both within, and extracted from, an EHR. *Data governance* refers to a set of best practices for handling all types of data and provides a useful framework for handling the EHR data used for QI.

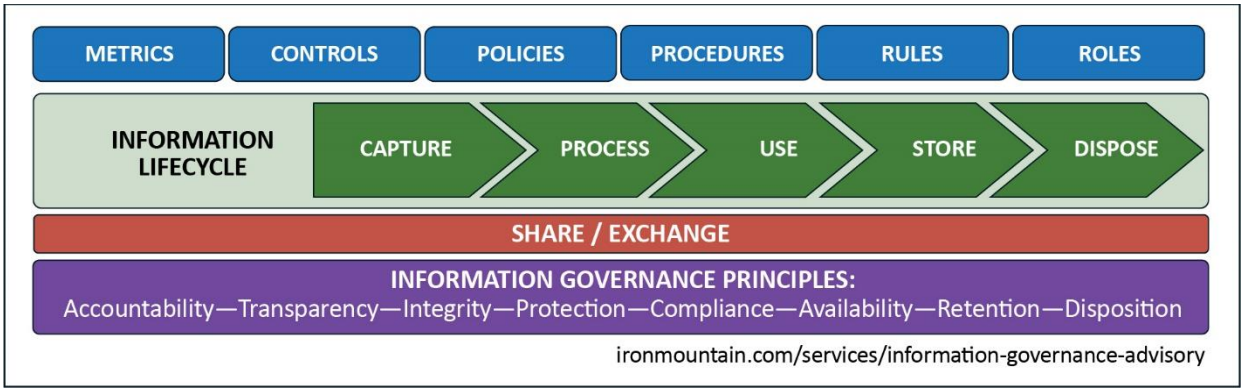
This section is presented in two parts: the first addresses general concepts for data governance; the second focuses on a brief review of HIPAA and other privacy and security requirements.

The Information Lifecycle

The *information (or data) lifecycle* contains all of the processes needed to collect and manage data. The lifecycle model shown in Exhibit 20 was developed by the American Health Information Managers Association (AHIMA; now under copyright to Iron Mountain)[42] and can be used by Health IT Advisors as a comprehensive framework to ensure accountability, transparency, integrity, protection, compliance, availability, retention, and disposition of any clinical data used for QI.

We will use the Iron Mountain lifecycle model to provide tips for the collection, use, storage, and disposal of EHR data used in the course of a QI project.

Exhibit 20: Information Governance Framework and Lifecycle



Capture: Acquiring Quality Data from the EHR

Data stored in an EHR can come from multiple sources. For example, a single EHR may include data from *internal* sources (data entered by typing, scanning, dictating, touchscreen, etc.) and *external* sources (outside results, summaries, immunization, medication, acute or long-term care records, etc.).

Moreover, data in an EHR may be created or reported by a wide range of actors, including providers, staff, electronic interfaces, and patients or their caregivers through the use of portals and phone apps (patient-generated data is discussed in Section 5).

When using EHR data, it is vital that the original source be considered including the following questions:

- Where did the data originate from and who created or reported it?
- Who is accountable for ensuring accuracy and completeness of data at the point of collection?
- How is it incorporated into the EHR and by whom (user or automated processes)?
- If data originates on paper forms, are they kept?
- Are special protections needed when accessing stored paper records?
- Is there a risk of data being hidden, lost, or altered when it is incorporated into an EHR?

Importantly, too, custom methods developed for acquiring quality data from the EHR should be added to the clinic or system's Data Quality Improvement Plan (see Section 1.7).

Processing: Extracting Data from an EHR

The methods used to pull data from an EHR will vary depending on several factors discussed below; however, the following considerations apply to all methods. Health IT Advisors must ensure that data are not lost or altered during retrieval from reports and dashboards, electronic extraction from the EHR, or abstraction from manual chart audits.

- Are required data agreements in place before accessing the EHR data?
- Who is responsible and accountable for extracting/abstracting data from the EHR?
- Who will control and monitor the quality and integrity of the data retrieved from the EHR?
- How will you ensure privacy, security, and integrity when processing and transporting the data?
- If required, how will the retrieved data be de-identified, encrypted, or securely transmitted?
- Is the extraction file format appropriate for the data to be extracted [comma separated value (CSV), proprietary file]?

Use: Managing EHR Data after Extraction/Abstraction

The goal of extracting EHR data is to draw meaningful and accurate conclusions about patient populations, clinical quality and performance, or outcomes of quality interventions. Here are some considerations for managing extracted data:

- Who will manage, update, maintain and protect data sets after extraction (paper or electronic)?
- Are there constraints on how EHR data can be used or shared within and outside the team?
- Are there any data elements that require special care under HIPAA and other regulations?
- Has the quality of the extracted data been assessed prior to using it for the project?

Storage and Disposal: Protecting and Disposing of Extracted EHR Data

Most data acquired from a clinic's EHR will contain PHI falling under HIPAA privacy and security rules (see Section 2.5 below). Storage and final disposition of the data used for a quality project are sometimes an afterthought, but these considerations are important to meeting requirements for privacy and security.

- Will PHI and other sensitive data be removed from the clinic (electronic, paper)?
- Does the quality team have appropriate training in handling sensitive data?
- Are all required agreements in place authorizing the storage and use of EHR data?
- Are procedures in place to use transfer, store, and dispose of EHR data used by the team?
- Is the technology used to store electronic EHR data approved and configured for PHI?
- Are the data extracted from the EHR the "minimum necessary" for the project?
- How long can data be stored and who manages and disposes of "old" data?

2.5 *Privacy and Security Considerations for EHR Data*

No discussion of data governance would be complete without addressing the unique regulatory requirements involved in retrieving, handling, and storing clinical data defined as PHI under the Health Insurance Portability and Accountability Act's (HIPAA's) privacy rule.

PHI is defined by the HIPAA Privacy Rule as demographic data, which relates to: the individual's past, present or future physical or mental health or condition; the provision of healthcare to the individual; or the past, present, or future payment for the provision of healthcare to the individual. It is also data that identifies the individual or for which there is a reasonable basis to believe it can be used to identify the individual. Individually identifiable health information includes many common identifiers (e.g., name, address, birth date, Social Security Number). [43]

As discussed in Section 1, Health IT Advisors working with EHRs will have access not only to PHI, but other types of data protected by national and/or state regulations. Any quality team members who work with these data should have, at a minimum, documented HIPAA training and a thorough understanding of their obligations to the clinic as a participant in a Business Associate Agreement or through a Data Use Agreement mentioned earlier in the handbook.

In addition to HIPAA, other laws or regulations may constrain how EHR data can be used in a project, and how it must be managed and disposed of if taken out of the clinic on paper or electronically. Examples include the following:

- Rules set by the Institutional Review Board that approved the project
- Organizational rules for protecting and storing sensitive data
- Additional protections for data relating to mental health and substance use (code of federal regulations (CFR) 42 Part 2) [44]
- Special protections for educational records [Family Educational Rights and Privacy Act (FERPA)][45]
- Financial and administrative data that should not be shared outside the team.

2.6 *Extracting Data from an EHR*

This section addresses how EHR data can be retrieved from built-in EHR reports and dashboards, extracted to an electronic data file, or abstracted by visual inspection of the electronic chart for use in a QI project.

Using Built-In EHR Reports and Audits

EHRs offer many standard reports and audits that can be useful for QI work. Unfortunately, few users take the time to explore all of the reporting options available to them and may overlook a relatively easy way to retrieve data for a project.

Built-in, or "canned," reports and audits cover the spectrum from financial reports (daily charge summaries, missing billing codes), security audits and logs (login attempts, clinical decision support system (CDSS) overrides), administrative reports (patient no-shows), and enrollment and management for special programs (Medicare Chronic Care Management services).

Clicking through the "Report" or "Quality" menus in an EHR can uncover a variety of useful reports including patient lists, quality measures, clinical decision support logs, and specialty reports. Often, the clinic may not be aware that these reports are there, but make sure you have permission before you browse.

Exhibit 21: Advantages and Challenges of Using Built-In EHR Reports and Audits

Advantages	Challenges
• Leverages existing EHR capabilities • Available with little or no configuration • Output can often be exported to Excel or CSV • Standard reports can be compared across clinics	• The vendor defines the format and contents • Access may be restricted • Vendors may charge extra for specialty reports • Not all reports work "out of the box" • May include more data than is needed • Need to validate data in reports

Using EHR Registry Searches and Patient Lists

Many EHRs provide powerful search tools to pull lists of patients who meet specific criteria for diagnoses, encounter history, results of screening or laboratory tests, medications, provider panels, patients attributed to payers, and many other parameters. Examples of the names vendors use for this feature includes "Registry" (eClinicalWorks), "Report Builder" (Athena Health), and "Report Workbench" (Epic). Note that registries external to EHRs are addressed in Section 7 and can also be a valuable source of data.

Pulling filtered patient lists from a registry can be a powerful tool for QI. Not only can subpopulations of patients be found meeting very specific parameters, but EHRs often integrate patient lists with features to view the chart, launch patient messaging, create alerts, or identify patients with special needs or chronic illness for targeted care management.

EXAMPLE:
You want to pull a list of all of the clinic's adult patients with diabetes seen within the last six months for a targeted intervention. After reviewing the EHR's registry feature, you find that a search can be created for the needed age range, specific diabetes diagnoses, a visit date within your project's time range, and whether they have already received the intervention (assuming this is recorded in the EHR).

Exhibit 22: Advantages and Challenges of Using EHR Registry Searches and Patient Lists

Advantages	Challenges
• Leverages existing EHR capabilities • Available with little or no configuration • Offers flexible search and filter options • Output can often be exported to Excel or CSV • Registries are used by clinics for population health	• Access may be restricted • Creating a search may take some training • Not all vendors provide these tools • Vendors may charge for advanced reporting • Need to validate data in reports

Using EHR Dashboards

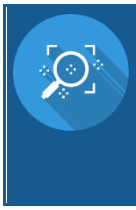
Dashboards are a form of built-in report designed to calculate and display a variety of clinical, process, and financial metrics. Because many EHR incentive programs (MIPS, UDS) require reporting of EHR-

generated measures (CQMs), most EHRs provide a dashboard that can present a selection of quality measures chosen by the vendor.

Most certified EHRs can present both aggregate data (numerator, denominator, exceptions, exclusions, and performance rates) and patient-level details using graphical and tabular formats that can be saved to Excel or a CSV file. Lists of patients who meet or fail to meet a specific quality measure are often called "gap lists," and these are discussed further in Section 6.

A robust dashboard will allow users to filter and segment quality measures so that patient sub-populations and measurement periods can be adjusted to fit the project (these may be available as an add-on purchase to the EHR or as a third-party product).

Note that smaller vendors may choose to partner with a third-party or registry to provide an external dashboard. For example, the PrimeRegistry is available to members of the American Board of Family Medicine diplomates at little or no cost. External registries and dashboards are discussed in Section 7 along with tips for finding out which measures are supported by a given EHR.



EXAMPLE:
In preparing for the diabetes project, you find that the clinic's EHR quality dashboard has a certified quality measure for Poor Diabetes Control (CMS 122, NQF 0059) [34] that will work for the project; however, it does not support the measure for Diabetic Eye Exam (CMS 131, NQF 0055). [34]

EHR vendors can pick and choose which quality measures they wish to develop or package as an additional module for population health management. When a needed CQM is not provided by an EHR, your only recourse is to seek alternatives to extract the raw data (see below) or to seek it elsewhere (see Section 7).

Exhibit 23: Advantages and Challenges of Using EHR Dashboards

Advantages	Challenges
• Leverages existing EHR capabilities • Vendor eCQMs must pass certification • Dashboards may provide useful filters • Dashboards can link to patient-level data	• Vendor's measure logic can be hard to validate • Measure logic usually cannot be changed • Measures rely on specific workflows for data • Needed measures may not be available or free • Need to validate data in reports

Extracting EHR Data to Electronic Media

Creating custom programs or reports to extract EHR data is an appealing option for QI work. The data extracted by a custom extraction will exactly match the needs of the project and the output can be tailored to streamline review, assessment, and easy integration with spreadsheets, external databases, or analytics software. Unfortunately, developing the queries needed to extract EHR data comes with several challenges.

Exhibit 24: Advantages and Challenges of Using Custom Extraction

Advantages	Challenges
• A custom report or query extracts only the needed data elements for the project • The output can be tailored to streamline review, transfer, and analysis • Raw data files can be imported into external databases or combined with other data sets • Some quality teams have extensive experience in extracting data from EHRs • A custom query can be programmed and run without clinic participation (provided access is granted)	• EHR reporting tools can be costly and difficult and can be difficult to learn • "Back-end" database access may be limited (or prevented) by the vendor or IT department • Custom reports and queries are often a low priority for local IT resources, or costly for a vendor to develop • EHR databases are not standardized, requiring detailed knowledge of each product • The access required to create custom extracts can expose sensitive information • It takes time experienced developers to design, write, test, and deploy a custom query • Queries may have to be adapted for use in other clinics using the same product • Need to validate data in reports • Custom reports often stop working with new EHR versions

Unless the project team has the access, resources, time, and knowledge to develop custom EHR reports or queries, Health IT Advisors are advised to prioritize other methods to obtain needed data.[46]

FHIR, the future of EHR data extraction for quality?

Health IT Advisors have a limited choice of options to retrieve, extract, or abstract data from an EHR to support QI projects. The government and healthcare industry both recognize that there is an urgent need to make secure retrieval of EHR data much easier for patients, providers, and payers.

Encouraged by federal requirements to alleviate "information blocking" under the 21st Century Cures Act, vendors have started opening their EHRs to application programming interfaces (APIs) using an interoperability standard called FHIR®, which has been developed by Health Level Seven International (HL7®).

Updates to the MIPS certification requirements in 2022 will require vendors to supply APIs to extract with patient and population level data needed to measure quality and calculate CQMs.

The FHIR framework is discussed in Section 10 of the handbook. See fact sheets for more information about FHIR.

Using Chart Audits to Abstract EHR Data

Compared to the convenience of using existing EHR reports or the complications of developing custom extracts, using a chart audit to retrieve EHR data for QI is often a last resort. Manually abstracting data is labor-intensive and requires broad access to patients' records to find and record needed data elements.

Exhibit 25: Advantages and Challenges of Using Chart Audits to Abstract EHR Data

Advantages	Challenges
• A "low tech" option that can be used anywhere • Provides data for QI while data challenges (e.g., mapping errors) are resolved • Provides access to non-structured data • Can provide data for rapid testing of process improvements that have not yet been spread throughout the practice • Sampling strategies can reduce the work effort • Procedures for abstraction are more flexible • Can usually be done remotely	• Requires significant time and resources • Quality of data can vary depending on auditor • Auditors require broad access to patient records • A sampling strategy may exclude important data • Clinics may be reluctant to allow access to charts

When should chart audits be used?

Sometimes, when a chart audit is not prohibited by limited resources and physical (or virtual) access, doing a manual chart audit to retrieve EHR data can actually be the best choice. Health IT Advisors might consider doing a chart audit to collect data in the following situations:

- When clinics are already are doing chart audits and are willing to collect extra data
- When a small number of records needs to be audited to provide required data elements
- When required data elements are "hidden" in narrative text, notes, or scanned documents
- When additional interpretation or context is needed to collect the needed data elements
- When measures produced by EHR reports are challenged as inaccurate
- When the use of a sampling strategy will not impact data quality
- When testing improvements with a subset of the practice
- When there is a desire to validate the data coming from automated reports
- When there are no other options to retrieve EHR data.

EXAMPLE:
In a previous example, your goal of extracting A1c values directly from the EHR was complicated by the significant number of results "hidden" in scanned documents. Once you have ruled out modifying workflows to capture structured data, using an existing EHR report, dashboards, or requesting/developing a custom query, then a protocol to extract the lab results visually from the scanned documents may be the only choice.

Procedures for Conducting Chart Audits

Health IT Advisors should be familiar with the best practices for sampling, record access, rules for handling missing or discrepant data, and procedures for handling PHI. For example, in addition to planning the design and logistics, a data abstraction form like the one shown in Exhibit 26 should be developed to ensure consistent data collection.

For those not familiar with procedures for auditing electronic (or paper) charts, we recommend "8 Steps to a Chart Audit for Quality" by Gregory, et al.[47] For a more detailed introduction to conducting chart audits, see Module 14: *Collecting Performance Data Using Chart Audits and Electronic Data Extraction*, of the Primary Care Practice Facilitation Curriculum, as well as a related Practice Facilitation Training Module on chart audits.

Exhibit 26. Sample Data Abstraction Form for Use in a Chart Audit[48]

Diabetes Chart Audit Form

Practice Site:	Date of Audit:	PF Reviewing:

a	b	c	d	e	f	g	h	i	j
Pt. ID (do not include names)	**HbA1c in the past 3 months?** 0=NO 1=YES	**HbA1c less than 7.0?** 0=NO 1=YES	**BP documented at last visit?** 0=NO 1=YES	**BP less than 130/80 mm Hg?** 0=NO 1=YES	**LDL-C in past 12 months?** 0=NO 1=YES	**LDL-C less than 100mg/ dL?** 0=NO 1=YES	**Eye exam in the past 12 months?** 0=NO 1=YES	**Foot exam in the past 12 months?** 0=NO 1=YES	**Other indicator (per practice):** 0=NO 1=YES
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
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30.									
Totals	**Total(b)=**	**Total(c)=**	**Total(d)=**	**Total(e)=**	**Total(f)=**	**Total(g)=**	**Total(h)=**	**Total(i)=**	**Total(j)=**

2.7 *Obtaining EHR support for Quality Improvement Projects*

Health IT Advisors will encounter a wide range of EHR vendors, products, and versions when working with clinics. While this handbook emphasizes common themes, no individual can be an expert on every EHR. In this section, we provide tips on where to turn for support.

In most cases, the type of support required will determine whether an experienced colleague on the quality team, local experts within the clinic, or direct contact with the EHR vendor (with a representative of the clinic present) is needed to address a question or issue. Below are some common areas where EHR support may be needed:

- Education and training
- Population health reporting
- Clinical decision support
- Design and configuration options
- Clinical content
- Troubleshooting and bug fixes
- Enhancement requests
- Custom reports and programming
- Peer group support
- Best practices
- IT and communications infrastructure
- Security and compliance
- Health information exchange and interoperability

The EHR support most accessible to a Health IT Advisor will be the quality team assigned to the project. Often, another Health IT Advisor will have run into a given situation or have previous experience with a specific EHR product.

The second-best resource is the clinic's internal EHR support. In many small practices this might be a medical assistant trained as a "super-user" or a tech-savvy clinician. In larger organizations there may be dedicated IT support that can help with EHR or data questions. Be sure to get approval before approaching clinic staff outside of the project team. Going outside of the official contacts for the clinic, even with the best intentions, may damage relationships.

The last line of support will be the EHR vendor. Health IT Advisors will rarely have direct access to a vendor's help desk or online support tools unless working for the clinic or having access through their own organizations.

EXAMPLE:
Your team has a great idea for a quality intervention that uses the EHR's CDS capabilities to generate an alert that blocks providers from ending a visit without asking about smoking. It is tempting to ask IT directly whether this alert is feasible and how long it would take to implement but doing this runs the risk of damaging your relationships.

TIPS FOR ACCESSING SUPPORT RESOURCES:

1. At the beginning of the relationship with a clinic, Health IT Advisors should assess their internal and external EHR support capabilities by asking the following questions during the planning stage of a project (also see Section 1.1):
   - Who is responsible for the day-to-day operation and maintenance of the EHR?
   - Who do you call when there are software, hardware, or network issues?
   - Who approves and manages upgrades, enhancements, or changes to the EHR?
   - Who provides user training to clinicians and staff?
   - What is the process for making content or workflow changes?
   - Who decides what CDS is appropriate?
   - Who handles requests for new reports or queries?
   - Who should I call with EHR questions related to the project?
2. Become familiar with major menu options and identify screens that capture or display data elements needed for the project. Remember that individual users may have different configurations based on their role and security level. If you plan to retrieve, extract, or abstract data it helps to know the following for each EHR:
   - How to search for a patient
   - How to access problems, medications, vital signs, test results, and chart notes, etc.
   - How progress notes are organized
   - How external reports, summaries, and external records are accessed
   - EHR-specific terms that are used as shorthand ("dot-phrase," "macro," "flowsheet").
3. A Health IT Advisor who has a long-term and valued relationship with a clinic may be given access to internal and external EHR resources like a vendor's support portal. Remember that vendor documentation (including screen shots) is usually proprietary and use by third parties may be explicitly prohibited. Resources may include the following:
   - Access to training and support documents and videos
   - Help files or on-line reference material access through the EHR application
   - "Cheat sheets" developed by or for the clinic with tips and shortcuts
   - Access to a training system, or "sandbox" EHR that does not contain patient data.

TIPS FOR WORKING WITH EHR SUPPORT DESKS:

1. Only contact the clinic's help desk with permission from the project lead for the clinic. In addition to having permission, a best practice as a Health IT Advisor is to contact the EHR Support Desk with a clinic staff member or project lead present in order to ensure awareness and clear understanding. This also may avoid future confusion if a charge is incurred to the practice related to support-desk outreach.
2. When creating service requests (sometimes called "logging a ticket") online or by phone, be sure clearly identify the question or issue and include the following information:

   Any troubleshooting steps you have tried

   The correct support team or resource to handle the request

   Examples or screen shots (be careful when including PHI)

   An appropriate priority (do not abuse high priority tickets), and

   Direct-contact information and available times.
3. Track and follow up on open service requests.
4. Be sure to "close" the ticket when a problem or question is resolved.

TIPS FOR REQUESTING REPORTS, DATA EXTRACTS, AND CUSTOM QUERIES:

When requesting special access or asking for a custom report or data extract it is important to be prepared. Collect the following before you work with an analyst:

- Confirm that the requested data exists in the EHR
- Specify the data elements needed for the project
- Specify the parameters for selecting patient records
- Specify the reporting parameters including date range and any special filters
- Provide an estimate of the number of records you expect to extract
- Be clear about how the report should be formatted and delivered

Exhibit 27 shows an example of an IT request asking for A1c data on a sub-population of patients with diabetes.

For good reason, clinics carefully control who has access to their EHR. Gaining direct access to advanced report tools or "backend" connections to the EHR database will need to be explicitly approved by the clinic's management and all privacy and security regulations must be followed; this includes, but is not limited, to HIPAA.

EXAMPLE:
For a project collecting blood pressure values, the clinic's IT analyst agrees to pull an extract file containing the information you need. In the data request, however, you did not consider that some visits will have multiple blood pressure readings in different positions (standing, sitting), or as a repeat measurement for "white coat syndrome" (nervous patients have higher blood pressures). As we have discussed before in the handbook, the time to evaluate what data will be needed and how they will be collected for a project should happen early during the planning stage (see Section 1). This situation might require a targeted workflow analysis to clarify specific data needs and potential issues with the data.

Exhibit 27: Example of an IT Request for Data Extract [49]

Diabetic Patient Identification
IT Instructions

Patient list generator

Step 1: Identify all patients that meet all of the following criteria:

- **Diabetic:** Select patients with any ICD9 = 250.xxx in the billing data.
- Among those, select patients with birth dates after 1/1/1927 and prior to 1/1/1962 [**Age > 50 years and <85 on 1/1/12**]

➢ Record number of patients seen at least twice in the 2-year period (3/30/2010-3/31/2012) ___

- Generate list seen at least once in both 12-month periods (3/30/2010-3/30/2011 AND 3/31/2011-3/31/2012).

➢ Record number of diabetics identified ___

- Of diabetic patients selected, select those with three hemoglobin A1c values dated from 3/31/2011 to 3/31/2012:
  - Record number of patients identified ___

Step 2: Identify all patients that meet all of the following criteria:

- **Hypertensive:** Select patients with any ICD9 = 401 or 402 or 403 or 404.
- Among those, select patients with birth dates after 1/1/1927 and prior to 1/1/1962 [**Age > 50 years and <85 on 1/1/12**]

➢ Record number of patients seen at least twice in the 2-year period (3/30/2010-3/31/2012) ___

- Generate list seen at least once in both 12-month periods (3/30/2010-3/30/2011 AND 3/31/2011-3/31/2012).

➢ Record number of hypertensives identified ___

Of diabetic patients identified in Step 1 (excluding criteria for hemoglobin A1c values, including those seen twice in both 12-month periods and only those within the range of birth dates listed), how many have any ICD9 = 401 or 402 or 403 or 404?

2.8 *Tips for Documenting and Sharing EHR Best Practices*

Health IT Advisors have a unique opportunity to discover and share how individual clinics design identify, prioritize, and implement QI using their EHR or other health IT. Here are some tips for documenting and sharing EHR best practices:

1. Recognize that specific vendor capabilities, local EHR configuration, workflow, and user preferences can make it difficult to generalize about EHR workflows and best practices.
2. When documenting innovative workflows, try to use vendor-neutral terminology. For example, "dot phrase" and "smart form" are both fairly specific to a particular EHR (Epic and eClinicalWorks, respectively); consider "templated structured data" as a more general term.
3. Get the clinic's permission to share examples and stories that may identify them or an individual. For example, sharing forms with a clinic logo or screen shots that contain identifying information about a clinic or provider.
4. Only share vendor materials, including screen shots, with permission. Screen design is protected by intellectual property rights; and vendors may be strict about how product images are used even for academic, research, and QI purposes.
5. Make sure that examples, screen shots, forms, and images are clear of any PHI. When obscuring PHI in a slide presentation, be sure to completely replace the image so that it cannot be re-edited. For paper, a black marker is often used to obscure PHI.
6. Flowcharts, swim-lane, and workflow diagrams are an excellent way of representing before-and-after process changes or comparing work practices in different clinics.
7. Consider presenting the results of your project to local, regional, or national EHR user groups and industry associations (The Healthcare Information and Management Systems Society [HIMSS], The American Medical Informatics Association [AMIA], The American Health Information Management Association [AHIMA]). For user groups, vendor-specific material and terminology are often appropriate (and appreciated by fellow users).

Section 3: Clinical Decision Support

Clinical Decision Support (CDS) is a broad term for a powerful set of health IT features that provide users with context-sensitive guidance, information, warnings, and prompts for actions through the application of pre-defined rules, algorithms, or clinical guidelines.

For QI projects, CDS in an EHR can be a source of data (e.g., a project to measure the frequency of user overrides on medication alerts) or serve as a quality intervention (e.g., implementing a preventive care guidance tool to improve colorectal cancer screening).

The term CDS can be used differently by clinics, vendors, and even informaticists. To help conceptualize the types of CDS when preparing QI projects, we suggest the taxonomy developed by Wright, Sittig, Ash, and colleagues shown in Exhibit 28. [50, 51]

Exhibit 28: Types of Clinical Decision Support Commonly Found in EHRs

Clinical Decision Support	CDS Type	Examples/Descriptions
Condition-specific order sets	Guidance	• Evidence-based menu or picklist to guide appropriate orders for tests, procedures, medication, education, and treatment based on specific conditions or risk factors.
Contextually relevant reference information	Informational	• Provides access to context-specific medical reference and patient education resources tailored to the patient or situation. This can be helpful in effectively engaging in shared decision making and providing patient-centered care.
Diagnostic support such as differential diagnosis tools	Guidance	• Uses data in the EHR and reference sources to aid in diagnosis using evidence-based probabilistic algorithms (and more recently artificial intelligence).
Documentation templates	Guidance	• Provides pre-defined clinical content that can be structured to guide documentation quality and support decision making.
Drug-drug and drug-allergy interaction checks	Alert or Warning	• There is a potential drug-drug interaction or the patient is allergic to a medication being prescribed.
Electronic presentation of clinical guidelines	Informational	• Display of evidence-based care plans for patients with specific conditions or risk factors. (Also helpful in shared decision making/efforts to center care on the patient.)
Focused patient-data reports and summaries	Informational	• Reports or screen displays optimized for specific tasks, clinical contexts, or conditions. Used to focus attention by tailoring how information is presented.
Health maintenance reminders	Prompt	• Patient is overdue for colonoscopy, mammogram, Pap, or other preventive care.

Using CDS for Quality Improvement

CDS can be a powerful tool for QI, but overuse of alarms and other reminders has been shown to create "alert fatigue" and even lead to important warnings being ignored or bypassed when users are busy or under stress.[52]

Below are some things Health IT Advisors should consider when incorporating a provider-facing CDS intervention in an EHR:

- Remember that CDS includes several possible interventions, including on-demand contextual access to reference data, "smart" documentation templates and phrases, and the design and layout of flowsheets and rounding sheets (a "synoptic report" for diabetes care was used in the Case Study presented in Section 6). Even printed reports can be organized and presented to enhance clinical decision making, thus making them a form of CDS using our broad definition.
- Overuse of CDS alerts and other reminders, poorly designed prompts, and "bad" data leading to inappropriate triggers can all lead to alert fatigue. Clinics should carefully prioritize and manage the number and intensity of CDS interventions and be cautious about adding new interruptive prompts or warnings that can distract (and annoy) clinicians and staff.
- CDS interventions should align with related quality efforts. For example, if a clinic is reporting quality measures to focus attention on diabetes care, including a CDS alert to flag high or missing A1c values would be a logical choice.
- EHR vendors often provide pre-defined CDS content in the form of a menu of prompts, alerts, templates, order sets, and third-party content. Where possible, these should be carefully evaluated and tailored to fit the clinic's workflows and priorities.

EXAMPLE:
After proposing a new CDS alert as part of a QI project, you find that the clinicians are actively hostile to the idea of adding "another click" to their workflow. You dig deeper and find that the vendor had turned on many alerts by default, leading to alert fatigue. After addressing default alert settings, you suggest that—additionally—a review seeking "low-value" CDS be performed, which may also reduce unhelpful alerts and alert fatigue.

When Health IT Advisors plan to implement new CDS interventions, they can assist clinics by first reviewing and optimizing existing alerts and prompts to weed out those with low value and/or those driven by poor data, as well as to ensure—before implementation—that any planned CDS efforts will have sizable, meaningful impact.

- Patient data needed to drive CDS triggers and logic must be as complete as possible. For example, setting a ten-year time window for a preventive alert for colonoscopy only works if ten years of data are accessible by the EHR and not "hidden" in scanned documents or clinical narrative.
- CDS interventions should be evidence-based. Before designing or implementing a new CDS intervention, search the literature for triggers and logic paths that have been validated in a similar setting and with a comparable patient population.

- As artificial-intelligence (AI) tools are added to EHRs and other health IT platforms, it is critical to ensure that logic paths and algorithms--and the data on which algorithms are based--are transparent and predictable, and that they produce accurate, consistent, and equitable guidance for clinicians or patients.

Additional information about how health advisors may use CDS for quality improvement may be found through the Electronic Clinical Quality Improvement (eCQI) Resource Center. Health advisors may also find re-usable, interoperable CDS resources and artifacts as building blocks for their CDS projects at AHRQ's CDS Connect platform.

Section 4: Patient Portals and Engagement Technologies

Before smartphones and personal health applications, a "patient portal" usually meant a secure website typically integrated with an EHR that allowed patients to view (some of) their medical record and securely exchange messages with clinic staff. Patient portals and related engagement tools (smartphone apps, text messaging, personal health records) have rapidly evolved to provide patients and caregivers with a more "connected experience." Recent federal requirements meant to streamline access to an individual's own health records has created new opportunities to view and interact with data.

For the Health IT Advisor, patient portals and related platforms can provide data for QI and deliver targeted interventions directly to patients.

Patient-generated data (see also Section 5) captured through a portal could include health screening results, health logs, and (increasingly) biometric data from devices.

Patient-facing interventions delivered by portal could include patient reminders for preventive care, individualized education and self-care instructions, and motivational messaging.

Common features found in many patient portals include:

- Providing patients, parents, and caregivers with secure electronic access to parts of their EHR including the following:
    - Demographics and insurance information
    - Visit and referral history
    - Laboratory and imaging orders and results
    - Care summaries and procedure reports
    - Problem and medication lists
    - Vital signs
    - Provider progress notes
    - Individualized care plan
- Serving as a platform for telehealth and virtual care by providing real-time communication with clinic staff and providers
- Delivery and management of secure messages, test results, alerts, reminders, and personalized education material
- Allowing users to download and share their medical record by securely transmitting a summary to another provider or a personal health record or smartphone application (e.g., Apple Health)
- Remotely capturing and incorporating patient-provided data into the EHR, including electronic forms, questionnaires, and assessments
- Remotely and securely capturing and incorporating data from personal health devices including glucometers, step counters, and blood pressure cuffs; this includes real-time remote patient monitoring solutions (RPM).

Using the Portal for Quality Improvement

EHR portals and patient engagement platforms have the potential to reshape how, where, and when an individual's health data are collected. Information that once used pen and clipboard can be acquired in the clinic on a tablet computer or kiosk, or outside of the office.

Health IT Advisors should consider the following use cases when a patient portal is available:

1. Use EHR logs and audits to measure how and when users interact with portals and apps.
2. Incorporate structured data from forms, questionnaires, and assessments collected via a portal or app into a QI project.

The principles of data governance (see Section 2) also apply to data collected through portals or other patient engagement technologies. When it is used for QI, Health IT Advisors should observe how patients or caregivers interact with the portal to look for gaps or red flags in data quality. For example, there may be issues with how data are collected (unformatted text, for example) and when and how data are transferred and incorporated into the EHR.

And most important, not all patients can (or will) use patient engagement platforms, including traditional EHR patient portals. You should carefully consider whether adoption and use may be limited to a subpopulation with higher literacy and numeracy and/or greater access to or affinity for technology. Equity and inclusion are important issues that need to be addressed when use of patient-facing technology is being considered.

Section 5: Incorporating Patient-Generated Data for Quality Improvement

5.1 *Advantages of Patient-Reported Outcomes and Patient-Generated Data*

Patient-reported data and patient-generated data together offer an opportunity to capture information for use at the point of care, with potential cost savings and improvements in quality, care coordination, and patient safety.[53] Patient-generated health data (PGHD) includes patient-reported outcomes (PROs). According to the Food and Drug Administration (FDA), a PRO is a report coming directly from the patient regarding the status of a patient's health condition without amendment or interpretation of the patient's response by a clinician or anyone else.[54]. Data can be captured by a patient, family caregiver, provider, or device. Data can be retrospective (i.e., capturing data on things that have occurred in the past) or entered in real time. AHRQ has published an important resource on this topic, *Integrating Patient-Generated Health Data into Electronic Health Records in Ambulatory Care Settings: A Practical Guide*.[53]

PROs can be collected from patients at various times and in various ways, including:

- during clinic visits
- when they are at home (including all locations in someone's daily life)
- online through various web tools
- through mobile devices used either for treatment or for research.[54]

PGHD includes any health-related patient data that originates from the patient or patient designee. This includes data captured by:

- wearable technology
- sensors
- patient-reported treatment, symptom, or lifestyle data

It is now understood that it is critical to value the patient as a source of vital health information. The timely receipt of additional data from the patient, the patient's family, or other caregivers outside of the clinical visit can eliminate critical information gaps, such as recent changes in the patient's condition or symptoms that might prompt a change or reconsideration of the care plan.[55]

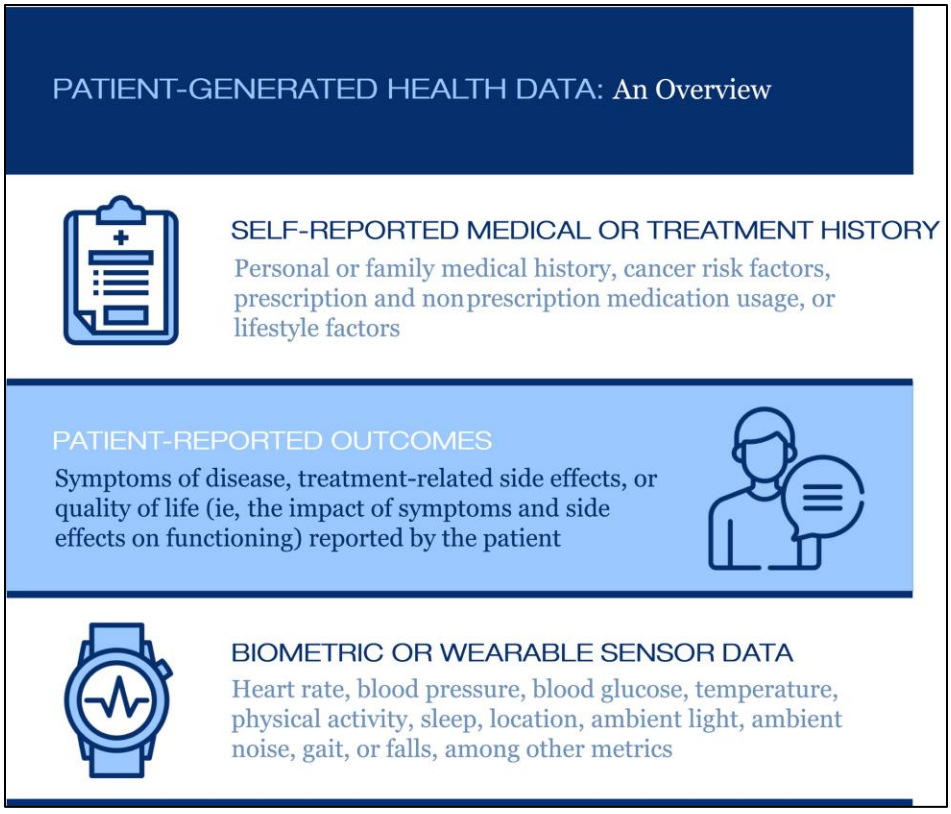
Acquiring knowledge that a patient had a procedure or test from another provider can help reduce duplicative services. Additionally, an up-to-date list of medications from all providers, including what is being taken as compared to what has been prescribed, is vital for care coordination. Data regarding medications, allergies, intolerances, and outcomes can help mitigate safety risks and adverse outcomes.

Policies and practices for the safe and effective collection and use of data generated by patients outside the clinical setting will help support delivery and payment reform goals. Developments in healthcare delivery, such as patient-centered care, the patient-centered medical home, and payment reform programs such as Accountable Care Organizations (ACOs) seek to strengthen patient engagement and care team coordination as contributors to better outcomes and efficiencies.[55]

Additionally, the use of PGHD can spur patient engagement, self-monitoring, and self-management. This encourages some activities to shift from being provider-driven to patient-led.[55]

Health IT Advisors can teach practices to incorporate PROs and PGHD with point-of-care information to improve coordination of care and include the patient as an active care participant. Workflows to include this external information in the medical record and in shared decision making will also be essential for practices.

Exhibit 29: Overview of Patient-Generated Health Data[56]



5.2 *Patient-Reported Data Examples and Sources*

A patient's health history can be collected in an outpatient or inpatient setting. The purpose of obtaining the health history is to gather subjective data from the patient or the patient's family. The health history is essential so the healthcare team and the patient can collaboratively create a care plan that will promote health, address acute health problems, and minimize the effects of chronic health conditions.

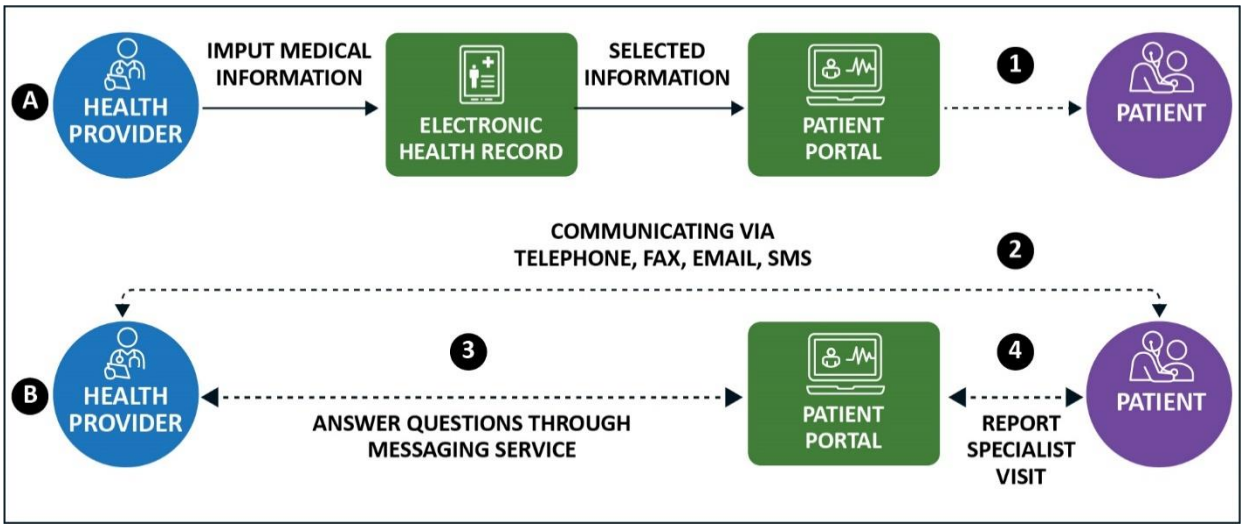
Health history data is traditionally gathered from patient encounters at the point of care. Health history data collection requires additional resources and typically must be completed during the patient visit. Patients may also be provided the option to enter these data through a patient portal. Enabling patients to enter this historical information through a portal has many benefits as noted above.

Health IT Advisors can help practices develop workflows that reinforce patient data entry of health history changes into the patient portal and incorporating new patient-generated data into point of care visits. Workflow changes include asking patients during triage if they have had any ancillary treatments,

appointments, or admissions since their last encounter. This self-reported information is then entered into the EHR.

Exhibit 30 below demonstrates how health-provider-generated data can be transmitted to a patient and how patients can self-report information that can be transmitted back to their health provider through a patient portal.

Exhibit 30: Integrating Patient-Generated Data Directly into Primary Care Providers' EHR Workflow[57]



Graphic adapted with permission.

Providers with registry capabilities or affiliations with hospital networks may have access to emergency room and inpatient admission data. Unfortunately, though, many independent and rural primary care practices do not have this kind of direct access to inpatient utilization data. (A clinical registry is an ancillary computer database that collects secondary information about patients. Information can include prescriptions, immunizations, diagnosis, conditions, and procedures.)

Health IT Advisors can work with providers to assess available sources of external data for their particular practice, and help determine the costs and benefits of integrating with existing data sources or setting up new internal processes for collecting data from patients.

5.3 *Technical Issues/Privacy & Security/Barriers*

Technical Issues

Technical and data standards are vital to the effective use of PGHD. Patients may need to be taught how to measure data accurately, track changes in health, and transmit data in a standardized manner. The information must be collected and submitted in standardized ways that ensure that the information can be received, understood, and integrated into the EHR if desired. [53]

User-friendly data dictionaries will be required to enable standardized data entry and integrate patient activity into patient portals, electronic health tools, and platforms to create useful health information. (A good resource regarding data dictionaries can be found at: What is a Data Dictionary? | Journal Of AHIMA.) In a dynamic consumer electronic health environment, it will be critical to incorporate PGHD into the EHR.

Privacy and Security Issues

Patients and providers need to be assured that data transmitted and received are private and secure. Authentication of the patient (or caregiver if that person is submitting information) is critical to ensure that information authorship can be correctly attributed. A method of connecting specific information to its source is essential to track data moving from system to system, particularly from patient-controlled sources to provider EHRs, so that the integrity of the data can be ensured. [55] Encryption is another option to secure transmitted patient-generated data. However, this requires the additional steps of creating and storing passwords which may hinder patient usability. [53]

Health IT Advisors may support practices and providers by identifying security needs including encryption and workflows that include obtaining additional patient consent for sharing private health information. There could be a need to address patient authorization for secondary sharing of PGHD, if the patient prefers that the data not be shared with other providers or for other purposes. [53] In general, adhering to best practices regarding data governance is particularly important in the context of PGHD. The AHRQ PGHD *Guide* mentioned above has a section on data governance (Folio 4).

5.4 *Patient-reported Symptoms and Health-Related Quality of Life*

Patient-reported symptoms regarding health, pain, and well-being can be helpful to determine current treatment plan effectiveness as well as future treatments. [58] These may include symptoms after cancer treatments, surgical procedures, or changes in medications. Patients can relay symptoms through connection to a web-based platform.

PROs can take a variety of forms, including measures of differences in symptom severity and impact and measures of health-related quality of life (HRQoL). A consensus among health researchers is that HRQoL is a multidimensional construct composed of at least four dimensions:

- Physical function (i.e., daily activities, self-care)
- Psychologic function (i.e., mental state, mood)
- Social role function (i.e., social interactions, family dynamics), and
- Disease or treatment symptoms (i.e., pain, nausea) [59]

Symptom reports represent a subset of HRQoL. Symptoms are viewed as the patient report most closely related to the disease process and may be as impactful as HRQoL components such as well-being, perception of daily functioning, global impressions of the impact of treatment on daily life, satisfaction with treatment, and perception of overall health status. [59]

5.5 *Home-Reported Outcomes/Patient-Generated Health Data*

Physicians regularly collect data on patients' physical vital signs at the point of care, but they most likely do not know much about their patients' home and community environment. This lack of information is problematic because factors such as where you live, what you eat, whether you have the chance to exercise, and other social factors have a significant impact on patient health outcomes.

Appropriately collecting and acting on PGHD, such as self-measured blood pressure data, has the potential to better engage patients in self-care, improve patient outcomes, and reduce healthcare costs related to readmission and emergency room visits. [60] This can be done through telemonitoring devices

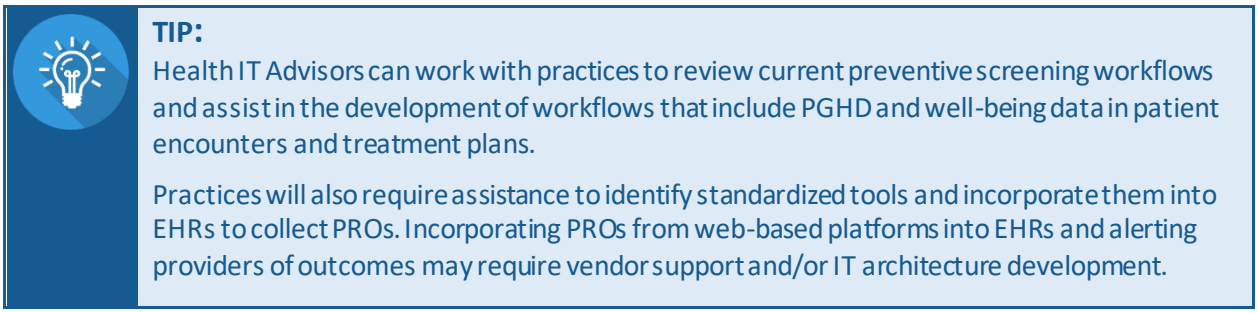
such as automated blood pressure machines, pulse oximeters, scales, and other measurement mediums. There are options for these devices to be connected to a web-based platform or transmitted directly into EHRs.

In addition to tele-monitoring, other technologies have been developed to enable patients to collect their health information beyond the clinical setting and share that information with providers. Examples of these new technologies and applications include Personal Health Records (PHRs), wearables, and telephonic applications such as those that utilize Bluetooth to send data to a patient's phone and generate reports and data that can be shared with healthcare providers. Connected devices have also been developed to test a variety of other health indicators such as blood glucose, cholesterol, and oxygen levels.

5.6 *Electronic Health/Well-being (Preventive Screenings)*

With chronic disease prevalence signaling the need for a refocus on primary prevention, electronic PGHD might be essential in strengthening proactive and person-centered healthcare.[61] Screenings such as depression, weight, nutrition, smoking cessation, and substance use can be incorporated into patient portals or administered utilizing remote video-conferencing platforms. Screenings can also be paired with external devices such as smart watches, pedometers, glucometers, and scales.

Patient-generated health screening data can potentially improve health literacy and patient engagement through promotion of improved patient engagement in care.[61] Preventive health management alone requires patient participation and goal setting. Generating and transmitting prevention/screening data can be taxing for the patient and provider; however, this type of data is vital to help providers determine if health and well-being factors may impact disease and the patient's ability to adhere to a treatment plan. In order to prevent implementation of PGHD from causing disparities, practices need to ensure that patients with limited ability or access to computers and the Internet, or limited numeracy, have the opportunity to provide PGHD.



5.7 *Data Collection and Use Challenges*

There are many challenges to collecting patient-reported data and patient-generated data. There is an overall lack of motivation and cost benefit to collecting and using PROs.[62] Inclusion of patient-reported data into the EHR may require changes in workflow, increased staff allocation for transcription or review, and clinical decision support modifications. If PROs are not incorporated in treatment, then providers may not see the value in their use.

Recently, stakeholders have become interested in expanding the use of PROs for direct patient care. Other stakeholder efforts include input in quality measurement and patient-reported outcome measures in value-based payment programs. To optimize the value of care we provide from our patients' perspective, we must ensure that the right patient-reported outcome measure (PROM) is used for the appropriate indication. Without proper alignment between PROMs and measurement goals, data may be unfounded and may result in poor decision making.[63]

Additional barriers might also impact the standardized collection of patient-reported outcomes in clinical practice. Lack of motivation to collect and use PRO data driven by inertia is a significant concern, just as inertia is a barrier to widespread adherence to clinical guidelines.[62] There are many HRQoL instruments; however, clinicians are generally unfamiliar with them. Additionally, providers may not know what action is appropriate to take on PRO data and/or may not know how best to incorporate this data into shared decision making. Even exposure to educational programs to improve knowledge of PROs may not be sufficient to change clinicians' behavior enough to improve health outcomes.

Section 6: EHR Use Cases for Quality Improvement

This section contains a practical guide for the two major applications (or use cases) of an EHR in QI work. The first is to provide a source for the various data elements needed to inform, monitor, and evaluate a QI project (a CQM for example); the second is to act as a platform for delivering a wide range of interventions (CDS).

Choosing from the range of potential uses for an EHR can be overwhelming. For each project it is important to anticipate whether an EHR is capable of meeting the project's needs and whether the time, resources, knowledge, and skill exist to support its use.

We begin this section with a case study that illustrates how one large health system strategically used their EHR as the cornerstone for improvements to diabetes care, both as a data source and as a platform for interventions. (Alternative data sources are addressed in Section 7.)

6.1 *Case Study: Leveraging an EHR to Transform Ambulatory Diabetes Care*

The following is a published case study from MetroHealth System in Cleveland, Ohio (MHS), a large organization that leveraged their EHR in a comprehensive QI initiative to improve ambulatory diabetes care between 2007 and 2014.[64, 65]

MHS is a large organization with a robust EHR (Epic) and strong technology support. When reviewing this case study, Health IT Advisors should keep the following points in mind:

- There were eight specific EHR-related interventions deployed in phases over seven years.
- Each phase built on previous interventions in a sustained and comprehensive QI project.
- The length and scope of this project is not typical of most practice facilitation efforts.
- MHS used their EHR to improve their performance on key process and outcome measures.
- Data showed a significant improvement in measures of quality for diabetes care.

MHS introduced eight EHR interventions one after another with two evaluation points. The first was between 2005 and 2006 and the second between 2007 and 2014.

Measuring Quality of Care for Diabetes

A difficult step in any QI project is in selecting (or creating) CQMs. MHS used data from their EHR to *provide the data* for nine custom-developed quality measures (five process and four outcome measures) to inform and evaluate their progress. The nine measures are included in Exhibit 31.

Exhibit 31: MHS' Custom Developed Quality Measures

MD Centric EHR Measures	Patient centric EHR Measures
Delivery and documentation of diabetic eye and foot exam	Smoking status documented
Pneumococcal vaccination	Body Mass Index (BMI)
Monitoring or treating kidney disease	Glycemic control (A1c)
Cholesterol level for patients taking a statin drug (2005 to 2007)	Blood pressure
A1c test performed (2007 - 2014)	

EHR-based Quality Interventions

The EHR was also used as a *platform to deliver* eight interventions between 2007 and 2014 specific to diabetes care. These are listed below and summarized in Exhibit 32.

- One (1) intervention was a form of CDS that provided contextual alerts and notifications highlighting gaps in diabetes care (Epic calls these Best Practice Alerts, or BPAs).
- Two (4 and 6) interventions used the EHR to improve documentation of care plans and to capture eye and foot examinations as structured data.
- Four (2, 3, 5, and 8) interventions used the EHR to present tailored data to providers (using a specially developed summary screen) as a resource to engage patients with diabetes in their care planning (EHR-generated letters).
- One (5) intervention used EHR data to create comparative performance reports to spur competition and to provide individual providers with detailed information on the patients in their panel.

Exhibit 32: Introduction of EHR interventions for Diabetes Care at MHS (2007 to 2014) [64]

Quality Interventions at MHS:

1. Updated best-practice advisories (a CDS alert) in Epic EHR.
2. Developed comparative performance reports for selected measures.
3. Developed letter templates for diabetes care plans.
4. Enhanced EHR to capture structured documentation for diabetic eye and foot exams.
5. Used comparative performance reports to develop financial incentives.
6. Enhanced diabetic care plan templates to capture goals, barriers, and interventions.
7. Developed customized "synopsis" screen in the EHR to highlight data elements for diabetes care.
8. Updated provider-specific patient lists to improve clinicians' awareness and accountability.

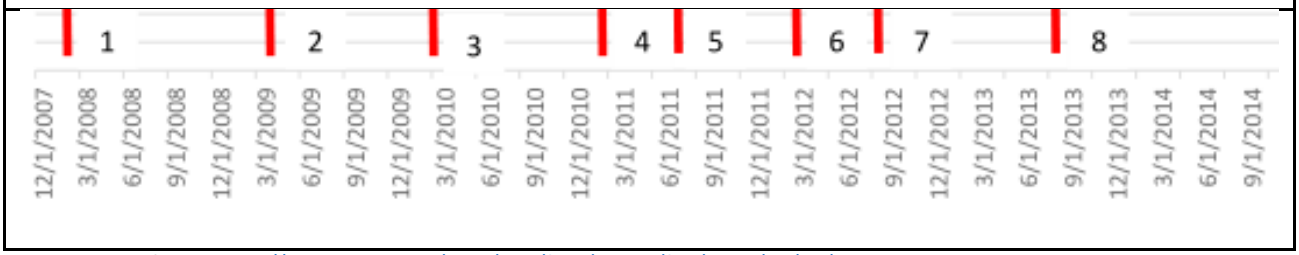


Chart adapted from: https://www.himss.org/sites/hde/files/media/file/2021/01/20/metrohealth-davies-diabetes-management-case.pdf.

Discussion

There are three key lessons that Health IT Advisors can draw from how MHS leveraged their EHR to improve diabetes care.

First, their choice of process and outcome measures was based on a detailed assessment of what data existed in the EHR, how it was stored, and the feasibility of retrieving it for reports and letters, CDS, and tailored EHR "synopsis" displays (another form of CDS).

Second, we can infer that the data limitations found early in the project informed the selection of later interventions. For example, the intervention to introduce new fields to capture diabetic eye and foot exams as structured data is a logical prerequisite to measuring whether these services were delivered.

Third, MHS approached this as a total transformation of ambulatory diabetes care and not as a technical project to turn on EHR features. Each intervention was tied to the larger objective: leverage the EHR to improve processes and outcomes for patients with diabetes. To assess the impact of each intervention separately, a different design for measurement and evaluation would have been required.

Among other lessons, the authors described specific examples of how their Epic EHR was used to support their quality goals in diabetes care. We suggest that readers dig deeper into the design, implementation, results, use of data visualizations, and lessons learned summarized and discussed in by the MHS team in several publications, including the following:

- Electronic Health Records and Quality of Diabetes Care; Cebul, et al.; NEJM 365:9 (2011)
- MHS Case Study for the HIMSS Davies Award

6.2 *Use Cases for EHR-supported Quality Improvement*

Each of the use cases presented considers how a clinic's EHR can be used to provide data for QI and serve as a platform for delivering quality interventions.

Hera are some common themes across all of the use cases presented:

- EHRs *may* provide a wide range of demographic, clinical, administrative, and financial data useful for QI.
- EHRs *may* provide options for reporting at least some CQMs, generate graphs and dashboards, and generate patient lists filtered by demographic and clinical parameters.
- EHR data *must* be captured and stored as structured data for most of the uses described here. Inconsistent workflows and poor data quality (see Section 2) will lead to erroneous conclusions (Issues with poor data quality are often referred to as "garbage in, garbage out").
- EHR-delivered interventions *depend* on good data, consistent workflows, proper training, evidence-based design, and organizational support for success.
- EHRs are *not* the only health IT tool useful for QI and may not even be the best choice for a given project (see Section 7 for alternative data sources).
- Incorporating an EHR into practice transformation can be challenging. We discuss how some of these challenges can be addressed at the end of the section.

Important data considerations for finding and using EHR data use the terminology framework introduced in Section 2 (USCDI 3.0), but remember that different EHRs may have unique ways of naming and organizing the same information.

EHR Use Case 1: Reporting Clinical Quality Metrics from an EHR

Obtaining and using clinical performance data is a core function of practice facilitation and health IT advising. Extracting performance data from an EHR can be done in many ways (see Section 2), but the built-in quality measures provided in an EHR are a good place to start when custom measures are not required.

The need for EHRs to generate standardized CQMs has been part of federal EHR incentive programs beginning with the original Meaningful Use objectives released in 2009. The current Quality Payment Program (QPP) under MIPS attributes 30% of a provider or group's overall performance score based on a peer comparison of specific quality measures. [66]

While the Medicare programs have had the most influence on what measures a given EHR vendor will provide, Health IT Advisors will quickly find there is a vast selection of CQMs to choose from (also see Section 8) and not all will be found in a clinic's EHR; Section 7 discusses alternatives to the EHR.

Finding CQMs provided by a specific EHR

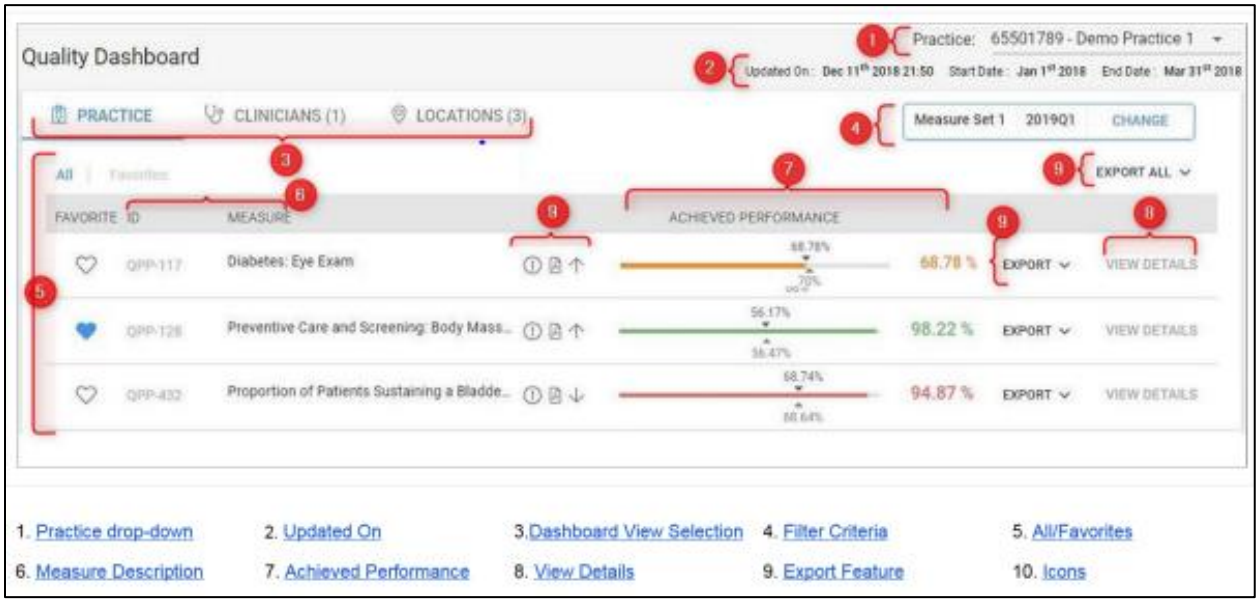
Most clinics report at least some quality data to incentive programs [MIPS, Comprehensive Primary Care Plus (CPC+)] or payers using EHR-generated CQMs. CMS maintains a searchable library of current eCQMs along with detailed specifications and logic diagrams.

Vendors must complete a certification process for any CQMs their customers will submit to CMS through the MIPS Quality Performance Program. Health IT Advisors can take advantage of this requirement by searching the ONC's Certified Health IT Product List (CHPL) for any certified EHR by vendor and version.

Accessing EHR CQM reports and dashboards

Finding an EHR's CQM reporting module may require some searching. Most vendors will provide a special dashboard, subsystem, or third-party registry to access CQMs used for MIPS and other quality incentive programs [CPC+, HEDIS (Healthcare Effectiveness Data and Information Set), UDS]. Exhibit 33 shows a typical dashboard for measures used by the Medicare value-based payment program for ACOs.

Exhibit 33: Example of a CQM Dashboard[67]



Graphic included with permission from The American Board of Family Medicine.

Data and Workflow Considerations

You are not limited to using certified MIPS measures for QI projects. A clinic's EHR may offer many additional quality measures found in the NQF database for preventive care guidelines, specialty care, federally qualified health centers (FQHCs, called the Uniform Data System, or UDS), and special CQMs for use in value-based payment models (see Section 8 for a primer on CQMs and where to find them).

When standard CQMs are needed for a project, the built-in CQMs provided in an EHR can save time and resources. However, there are some things Health IT Advisors should consider (also see Section 2):

- Standardized CQMs require rigid conformance to specifications and timely updates to measure logic and code values used for inclusion/exclusion criteria. The inner workings of the CQM provided by a vendor may not be clear, making troubleshooting and data validation difficult.
- Vendors may be slow to make changes to the CQM programming when errors or outdated codes are found (not all CQMs require certification with ONC).
- The selection of CQMs provided by a given vendor is limited and may depend on the target specialty for the EHR. For example, a specialty EHR for gastroenterology may not include CQMs useful for primary care, pediatric medicine, or other specialties.
- Most CQM dashboards can provide both aggregate (numerator, denominator, exclusions, and performance rate) and patient-level data. Unfortunately, clinics often must purchase more robust population health software to access advanced features for segmenting a CQM by additional patient demographics, attribution models, or other criteria.
- Some of the limitations of using built-in CQMs can be overcome by exporting the EHR data and combining it with other sources using desktop or analytics software. *Example:* An all-payer CQM for Depression Screening and Follow-up (CMS 2, NQF 0418) could be combined with a

demographic report that includes the patient's payer(s) and/or that is stratified by age or gender.

And most important:

- The logic and data used by an EHR to calculate a CQM depends entirely on the completeness, accuracy, format, and code mapping of the underlying data elements. An EHR-generated performance metric should only be used if it has been validated and found to be reliable. Tips on assessing data quality are discussed in Section 2.

*Exhibit 34: EHR Data Considerations - **Using Clinical Quality Measures from an EHR***

EHR Element	Description
Assessment and Plan of Treatment	• Diagnosis codes entered as encounter assessments are often used as inclusion/exclusion criteria for EHR-generated CQMs.
Clinical Notes	• Information in unstructured notes, scans, or faxes cannot be used to generate CQM denominators, numerators, exclusions, or exceptions. • Some EHRs can incorporate structured data into clinical narrative and may be able to capture key elements for CQM calculations.
Clinical Tests	• Tests and procedures performed in the clinic must be properly documented and coded to be used in a CQM calculation.
Diagnostic Imaging	• Orders for diagnostic imaging must be properly documented and coded to be used in a CQM calculation. • Results for diagnostic imaging must be recorded as structured data to be used in a CQM calculation.
Encounter Information	• Encounter coding is frequently used as inclusion criteria for CQM denominators, numerators, or exclusions (CPT, ICD, SNOMED). • Some encounter types may be explicitly excluded from a CQM by local configuration or vendor specification. • Encounter dates for eligible visits are frequently used when calculating the measurement period for a CQM.
Health Concerns	• Self-reported data and assessments must be recorded as structured data to be used in a CQM calculation. • Specific questions and responses for questionnaires may need to be explicitly coded to correctly calculate denominators, numerators, and exclusions (LOINC, SNOMED).
Immunizations	• Vaccines must be mapped to the correct NDC and/or CVX code to be used in a CQM calculation.
Laboratory	• Laboratory tests and results must be mapped to the correct LOINC code to be used in a CQM calculation.
Medications	• Medications and therapeutic injections must be mapped to the correct NDC and/or RXNORM code to be used in a CQM calculation.
Patient Demographics	• Missing or incorrect data for age, gender, and other demographic fields will affect CQM calculations that use them.

EHR Element	Description
Problems	• Diagnosis codes entered in the problem list are often used as inclusion/exclusion criteria for EHR-generated CQMs. • Diagnoses must be coded with SNOMED and/or ICD to be used in a CQM calculation.
Procedures	• Procedure codes must be coded with CPT to be used in a CQM calculation.
Vital Signs	• Variation in how and when vital signs are recorded in the EHR may affect CQM calculations (height, weight, blood pressure, BMI, BMI%). • Workflows for recording repeat readings can affect CQM calculations (the last BP recorded in a visit is often the lowest). • Height and weight must be consistently recorded to produce accurate BMI and BMI% if used in a CQM calculation.

EHR Use Case 2: Improving the Delivery of Preventive Care

Improving the delivery of preventive healthcare services in the U.S. is a public health priority.[68] However, as Banksy et al. reported: "As of 2015, only 8 percent of US adults ages thirty-five and older had received all of the high-priority, appropriate clinical preventive services recommended for them. Nearly 5 percent of adults did not receive any such services."[69]

The gap between evidence-based screening practices and actual care delivery makes preventive care an important target for QI and practice transformation projects. Often, these data come from claims (see Section 7), but EHRs are increasingly used to support preventive care by measuring clinical quality, targeting interventions, and determining how much providers are paid under value-based payment contracts. In the U.S., evidence-based guidelines for preventive healthcare are developed and disseminated by the U.S. Preventive Services Task Force (USPSTF). EHR-driven QI projects frequently target one or more of these recommendations.

EHR Data

- **Measuring the delivery of preventive care services:**

  Some of the first CQMs developed for EHRs calculate performance rates for delivering specific preventive services. As a result of the federal EHR certification requirements under Meaningful Use and the QPP, Health IT Advisors will find that most clinics can produce common CQMs including performance rates for Screening for colorectal, breast, and cervical cancer; Screening for depression; Recording of smoking status and delivery of cessation counseling; and Age-appropriate immunizations.

  The completeness and accuracy of EHR-generated measures for preventive care is heavily dependent on the quality of the underlying data. For example, depending on how long a clinic has used their EHR, it may not be possible to determine whether the guideline for colorectal cancer screening by colonoscopy was met without access to ten continuous years of structured data (see CMS 130, NQF 0034).

- **Targeting populations and individuals for interventions:**

  Using EHR data to inform population health is a recurring theme across most QI use cases. EHRs that can calculate CQMs often allow users to "drill down" to a list of individual patients meeting, not meeting, or excluded from a preventive care measure. These lists are often called "gap lists" because they highlight specific gaps in recommended care, and in more robust EHRs can further segment quality data by demographic, administrative, and other parameters useful for targeting interventions.

EHR Interventions

- **Clinical decision support tools:**

  In Section 3 of this handbook, CDS interventions are described as a collection of EHR features and functions designed to draw attention to specific gaps in recommended care. For example, a CDS intervention could be configured as an alert window that pops up in a patient's chart when age- and gender-appropriate preventive cancer screening tests have not been ordered or performed.

  CDS is a powerful QI tool, but can exacerbate alert fatigue among providers. Therefore, Health IT Advisors should be cautious before recommending new provider-facing CDS alerts. (Also see Section 3.)

- **Patient engagement as an intervention:**

  Successful preventive care depends on individuals' following through with provider's recommendations for screening tests and procedures -- especially unpleasant procedures like a colonoscopy or a mammogram. EHRs can be used to deliver patient-facing reminders, education material, encourage virtual visits, and other targeted interventions. (Also see Section 3.)

  EHRs can also collect data (e.g., blood pressure) and online assessments directly from patients via a portal or smartphone application. For example, a standardized questionnaire to screen for depression such as the Patient Health Questionnaire (PHQ-2 or PHQ-9) can be completed by a patient the day before a visit – freeing up time in the exam room.

*Exhibit 35. EHR Data Considerations - **Improving the Delivery of Preventive Care***

EHR Element	Description
Assessment and Plan of Treatment	• Assessment and billing codes applied to an encounter may indicate services and tests provided for screening and preventive care. • A treatment plan may include referrals or orders for future screening tests (labs) and procedures (colonoscopy).
Clinical Notes	• Patient-reported history or screening results from external providers may be recorded as narrative in clinical notes or medical history.
Clinical Tests	• In office tests and procedures might be used for preventive care or as part of diagnosis, treatment, and management.
Diagnostic Imaging	• Results for mammograms and other preventive imaging studies may be available as structured data or "hidden" in scanned documents and faxes.

EHR Element	Description
	• Imaging results from different providers may have unique names in the EHR (Mammogram versus Mammogram, Screening) or incorrect test code mapping (LOINC, CPT). • Diagnostic imaging results may be received as unstructured text (scans, faxes).
Encounter Information	• Screening tests are often requested for annual wellness visits as part of standing order protocol. • Assessment and billing codes applied to an encounter may indicate services and tests provided for screening and preventive care
Health Concerns	• It may be difficult to distinguish tests and services ordered for diagnostic, treatment, and management purposes from "true" preventive care (mammograms, Pap tests, colonoscopy). • Self-reported assessments on substance use and depression may not be recorded as unstructured data (scans, faxes). • A validated screening tool must be used for gathering patient substance use data.
Immunizations	• Immunization data in an EHR may not include vaccinations delivered outside of the clinic (see Alternative Data Sources). • Immunizations can be confirmed with state immunization registries and some practices have a link to their state immunization registry on their website.
Laboratory	• Results for screening tests may be recorded as unstructured data (scan, fax). • Results from outside labs or providers may not be recorded in the EHR (see Alternative Data Sources). • Results from different labs may have unique names in the EHR (HbA1c versus Hemoglobin A1c) or incorrect test code mapping (LOINC). • Pathology and cytology results (Pap tests) may be received as unstructured text (scans, faxes).
Medications	• Rarely used for preventive care QI.
Patient Demographics	• Used to identify individuals eligible for recommended preventive care services. • Patient demographics information can drive further assessment of health-related social needs regarding preventive care.
Problems	• Used to exclude individuals with an established diagnosis who are in treatment or management and no are longer eligible for screening.
Procedures	• Procedure notes and summaries from outside providers may be recorded as unstructured data (scan, fax). • Procedure notes and summaries from outside providers may not be recorded in the EHR (see Alternative Data Sources).

EHR Element	Description
	• Colorectal cancer screening using invasive procedures may still be considered "diagnostic imaging" by some EHRs (colonoscopy).
Vital Signs	• There may be variation in how and when vital signs are recorded in the EHR (height, weight, blood pressure, BMI, BMI%). • Workflows for recording repeat readings for blood pressure can impact data quality. • Height and weight must be consistently recorded to produce accurate BMI and BMI%.

EHR Use Case 3: Behavioral Health and Social Needs

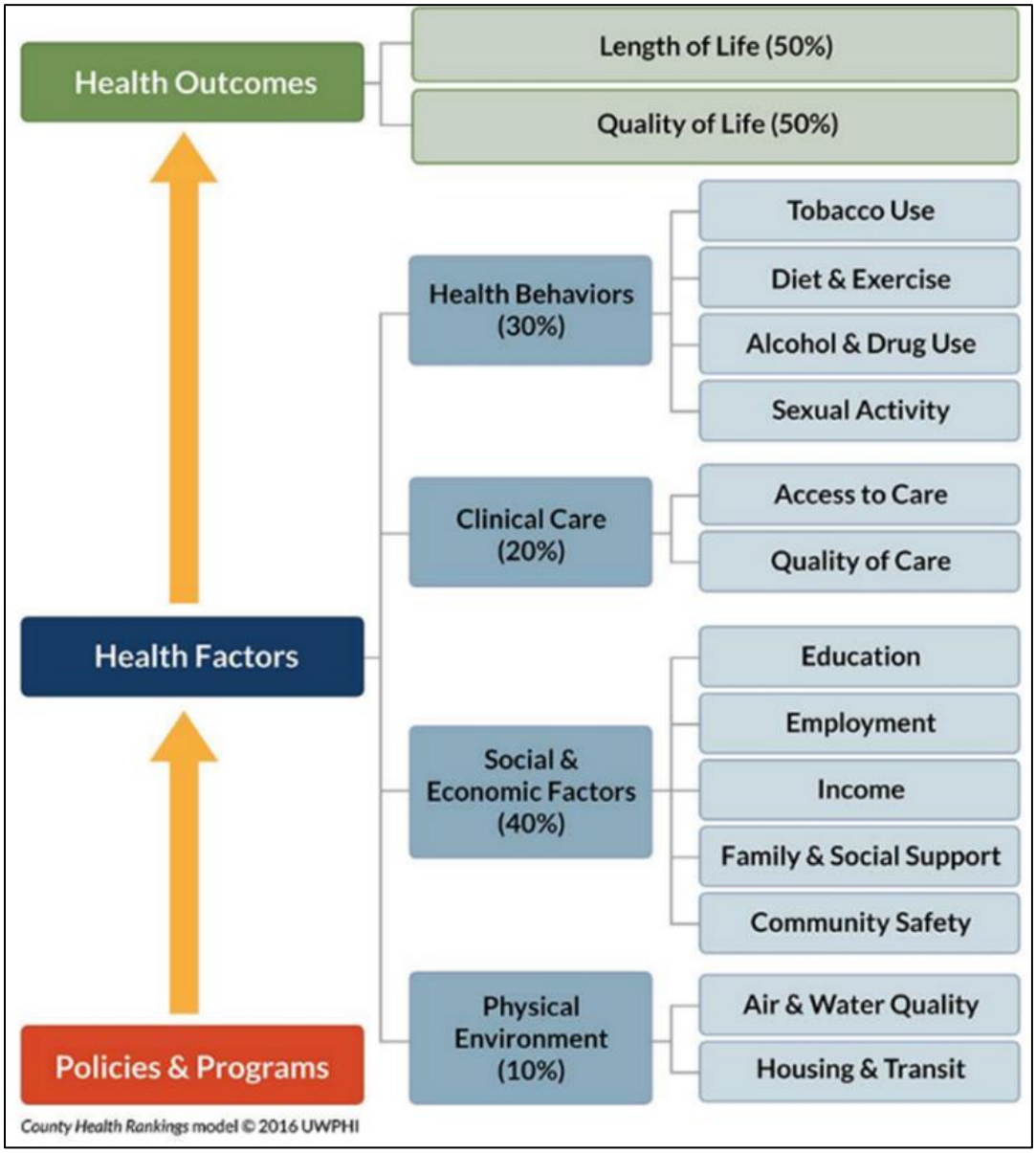
One of the overarching goals of the U.S. Department of Health and Human Services' (DHHS) Healthy People 2030 Plan is to *"Create social, physical, and economic environments that promote attaining the full potential for health and well-being for all."* [70] The priority DHHS has given to identifying and addressing SDOH highlights the increasing need to collect information on patients' health-related behavioral, social, and community needs.

Until recently, EHRs used in primary care settings did a poor job of handling data outside of the traditional medical encounter. However, the move to integrate or "embed" behavioral, mental health, and social services into clinics is rapidly expanding the types of data an EHR can provide for QI.

What are Social Determinants of Health (SDOH)?

Research suggests that traditional medical care contributes only 20% to overall health outcomes in the United States.[71] As the healthcare system seeks to address the 50% of health-related social factors, practice transformation and QI will increasingly require data on economic, educational, environmental, and social/community contexts for their patients. Health IT Advisors can play an important role in helping clinics establish the needed workflows and EHR settings to consistently and accurately capture SDOH data, including demographic factors that can affect health such as self-reported race, ethnicity, and language preference, as well as other factors important in SDOH mentioned above including education level attained and other socioeconomic information. For example, if programmed for this, EHRs can capture data about a person experiencing homelessness, depending on public transportation to access health services, and/or living in a building with known high lead levels, etc. The County Health Rankings Model in Exhibit 36 shows how social factors can impact health and health outcomes.

Exhibit 36: Determinants of Health from the County Health Rankings Model (2016)[72]



Graphic included with permission. © 2016 University of Wisconsin Population Health Institute (UWPHI).

EHR Data

- **Identifying Social and Behavioral Needs:**

  More EHRs are capable of incorporating SDOH and behavioral health data in the form of validated assessments, such as Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences from the National Association of Community Health Centers (PRAPARE - NACHC), and as structured data that can be mapped to standard code values. For example, you will increasingly find that EHRs provide (or can be configured with) structured demographic fields for sexual orientation and gender identity (SOGI), race, ethnicity, language, and disabilities. Standard codes are also being developed and implemented for social needs pertaining to health, including housing, food, and/or transportation.[73] AHRQ's social

determinants of health microsite provides additional information, including tools to assess patients social risks and needs.

A QI project focused on SDOH could further segment traditional CQMs. For example, structured data capturing food insecurity might be combined with a CQM for controlling hypertension to provide new insights and target interventions.

Because many clinics are early in their efforts to integrate behavioral health and screening for social needs, Health IT Advisors can provide valuable assistance in developing the workflows and EHR capabilities needed to assess, capture, and use data on non-medical domains of health.

EHR Interventions

- **Clinical decision support tools**:

  There are exciting opportunities for QI once supporting data on social and behavioral health are available in the EHR and accessible by CDS. For example, structured data collected by screening for depression or unhealthy alcohol use could be used to trigger a reminder when appropriate follow-up, referral to care, or medication is not provided to high-risk individuals. A care-coordinator dashboard can be implemented, and automated referrals to social workers can be included, as well as pre-populated home visit templates for community health workers or visiting nurses.

- **Patient engagement as an intervention**:

  Patient portals can be used to collect SDOH demographics and screen for behavioral and social needs and to deliver tailored education and instructions for self-care. Health IT Advisors must consider whether an EHR-based intervention is appropriate or equitable based on the population of interest. For example, individuals dealing with homelessness may have difficulty accessing patient portals or smartphone apps.

Many EHR data considerations that are related to social and behavioral needs are outlined in Exhibit 37.

*Exhibit 37: EHR Data Considerations - **Identifying/Managing Behavioral and Social Needs***

EHR Element	Description
Assessment and Plan of Treatment	• Assessment and billing codes applied to an encounter may indicate services and tests to assess and document behavioral and social needs. • A treatment plan may include referrals to behavioral or community services to address needs identified during an encounter.
Clinical Notes	• Patient-reported concerns about food, housing, transportation, mental health, and other health-related risks may be recorded as narrative in clinical notes. • Records of treatment for substance use are protected by CFR 42 Part 1 and may not be accessible in the EHR.
Encounter Information	• Assessments for behavioral (depression, anxiety, substance use) and social/community needs may be recorded during an annual wellness visit.

EHR Element	Description
	• Assessment and billing codes applied to an encounter may indicate what assessments were done and needs identified. • Records of outside assessment, counseling, specialty care, and community services may not be incorporated into the clinics EHR.
Health Concerns	• Routine collection of self-reported assessments for behavioral (depression, anxiety, substance use), social/community needs, and disability status are becoming more common in primary care settings.
Medications	• Certain medications may indicate a positive finding for behavioral health concerns (anti-depressants) and substance use (naltrexone).
Patient Demographics	• Screening tools are often validated for specific age groups (CRAFFT for adolescents versus AUDIT for adults) or scored by gender (alcohol consumption).
Problems	• Used to identify individuals with or without specific behavioral conditions or diagnosed substance dependency. • Diagnosis coding standards for SDOH are still in development and may not be represented on a problem list. • Expect variation in how individual providers document "diagnoses" for behavioral conditions, substance use, and social needs using EHR problem lists.
Social Determinants of Health	• Version 2.0 of the USCDI explicitly creates new data elements to capture and exchange SDOH information as structured data. • To be useful for QI, SDOH data must be recorded as structured data either directly from the questionnaire (an electronic form) or re-entered by staff or clinicians. • Terminology and coding standards for SDOH domains are being developed and may not be fully implemented by the vendor. • Race, ethnicity, language, and disability is often recorded as a demographic data element.

6.3 *Tips for Health IT Advisors on Using EHR for Quality Improvement*

Earlier in the handbook we made five statements about how EHRs *might* be used by Health IT Advisors to support QI projects. Here, we return to these broad generalizations and provide some practical tips for effectively using the EHR as a tool for practice transformation.

1. EHRs *may* provide a wide range of demographic, clinical, administrative, and financial data useful for QI:
    - Once you have a grasp on the goals, objectives, and data requirements for a project, create a written data plan explicitly listing the data elements that will be needed. Use this list to determine whether the EHR can supply these data, and in a form you can use.

- Consider mapping terms that people in the clinic use to refer to important types of data to make sure you are requesting or retrieving the correct information from the EHR. Remember that the USCDI nomenclature used here is meant to be generic.
- In addition to knowing if you will find needed data elements stored in the EHR, you must also determine whether the workflows for capturing data are used consistently and data are incorporated without errors in the form you expect. For more on assessing workflow and data quality, see Section 2.

2. EHRs *may* provide options for reporting at least some CQMs, generating graphs and dashboards, and producing patient lists filtered by demographic and clinical parameters:
   - Choosing and using appropriate and meaningful CQMs is one of the most important considerations when designing a QI project. Different EHRs vary widely in what CQMs are supported and how they are accessed. Health IT Advisors will quickly learn how common vendors generate and report CQMs, for example, how to get to a MIPS dashboard to retrieve CMS measures or run a registry report to pull a filtered patient list.
   - Clinics rarely use all the features in their EHR. Unless they are currently pulling CQMs for incentive programs (MIPS, Patient-centered medical home, UDS) or their own internal use for QI, they may not know what data capabilities they really have. Health IT Advisors serve an important role in helping clinics learn their own technology.
   - EHR vendors will do their best to accurately calculate quality measures. Unfortunately, you may find that built-in reports and CQMs are thrown off by missing data, unexpected workflows (entering blood pressure values as free text), or improper configuration (lab results not being mapped to LOINC in the EHR). The answer to this is to systematically assess the quality of ANY EHR data being used (see Section 2 for how to do this).
   - You may find that a built-in CQM is close, but not quite what is needed for your project. One solution is to combine data extracted from the EHR, for example a list of patients in the denominator of the Poor A1c Control CQM (CMS 122, NQF 0059), with a separate file containing additional variables using spreadsheet, database, or analytics software. Use caution, however. Combining data sets can introduce errors if record matching is done incorrectly.
3. EHR data *must* be captured and stored in an appropriate form, usually as structured data. Inconsistent workflows and/or poor data quality (see Section 2) will lead to erroneous conclusions:
   - This is a recurring theme in this handbook. From the start of a project, it should be clear that all needed data is consistently captured, stored, and extracted in a form that is appropriate to the analysis. With very rare exceptions, this means that structured data will be required.
   - QI projects can always be designed to include training, workflow changes, or new data fields that will support consistent and accurate data capture. In fact, a project might explicitly include improved clinical documentation as one of its objectives.
   - There are alternatives when needed data elements are not available as structured data. The most common is to perform a manual chart abstraction (see Section 2), but in the future

sophisticated software for natural language processing (NLP) may open up how data stored as free text can be used for QI.

4. EHR-delivered interventions *depend* on consistently entered data that is located in the correct documentation location, consistent workflows, proper training, evidence-based design, and organizational support for success:

    - Quality interventions using an EHR may involve the delivery of context-sensitive information to a user when a trigger condition is met. We have broadly referred to this in this handbook as a form of CDS. It is imperative that Health IT Advisors carefully consider the quality and completeness of the underlying data used to generate an alert or display clinical information. It does not take long for clinicians to lose confidence when alerts or information pop-ups are firing inappropriately or are incorrect.

    - CDS alerts and other types of EHR interventions directed toward clinicians require special attention, even when a CDS alert is well designed and incorporates high-quality data. Introducing another "click" to a provider's workflow can contribute to alert fatigue even when the notification is timely and accurate. Health IT Advisors must include user input and engage in a formal acceptance process before implementing any interruptive CDS interventions.

5. EHRs are not the only health IT tool useful for QI and may not even be the best choice for a given project (see Section 7 for alternative data sources).

    - As Health IT Advisors get more familiar with specific EHRs, it is tempting to see them as a one-stop source for quality data and for delivering interventions. Remember, though, that the EHR may not always be the best choice: be sure to consider external data sources and even non-technical solutions. The next section of this handbook addresses possible alternatives.

Section 7: Beyond the EHR: Alternative Data Sources for Quality Improvement

EHRs are the most common and obvious source of data for quality improvement projects. However, EHRs may not contain information needed for a specific QI project and Health IT Advisors may need to help practices look beyond their EHR for data.

In this section, we review three alternative sources of QI data:

- Payer claims data
- Databases external to EHRs, often called registries, and the growing number of sophisticated third-party population health platforms that can consume and analyze both EHR and claims data
- Health information exchanges (HIEs) that aggregate clinical data for care coordination across multiple EHRs, clinics, and health systems.

7.1 *Using Claims Data for Quality Improvement*

While the proliferation of EHR software has led to an increase in the use of eCQMs (see Section 8), the use of health insurance claims as a resource for quality measurement, research, and policy analysis is well established.[74-79] Claims data are collected routinely at each encounter for the purpose of reimbursement and include dates of service, demographics, diagnoses, procedures, charges, and more. Every medical practice is therefore generating information with potential value for QI projects during the billing process.

When considering how to leverage claims data for QI, it is important to recognize limitations up front. Relying on information used primarily for reimbursement can introduce measurement bias,[80] as the traditional fee-for-service model was not designed to incentivize comprehensive clinical documentation. Claims data lack the rich contextual information typically present within the patient's medical record, such as free-text notes, provider orders, problem/medication/allergy lists, and test results. Additionally, practices are often limited to what has been generated internally, as claims data from other providers of care, suppliers, or pharmacies is typically unavailable without special effort.

Despite these limitations, claims data can be valuable alone or as a complement to other data sources for QI. They benefit from being readily available and represented using standard formats and codes that enable reporting on populations meeting specific criteria. For practices without an EHR, claims data can be used to identify patients eligible for measures of interest and calculate performance rates that can be validated through chart audit where appropriate. For practices using EHRs to report eCQM, claims data can fill gaps where preferred measures are unavailable, inaccurate, or unreliable.

Claims data are also central to quality measurement for health plans. The Healthcare Effectiveness Data and Information Set (HEDIS), used by more than 90 percent of payers to assess provider performance, contains over 90 quality measures driven primarily by claims.[81] CMS accepts Quality Data Codes (QDC) to support claims-based reporting of quality actions for programs such MIPS.[66] As payers move forward with value-based contracting, transparency regarding how claims data are used to measure patient outcomes will promote provider accountability and increase the importance of billing and coding best practices.

Health IT Advisors can support the use of claims data in QI initiatives by:

- Understanding what data elements are included in claims
- Recognizing the importance of coding standards in claims-based quality measurement
- Educating practices on how payers use claims data to evaluate quality
- Facilitating the design and implementation of claims-based quality projects

What Data Elements Are Found in Claims?

Claims for **non-institutional providers** (i.e., individual professionals and practices) include a number of data points relevant to quality measurement, such as:

- Provider information:
  - National Provider Identifier (NPI)
  - Location
- Patient and insured's information:
  - Health plan (type, name, ID number, group number)
  - Demographics (date of birth, sex)
  - Contact information (address, phone number)
  - Related hospitalization
- Encounter information:
  - Date(s) of service
  - Diagnosis code(s)
  - Procedure/service code(s)
  - Place of service
  - Charged amounts

Claims for **institutions** (e.g., hospitals, skilled nursing facilities, long-term care facilities) include similar provider, patient, and encounter details **as well as** unique fields such as:

- Admission type and source
- Discharge status
- Condition code(s)
- Occurrence code(s) and spans
- Value code(s)

These data points are sufficient for quality measurement basics such as:

- Establishing populations based on patient and encounter characteristics
- Setting reporting periods based on dates of service
- Identifying patients seen by each provider during the reporting period
- Assessing delivery of recommended services
- Linking of quality measures to cost

However, and importantly, there are several data points that are **limited or unavailable** from these claims that limit the scope of quality measurement. These include:

- Encounter notes
- Vital signs
- Lab values
- Findings from screening and other procedures
- Drug code(s), name(s), and prescription detail (captured separately on pharmacy claims)
- Social determinants of health

Takeaway: In order to support practices using claims data in QI, Health IT Advisors must first understand what data points are available. Quality measurement projects should be designed around these criteria and their limitations.

Claims Coding

Effective claims coding is an essential component of healthcare administration and payment. Representing diagnoses, procedures, and services as alphanumeric codes provides the basis for clearinghouses to screen claims data and submit to payers for reimbursement. Insurance contracts define negotiated rates for procedures and treatments and rely on codes to adjudicate claims and authorize payment to providers based on the applicable fee schedule. Adherence to coding best practices offers the secondary benefit of richer claims data for use in QI.

Under HIPAA, DHHS adopted specific code sets for diagnoses and procedures used in all transactions. Key code sets used for medical claims include:

- International Classification of Diseases (ICD-10) for diagnoses [82]
- Current Procedural Terminology (CPT) [83]
- Healthcare Common Procedure Coding System (HCPCS) [84]

Applying these codes for optimal reimbursement does not necessarily result in claims data sufficient for QI. For example, providers may not address all patient diagnoses during an encounter and may deliver services or procedures that are not reimbursable by payers, and providers will document some diagnoses as a prerequisite for ensuring that payers will cover the costs of more complicated exploratory laboratory tests and imaging. While failing to include this information will not impact payment, it can result in missing data otherwise needed to calculate performance metrics of interest.

Addressing this barrier may require expanding both the amount and nature of codes compared to what is required for payment. For diagnoses, comprehensive ICD-10 coding supports stratification of populations based on factors such as comorbidities, severity of illness, or anatomic location. For procedures, including "unbillable" CPT and HCPCS codes (charged at $0.00 or $0.01) allows tracking services relevant to quality measurement regardless of payment.

To the extent claims coding for QI adds burden to clinicians and staff without direct reimbursement from a payer's fee schedule, practices should select measures recognized as intrinsically valuable to patient care to justify the resource cost. Another factor to consider is which measures have downstream benefit such as rewards in pay-for-performance programs or quality rating systems made publicly available to consumers. [85]

Takeaway: The feasibility of using claims data for QI is dependent on how a practice uses standard code sets for diagnoses and procedures. Health IT Advisors can examine coding practices to assess whether data required for analysis are available and provide education on expanding or enhancing use of codes where necessary.

Claims Data for Quality Measurement by Payers (HEDIS and CMS)

While payers are expanding the use of clinical data from EHRs, they continue to rely on claims data as a primary source for evaluating practice performance. The Healthcare Effectiveness Data and Information Set (HEDIS) is one of the most widely used performance improvement tools, with 191 million people enrolled in health plans that report results primarily by way of claims analysis. The National Committee for Quality Assurance (NCQA) collects HEDIS measures from health plans across six domains of care:

- Effectiveness of Care
- Access/Availability of Care
- Experience of Care
- Utilization and Risk Adjusted Utilization
- Health Plan Descriptive Information
- Measures Reported Using Electronic Clinical Data Systems

Many HEDIS measures are reported entirely through claims and depend on accurate coding of diagnoses and procedures. [86] Health plan tip sheets, which can be a useful tool for educating providers on the link between claims and quality measurement, may be publicly available on the internet or upon request. [87-89] Exhibit 38 is an example excerpted from an educational resource created by Aetna, which identifies coding tips for the Breast Cancer Screening measure along with definitions and tips for providers seeking to improve their performance. [86-89]

Exhibit 38: Example Health Plan Tip Sheet [89]

HEDIS Measure Definitions	What You Can Do	Coding Tips
BCS - Breast Cancer Screening Women 52-74 years of age with one or more mammograms within the last 2 years (starting at age 50).	Educate women regarding the benefit of early detection of breast cancer through routine mammograms Encourage mammography to all women who are within measure age group. Submit the appropriate mastectomy code to exclude women from this measure if it is part of their history	**Breast Cancer Screening Codes** **CPT Codes:** 77055-77057, 77061-77067 **HCPCS** G0202, G0204, G0206 **UB Rev Codes** 0401, 0403 **Exclusions:** **Bilateral Mastectomy** **ICD-10CM :** Z90.13 (history of bilateral mastectomy) * See exclusion note on last page

CMS's MIPS, a participation path within Medicare's Quality Payment Program (QPP), is another national payer program that relies in part on claims to assess provider quality. [90] While Medicare has proposed to phase out MIPS claims reporting in favor of digital quality measurement by 2025, it remains a popular option among small practices that have not adopted EHR software or that are using technology that is not certified for MIPS quality reporting. Furthermore, administrative claims will continue to be used for certain quality and cost metrics, such as those related to hospitalizations and other episodes of care.

Reporting MIPS quality measures through the Medicare Part B claims submission method is similar to reporting HEDIS measures through claims. Each measure has specifications that identify the measure type, description, and instructions along with detailed criteria for establishing the denominator (eligible

population) and using claims codes for the numerator (population satisfying the measure), exceptions, or exclusions (for more about measuring clinical quality, see Section 8 of the handbook).

Exhibit 39 shows how Medicare identifies denominator-eligible patients for the MIPS measure Age-Related Macular Degeneration: Dilated Macular Examination using data points included on the claim [date of birth (DOB), date of service, ICD-10, CPT].

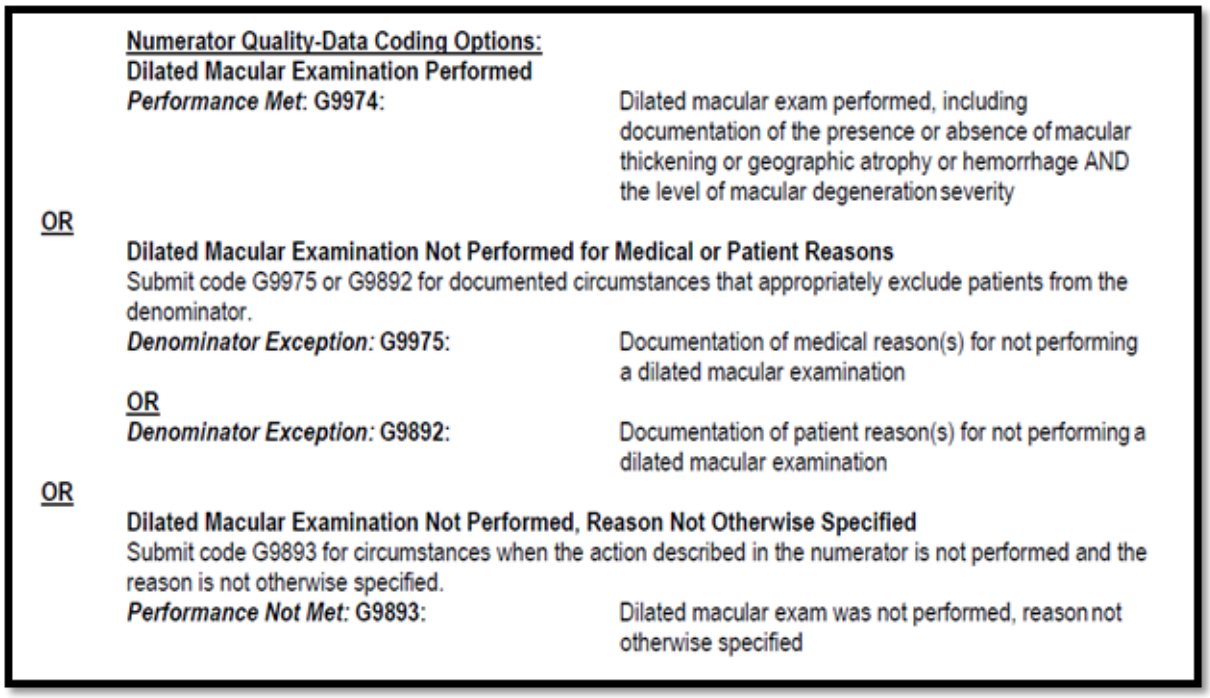
Exhibit 39: Example Denominator-Eligible Patient Identification

DENOMINATOR:
All patients aged 50 years and older with a diagnosis of AMD

Denominator Criteria (Eligible Cases):
Patients aged ≥ 50 years on date of encounter
AND
Diagnosis for age-related macular degeneration (ICD-10-CM): H35.3110, H35.3111, H35.3112, H35.3113, H35.3114, H35.3120, H35.3121, H35.3122, H35.3123, H35.3124, H35.3130, H35.3131, H35.3132, H35.3133, H35.3134, H35.3210, H35.3211, H35.3212, H35.3213, H35.3220, H35.3221, H35.3222, H35.3223, H35.3230, H35.3231, H35.3232, H35.3233
AND
Patient encounter during the performance period (CPT): 92002, 92004, 92012, 92014, 99202, 99203, 99204, 99205, 99212, 99213, 99214, 99215, 99304, 99305, 99306, 99307, 99308, 99309, 99310, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337
WITHOUT
Telehealth Modifier: GQ, GT, 95, POS 02

Each claim that meets denominator criteria is then analyzed for numerator criteria, which depend on the application of quality data codes (sometimes referred to as "G codes" because many begin with the letter G) to identify whether recommended quality actions were taken and why. Exhibit 40 shows numerator quality data codes options for the AMD measure.

Exhibit 40: Numerator Quality Data Codes Options for the AMD Measure



Numerator Quality-Data Coding Options:
Dilated Macular Examination Performed
***Performance Met*: G9974:** Dilated macular exam performed, including documentation of the presence or absence of macular thickening or geographic atrophy or hemorrhage AND the level of macular degeneration severity

OR

Dilated Macular Examination Not Performed for Medical or Patient Reasons
Submit code G9975 or G9892 for documented circumstances that appropriately exclude patients from the denominator.
***Denominator Exception:* G9975:** Documentation of medical reason(s) for not performing a dilated macular examination

OR
***Denominator Exception:* G9892:** Documentation of patient reason(s) for not performing a dilated macular examination

OR

Dilated Macular Examination Not Performed, Reason Not Otherwise Specified
Submit code G9893 for circumstances when the action described in the numerator is not performed and the reason is not otherwise specified.
***Performance Not Met:* G9893:** Dilated macular exam was not performed, reason not otherwise specified

Takeaway: Whether or not a practice is using claims data for QI, it is likely their payers are doing so. Health IT Advisors equipped with an understanding of the mechanisms used in existing programs such as HEDIS and MIPS can offer educational resources and guidance on proactive engagement with payers on value-based care initiatives. [91]

Facilitating Claims-Based QI Projects

Claims-based performance feedback can provide valuable opportunities for QI, but leveraging claims data effectively in QI can demand significant time and resource investments. [92] Designing an appropriately scoped project depends on assessing questions such as: [92]

- What quality performance metrics are most important to our practice/payers?
- Can the data needed to measure performance be collected on claims?
- Are these data collected reliably and consistently? If not, what changes are required to do so?
- Are these data available internally? If not, are external data accessible (e.g., provided by payers)?
- In what format and by what means can we retrieve claims data?
- Do we have the technical expertise to organize and analyze claims data?
- How will our practice use these data for continuous improvement?
- Is the project focused at the population or individual level?

Health IT Advisors should connect with the claims/coding specialist at the clinic, as possible, before trying to answer the above questions on their own. Health IT Advisors with an understanding of the limitations and potential uses of claims data can more effectively support practices seeking to answer these questions and use the answers to implement successful QI initiatives.

7.2 *Registries, Population Health Platforms, and Health Information Exchanges*

Providers within a single organization will depend on their EHR to support the health services they provide (physical, behavioral, and more recently, social). These organizations range in size from small solo physician's offices to giant national healthcare systems operating one or more EHRs. The fragmentation caused by EHRs acting as islands of information, or "data silos," make it difficult to measure quality performance across larger populations, regions, or even nations.

Registries and *Population Health Analytics Platforms* have emerged as a way of consolidating fragmented information by "consuming" key data elements from the EHRs (and often payer claims) of individual organizations to create a person-centered data pool for research and population health. Related work is being done by Coordinated Registry Networks or "CRNs," such as that developed by the FDA and National Library of Medicine (NLM) focused on women's health; information about that effort is available here. AHRQ's guide, Registries for Evaluating Patient Outcomes: A User's Guide: 4th Edition, is an important resource on this topic.

By contrast, *HIEs* exist to aggregate and distribute patient data through interfaces to EHRs, or direct access through dedicated HIE portals.

These are imprecise distinctions. For example, many HIEs offer both registry and population health analytics as a sort of trifecta of data aggregation.

Two Meanings for "Health Information Exchange"

You will hear the term "HIE" used in two different ways. As a noun, "HIE" refers to a specific IT platform or network that consumes and distributes clinical data from EHRs and other sources. However, as a verb it means to actively exchange clinical data between interoperable IT systems (Appendix A provides a primer on interoperability). Examples of both are shown in Exhibit 41.

Exhibit 41: Two Meanings of Health Information Exchange

Use of HIE	Meaning and Examples of This Use

HIE as a noun	• National data exchange networks
	• Vendor consortiums
	  ○ CareQuality
	  ○ CommonWell Alliance
	  ○ Sequoia Project
	• State or regional health information exchanges
	  ○ CalRHIO (California)
	  ○ MiHIN (Michigan)
	  ○ Reliance eHealth Cooperative (Oregon)
	• Acute care admission, discharge notification systems
	  ○ Collective Medical
	• Dedicated platforms for addressing social needs
	  ○ UniteUs
	  ○ Aunt Bertha

HIE as a verb	• Use of interoperability standards to exchange clinical data:
	  ○ Send and receive orders, results, and documents
	  ○ Send and receive immunizations, use of controlled substances

	○ Send and receive electronic care summaries [continuity of care documents (CCDs)] ○ Send and receive electronic transition of care notifications ○ Send and receive referrals for medical, behavioral, and social needs

Tips for Health IT Advisors

In some respects, the aggregation pools of EHR data provided by registries, population health tools/platforms, and HIEs seem like a giant extension of the organizational EHR with silo walls torn down. There are, however, some important differences.

Some common themes, adapted from Section 7, include:

1. External data sources *may* provide a wide range of demographic, clinical, administrative, and financial data useful for QI:
    - Registries, population health tools, and HIEs vary widely in the scope, content, and the original sources they consume. For example, a registry hosted by a medical specialty or research organization may only incorporate specific types of data on a subset of patients.
    - Population health tools and HIEs are limited by the cost and complexity of the connections used to pull data from EHRs, claims, and other sources.
    - More sophisticated analytics platforms are often operated by health plans or commercial payers and are limited to data on their beneficiaries.
2. External data sources may provide options for reporting at least some CQMs, generate graphs and dashboards, and generate patient lists filtered by demographic and clinical parameters:
    - Population health platforms, registries, and many HIEs were built to use the data they collect to measure clinical quality and usually offer a wide assortment of CQMs.
    - EHRs are still somewhat limited in the measures they offer and the options for in-depth analysis; external data sources are often designed and built to provide sophisticated analytics beyond simple performance rates.
    - Population health tools (and some HIEs) incorporate advanced computational techniques including natural language processing (NLP), artificial intelligence (AI), and machine learning to provide sophisticated analytics capabilities. Examples include assessing group and individual health risks, generating predictive models, and (when combined with claims data) analyzing healthcare costs.
    - Just like EHRs, these platforms *must* capture and store data in an appropriate form, usually as structured data. Inconsistent workflows and poor data quality will lead to erroneous conclusions (see Section 2).
    - Errors and distortions can occur as information travels farther from the point of collection. Because aggregate collections of clinical data are completely reliant on feeder systems, the potential for data quality issues is multiplied compared to using a clinic EHR as a single source.
    - Issues can include technical problems with data transfer, challenges linking individual patient records across feeds, and data formatting and mapping problems. For example, HIEs that receive electronic care summaries as continuity of care documents (CCDs) may have trouble

parsing out and mapping laboratory results embedded in a CCDs sent by different sources causing missing data that is difficult to detect.

3. Interventions delivered through external platforms depend on good data, consistent workflows, proper training, evidence-based design, and organizational support for success.
    - Health IT Advisors will rarely use external data sources to create and deliver interventions and instead will extract data to inform QI and target other interventions.
        - An exception to this is when a clinic has access to separate platforms to help aggregate and analyze their data (e.g., through an EHR vendor or by being part of a larger health system that built their own such platform).
        - Another exception to this is when an HIE (noun) uses HIE (verb) to send clinic notifications based on clinical events (an emergency room discharge) or a predefined data trigger (receipt of a positive COVID-19 test from a "feeder" laboratory).
    - Because external data platforms can "see" a more complete picture of an individual's health history, they may play a larger role in directly impacting quality by delivering CDS interventions in the future.
4. External data sources are not the only health IT tool useful for QI and may not even be the best choice for a given project (see Section 6 for how EHRs may be used).
    - A clinic's EHR will usually be the most accessible data source for a QI project. Health IT Advisors should be aware, however, of what alternatives may be available and choose the best fit for the project.

Section 8: Review of Clinical Quality Measures

Clinical quality measures (CQMs) are used to measure and track the quality of healthcare services. They can range from simple metrics devised by an individual clinician to curated collections of related measures. For example, Exhibit 42 includes measure sets used by CMS, Health Resources and Services Administration (HRSA), and commercial payers to assess and compare clinical quality.

An example of a "homegrown" measure is presented at the end of this section and in the Diabetes Case Study presented in Section 6.

Common Quality Measures for Quality Improvement

Standardized CQMs from many sources are used by various stakeholders to compare the quality of providers, calculate reimbursement and incentives in value-based payment, and to rank payers by quality (the HEDIS 5-Star ratings for commercial Medicare Advantage Plans use CQMs to determine performance on a range of measures). Some examples of common CQMs are shown in Exhibit 42, but by are by no means the only options available for QI projects.

Exhibit 42: Examples of Clinical Quality Measures

Clinical Quality Measure	Domains or Examples
CMS Quality Payment Program Measures for Medicare (MIPS) Used by CMS to report quality data for Medicare incentive and value-based payment programs	• Patient and Family Engagement • Patient Safety • Care Coordination • Population/Public Health • Efficient Use of Healthcare Resources • Clinical Process/Effectiveness Link: https://ecqi.healthit.gov/ep-ec?qt-tabs_ep=1
Uniform Data System (UDS) Used by Federally Qualified Health Centers (FQHCs) under the U.S. Health Resources & Services Administration (HRSA)	• Diabetes Control (HbA1C > 9%, D-5.1) • Hypertension BP Control (BP < 140/90, HDS-12) • Access to Prenatal Care (MICH-10) • Childhood Immunizations (IID-8) • Cervical Cancer Screening (C-15) • Colorectal Cancer Screening (C-16) • Dental Sealants for Children (OH-12.2) • Low Birth Weight (MICH-8.1) Link: https://bphc.hrsa.gov/program-opportunities/sac/uds-measures-and-hp-goals
Healthcare Effectiveness Data and Information Set (HEDIS) Used by government and commercial payers to measure clinical quality for value-based payment and comparative provider ratings.	• Effectiveness of Care • Access/Availability of Care • Experience of Care • Utilization and Risk Adjusted Utilization • Health Plan Descriptive Information • Measures Reported Using Electronic Clinical Data Systems Link: https://www.ncqa.org/hedis/

8.1 *Types of Clinical Quality Measures*

Quality measures are generally divided into three types using a quality model first developed by Avedis Donabedian[93]:

- **Structural Measures** evaluate healthcare providers capacity, systems, and processes to provide quality healthcare. For example:
    - The use of a certified electronic medical record
    - The number or proportion of board-certified physicians within a healthcare organization
    - The ratio of providers to patients
- **Process Measures** evaluate healthcare providers use of evidence-based processes to maintain or improve health, typically reflecting generally accepted recommendations for clinical practice, such as those developed by the United States Preventive Services Task Force (USPTF). Most healthcare quality measures used for public reporting are process measures. For example:
    - The percentage of people receiving preventive services (such as mammograms or immunizations).
    - The percentage of people with diabetes who had their blood sugar tested in a timely manner.
- **Outcome Measures** reflect the impact of the healthcare service or interventions on the health status of patients. For example:
    - The percentage of patients who died as a result of surgery (surgical mortality rates).
    - The rate of surgical complications or hospital-acquired infections.

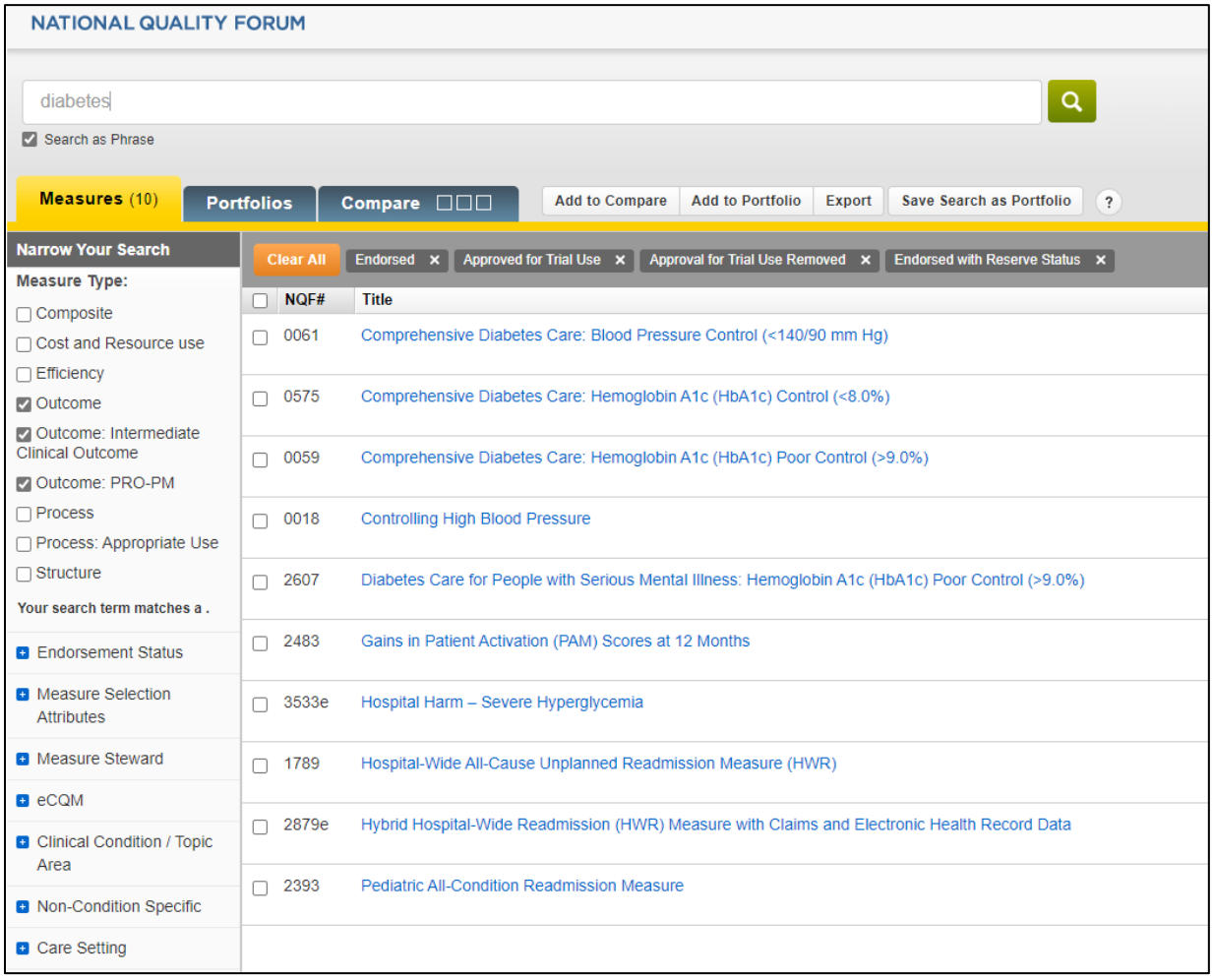
8.2 *Finding Clinical Quality Measures for Use in Quality Improvement*

Common CQMs, however, may not include what you need to measure and track quality performance for a given QI project. This leaves two options: find another quality measure or create a custom measure of your own.

For searching a comprehensive database of CQMs, NQF provides a web search tool called the Quality Positioning System.

Measures can be searched using multiple criteria and undergo a rigorous review process before they are endorsed by NQF. The measure identifier assigned by NQF is widely used to reference specific quality measures (for example, NQF 0018 measures blood pressure control in patients with hypertension).

Exhibit 43: Search Screen of the NQF CQM Database [94]



Note: Learning to find and use standardized CQMs is a core QI skill. To learn more, please see the Module 13: Measure and Benchmarking Clinical Performance in the AHRQ Primary Care Practice Facilitation Curriculum and the Practice Facilitation Training Module Standardized Quality Measures.

8.3 *Anatomy of a Clinical Quality Measure*

A CQM uses four parameters to calculate a ratio representing the performance rate: an *initial patient population* (IPP), a *denominator*, a *numerator*, and *exclusions/exceptions*. The rate is expressed as a percentage, for example: Clinic ABC performed at 89.3% on Controlling Hypertension (CMS 165, NQF 0018)[95] for the measurement period January 1, XXXX to December 31, XXXX.

If you are new to using CQMs, it may be difficult to conceptualize what the performance rate is actually saying about how well (or poorly) a provider or clinic is meeting a structural, process, or outcome metric.

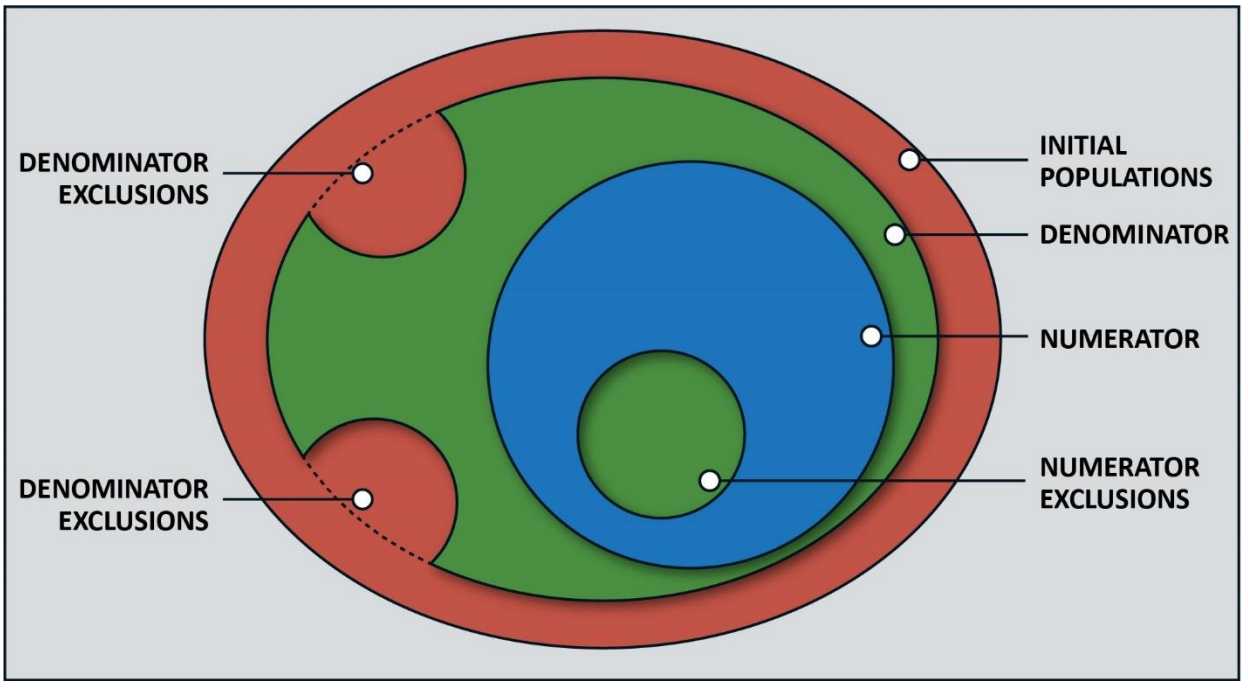
It helps to visualize a CQM as a series of concentric circles. In Exhibit 44, the outer circle defines the total *initial patient population* of interest. From this group, *exclusions* and *exceptions* are subtracted to generate a *denominator*. The numerator is the inner circle including only patients with (or without)

specific characteristics of interest. The CQM performance rate is represented as a percentage from the simple calculation below.

Performance rate (%) = (Numerator)/ (Initial Population - (Exceptions + Exclusions))

Note: A worked-through example of a CQM calculation is shown below in section 8.5.

Exhibit 44: Illustration of the Components of a CQM calculation [96]



8.4 *Clinical Quality Measure Specifications*

CQM developers (and there are many) are responsible for clearly and unambiguously defining which individuals fall into each circle by creating detailed specifications. Before choosing a CQM for a QI project, Health IT Advisors should clearly understand what a final performance rate is (and is not) telling you about actual quality by carefully reading through the specifications.

Detailed specifications, lists of code values (value sets), and logic diagrams can be found online in many places, including the NQF Quality Positioning System (described above) and the online eCQM Clearinghouse for the measures used by CMS for MIPS and other programs.

For example, Exhibit 45 shows an excerpt of the CMS specification CQM for Controlling High Blood Pressure (CMS 165v9, NQF0018). This measure could be summarized as follows: "Percentage of patients 18 - 85 years of age who had a diagnosis of hypertension and whose blood pressure was adequately controlled (< 140/90 mmHg) during the measurement period." It will be important to understand denominator exclusions here (e.g., patients who have not been seen in the last year) to be able to accurately interpret final results.

Exhibit 45: Specification Excerpt for Controlling High Blood Pressure (CMS 165v9)[95]

CQM Component	Specification
Measure Description	Percentage of patients 18-85 years of age who had a diagnosis of hypertension overlapping the measurement period or the year prior to the measurement period, and whose most recent blood pressure was adequately controlled (<140/90mmHG) during the measurement period.
Initial Population	Patients 18-85 years of age who had a visit and diagnosis of essential hypertension overlapping the measurement period or the year prior to the measurement period.
Denominator Statement	Equals initial population
Denominator Exclusions	Patients with evidence of end state renal disease (ESRD), dialysis or renal transplant before or during the measurement period. Also exclude patients with a diagnosis of pregnancy during the measurement period. Exclude patients whose hospice care overlaps the measurement period. Exclude patients 66 and older who are living long term in an institution for more than 90 consecutive days during the measurement period. Exclude patients 66 and older with advanced illness and frailty because it is unlikely that patients will benefit from the services being measured.
Numerator Statement	Patients whose most recent blood pressure is adequately controlled (systolic blood pressure <140mmHg and diastolic blood pressure <90mmHg) during the measurement period.
Numerator Exclusions	Not applicable
Denominator Exceptions	None

8.5 *Example: Working Through a Clinical Quality Measure*

There will be situations where an existing CQM cannot be found or does not meet the needs of a particular project. This example illustrates a hypothetical CQM constructed from the bottom up.

Dr. Chavez wants to answer the question: *"What percentage of my patients have high blood pressure?"* The following steps show how this clinical question could be converted to a very basic CQM.

Dr. Chavez: "*How many of my patients have with a diagnosis of hypertension?*"

The *denominator* for this example will be the total number of individuals in the doctor's panel. The *numerator* would be the total number of patients from the denominator found to have a diagnosis of hypertension. Note this assumes that Dr. Chavez was explicit about how "diagnosed with hypertension" will be determined for the new metric ("real" measure specifications include all of these details).

150 patients with hypertension / 3000 patients = 0.05 x 100 = 5.0%

Dr. Chavez: "*Ok, but can we just run it for patients I've seen in the office in the past year?*"

Now, we would adjust the initial population in our specification to include only patients seen by Dr. Chavez within the last year.

110 patients with hypertension / 2000 patients = 0.055 x 100 = 5.5%

Dr. Chavez: "*Can we exclude patients with renal disease or pregnancy, two conditions that affect blood pressure?*"

In this last step, we will add an *exclusion* to remove patients with pregnancy and/or renal disease from the *denominator*. Once again, the *numerator* may or may not be lower after removing the excluded individuals.

85 patients with hypertension / (2000 patients - 100 excluded patients) = 0.045 x 100 = 4.5%

From the Dr. Chavez example, we can see that, as our asks of the data become more complex, so does the reporting burden. For this reason, there is always the underlying question of whether or not there is an existing quality measure that fits an organization's needs or is there a need to create a measure and subsequent report.

Continuing this example, a Health IT Advisor might find that Dr. Chavez's EHR has a CQM called "Controlling Hypertension" (CMS 165, NQF 0018) built into its dashboard for MIPS reporting (this CQM is described above).

Note: Clinics are frequently unaware of which measures their EHR may support "out of the box." In Section 2 we discuss how to search for measures supported by specific EHRs.

8.6 *Tips for Presenting Clinical Quality Measure Data*

Health IT Advisors should not only be adept at finding, extracting, and analyzing data on quality performance, but also skilled at presenting these data to diverse audiences. It is not unusual for a single project to incorporate more than one CQM to establish baseline performance, monitor progress, and evaluate success. (See the AHRQ Practice Facilitation Training Module Presenting Performance Data).

Below, we review tips for visually organizing CQM performance rates using tables and graphs and discuss how the best approach will depend on your audience.

Option 1: Describing CQM data in text

CQM data can be presented in text by describing the measures used, references to standard specifications (if used), the measurement period, and the performance rate. For example:

"…Between January 1, XXXX and December 31, XXXX, Clinic ABC achieved a performance rate of 50.0% on Controlling Hypertension (CMS 165, NQF 0018). The rate was extracted from the clinic's EHR (DocuWare 4.5) and includes all providers and all payers."

It is often useful to expand this to include the numerator, denominator, and exceptions/exclusions to provide context to the audience.

"…a performance rate of 50.0% (Initial population 210, Numerator 100, Denominator 200, Exclusions 10) on…"

Finally, you should include a benchmark or target performance rate if it is relevant.

"*This compares with the project goal of 60% over the same time period.*"

Option 2: Presenting CQM data in a table

Using text to summarize complex data rapidly becomes cumbersome for both the author and the reader. A second option uses a simple data table to present CQM data like the one shown below.

Exhibit 46: Simple Example of a Data Table Showing CQM Performance

Measure Name	Measure Co..	Total	Den	Num	Excl	Except	Rate
Controlling High Blood Pressure	CMS165	456	456	350	5	0	77.61%
Diabetes: Hemoglobin A1c (HbA1c) Poor Control (>9%)	CMS122	93	93	25	0	0	26.88%
Preventive Care and Screening: Screening for Depression and Follow	CMS2	3,097	3,097	1,133	850	0	50.42%
Preventive Care and Screening: Tobacco Use: Screening and Cessatio..	CMS138A	2,158	2,158	1,904	0	0	88.23%
Weight Assessment and Counseling for Nutrition and Physical Activity for Children and Adolescents	CMS155A	668	668	594	0	0	88.92%
	CMS155B	668	668	536	0	0	80.24%
	CMS155C	668	668	533	0	0	79.79%

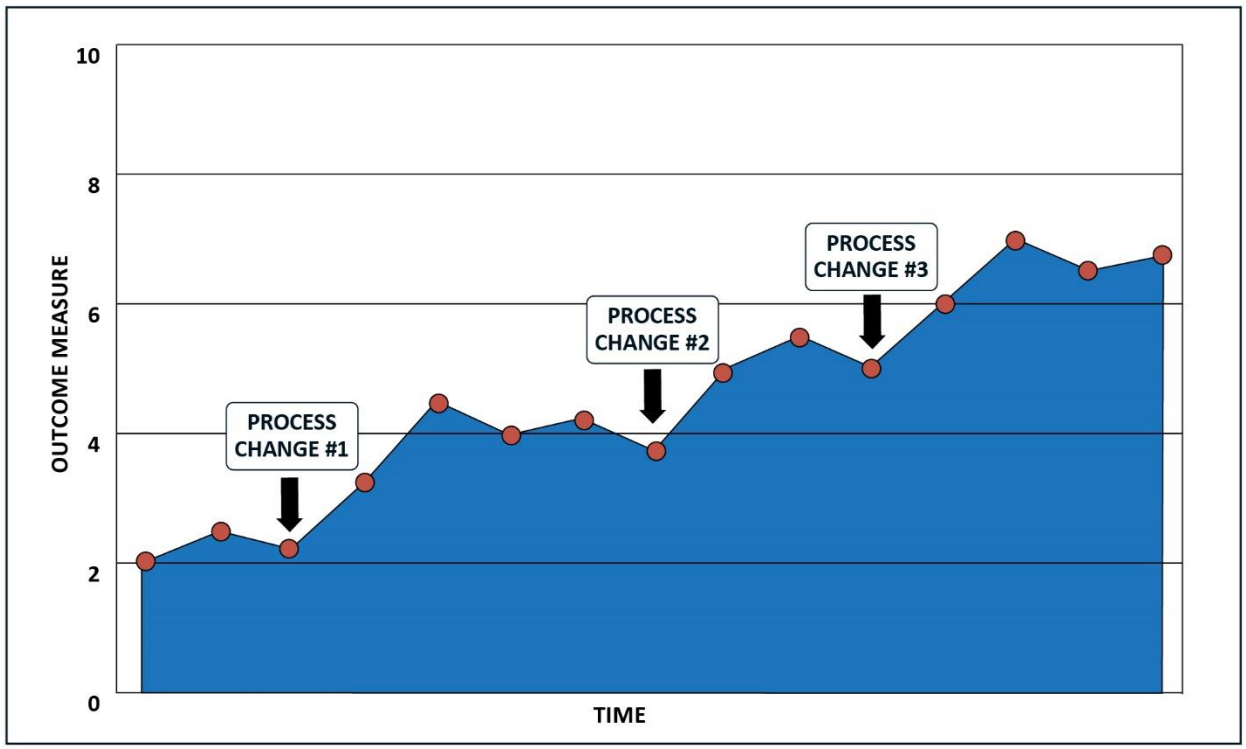
Tables are easy to create and allow for some visual flourishes to aid the viewer like ranking the data, color coding, and even links to the raw data files (be careful that these links do not expose PHI).

Option 3: Using graphs and other data visualizations

Graphs and other data visualizations are often the best way to present CQM data when you want to highlight change over time, differences between groups, or comparison to a benchmark or target performance rate.

The most basic visualization for CQM data is the classic run chart, showing performance over time. Exhibit 47 shows a generic example of a run chart. Note that the timing of specific interventions is highlighted on the timescale showing a possible relationship to improved performance.

Exhibit 47: Generic Example of a CQM Run Chart



Exhibits 48 and 49 illustrate a more complex use of a time-oriented visualization from the MHS Diabetes Case Study presented in Section 6. Exhibit 48 shows how a composite performance measure was used to plot changes in the quality of diabetes care. Not only is the trend easy to see, but the difference in performance between MD-centric measures (process) and Patient-centric (outcomes) raises some intriguing questions. Exhibit 49 yields even more information by combining a time series, performance rates for five different CQMs, and highlights the timing of eight specific EHR interventions.

Exhibit 48: CQM Visualization from the MHS Diabetes Case Study (Example 1)[64]

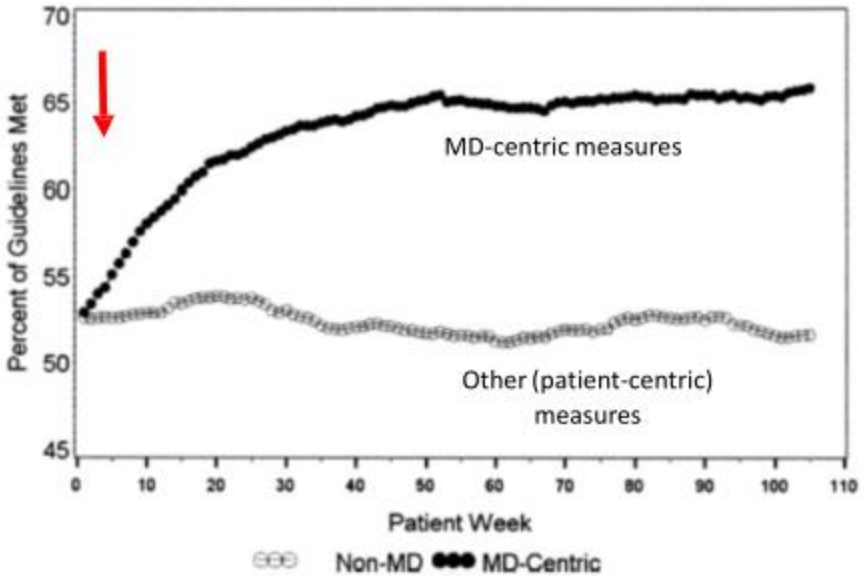


Figure 6 – Diabetes care process (MD-centric) and outcome (Other [patient-centric] measures), 2005-2006. Initial diabetic best practice advisories and provider level diabetes population level report implemented at Patient Week "0" (red arrow)

Graphic above included from: https://www.himss.org/sites/hde/files/media/file/2021/01/20/metrohealth-davies-diabetes-management-case.pdf.

Exhibit 49: CQM Visualization from the MHS Diabetes Case Study (Example 1)[64]

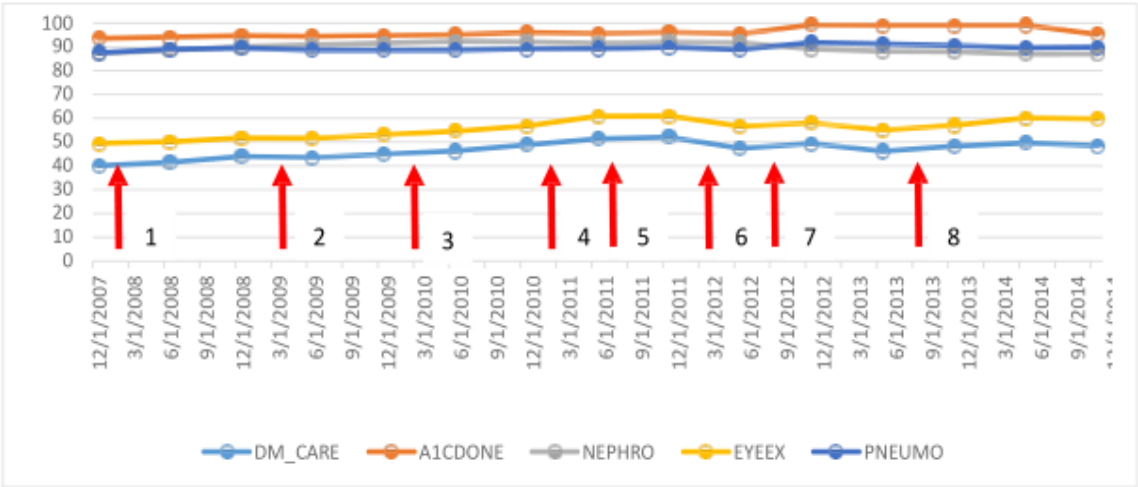


Figure 7 – Summary diabetes care measures 2007-2014. Red arrows indicate EHR interventions: 1-updated best practice advisories, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports with financial incentive, 6 – updated diabetic patient care plans (goals, barriers and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists. DM_CARE is overall composite diabetes care measure. A1CDONE is hemoglobin A1C performed. NEPHRO is monitoring or treating kidney impairment with appropriate medications (angiotensin converting enzyme [ACE] inhibitors or angiotensin receptor blockers [ARBs]). EYEEX is diabetic eye exam performed. PNEUMO is pneumococcal vaccination given.

Graphic above included from: https://www.himss.org/sites/hde/files/media/file/2021/01/20/metrohealth-davies-diabetes-management-case.pdf.

The examples above highlight the time element; however, for straight comparisons between groups or individuals "old school" bar graphs and pie charts may be a good choice for some audiences. Exhibits 50 and 52 show the performance of several CQMs presented in both formats.

Exhibit 50: CQM Performance Presented as Bar Chart

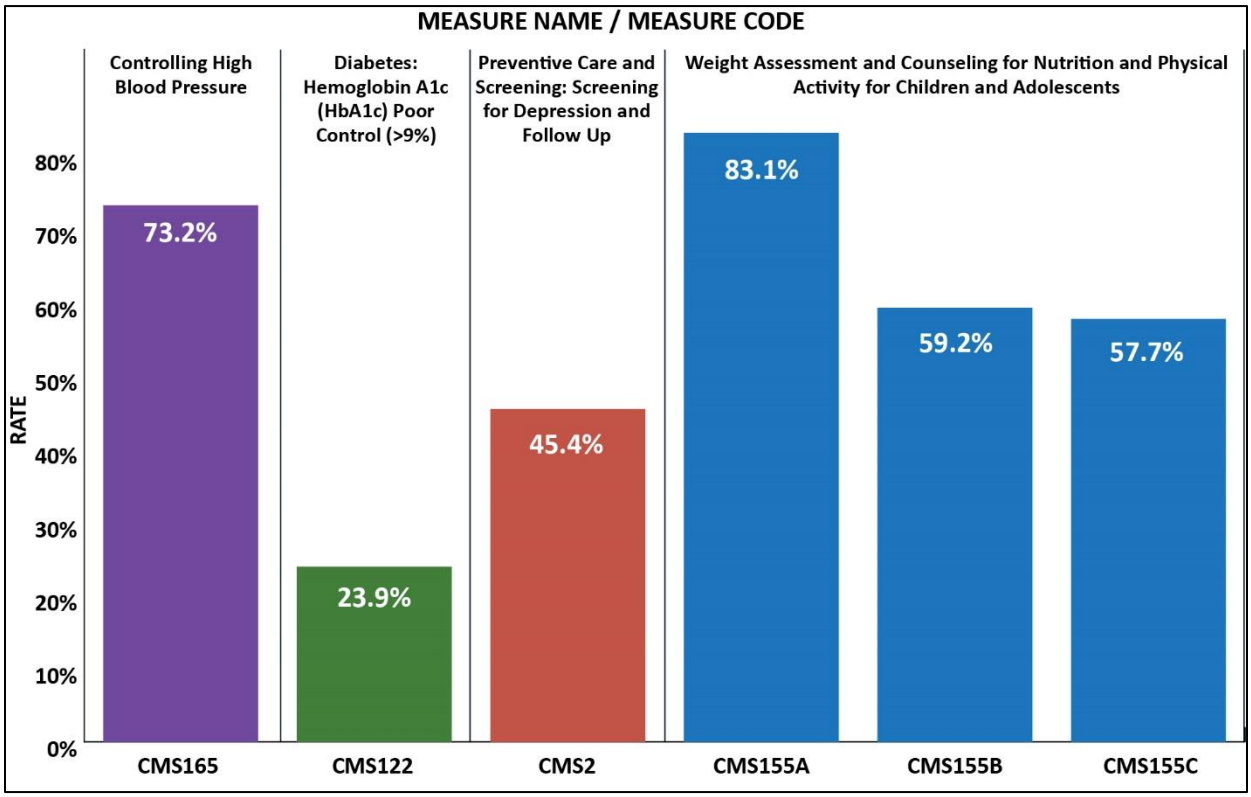
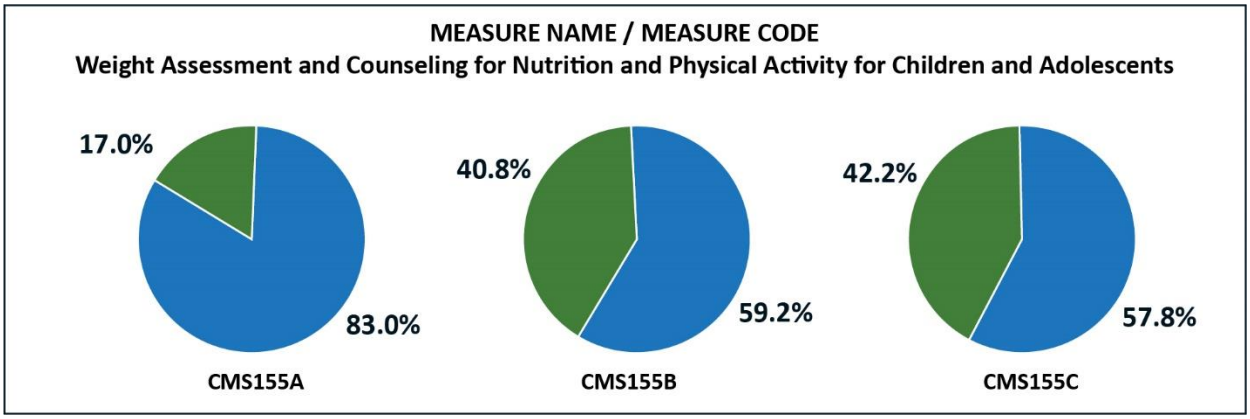


Exhibit 51: CQM Performance Presented as Pie Chart



8.7 *Conclusion*

CQMs are important tools for measuring and tracking the quality of healthcare services. They can range from simple individual metrics devised by a clinician to curated and broadly applicable collections of related measures. It is also important to keep in mind the fact that CQMs have directionality, which varies among measures: i.e., a "good" score on one CQM will be a high number, while a "good" score on another CQM will be a low number. Also keep in mind that CQMs can change, so be sure when presenting time series data that the same version of the measure is being used. EHR updates may automatically include the most recent version of eCQMs. Choosing the best way to visualize CQM data is an art. Experienced data analysts work from a large palette of techniques and always target data presentations to the audience. For example, a chart created to show providers how they compare to each other would be very different from one created for a scientific publication. We have included a primer for creating data visualizations in Appendix D of this handbook.

Section 9: Review of Risk-Stratification in Primary Care

Risk stratification is the process of separating patient populations into high-risk, low-risk, and rising-risk groups. Risk stratification in healthcare settings involves the division of patient panels (patients attributed to a specific provider) into tiers or levels based on health and social factors to identify and address potentially avoidable and expensive adverse health outcomes. Data and factors utilized include, e.g., medical diagnoses, age, healthcare costs, inpatient and emergency room utilization, prescriptions.

A key step in risk stratification is the identification of high-risk patients through these divisions and then referring them to appropriate resources based on their risk levels.

Segmenting patient populations by risk using objective and subjective data to assign patients to risk levels allows primary care teams to identify individuals with specific needs and effectively manage patients with complex medical conditions and socioeconomic issues and/or challenges.[97]

There is a significant opportunity for unconscious and/or conscious bias to arise in this process. Health IT Advisors will want to help practices think through these potential biases to ensure that some populations are not unfairly treated or risk stratified in a way that may lead to poorer access to needed resources. Also, it is important to acknowledge that biases in how data are recorded in the EHR may lead to biases in risk stratification.

A Health IT Advisor will help providers and practice staff understand risk stratification, generate accurate quality reports, and identify patients who require more coordinated care and more frequent visits.

9.1 *Identification of High-Risk Patients*

Data utilized to identify a patient's risk include diagnosis, inpatient and emergency room utilization, emergency room visits, biometric data (e.g., blood pressure, age), and test results. Patients vary widely in the number of services required based on medical, behavioral, and social complexities. Risk stratification assists providers and support staff by assigning a numeric or categorical (low, high, severe) risk level to better allocate limited resources, anticipate needs, and more proactively manage their patient populations.[98]

SDOH, such as income or educational level, are also risk-stratification factors as they can affect healthcare access and utilization. SDOH include the conditions in which people live, learn, work, and play, which in turn affect a wide range of health and quality-of-life risks and health outcomes.

Depending on a clinic's EHR and other health IT resources, a Health IT Advisor may be able to leverage the EHR and available tools/instruments to help a clinic do the following, for example:

- Obtain electronic notifications of inpatient and emergency visits and track the numbers of these visits
- Monitor the timeliness of a follow-up visit after hospitalization or an emergency-department encounter and/or prompt the provision of follow-up care with, e.g., appointment reminders
- Assist with workflows to receive data directly from acute care settings (such as lab results, chief complaint, vital signs)
- Capture and use SDOH data in EHRs in a standardized manner.

9.2 *Health and Social Factors (Social Determinants of Health)*

As discussed in Section 6, having clinics seek to manage behavioral and social needs in their EHRs is a relatively new, but growing, part of primary care. Health IT Advisors can assist clinics in creating new workflow processes and helping with EHR configuration to ensure that necessary data are being captured in structured data fields.

Integration of SDOH data into EHRs offers great potential for improved care and health. This includes a better understanding of the influence of community-driven characteristics on health (i.e., the conditions in which people live, learn, work, and play, noted above); improved connections between providers of medical care and community services; and a chance to treat the "whole patient."[99] Individual health status is affected by inherited diseases and conditions that require medical care, and the prevalence of such conditions may differ by sex, age, race and ethnicity, employment status, and other factors.[99]

Increased utilization of healthcare services may not always correlate to a greater need for care. Many factors affect healthcare utilization independently of need and reflect differences among population groups. Some of these factors relate to biologic or environmental differences among groups, such as disproportionate residence in polluted environments, access to healthful food and adequate housing, and education associated with effective use of healthcare.[100] Others are related to differences in access, such as health insurance coverage or income needed to obtain services, ease of obtaining services, and discriminatory practices of providers.[100]

SDOH may include health literacy, education, employment, functional status (i.e., ability to complete activities of daily living), and even quality of sleep. Sleep deficiency can lead to physical and mental health problems, injuries, loss of productivity, and even a greater risk of death. In practice, it is vital to assess determinants that may help to understand socioeconomic status (and in turn health status). These include transportation availability, medication and food insecurity.[101] Screenings for smoking, depression, substance use, and anxiety are also included in this category. The Health IT Advisor can help practices develop and implement methods and workflows for capturing this important information, and then for utilizing it to improve quality of care.

9.3 *Diseases and Risk-Stratification*

Chronic diseases that influence resource allocation, healthcare costs, and overall outcomes may include cancers, heart disease, chronic obstructive pulmonary disease (COPD), asthma, diabetes, hypertension, obesity, depression, and other mental health conditions. When a patient has more than one disease (multiple comorbidities), risk for adverse health outcomes and elevated costs increases substantially.

A patient's risk level is in part determined by the number of conditions they have. While practices can have slightly different "cut-offs" for different risk groups, in general, the highly complex group will include patients with six or more chronic conditions. The high-risk group will include patients with condition counts in the range of four-five. The rising-risk group will include those with two-three conditions. Patients with either zero or one selected conditions will comprise the low-risk group[102] (see Exhibit 53). Once the number of patients in each category is calculated, this data can be used to re-allocate patients to other providers to help maintain equitable distribution of higher risk patients in a practice, and/or to help patients in need access higher levels of or more specialized care.

Algorithms and other formula-based tools can risk stratify based on disease severity, functional status, and other factors such as SDOH. Bias can be unintentionally "baked in" to algorithms and related instruments, so it is important to continually seek to identify and eliminate it.

Uniform Data System (UDS) reporting [103] for the Health Resources and Services Administration (HRSA) is used in federally qualified health centers (FQHCs). The National Association of Community Health Centers (NACHC®) uses the groupings of diagnosis codes shown in Exhibit 52 in assigning an individual patient risk level.

Exhibit 52: Uniform Data System Diagnostic Categories and Corresponding ICD-10-CM Codes [102]

Uniform Data System High Risk Conditions	Applicable ICD 10 CM CODE[1]
Cancer (abnormal cervical findings)	C53-, C79.82, D06-, R87.61, R87.629, R87.810, R87.820
Heart Disease	101-, 102- (exclude 102.9), 120- through 125-, 127-, 128-, 130- through 152-
Chronic Obstructive Pulmonary Disease	J40- through J44-, J47-
Asthma	J45 codes
Diabetes	E08- through E13- O24- (exclude O24.41-)
Hypertension	I10- through I16-
Obesity	E66-, Z68- (exclude Z68.1, Z68.20 through Z68.24, Z68.51, Z68.52)
Depression	F30- through F39-
Other mental disorders	F01- through F09- (exclude F06.4), F20- through F29-, F43 through F48- (exclude F43.0 and F43.1), F50- through F99- (exclude F55-, F84.2, F90-, F91-, F93.0, F98-), 099.34 R45.1, R45.2, R45.5, R45.6, R45.7, R45.81, R45.82, R48.0

Table included with permission. © National Association of Community Health Centers, Inc., 2019

As presented in the National Association of Community Health Centers' *Population Health Management: Risk Stratification Action Guide*, the following four steps will provide a basic risk-stratification score [102]:

- **Step 1**: Generate a List of the Provider's Patient Panel. This list should include not only patients who come in for care, but also patients assigned to the provider from healthcare institutions and payers.

[1] "The select list of conditions match HRSA's UDS 2021 Health Center Data Reporting Requirements for Table 6A, including the diagnostic categories and applicable ICD-10-CM codes on pages 77-78. Selected diagnoses do not represent the full range of diagnoses or services captured in Table 6A, nor offered by a health center, but were selected to represent significant high-cost, high-burden conditions prevalent among health center patients. Using the above as a starting point, health centers can add/subtract conditions based upon local health conditions and clinical priorities."

- **Step 2**: Sort Patients by Condition: You can use the Uniform Data System (UDS) codes in Exhibit 52 to identify high-risk conditions co-morbidities or a custom list that is appropriate to your patient population.
- **Step 3**: Stratify Patients to Segment the Population into Target Groups: Start by using the method of "condition counts" (the number of conditions per patient) illustrated in Exhibit 53.
- **Step 4**: Design Care Models and Target Interventions for Each Risk Group: Each cohort (highly complex, high-risk, rising-risk, and low-risk) should be matched to a care model that meets their needs.

Exhibit 53: Example of Condition Counts Used to Establish a Risk Level

Risk Level	Number of Conditions
Highly complex	6 or more
High-risk	4-5
Rising-risk	2-3
Low risk	0 or 1

A different risk model developed by the American Academy of Family Physicians (AAFP) uses both diagnosis codes and healthcare utilization across varied care settings. This can be considered a more complex model and may require additional data not found in an EHR to apply in the clinic (utilization is often derived from payer claims).

Some EHRs (and many population health platforms) offer automated algorithms to assign risk scores, but clinics may use a manual approach or a hybrid method when stratifying their patient population or provider panels. As noted above, if using automated algorithms, transparency is vital as is seeking to ensure that bias is not thereby introduced.

Practices may require assistance from Health IT Advisors for configuring health assessments, scoring algorithms, and incorporating CDS into the EHR. [97] Custom programming requires proficient health IT skills and most likely assistance from the EHR vendor, which may incur additional costs to the provider.

9.4 *Implementing Risk Stratification in Practices*

Daily staff huddles include a review of objective and subjective data for all patients for the current or next day as well as for the coming weeks and months. Huddles promote discussion among team members and promote valuable information for assignment of risk scoring that brings vital patient information to the attention of the care team.

Huddles can include a brief online or paper chart audit as well as review of any inpatient utilization or outpatient referrals in between visits. This can be useful to pre-stratify patients prior to their visit to help the care team assess patient needs according to risk level. Visit efficiency can be improved if care resources and needs are identified prior to the health encounter.

Some tips for supporting clinics in this work include:

- Include the entire team when assigning risk levels
- Use daily huddles and weekly team meetings to discuss patient risk scores

- Adjust risk levels as the patient's situation changes or based on new information from other sources such as inpatient/ER admissions or patient-reported data; consider whether "missing" patient data could impact assessment of risk level
- Reassess individual risk levels regularly as they tend to change over time
- Document important data in standardized data fields to best utilize EHR-generated data.

There are many risk models that will support a clinic's efforts to assess and stratify their panels. Health IT Advisors can explore additional methods like the ones shown below to help find the best match for practices they support.

More Risk Stratification Methods

- Health IT Advisors can help practices develop workflows that reinforce patient data entry of health history changes into the patient portal and incorporating new patient-generated data into point of care visits. Workflow changes include asking patients during triage if they have had any ancillary treatments, appointments, or admissions since their last encounter. This self-reported information is then entered into the EHR.
- **Hierarchical Condition Categories (HCCs)**: Part of the Medicare Advantage Program for CMS, HCC contains 70 condition categories selected from ICD codes and includes expected health expenditures.
- **Adjusted Clinical Groups (ACG):** Developed at Johns Hopkins University, ACG uses both inpatient and outpatient diagnoses to classify each patient into one of 93 ACG categories. It is commonly used to predict hospital utilization.
- **Elder Risk Assessment (ERA)**: For adults over 60, ERA uses age, gender, marital status, number of hospital days over the prior two years, and selected comorbid medical illness to assign an index score to each patient.
- **Chronic Comorbidity Count (CCC)**: Based on the publicly available information from the Agency for Healthcare Research and Quality (AHRQ)'s Clinical Classification Software, CCC is the total sum of selected comorbid conditions grouped into six categories.
- **Minnesota Tiering (MN)**: Based on Major Extended Diagnostic Groups (MEDCs), MN Tiering groups patients into one of five tiers: Tier 0 (Low: 0 Conditions), Tier 1 (Basic: 1 to 3), Tier 2 (Intermediate: 4 to 6), Tier 3 (Extended: 7 to 9), and Tier 4 (Complex: 10+ Conditions).

[104]

Appendix A: Review of Interoperability and Data Standards

Interoperability can be broadly described as the capability to work together. Critical to it is the ability exchange information in a predictable, reliable way that ensures the fidelity of the information. In the context of healthcare, it is intended to allow information to be communicated beyond a single device, application, or vendor. If you use an electronic health record (EHR) system, you might be accustomed to sending a specimen out for processing by a lab vendor or even submitting a claim to a payer. The ability to do that and more is possible because there is an agreement on the standards for how data can be represented and communicated so that systems can *interoperate*.

Interoperability provides a whole host of additional benefits and opportunities, including:

- **Improvements to medical reference, decision support, and automated quality reporting**
  - Online reference and complex automation and alerting for clinical decision support, allergy evaluation, and drug-drug interaction checks are made easier. These can be targeted to a specific practice and patient population.
  - Data can be harvested and used for automated electronic clinical quality reporting.
- **Addressing fragmented care**
  - Sections of patient data live in multiple systems and organizations but that leads to incomplete information spread around in "pockets," each only portraying one part of the story. Systems should be able to network – just like they do in other areas of business – so they may seamlessly and safely share data to make sure a patient's comprehensive health history is available when they receive care.
- **New ways to for patients to engage physicians and participate in their own care**
  - Patient portals and mobile applications let patients access your health record on demand.
  - Data feeds from smart watches or other mobile health tools can give better insights into behavior that impacts patient health. In the age of "The Internet of Things," the modern EHR should be able to incorporate more of that data. A smart watch can help profile heart rates and communicate that information to a provider, who might call a patient and ask them to come for a visit. This can promote *proactive* preventive care.
- **Broadened insights and analytics**
  - Patient data can also be federated through a central hub called a registry. A registry serves to collect and broker your data so multiple facilities can "pull" that data from the central hub. These registries, in turn, can act to "push" key elements back out to health practices you visit as they are updated in the hub.
  - The use of registries also introduces the possibility of integrating analytics into population health. With that information, you can endeavor to better treat specific populations who might be challenged by health issues such as diabetes, cardiovascular disease, or cancer, which are more prominent in their given community. Analysts can look for patterns and

trends that may help improve health through additional care facilities or education via community outreach.

- Real-time monitoring of symptoms (syndromic surveillance) in the event of an outbreak of flu or some other highly communicable disease.
- Clinical quality and operations reporting is also improved as providers can more reliably identify challenges and determine if patients are receiving adequate, cost-effective care.
- Access to richer patient data allows researchers to collaborate, just like they would for quality and operations reporting, but for the purposes of evaluating areas of concern and opportunity for specific patient populations. Data is the fuel that powers research and in its absence progress stutters and stops. When there is data, it is often in a variety of non-compatible formats that slow its use to a trickle. Being able to identify new treatments or evaluate the impacts of existing ones is what drives progress and improves lives.

We are just at the cusp of an electronic healthcare revolution. The ability to extract, communicate, and utilize data are foundational for its success and that success relies *heavily* on interoperability.

Components of Interoperability

As EHRs emerged in the 1960s, 70s, and 80s, they promised a future that took them beyond being simply a word processor to capture a block of text. They provided new ways of discretely capturing problems, allergies, medications, labs, and a whole host of other facts which could be used to help drive care. These worked well when organizations used one and only one system but struggled when teams needed to exchange data between sites or even integrate new with a new system at the same site. Imagine you needed to transfer a patient and want to send their high-level information for continuity of care. When you hit "send" to communicate that data from one EHR to another, what is in the message and how is it sent? How can you be sure the receiving system was able to correctly interpret the associated diagnoses, medication, and procedures?

As computers and medical records systems started hitting their stride in the 1980s the pressure to allow for more seamless and faithful communication of data increased. There was recognition that to promote improved care, organizations needed to be able to integrate specialized components and tailor them to suit. Groups of like-minded physicians, informaticians, and technologists teamed up or formed entities dedicated to creating and promoting industry standards for representation and exchange of medical data. They worked to establish a variety of standards which could be used to ensure faithful communication of critical data.

Interoperability has three primary features:

- **Semantic**: The meaning of each piece of data - the nouns, verbs, and adjectives. Having common definitions to communicate concepts like diagnoses, procedures, laboratory tests, results, and other like notions are critical in communicating *meaning*.
- **Syntactic**: The structure and process of communication - the grammar. There needs to be agreement on how a computer-to-computer message and its contents should be communicated.

- **Policy:** Governance of the allowable use and methods of interacting with systems and data are defined and agreed-upon. There need to be defined *policies* that "legislate" the safe, accurate exchange of your data across organizational and even national boundaries.

Semantic Interoperability

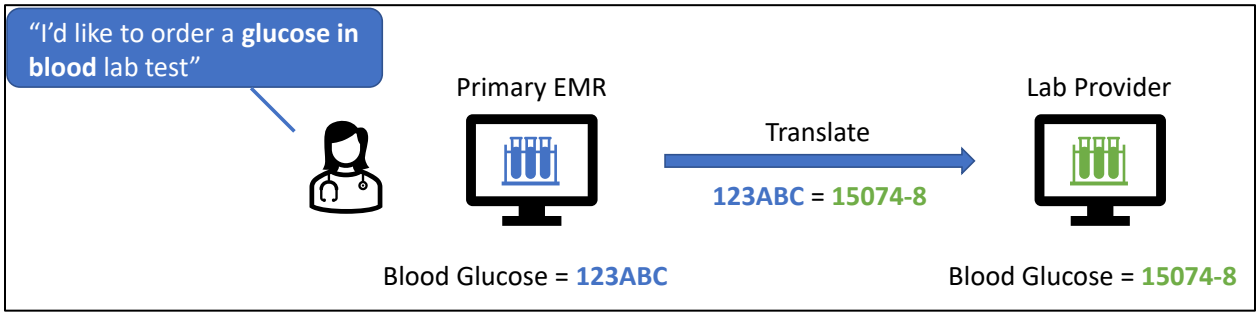
When data are recorded in or communicated between medical records systems, there is an assumption that a given medical concept is portable. When you record a specific medication, diagnosis, or result, in one system it would seem to be natural that the information be retrievable in another and retain the intended meaning. If a patient has their data recorded in their primary care provider's EHR, they should be able to be referred to a specialist who has access to that same data and can review it in their own EHR.

In practice, this has been a difficult proposition. Allowing for communication between one medical record system and another is highly complex. Most systems record and store data in their own native, proprietary formats. Each is effectively an isolated container – an island. To exchange data between two systems, each must translate between the sender and receiver of the communication.

Each specific domain of information like laboratory data, pharmacology information, etc. can be very complex and require specialized knowledge. For a large academic medical center with potentially hundreds of systems that is a great deal of coordination and management. If you attempt to integrate that information on a system-by-system basis, the result will be extremely complex and require constant ongoing support as each system changes.

What we need is standardized semantic interoperability. A simple way to describe semantic interoperability is: "Say the same thing, mean the same thing." When a discrete fact is stored within an electronic medical record system, it is most typically represented in some codified form that is intended to help reduce this potential confusion. This codified form represents a concept and all of its attributes. When you enter diagnosis, record an active medication, or order a lab, the human-readable description you see on the front-end of the EHR is probably not what is recorded on the computer. Instead, that order for a "glucose lab test" you see on screen is stored as something like "123ABC," a coded value that means "glucose lab test." The phrase "glucose lab test" is not what is typically recorded on the chart itself.

Exhibit 54: Visual Example of Standardized Semantic Interoperability



Why not just store "glucose lab test?" There are several reasons, but to just highlight a few:

- **Descriptions can change**. If there is a general label change to improve the readability or even to correct a spelling error, every single chart would have to be updated to reflect the revised label.

- **Some systems support multiple languages**. If that value is in one language it makes it very difficult to create meaningful data for users of another language. By using a coded value with an associated *language-specific* description, you can allow the user to select their preferred language beyond English.
- **Words can be a confusing way to record data**. Words are not always a clear way to communicate with precision and accuracy. We make every effort to say what we mean, but there is always a chance that the person reading the communication will not fully understand the author's intended meaning. The term "glucose lab test" might be misinterpreted as a specific form of lab even if that was not what the author intended.

With medicine, accuracy is critical. When we record or communicate data it is important that the meaning be conveyed with fidelity or there may be significant risk to the patient. If, for example, a patient is administered the wrong medication due to a miscommunication, there could be a serious adverse reaction. To ensure there is a commonly understood *meaning* for a piece of information, it is often expressed in a "coded" form like we mentioned above in the glucose lab example. By agreeing on a standard set of codes before data are recorded or communicated, we decrease the likelihood of inferring an unexpected meaning.

There are a large variety of "coding systems" (also known as vocabularies) – methods of expressing complex pre-defined meanings and relationships in portable combinations of letters and numbers. Given the rich nature of medicine and need to be both accurate and precise, many are specific to a particular discipline like pathology, pharmacology, medication, laboratory-related data, or a host of other areas.

In the United States, the federal government has chosen to focus on a few key coding systems for the purposes of data portability. The United States Core Data for Interoperability (USCDI)[35] specifies particular systems by topical area and purpose.

Exhibit 55: Coding Systems by Topic Area

Topic	Coding System
Allergies and Intolerances	Substances: SNOMED CT Medication Class: SNOMED CT Medications: RxNorm
Conditions	Encounter Diagnosis: ICD-10-CM, SNOMED CT Problems: SNOMED CT
Immunizations	CVX, NDC
Medications	RxNorm
Laboratory Tests and Results	LOINC
Vital Signs	LOINC, UCUM
Procedures	HCPCS, CPT, SNOMED CT, CDT, ICD-10-PCS
Smoking Status	SNOMED CT
Race and Ethnicity	CDC-REC
Birth Sex	HL7

In addition to the ability to unambiguously express data, there are some other benefits of using coded data. Each of the individual coding systems we have listed above was purpose-developed to portray "right-sized" information specific to their respective area of focus. Some are incredibly rich and define far more than the human-readable term including additional attributes and references to other concepts.

You might think that systems would directly store some of these facts in one of the standardized code systems we mentioned, but that is extremely rare. Instead, most store information using their own private internal identifiers which *map* to equivalent values one or more code systems. There are some valid reasons this is done, but extended discussion of them is outside of the scope of this document. Instead, we are going to focus on the implications for cross-systems interoperability.

The reader will note we use the word "equivalent" when discussing mappings. That is intentional. Mappings are not always guaranteed to be "precise" direct identifiers for a specific coded term. Any mapping requires significant investment and expertise and is not something that should be done without exercising great care. Each effort requires subject matter expertise in topics like pathology, pharmacology, and laboratory science as well as deep expertise in the respective code system. *The key take-away is that it takes expertise in both of those areas*. There are nuances in how specific code systems model data that have serious ramifications in code selection.

The single greatest value of using common vocabularies is they increase the opportunity to exchange data on an organization, city, state, or even national level. This creates important potential applications for research, population health, and quality measurement. We can now see beyond one patient at one facility and start looking at entire *populations* of patients. We can glean insights across staggering volumes of data to help drive improvements in care that can benefit *millions* of patients. None of that would be practical without semantic interoperability.

Syntactic Interoperability

We have discussed how to capture the semantics of a concept, but we have yet to touch on how they might be assembled in a structured way so they can be communicated with meaning. This is known as *syntax*.

We are not going to go into detail as it exceeds the scope of this handbook, but we do want to touch on a few ideas. Possibly the easiest way to describe syntax is through a grammar in language. Effective communication requires a concept of nouns, verbs, adjectives, etc. as well as a set of rules on how those items can be combined to form a message (a sentence) to convey meaning.

Syntax often appears in two forms:

- **Structure of the message contents**: The message. There is usually a defined agreement on the "body" of a particular communication.
- **Protocols for operations**: The agreement on the required and optional series of actions that can be taken on the message during communication. A common example would be when placing an order, the sender will initiate the order and the receiver will acknowledge that the order was received correctly.

A concrete non-medical example is email. An email has a structure – a "to," a "from," a "subject," and a message body. The actions like sending, receiving, and deleting are the operations you can take on an

email. The reason emails work so ubiquitously is because there are standards on both the structure and the actions. Without those syntactical agreements you could not effectively send or receive messages – no system would know how to send, receive, or display the message contents. To oversimplify, healthcare systems work like very complex email systems; sending and receiving messages related to admissions, orders, results, and the other rich aspects of care.

It is common to find that specific areas of clinical focus will have their own defined standards for storing and transmitting data. Once you have common syntactical structures (and semantics), you can define methods of communication that specify the types of operations that can be initiated and how they can be used.

The dominant standards body that drives most *syntactic* healthcare interoperability is Health Level 7 (HL7). You often hear "HL7" expressed in a clinical setting. What might be a bit confusing is that "HL7" is not only the standards organization, but also one of their primary medical record standards, "HL7v2."[105] One of the reasons the HL7 standards are so prevalent is that they define most core types of messages and actions you might need for normal hospital operations. It covers everything from "basic" patient administration like admission, discharge, and transfer, order management (for everything you could imagine), communication of observations, management of patient demographics, and a host of other activities and data. When you look at a more complex environment like an academic medical center it is extremely common to have individual systems for specialized functions. Interface and messaging standards like HL7 allow for "best of breed" applications to be installed into an overall ecosystem that makes up the medical enterprise.

This approach – leveraging syntactic interoperability standards to allow applications to be broken into components – also allows for federation of functionality beyond the immediate EHR. If you think more broadly and consider the local practice's medical record system as one component in a state or federal network, you can envision how these interface standards might be used to support patient registries for state-wide immunizations. Each provider might now be able to submit or retrieve records of immunizations to ensure a patient's list of administered vaccines is up to date. Another common scenario is syndromic surveillance, where organizations are asked to submit arrival diagnosis from the emergency department to monitor outbreaks of diseases.

The evolution of syntactic interoperability is helping drive the interconnected medical system forward. If you have a watch or phone that records data which can now be integrated into your provider's chart – that is only possible due to standards.

Policy Interoperability

We described policy interoperability as governance of the allowable use and methods of interacting with the systems and data. To have meaning (semantic) and structural (syntactic) interoperability defines what we *could* do, not what we are *allowed* or *required* to do. Policy defines how and when data may be used as well as the manner and method in which they may be interacted.

One of the most important and widely known interoperability policies within the United States is the "Health Insurance Portability and Accountability Act of 1996" (HIPAA).[106] We typically know HIPAA as having a privacy rule (see Section 2), but it and its subsequent "Administrative Simplification Standard" also contained several other critical provisions:

- **Syntactic standards** for transactions including eligibility, enrollment, claims, and payment.[107]
- **Semantic standards** for data including ICD-10, HCPCS, CPT, CDT, and NDC.
- Rules for managing the **privacy and security of patient data**.[108] This includes definitions of PHI as well as specification of organizations and relationships which could safely exchange PHI in order to provide care.
- Use of **Employment Identification Numbers** (EIN) in electronic transactions.
- Standardization on use of the **National Provider Identifier** (NPI) for provider identification.
- **Pre-emption of any state laws which do not meet the minimum requirements** as defined in the rule. States may offer additional controls and protections in addition to the federal requirements but may not relax any requirements.

This was pivotal legislation as it provided a framework for clinicians and payers (with CMS being a primary one) to interact with each other in a safe, managed form that also mandated minimal standards to help ensure data were able to be communicated more easily without distortion. It also pre-emptively contained major potential problems with unmanaged sharing of patient data sharing that was sure to become an issue with the advent of computer networks.

Several future iterations of legislation followed HIPAA and its additions, encouraging the use of standards for safe management and transmission of patient data:

- **Meaningful Use**: Part of the American Recovery and Reinvestment Act of 2009, it introduced the concept of a "Certified EHR Technology," which set criteria expected for all participating medical record systems. This included both semantic and syntactic standards for transitions of care, syndromic surveillance, reportable labs, immunization registries, and several other areas where data are commonly exchanged. It also set new uniform requirements for securing and managing patient data. Critically, it also introduced new standards for eCQMs.
- **Trusted Exchange Framework and Common Agreement (TEFCA)**[109]: An extremely ambitious policy, TEFCA defines how Qualified Health Information Networks are allowed to function and interact in order to provide much-desired functions like health information networks, registries, or research networks.
- **21st Century Cures Act (Cures Act)**[110]: Continuing the march forward from Meaningful Use and leveraging TEFCA, this set of policies promotes greater patient access to data, specifies additional requirements on standard coding systems for semantic interoperability, and introduces new syntactic interoperability requirements focused on emerging standards like Health Level 7 Fast Healthcare Interoperability Resources (HL7 FHIR).[111]
- **Information Blocking Rule**[112]: Part of 21st Century Cures, this item specifically targets tools and vendors that proactively block access and exchange by restricting access to features and functions which facilitate data exchange or implement technologies which make it difficult or more expensive to access data within a system. This is a *landmark* action by the federal government.

These standards have only relatively recently been mandated by The Office of the National Coordinator for Health Information Technology (ONC) and The Centers for Medicare and Medicaid Services (CMS). To

improve the healthcare patients currently receive as well as accelerate growth and development of healthcare services in the United States, the government has set baseline minimum requirements for use of coding system and data exchange standards by vendors and healthcare providers.

Interoperability Standards

We have previously touched on the idea of standards which help drive interoperability between systems.

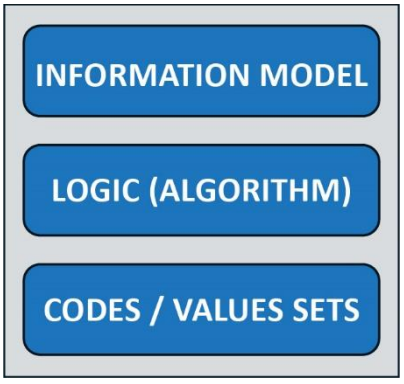
Electronic CQMs came to prominence with the advent of The ONC's Certified EHR requirements. They ultimately included three primary requirements for data capture and reporting [113]:

- **Patient data must use the mandated vocabulary standards**. Patient data must be able to be expressed using vocabulary standards like SNOMED CT, ICD, RxNorm, LOINC, and others.
- **Measure results must be correct**. Given a set of sample patients, computed results must match the expected results as defined by the testing tool.
- **Systems must use the mandated file formats**. Systems must be able to emit patient data and results in the required interoperable standard formats.

What this means to us is that we should be able to take source data from any (certified) medical records system, reliably produce the correct results, and then emit those results in standard formats that can be accepted by downstream applications. In doing so, the expectation is that we should be able to:

- Leverage interoperable data from one or multiple medical record systems with little or no subjective interpretation
- Reliably compute the results of a measure
- Share the results for ingestion into downstream systems like the clinician's view of the patient, population reporting tools, or even the Quality Payment Program site.

Exhibit 56: Measure Components



To achieve these goals, eCQMs are broken into a few components which neatly align with existing abstraction methods.

Information Model: The set of basic definitions of concepts that are used in the measure logic. Things like "encounter," "medication," "procedure," or even "time" must have guidance on their meaning, attributes, and use.

Logic: The questions and assertions that compose how the data are to be evaluated. We will not explore this in detail. It is simply important to recognize it as a distinct component.

Codes / Value Sets: For a given component like an "observation vital sign," the list of allowable vocabulary terms which define it. For example, a heart rate might be defined as LOINC code 8867-4.

The intent is to provide a set of standards that clinicians and developers can rely on as being common, reusable, and reproducible. Revisiting the example from above, we have broken out to more discretely express the way an abstractor is interpreting it, but in a way that starts to align with an electronically computable measure.

Information Models

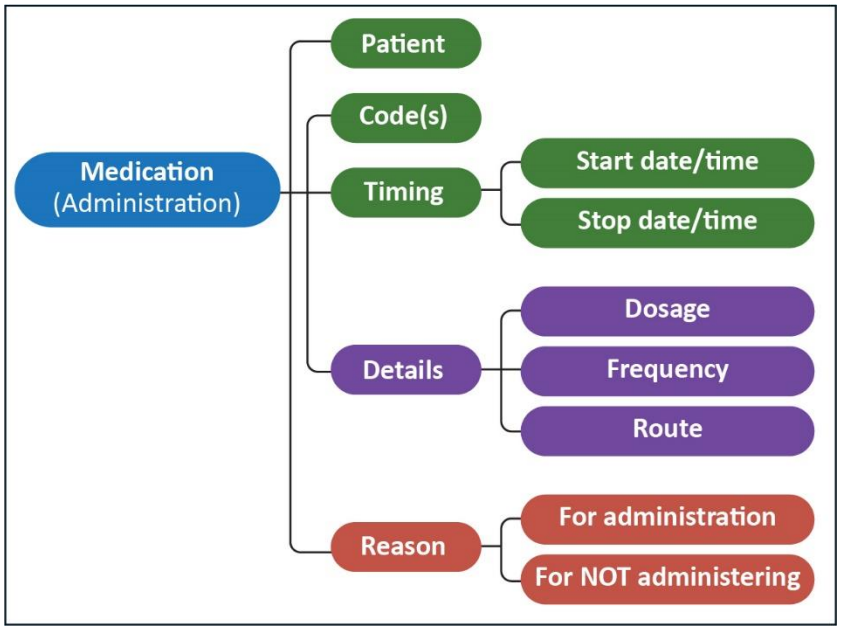
Using components of an information model, we can better understand the logic that underpins quality measures. As we look at the question of "did the patient receive medication day of or day after admission?" we touch on several data elements:

- **The patient**: Everything that makes up the demographics of the specific patient, including their name, their date of birth and age, administrative sex, related medical record identifiers, etc.
- **Encounter(s)**: The purpose/nature of the visit, the related start/end times, the care team, physical location(s), directly related diagnoses, etc.
- **Medication(s)**: (In this case medication administration information) Identifiers that express the specific medication, the start and stop date and time of the administration, the dose, route, and frequency details, as well as potentially the reason for giving (or not giving) the medication.
- **Time**: Given we are relating the encounter to the medication expressed by "day of or day after," a shared definition of what "day" means (going back to the prior discussion, is that a 24-hour period or a census day?)

For the purposes of avoiding confusion, each of those elements have structural definitions that include attributes of each concept as well as indicate whether a given attribute is mandatory or can contain multiple entries. That sounds abstract, so let us look at a medication (administration).

A medication administration is a record of a specific medication being given to (or not being given to) a patient. That means we need to, at least minimally, know who is receiving the medication and which medication is being given. We might also include specifics on the dosage, frequency, and route. We would also like to know when the administration occurred. In certain cases, it is also helpful to know why the administration occurred or why it was not given (often referred to as the "negation rationale").

Exhibit 57: Medication Administration Graphic



All of these ***attributes*** help make up the "***type***" of thing that a medication administration represents. The list of types is our first step toward defining an **information model**. The information model describes the types that it includes and how those types can be related. There may be different kinds or classes of types, some which are used within other types. The intention is to define a set of structural definitions and relationships that allow you to compose medical data such that it can be expressed in a known, predictable model.

Having that conformity is a central part of the goal. The intention is to introduce consistency and reusability to reduce the need to constantly transform between systems. That is the benefit of a standard.

In the context of CQMs and clinical decision support, there are two primary information model standards you will encounter.

- **Quality Data Model**: Originally created by the National Quality Forum, [114] the Quality Data Model (QDM) has historically been the primary information model used for CMS eCQMs since approximately 2010.
- **FHIR**: HL7 FHIR contains a series of types and classes which are used to compose "resources" – definitions of the elements like patient, encounter, medication, etc. Within FHIR, there is a set of additional modifications specifically to support quality measurement. These additional items and rules (known as profiles) are known as "QI Core." [115]

QDM is the information model currently in use for CMS quality reporting, but the future is FHIR. They are similar, but where QDM is targeted to particularly quality reporting, FHIR is meant for portrayal of comprehensive portray of EHR data and allows for the purpose-driven extension where required to support both new concepts as well as policy-driven constraints.

Coded Data

When we define a quality measure such as "*did the patient receive a specific medication on the day of or day after hospital admission*?" we have a list of the patient's medications we wish to compare with a pre-defined list of "allowed" medications per the measure definition. We need to know if the patient was administered a particular medication (potentially in a specific form and dose, administered through a particular route). That means we need to have a common definition.

A given measure will contain a list of finite medications, encounter types, etc. which are appropriate for evaluation. In the case of medications, we have standardized vocabularies like RxNorm and NDC. They allow us to portray the specific medications in a codified form, so we avoid subjective interpretation of text data. This is similar to previous abstracted versions in that there is a set of "allowed" medications, but in this case, they are fixed and mandate use of the standard. If a patient's data do not contain the precise medication in the specified terminology, then the rule will not consider those data.

Given an example of "did the patient receive appropriate venous thromboembolism (VTE) prophylaxis medication?" there would be provided sets of codes (known as a value set [116]) which define that list of medications. Take, for example, the Joint Commission's "Low Dose Unfractionated Heparin for VTE Prophylaxis" value set. [117] It contains a series of medications (only a subset depicted below), which are expressed using a terminology (in this case RxNorm) and codes. [117]

Exhibit 58: Subset of the Joint Commission's "Low Dose Unfractionated Heparin for VTE Prophylaxis" Value Set

Medication	Code System	Code
heparin sodium, porcine 1000 UNT/ML Injectable Solution	RXNORM	1361226
5 ML heparin sodium, porcine 2000 UNT/ML Injection	RXNORM	1361568
heparin sodium, porcine 20000 UNT/ML Injectable Solution	RXNORM	1361574

This set of values is exclusively what is used by the measure logic during calculation. That is important to recognize for a few reasons:

- **Value sets represent the single, authoritative list of allowed codes for a given portion of measure logic.** The value sets do not simply portray "categorized" labels or classes of information. An eCQM needs a prescriptive definition of the precise medication list. This also means all organizations and medical record systems implement identical evaluation based on a single central list verses a variable mechanism that relies on the relative knowledge of the person doing the evaluation. No variation of the individual codes within a value set are allowed or encouraged for the purposes of uniform measurement. In fact, some widely used value sets are copyrighted, require licenses for use, and have stringent restrictions on modification. [118] Value sets are maintained and accessible from the NLM Value Set Authority Center (VSAC) repository.
- **Value sets are versioned and updated with the measure**. A value set is rarely "static." The expectation is that it is clinically relevant. As care protocols, medications, procedures, and even vocabulary coding evolve, a value is updated to reflect those improvements. Value sets are most often versioned annually with updates to the related measure. In the above example, should a medication be taken off the market, it will be removed from the value set. Likewise, should a new medication be introduced and deemed appropriate by the measure steward, it will be added. The easiest example of this is the list of annual allowed influenza medications. Each year these are versioned as the CDC choose the appropriate target formulation. The value sets are updated to contain the new formulations and remove the older ones.
- **Mostly critically, the data in the patient record are expected to be coded in the vocabularies used in the value sets**. As we mentioned above, a value set is not simply a suggested list of general categories of medications, encounter types, procedures, etc. It represents a finite, fixed list in one or more coded vocabularies. That means that ***the target patient data being evaluated must also be accessible in the coded vocabularies used in that value set.*** Even if the data is visible in the chart through a note or some other screen, if it is not accessible in the required coding standard, it will be ignored.

That last point is a critical departure from abstracted quality measurement and bears repeating – the data being evaluated in the patient record must be accessible in the required vocabulary coding standard or it will not be considered in the measure. This is the single largest challenge most organizations face when transitioning to eCQMs and where a large portion of effort and expertise are invested. The patient record may be data rich, but information poor. Items recorded in text notes, flow sheets, or other areas of the chart may not be coded in a way that allows them to be exposed in the vocabularies that a measure's value sets use.

This is why policies are such an important part of the interoperability mission. Given the variety of coding systems that exist, it would be difficult to have measures all use a random series of choices for representation of key portions of the patient chart. Guiding the determination of which vocabularies are appropriate for a given value set are policies that mandate the use of USCDI [35], which we mentioned in the Interoperability section. USCDI helps to align, or "harmonize" the choice of vocabulary coding standards across measures and related value sets for a given class of data like an encounter, medication, allergy, etc. Policy standards help to ensure semantic compatibility across measures.

Successful Projects Start with Data Evaluation

Simply having an EHR, even with coded data, will not ensure that the data elements captured are in the vocabularies required by the measure standards. Previously, we mentioned the idea of code mapping where we potentially have a system-specific value for something like a medication ID or even a vital sign. When engaging in an initiative where you intend to use national standards for data exchange or measurement, anticipate that the effort should start with several initial "data assessment" tasks:

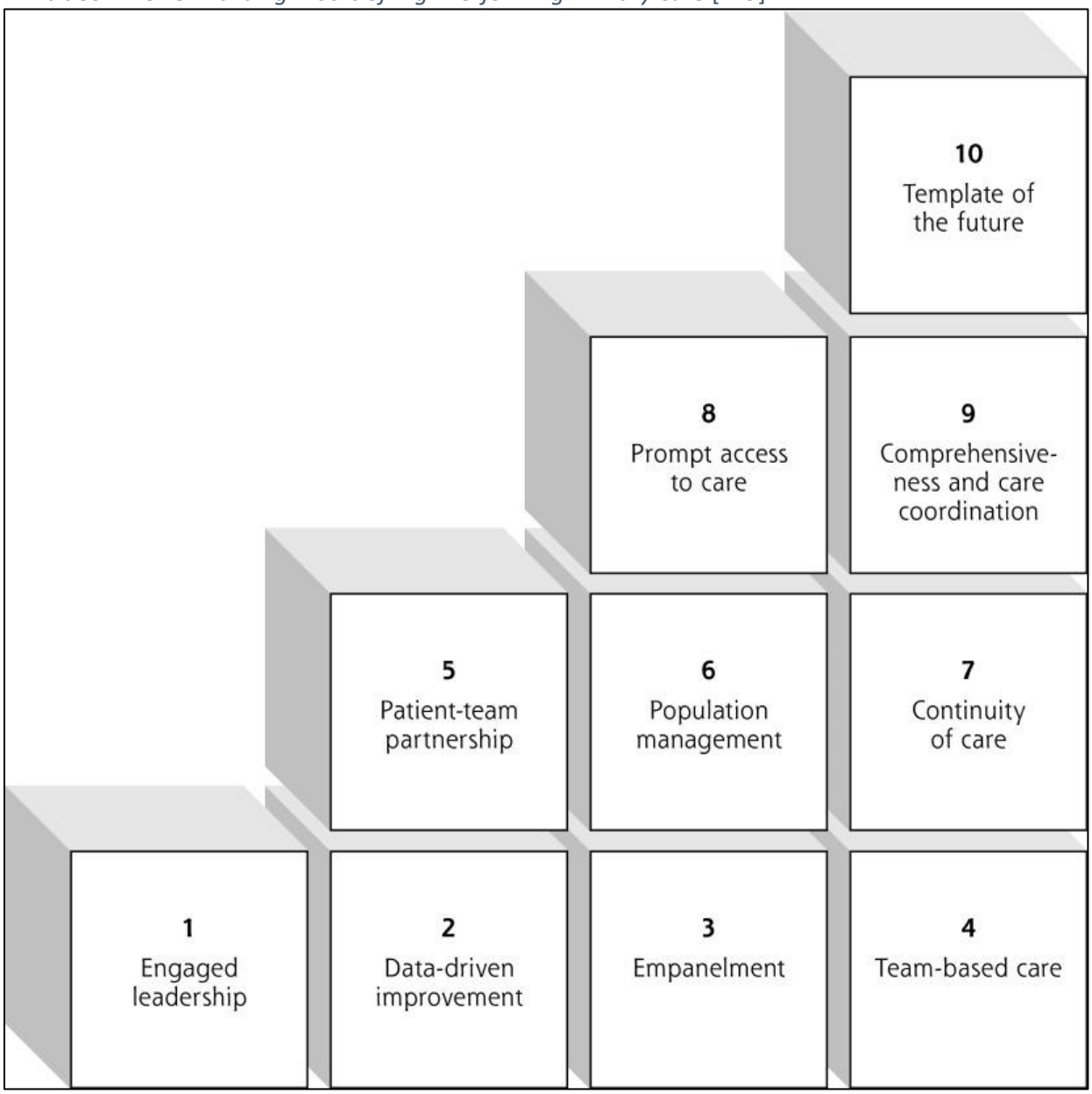
- **Are the data in the EHR captured in discrete coded forms?** If the medical record system or care teams make liberal use of text strings or text notes, then it will be more difficult and time-consuming to extract coded forms required for electronic exchange or measurement. To do so will certainly require extensive technology investment and may, in some cases, violate requirements for regulatory reporting.
- **Are the coded forms directly accessible in the preferred national vocabulary standards?** If there are discrete coded elements captured through medication systems, flow sheets, or other aspects of required data, they need to be accessible in the required vocabulary standards as defined by either policy or the measure (which are, hopefully, "harmonized"). Each individual data point must be able to be expressed (either directly or indirectly) through vocabulary standards like ICD-10, SNOMED CT, LOINC, RxNorm, etc. as required.
- **Over which time periods are various code systems accessible?** In some cases, as vocabulary standards are introduced to organizations and EHRs, they will be available for more recent data, but possibly not historical data. This is a common situation to encounter. If you are doing longer term longitudinal reporting, be sure to evaluate how far back in time any coded data exist.

When engaging on an electronic measurement effort it is helpful to first evaluate which measures you intend on calculating, gathering information on each major domain of information (labs, medications, patient demographics, etc.) are involved, and then performing an assessment on the availability and quality of any required data elements. By performing an assessment on data quality in advance, you can help ensure proper project planning and set expectations on what is possible early on. If there are gaps in mapping and coding, those should be identified at the initiation of an effort so you can engage the required subject matter expert.

Appendix B: Health IT Crosswalk for the Ten Building Blocks for Primary Care

The "10 Building Blocks for Primary care" is a useful framework for identifying the areas where an EHR can help support practice transformation. [119] Below, we review the implications for leveraging EHR technology for each of the 10 building blocks shown in Exhibit 59.

Exhibit 59: The Ten Building Blocks of High Performing Primary Care [119]



One: Engaged Leadership

Health IT Advisors will often provide performance data to clinic leadership to help them prioritize QI projects and assess progress and outcomes. The EHR is often the best source of these data, although there are alternatives (see Section 4).

Two: Data-driven Improvement

The Use Cases in Section 3 of the handbook show how demographic, clinical, administrative, and financial data managed by an EHR can support QI in two major ways: as a source of data and as a platform for delivering interventions.

Three: Empanelment

Empanelment is the explicit assignment of individual patients to a provider or care team to create a cohort, or patient panel. EHRs often include this information by capturing demographic fields (primary care physician; care team) that can be used to attribute performance and accountability to organizations, groups, or individual clinicians.

Four: Team Based Care

The EHR is an essential tool not only to support, but to facilitate, team-based care. For example, the use of an EHR to communicate and coordinate between healthcare providers increasingly includes roles outside of the traditional provider/medical assistant dyad, including care coordinators, health navigators, behavioral health clinicians, social and community service providers.

Five: Patient-Team Partnership

The EHR is becoming central to establishing and maintaining patient-team relationships. An EHR portal provides patients with a technology platform that allows access to their medical record, secure messaging, delivery of test results, tailored educational materials, preventive care reminders, and the option to collect and incorporate questionnaires and biometric data.

Six: Population Management

The EHR can be used to identify, assess, and monitor populations (or cohorts) defined by specific characteristics, needs, or health conditions. EHR or third-party population health tools can identify and manage cohorts based on demographics, medical or social conditions and risk factors, gaps in preventative care delivery, test results, insurance coverage by a specific payer, empanelment and payer attribution, and other criteria for targeting and measuring QI.

Seven: Continuity of Care

EHRs, aided by Health Information Exchanges, are getting better at exchanging data. While data siloes (isolated islands of patient data) still exist, it is now possible for EHR users to see much of a patient's medical data regardless of the provider and EHR vendor they use. Examples include immediate notification of acute care episodes, delivery of structured electronic discharge summaries, and adding two-way communication between providers for referrals and transitions of care.

Eight: Prompt Access to Care

The use EHRs for telehealth and asynchronous care delivery expanded rapidly during the COVID pandemic and may permanently shift (at least some) medical care away from traditional office visits, thus increasing prompt access to care.

Nine: Comprehensiveness and Care Coordination

The EHR serves a critical role in coordinating the care provided both in, and outside, of the clinic. Examples include sharing clinical information, communicating within the team, and exchanging information to support transitions of care (hospital admissions, transfer to long-term care).

Ten: Template of the Future

The top building block holds space for emerging EHR features and capabilities and will create new opportunities to leverage the EHR and other health IT to transform healthcare quality. Health IT Advisors can look forward to:

- Advances in how diverse EHRs can exchange structured electronic data
- New options for extracting data for QI using FHIR APIs
- Incorporation of patient-generated data from apps, portals, and devices
- Use of natural language processing (NLP) and artificial intelligence tools to enhance clinical decision support
- Improved capture of structured data for health related behavioral and social needs.

The table below is a comprehensive summary of how each of the Ten Building Blocks can leverage EHRs as a tool for transformation.

Exhibit 60: How the Ten Building Blocks Can Leverage EHRs[119, 120]

Building Block	Topic/Process	EHR Functionality
Engaged Leadership	**Strategy**	Accurate and robust reporting capabilities
	Trust/Buy-in	
	Resources	
	Data integral to strategy/improvement	
	Financial Management/Fiscal Health	
	Financial reports - PM	
	Revenue cycle management	
	Normalized and integrated data	
	Performance reports	
	Risk sharing analytics	

Building Block	Topic/Process	EHR Functionality
Data Driven Improvement	**Quality Monitoring and Improvement**	
	Data for reporting	Allows for workflows that use discrete data
	Data for decisions and improvement	Accurate and robust reporting for CQMs, clinical process and effectiveness measures
	Internal data sharing	Reports can be built, managed, and viewed by care team members
	External data sharing	Reports and datasets are exportable, interoperable with external partners; APIs
	Robust Clinical Information Systems	
	Appropriate applications - EHR	Medication management, scheduling, referral management, reporting, CDS, computerized provider order entry (CPOE)
	Habitual data validity review -audit	Ability to audit data for integrity, validity, and completeness
	Standardized, Evidence Based Guidelines	
	Standing orders	Order sets
	CDS	CDS
Empanelment	**Management of Patient Panels**	
	Assignation of patients to a particular clinician	Comprehensive assignment and tracking of patient/caregiver relationships
	Workload balancing across care team	Identify high risk patients; dynamic scheduling
Team Based Care	**Patient Centered care team**	
	Data supports action	Populate care plan
	Clinician/Care Team Engagement	
	Access to standardized forms	Make forms/care plan/encounter summary accessible to the entire care team
	Communication tools for use with colleagues	Direct Secure Messaging
	Usability of clinical information technology	Produces lists of problems, diagnoses, allergies, interventions (labs, tests)
Patient-Team Partnership	**Excellent Experience of Care**	
	Patient satisfaction	Patient access to manage information: results, schedule, encounter summary via patient portal and messaging
	Patient and Caregiver Relationship Management	
	Patient education	Patient access to relevant, reliable, culturally sensitive, and linguistically appropriate online educational resources;
	Patient communication	Secure messaging; Patient Portal
	Patient engagement/self-management	Incorporates patient generated data and/or data from other caregivers; APIs to connect to a patient's preferred health record and other provider portals

Building Block	Topic/Process	EHR Functionality
	Patient Empowerment	
	Patients understand their condition - SDOH, assessments	Shared decision-making tools, assessments; ability to record patient preferences
Population Management	**Cohort Management**	
	Assessment of the health of the organization's population of patients	Accurate and Robust Analytics for tracked Clinical Topics (e.g., Diabetes, cardiovascular health
	Identify cohorts of patients/population	Extract data from multiple sources: claims, practice management and clinical systems, health risk assessments; Identify patients by demographic, diagnosis, medication, lab result or problems; identify high risk patients; maintain lists of cohort(s)
	Monitor individual patients	Integrate patient goals, interventions in a sharable and reportable format; patient monitoring; flag and communicate needed interventions as appropriate; trending
	Evidence based medicine (EBM) CDS	EBM alerts/prompts via CDS: drug-drug formulary interactions, drug formulary checks, drug-allergy interactions; customizable order sets
	Interventions	CPOE for medications, labs& radiology tests; Appropriate use alerts
	Follow up	Identify and alert for missing care gaps (e.g., missed appt); timely lab/test results, review, communication with patients, schedule interventions; update care plan
	Monitor cohort	Calculate CQMs; present results from entire patient population; provide benchmarks and progress over time
Continuity of Care	**Cohesive Patient Care**	
	Prevention of Fragmented Care	Incorporates information from each care team member; missed intervention or appointment alerts; supports care coordination workflows and data entry
	Measurement of desired coordination outcomes	Accurate and robust reporting for CQMs, clinical process and effectiveness measures
Prompt Access to Care	**Access**	
	After hours communication- pt. portal, messaging	Patient portal
	Access-telehealth	Telehealth
	Access- Scheduling	Ability to access schedule and suggest

Building Block	Topic/Process	EHR Functionality
Comprehensiveness and care Coordination	**Referral Management**	
	Referral tracking and mgmt. process	Referral Management Process
	Care Coordination	
	Insurance eligibility checks	Auto-insurance eligibility checks
	Share data during transfer of care	Populate care plan and encounter summary
	Manage referrals	Referral management system
	Medication management and reconciliation	e-prescribing, Access to Medication lists (internal, external), auto-duplication alert, identify active medications, maintain history, evidence prescription was filled
	Clinical information reconciliation	Access to lists (external, internal) of problems, diagnoses, allergies, interventions (labs, tests); reconciliation signoff and reporting
Template of the Future	**Continuous Improvement**	
	Evaluation and incorporation of new technical tools	APIs
	Incorporating and contributing to EBM/Learning Health System	Bidirectional HIE
	Advanced analytics	Risk Stratification; predictive modeling

Appendix C: Example of Data Planning for Quality Improvement

A careful assessment of practice data capacity, both broadly and specific to the needs of a project, is a crucial initial step. This includes determining the specific EHR version and other data systems in use, the ability of the practice to generate key measures and data, the ability of the practice to produce usable, clean, and accurate data, and the use of data in QI and other practice management activities.

This appendix illustrates the steps a Health IT Advisor might take to iteratively assess and support a practice as they implement a new measure. The illustration uses Screening for Unhealthy Alcohol Use, but the process is applicable for any measure.

Measure: *Number of unique patients 18 years of age and over who have been screened for unhealthy alcohol use*

First the Health IT Advisor needs to meet with the practice's QI and IT reporting staff to discuss the meaning of the measure, and to confirm that the report should be run/built for all unique patients who are 18 and over. This group will be the denominator for the measure. If a patient is screened for unhealthy alcohol use during the reporting period, then they would be included in the numerator.

Next the Health IT Advisor needs to consider if there are variables that are missing from this definition that the QI and IT staff members might need to run or build this report. In this case we would want to define the time period for this measure. In this example we are going to select a 3-month time period that repeats on calendar quarters, like this: Jan – Mar, Apr – Jun, Jul – Sep, Oct – Dec.

Once everyone has agreed on the definition of the measure, the QI and IT staff members will need to determine if their EHR or Quality Registry are already able to run the measure. If the measure is available, then the practice will want to run the report and see if a numerator and denominator are being populated accurately. If the measure is not available in the EHR or Quality Registry, then the Health IT Advisor will work with the practice to determine what steps will be needed to build the report. If the report needs to be built, the Health IT Advisor should work with the practice and their IT/billing team to determine a realistic timeline in which to do this.

Once the measure is available, the Health IT Advisor and practice staff should review to ensure that the numerator and denominator look accurate. It is critical to have a staff member who is familiar with patient volumes look at these numbers to confirm that the numbers are reasonable in terms of what would be expected for the practice.

To ensure that the denominator (i.e., all unique patients 18 and over, seen during the specific timeframe) looks reasonable, review the following:

- **Is the denominator accounting for all providers in the practice, is it counting all unique patients or all patient visits during that timeframe?**
- **Does the timeframe seem reasonable?** For example, does it look like it includes all unique patients during a 3-month period or is it pulling all unique patients in a year?

Next you want to focus on the numerator (i.e., all patients screened for unhealthy alcohol use):

- **Are you getting zero for your numerator?** The practice might not have any providers using the unhealthy alcohol use screening tool, or providers may not be documenting the unhealthy alcohol use screening in the right place within the EHR.
- **Is the numerator lower than expected?** If so, review which providers are using the screening tool and look at their workflows. The Health IT Advisor should then talk to the practice staff about next steps based on the outcome of this review. Staff training may be needed to create consistency across the practice and improve performance on the measure.

Once the practice has a numerator and denominator they can trust, the Health IT Advisor should work with the practice to create or provide a feedback report. This feedback report shows how the practice is doing over time on the measure. It could also show how the practice is doing on the measure in comparison to other practices in the same system or it could show how specific providers in a clinic are performing in comparison to each other.

It is essential that the Health IT Advisor work closely with the practice's QI staff so they are developing something the practice will use. Ideally the practice's health IT staff should share these feedback reports with the clinic staff on a regular basis so everyone can see the progress on this measure.

Appendix D: Tips on Designing Reports and Data Visualizations

The first step in designing a report is to identify the task of the report. Who will be using the report? Will it be for internal clinicians, organization leadership, ACO, payer, regulatory, or something else?

A report should tell a story and it is important to think about the components that make up that story and maybe more importantly, the components that do not. Be careful mixing stories because this can lead to a busy and confusing report (see more below). What does the report need to convey? Think about the data that are needed to support this story. What systems do the data currently live in and what access is required, or is this new data collection? What frequency will the report need to be updated? Below we will cover some thoughts around automated and a method for semi-automation that does not require programming or systems administration.

Before embarking on creating a new report, first check to see if the report already exists (see Section 3). Is this report covered by a standard report (e.g., MIPS) that may be already built into your EHR? Check with the EHR vendor or handbook or website to see if a related report already exists. In some cases, the reporting role may require a separate license. With practice staff, ask your vendor if there is any training available for the reporting module. In most cases, the use of a standardized report is preferable to maintain consistency, ease of use, and reduce the practice resources needed. If you are in a health system, it may be a good idea to reach out to your data analytics team. They may know of something outside of the EHR.

If the report will be used in the clinic, think about the intended purpose. Will this be used to support day-to-day operations? For example, one idea is to create "buckets" that show how many patients are waiting in each room and for how long. Another is to track occurrences of incomplete, partial, or complete processes for review and improvement. Another idea is to use quality measures at the individual provider level and create a dashboard for teams of providers to see how they compare to their peers in terms of controlling for disease in their patient population.

Finally, a dashboard showing a running average of costs for procedures or processes can be helpful for a clinic to meet financial goals. Costs side-by-side with related quality measures could be a very powerful visualization.

Many EHRs provide an integrated reporting module that allows the user to build a report (there may be additional costs). The simplest of these reports is to run a list of patients that have a certain characteristic, for example, a hypertension diagnosis. The user interface and commands used to create a custom list will vary by EHR, but most support Boolean logic like that shown in the example below:

- Select (All patients)
- AND (Between 18 and 85 years old)
- AND (Seen within 365 days)
- AND (for an office visit) OR (for a tele visit))
- AND (having a diagnosis of ICD-10 I.10, Essential Hypertension)
- NOT (pregnant).

When getting started developing a data visualization, many people want to start by designing a data structure before they know what they want to present. While digging into and knowing the data is good from the standpoint of identifying what is possible, it is difficult to know exactly what structure is needed until there is a plan for the presentation and an intended purpose for the presentation. In this section we will discuss choosing a data visualization software solution, identifying the right data visualization for an intended purpose, as well as how to prep and structure data to feed the visualization.

Choosing a Software Tool

For simplification, all the examples in this section use Tableau Desktop, which is a popular software solution. However, it is important to note that there are many other software solutions available such as SAS Visual Analytics, Microsoft Power BI, Qlik, Microsoft Excel, and many more. There are also free tools such as Google Charts and Tableau Public. There are also several open-source programming frameworks that are powerful such as D3.js and Chart.js. The intention of this section is not to promote any one solution, however, there are some important considerations to take into account as a Health IT Advisor.

Ease of Use

If you do not currently have experience working with a particular tool, it is important to assess how much effort you are willing to put into learning a one. Are you a programmer or plan to become one? Using programming frameworks such as D3.js provide the most flexibility and capability but come at the steepest learning curve. Prior knowledge of JavaScript, at a minimum, is required. Non-programming tools such as Tableau and Microsoft Power BI, try to assist the user throughout the entire workflow starting with data ingest, such as connectors to some of the most popular data sources (excel, CSV files, database servers, SAS datasets, etc.), to identifying data types such as text/strings, numeric, dates, true/false, IDs, geographic variables, etc., to suggesting visualizations based on selected data (bar charts, line graphs, etc.), to publishing (export to a portable document format (PDF), embed in a website, upload to a tool-specific cloud hosting provider). Simplification usually comes at the cost of capability and flexibility. For example, a tool may enable you to easily build a beautiful, stacked bar chart by just pointing it to your data and dragging and dropping specific variables. However, if you want to customize the labels in the legend, change the display of hover values, or add click-through events when clicking on the chart, it simply may not be possible. Choosing a tool that meets your needs without exceeding the amount of time you are willing to dedicate is critical to your success. There are many online training resources available such as LinkedIn Learning, Coursera, and Udemy as well as many books on developing data visualizations and using specific tools.

Security / HIPAA

As health IT professionals we must take patient privacy and security seriously, which eliminates many data visualization tools from consideration. Cloud-hosted tools are numerous and growing in popularity. However, we cannot publish sensitive data to a cloud provider such as Google Charts or Tableau Public, without consulting with legal counsel. Doing so is usually only possible with a Business Associate Agreement (BAA) in which the cloud provider agrees to accept responsibility for keeping the data secure and private specifically for your organization. This limits us to locally hosted (on our Desktop) or organization hosted (company server) solutions. Luckily, there are many great options to choose from. Tableau Desktop, Microsoft Power BI, SAS Visual Analytics, and Excel, just to name a few, can all be installed on your desktop with a paid license and/or subscription. Your organization may choose to

provide one of these solutions on their servers, which is also a great, secure, option. No matter what, when working with sensitive data on our personal computers, it is important to keep in mind that we are taking on a much higher level of security responsibility and vulnerability to cyber-attacks. Our computers need extra protection, and we need additional training. User behavior is the number one reason why sensitive data are compromised. Consult with your IT department and let them know that you plan to store sensitive data on your computer prior to doing so. If you plan to develop on a laptop or portable device, we suggest that you implement "full disk encryption." With full disk encryption enabled, if your laptop is lost or stolen, the contents of your hard drive remain secure. We will not go into detail on how to set this up, so contact your IT department to learn more. When you are finished developing a data visualization, the next step is to share it. Be aware that some solutions make the underlying data accessible to the viewer. For example, if you share a Tableau Workbook, even if data being presented are aggregate and de-identified, the data source containing row level (patient level?) data is accessible. We will go into more detail on this and other considerations such as small cell sizes later.

Costs

The costs of software licensing can vary wildly depending on the specific situation. For example, if the organization currently supports an Office 365 environment, Power BI is currently available as part of the Office 365 Enterprise E5 version. If the organization does not have E5, it is available as a stand-alone cloud-based software as a service (SaaS). If the organization currently contracts with SAS, SAS VA may already be available (SAS VA is included with SAS Viya). The same goes for Tableau Enterprise. Your organization may already be using one of these solutions for internal reporting, which may provide the most cost-effective path for your project. Tableau Desktop is free if the intent is to publish to Tableau Public, however, given the sensitivity of the Health IT Advisor's work, this is typically not an option. Tableau does not allow the user to save any data locally in the free version, only to the Tableau public server. Most likely clinic-based reporting will need to be hosted on a solution paid for by the organization.

Please note, if hosted with a 3rd party vendor such as a cloud-based hosting solution, most organizations require a BAA to set expectations for liability associated with HIPAA.

Once you have identified which solutions, if any, most closely align with your organization's existing infrastructure, you will need to determine if you can handle the work or if you need to identify a developer. Most larger organizations have in-house business/data analytics teams that can help. This would likely be the most cost-effective route. If your organization does not provide this service, there are plenty of 3rd party contractors available. Just do a search on the most popular job community websites such as (e.g., Linked-In, Indeed, or Upwork) for your intended solution. For example, "Tableau Developer" or "Power-BI developer." At the time of this writing, you can expect to pay between $100-$175 per hour for an experienced developer that has prior experience designing visualizations with health data.

Keep it Simple

In general, many of these solutions provide default color schemes and default visualization options such as traditional/stacked/grouped bar charts, (multiple) line graphs, and pre-defined axis title and tooltip locations. If possible, stick with the defaults as this will simplify development and allow the developer to focus on what matters most. Do not underestimate the amount of effort it takes to customize these

options. Ask yourself, is this customization adding significant value to the visualization? Do not be afraid to frequently ask the developer for their opinion on the most cost-effective solution. Tell them upfront that you are interested in simplicity and to please let you know if they feel that anything you ask is disproportionately time-consuming with the return on investment (ROI).

Under the following examples, we will provide the estimated amount of effort that was required to create each visualization in terms of hours. Please refer to Section 2 of this handbook for the various methods and considerations related to extracting data, which plays a big part in the amount of required and cost.

Identifying the Message, Intended Purpose, and Minimum Viable Product (MVP)

Before identifying data, thinking about data structure, or even contracting with a developer, you should determine the intended purpose of the project. Here are a few examples:

- Quality of care improvement
- Process/Workflow efficiency
- Billing and or administration
- Data quality checks

One suggestion is to form a committee of stakeholders and conduct brainstorming sessions. What are the needs? Where are the gaps in the existing reports? develop a matrix of intended audiences and feature ideas. The intersection of the columns and rows should be a planned use case for how the intended audience will use that feature. See example in Exhibit 61.

Exhibit 61: Matrix of Intended Audiences

	Physician	Health IT Advisor / Practice Manager	Administrator
Feature #1	Physician use case for feature #1		
Feature #2		Practice Manager use case for feature #2	
Feature #3			Administrator use case for feature #3

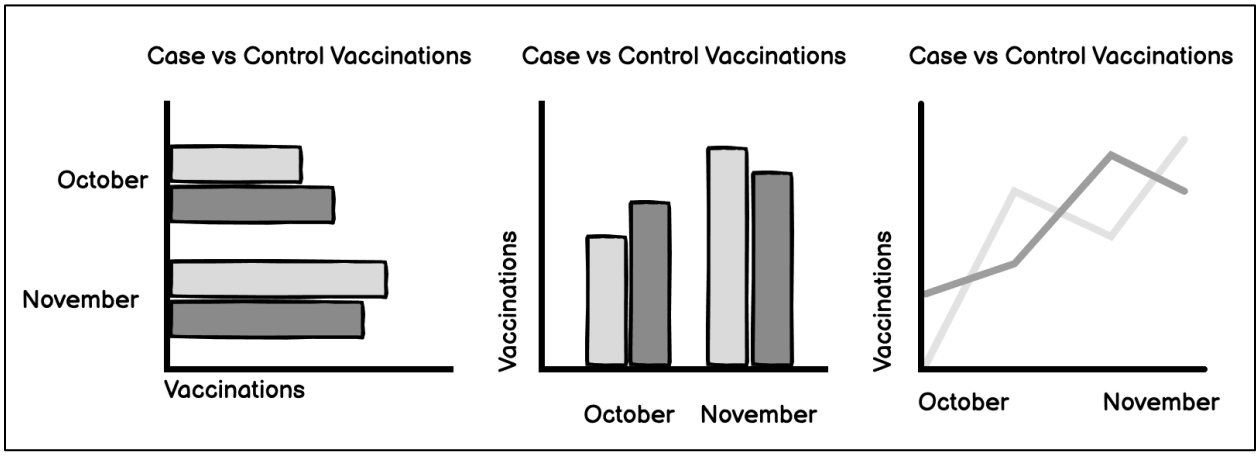
This tool will help you home in on which features are highest priority and part of the Minimum Viable Product (MVP) vs. those that are nice-to-haves. Having this knowledge before approaching development will save time, money, and produce a higher quality solution.

Wireframes and Mockups

Once you know the features that you plan to include in the MVP, it is time to start working on your design. Because data visualization ideas are hard to communicate using verbal language, it is sometimes more effective to use visual language such as with a wireframe. A wireframe is a representation of an idea in its simplest form. It is much easier to iterate on a design in its simplest form, and therefore time and money will not be wasted on implementation before the design has been communicated and thoroughly discussed. A wireframe could be a simple drawing on a whiteboard, which can then be shared by taking a photo with your phone. The most important thing to remember when wireframing is

to keep it simple and only draw what you need to get your idea across. For example, consider which option shown in Exhibit 62 is more effective for conveying the information:

Exhibit 62: Wireframe Data Presentation Examples



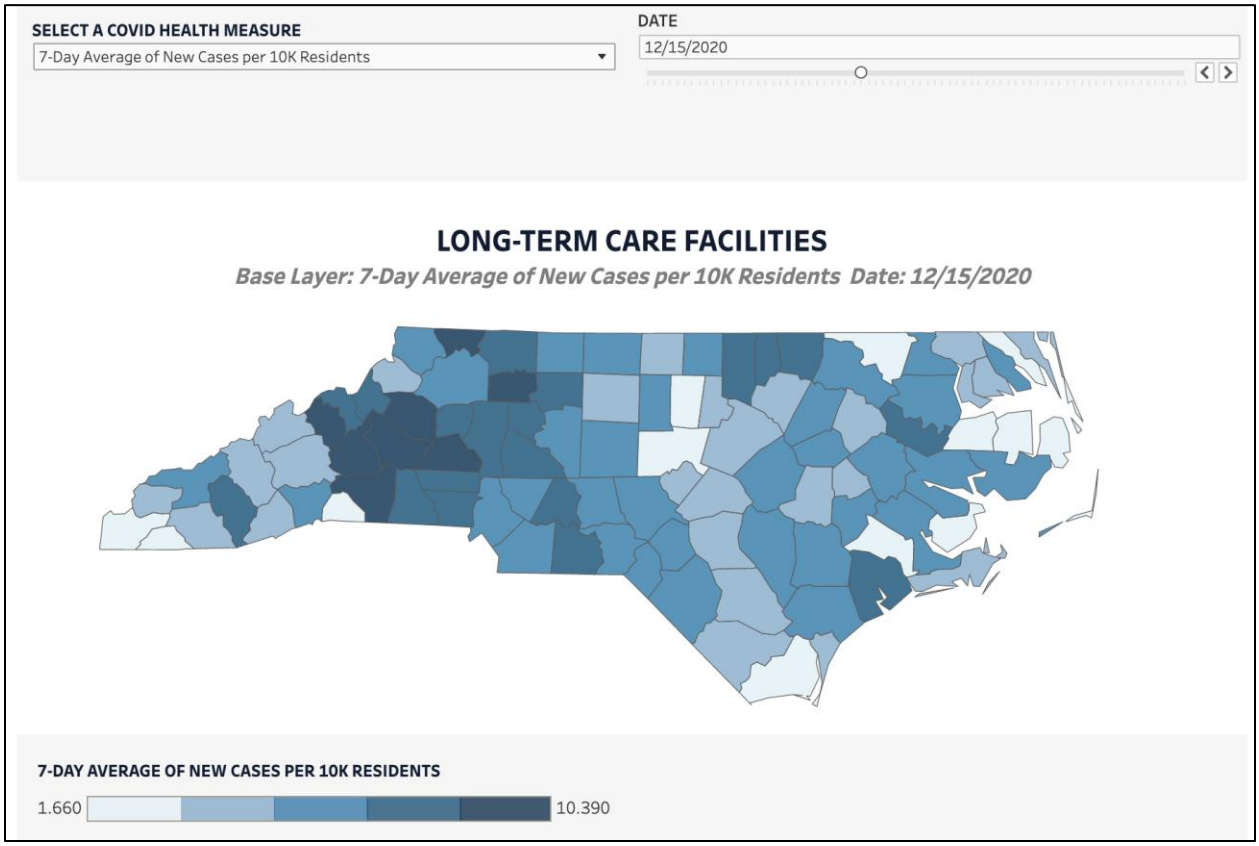
It would be hard to describe these with just words in a meeting or a phone call. The wireframes are able to communicate so much more in less time. The answer to "which is more effective?" is often subjective and will require discussion and possibly some usability testing on actual stakeholders. The good news is that with a wireframe, you can quickly make changes, possibly in real time. In addition to discussing pros and cons for each visualization, be sure to discuss titles, axis labels, choice of colors, in-chart data labels, legends, interactivity (hover tooltips), custom filters or user controls, and supporting content/documentation.

Once you have consensus on the most effective visualization(s) and design options, you have 2 options. You could dive straight into implementation, or you could build a mockup. A mockup mimics what the final product will look like. This includes color choices, layout of multiple components, supporting content, etc. This could be beneficial if you are building a dashboard or something more comprehensive than a single visualization. Unfortunately creating a mockup of a data visualization is difficult to do without actually building one. One method is to use a tool such as Tableau Desktop to quickly build your chosen visualization using dummy data. This serves two purposes. For one, it allows you to mockup what your final product will look like. And two, it allows you to start thinking about your data structure requirements for the chosen visualization and if your raw data will work for what you want to do. If you are building a dashboard, you can take screenshots of your dummy visualization and place them in a word document or design tool such as Visio (windows) or Omnigraffle (mac) and lay out the viz with supporting content such as an overview, FAQs, how-to instructions, and frequently used terms (see example dashboard below in Exhibit 63).

Preparing your Data for Visualization

Depending on your chosen visualization and tool, preparing your data and developing the viz may be a circular process. First you will want to use dummy data to create a visualization in your chosen tool. For example, do not spend time feeding in raw data and calculating aggregate results, only to change your mind on the entire visualization later. With your raw dataset in mind, build a sample dataset in excel by hand with minimal expected aggregate results. This will give you data to play with different visualization options and it will be easy to quickly change data structures.

Exhibit 63: Example Dashboard



Graphic included with permission from the Gillings Global School of Public Health COVID-19 Dashboard at the University of North Carolina at Chapel Hill: https://gillingscovid19.unc.edu/visualization/long-term-care-facilities [121]

Tableau expects the data structure to look like the table included in Exhibit 64.

Exhibit 64: Example Data Structure for Tableau

date	county	state	Population	cases10k	deaths10k	cases_rolling7	deaths_rolling7day
12/15/20	county a	NC	174055	21.14	1.21	0.71	0
12/15/20	county b	NC	38755	9.81	0	0.41	0
12/15/20	county c	NC	11510	15.64	0	0.62	0
12/16/20	county a	NC	25289	26.1	0.4	0.28	0.06
12/16/20	county b	NC	28150	12.79	0	0.1	0
12/16/20	county c	NC	18035	1.11	0	0	0
12/17/20	county a	NC	47490	7.58	0	0.12	0
12/17/20	county b	NC	19601	63.77	2.04	0.73	0
12/17/20	county c	NC	34444	30.19	0.58	0.41	0

Because the visualization allows the user to select multiple measures in the first drop-down, we need a column for each measure. The viz also allows the user to drag a slider to select the date they would like to view COVID-19 data for. Without the date selector, you would only need one row per county. With the date selector, you must have one row per county per date. As you can see, adding features to your data viz can drastically change the data structure required.

After you have your data structure with dummy data and your visualization looking the way you want it, now you should have some idea of what processing will be needed in order to manipulate your raw data into the expected data structure required for the viz. For this handbook, we will not go into all the different methods of processing and transforming data. However, if you plan to publish your visualization to Tableau Public, it can be to your advantage to handle data processing outside of Tableau. Data processing within Tableau can drastically slow your visualization, especially if you have a lot of data. If you plan to export a PDF, JPG, or some other static form of your visualization, it will not matter if you do all your data processing in Tableau or not.

If this report will be published to a website, you will most certainly want to think about automating the data refresh. This plays a large role in your design. Generally, you will want to avoid any manual/human process because humans cannot be automated. For this handbook, we will not go into all the methods of automation which may require shell scripting, Python or programming languages, and possibly support from systems administration. One semi-automated method worth mentioning though is with Tableau Public. If you have decided to use Tableau Public, and your data can be made completely public, Tableau public can read from a Google Sheet. This is handy because there are many ways to update a google sheet. You can sync the sheet to your desktop and have a semi-automated process on your desktop that updates the sheet. You can share the sheet with staff and ask them to update the sheet, which will in-turn update the Tableau. This is a nifty trick to have in your back pocket, which may just meet your requirements without involving a programmer or system admin.

Data Quality and Missingness

Once you have your raw data loaded into your data visualization, now is the time to look for anomalies. Spikes in line graph that would otherwise be a smooth and continuous line, may indicate missing or erroneous data. The same goes for expected bars missing from a bar chart, or other anomalies. Data visualizations are a great way to check for data quality. Also, missingness in data may not be an error. Missingness can be an important story in your data that you will want to highlight in your supporting content. For example, data suppression due to HIPAA concerns with respect to protecting the privacy of patients, can create missingness. Most organizations will implement a minimum small cell count. This is something you will want to explain in a sidebar and/or FAQ.

Developing and Sharing Visualizations

It is a good idea to start designing your visualization on paper or using tools such Visio (for windows) or Omnigraffle (for Mac) first, before jumping straight into development. This can save you time and money overall because it is much easier to iterate on a design than it is to develop the solution. There are some exceptions to this though. If your intended solution is a very simple data viz such as a bar chart or a line graph, then many of these tools will allow you to explore and "play" with various visualizations. For example, some tools will allow you to load your data into an X and Y axis and then browse visualizations that it suggests based on your data. Be very careful with this feature though as it is easy to make assumptions in what it is presenting you that are simply not factual. It can be a quick turn-around solution if your data are simple, verifiable, and it fits your needs.

The purpose of this handbook is not to be an all-encompassing tutorial on every possible data visualization. For a large gallery of visualizations and a great place to find inspiration, visit the D3 gallery. D3 is a JavaScript library that is not for the novice, but if you are working with a developer or simply want to find ideas you can implement, it is a nice place to browse.

Considerations Around Diversity, Equity, and Inclusion

One important step that many organizations miss is pilot your solution before publishing. Having stakeholders from your intended audience review and provide feedback can uncover gaps in your planned design. It can also prevent embarrassing mistakes or oversights from being released to a wider audience and minimize risk or possible damage. For example, the decision to list white males first in every data visualization may have just been an oversight but could send a completely different message than you intend. The stakeholder committee could simply be the original committee you initially engaged with, but do not overlook the opportunity at this step to identify members of the broader community.

This would be a good time to identify actual users and get their feedback. One exercise that we found particularly useful was to organize is light-weight usability study. Here are the steps we followed:

- Identify actual users/stakeholders from your intended audiences who will agree to participate in a study where they will be recorded as they attempt to complete various tasks using your new solution
- Schedule meetings with each stakeholder to meet with an interviewer on a video conferencing solution (Zoom, MS Teams, etc.) to discuss the format, content, presentation, and aesthetics of the visualization.

Conclusion

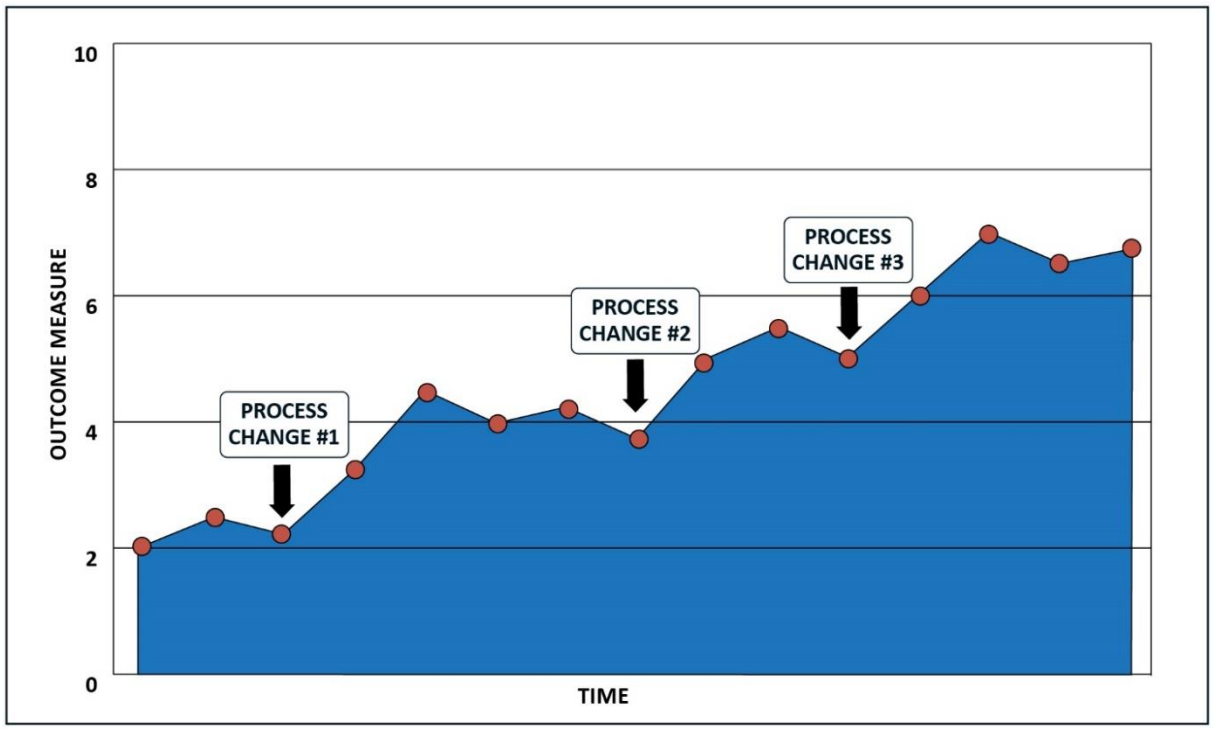
As discussed in this Appendix (also see Section 8), designing visualizations to present quality data to diverse stakeholders is an art and a science. Below are some examples of different visualization types that may be of use.

Example 1: Line Graphs / Run Charts

Generally, in order to track performance over time, it is useful to display quality and performance measures graphed as a function of time, a display called a run chart. [122]

The run chart below is a generic example. In a run chart, it is often helpful to show all patients seen during a given unit of time (such as a month), to create visual evidence of the effect of various improvement interventions. In this example, the time points of the process change activities are indicated by the call-outs boxes.

Exhibit 65: Example Run Chart



Example 2: Bar and Pie Charts

Exhibit 66: CQM Performance Data Presented as a Bar Chart

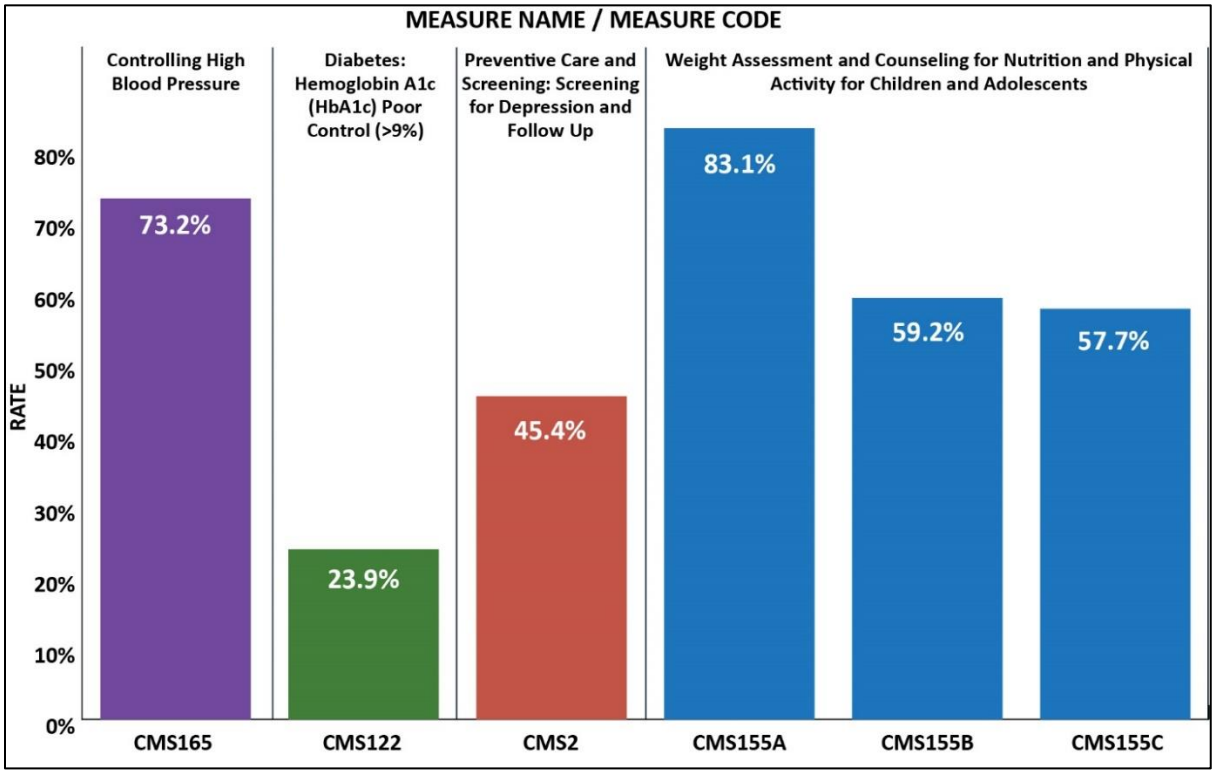
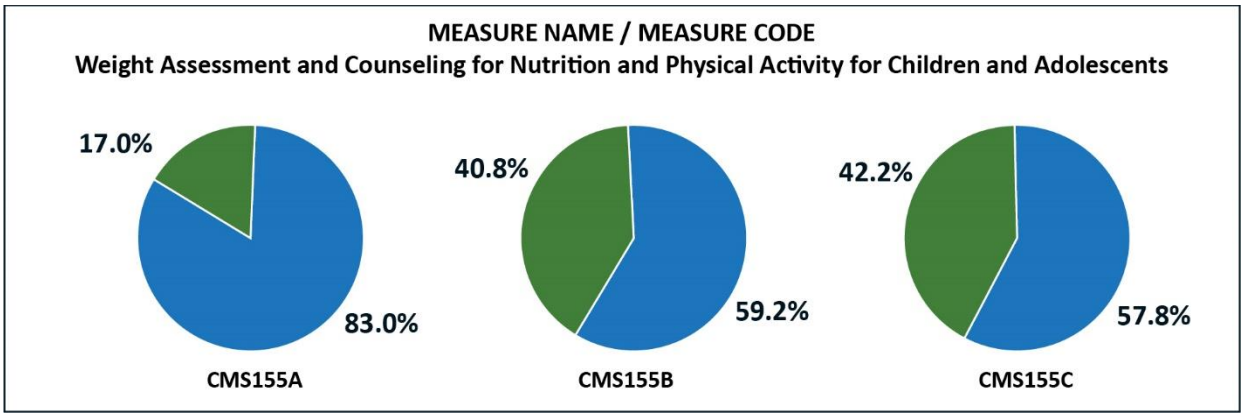


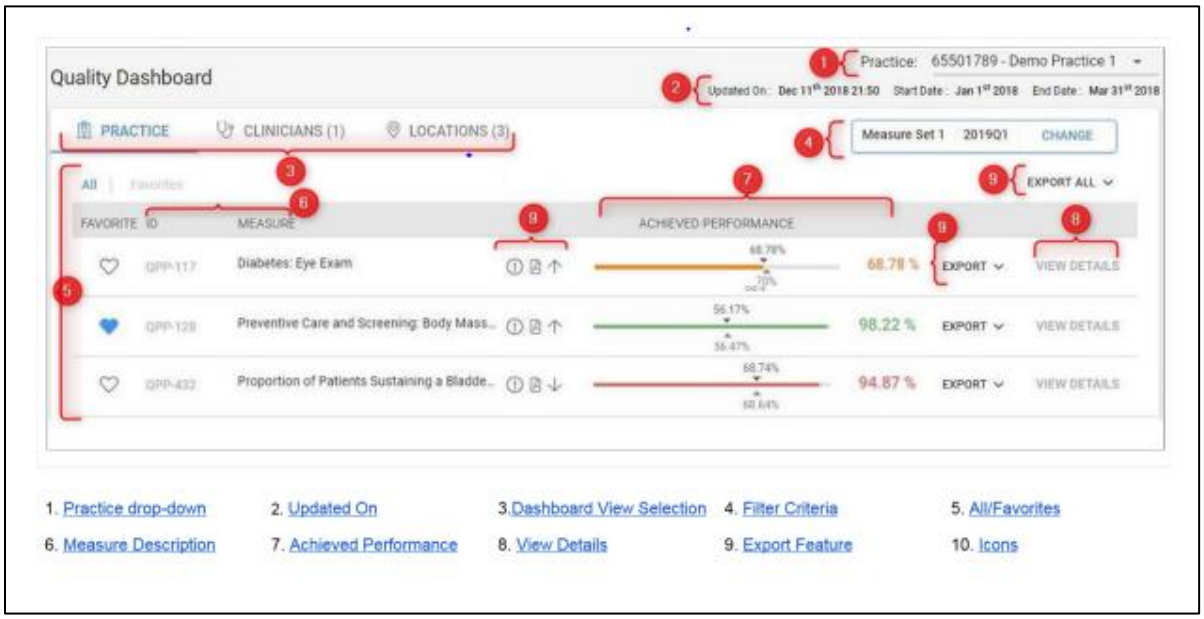
Exhibit 67: CQM Performance Data Presented as a Pie Chart



Example 3: EHR or Population Health Dashboards

A dashboard pulls together multiple data visualizations into a single view for the user to see at a glance related metrics. For example, the following dashboard shows multiple measures that are related. It is important to know that dashboards can get very busy and detract from their intended purpose or worse, confuse the user into thinking something is true that is not. In the below example, you can see that the developer chose to use color and text formatting very sparingly because there is a lot of information on the screen. The user's eye is drawn to the changing colors and triangles, which is the intent of the design. All of the information in view is related. Additional detail and other views are separated into tabs across the top.

Exhibit 68: Example Dashboard [67]

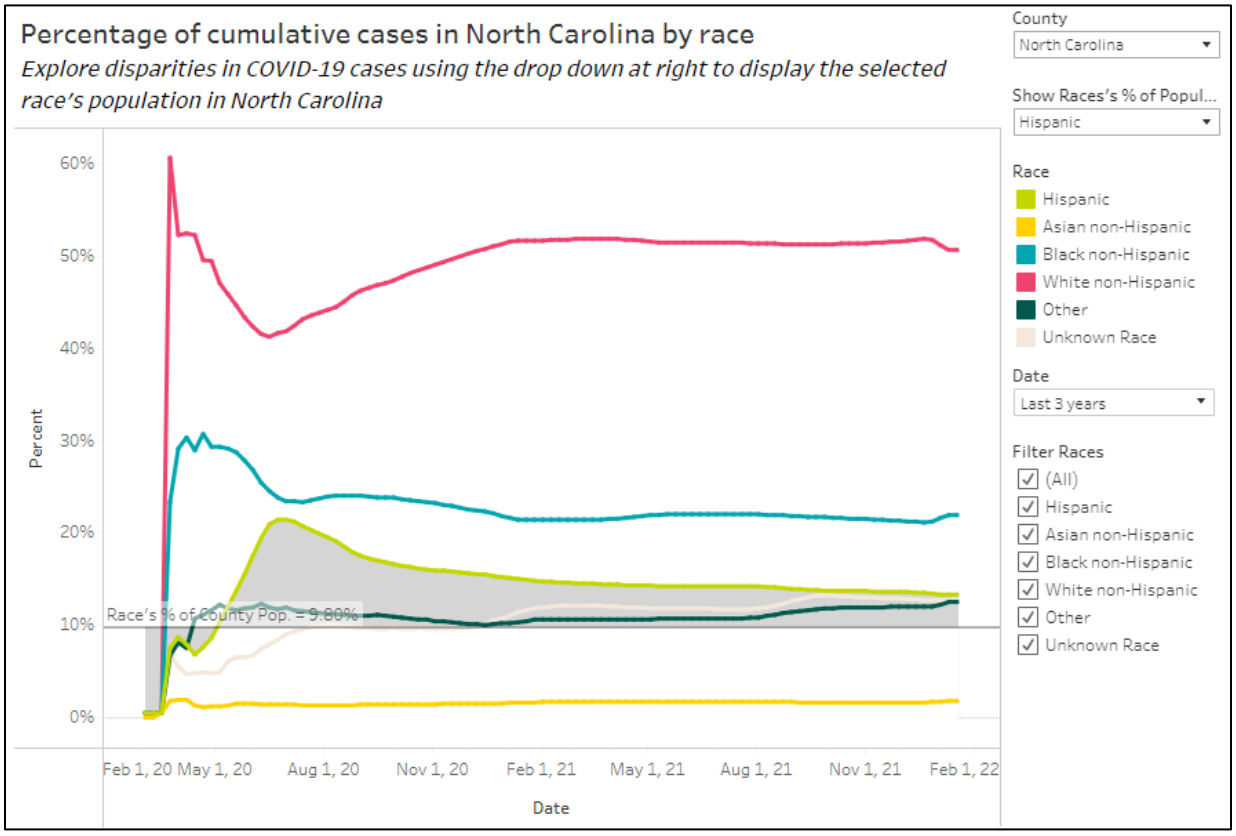


Graphic included with permission from The American Board of Family Medicine.

Example 4: Complex Time Series

The next example is a very complex data visualization that requires a lot of explanation. This is actually part of a larger COVID-19 dashboard, but we chose to separate each visualization on its own page in order to provide enough space and supporting content around each visualization to address questions a user may have. Users of this dashboard ranged from the general public to county administrators, to state legislatures, to research scientists. In addition to the visualization, each of the following components were considered when creating this dashboard page: Title, Overview, frequently asked questions (FAQ), How to Use, and Terms Used. Each visualization on the dashboard had a similar page with all of the same components.

Exhibit 69: Complex Time Series Visualization



Graphic included with permission from the Cecil G. Sheps Center for Health Services Research for the Gillings Global School of Public Health at the University of North Carolina at Chapel Hill.

Table of Acronyms

Acronym	Full Name or Term
AAFP	American Academy of Family Physicians
ACG	Adjusted clinical groups
ACO	Accountable Care Organization
ADT	Admission, discharge, transfer
AHIMA	American Health Information Managers Association
AHRQ	Agency for Healthcare Research and Quality
AI	Artificial intelligence
AMD	Age-related macular degeneration
AMIA	American Medical Informatics Association
API	Application programming interface
ARRA	American Recovery and Reinvestment Act
AUDIT	Alcohol Use Disorders Identification Test
AUDIT-C	Alcohol Use Disorders Identification Test – Consumption
BAA	Business associate agreement
BMI	Body mass index
BP	Blood pressure
CCC	Chronic comorbidity count
CCD	Continuity of care documents
CCPA	California Consumer Privacy Act
CDC-REC	Centers for Disease Control - Race and ethnicity code set
CDS	Clinical decision support
CDSS	Clinical decision support system
CEHRT	Certified electronic health record technology
CFR	Code of federal regulations
CHPL	Certified health IT products list
CMS	Centers for Medicare & Medicaid Services
COPD	Chronic obstructive pulmonary disease
CPC+	Comprehensive Primary Care Plus
CPOE	Computerized provider order entry
CPT	Current procedural terminology
CQM	Clinical quality measure
CSV	Comma separated value
DHHS	Department of Health and Human Services
DOB	Date of birth

Acronym	Full Name or Term
DUA	Data use agreement
EBM	Evidence based medicine
ECG	Electrocardiogram
eCQM	Electronic clinical quality measure
EHR	Electronic health record
EIN	Employment identification number
ERA	Elder risk assessment
ESRD	End stage renal disease
FAQ	Frequently asked question
FERPA	Family Educational Rights and Privacy Act
FHIR	Fast healthcare interoperability resources
FQHC	Federally qualified health center
GDPR	General data protection regulation
GXT	Graded exercise testing
HCC	Hierarchical condition categories
HCPCS	Healthcare common procedure coding system
HEDIS	Healthcare effectiveness data and information set
HIE	Health information exchange
HIMSS	The Healthcare Information and Management Systems Society
HIPAA	Health Insurance Portability and Accountability Act
HIT	Health information technology
HITECH	Health Information Technology for Economic and Clinical Health Act
HRQoL	Health-related quality of life
HRSA	Health Resources and Services Administration
HRSN	Health-related social needs
ICD	International classification of diseases
IID	Individuals with intellectual disabilities
IRB	Institutional review board
IT	Information technology
LOINC	Logical observation identifiers, names, and codes
MACRA	Medicare Access and Children's Health Insurance Program Reauthorization Act
MEDCs	Major extended diagnostic groups
MHS	MetroHealth System
MICH	Maternal, infant, and child health
MIPS	Merit-based incentive payment system
MVP	Minimum viable product
NACHC®	National Association of Community Health Centers

Acronym	Full Name or Term
NCQA	National Committee for Quality Assurance
NDC	National drug code
NLM	National Library of Medicine
NLP	Natural language processing
NPI	National provider identifier
NQF	National Quality Forum
ONC	Office of the National Coordinator for Health Information Technology
PDF	Portable document format
PF	Practice facilitator
PGHD	Patient-generated health data
PHI	Protected health information
PHQ	Patient health questionnaire
PHR	Personal health record
PMI	Precision medicine initiative
PRAPARE	Protocol for responding to and assessing patients' assets, risks, and experiences
PRO	Patient-reported outcomes
PROM	Patient-reported outcome measure
QDC	Quality data codes
QDM	Quality data model
QI	Quality improvement
QPP	Quality payment program
RECs	Regional extension center
ROI	Return on investment
RPM	Remote patient monitoring
SBIRT	Screening and brief intervention and referral to treatment
SBPM	Self-blood pressure monitoring
SDOH	Social determinants of health
SIM	State innovation model
SMART	Specific, measurable, achievable, realistic, and timely
SMBP	Self-measured blood pressure
SNOMED	Systematized nomenclature of medicine
SOAP	Subjective, objective, assessment, and plan
SOGI	Sexual orientation and gender identity
TEFCA	Trusted exchange framework and common agreement
UCUM	Unified code for units of measure
UDS	Uniform data system
USCDI	United States core data for interoperability

Acronym	Full Name or Term
USPSTF	United States Preventive Services Task Force
UWPHI	University of Wisconsin Population Health Institute
VA	United States Department of Veterans Affairs
VBP	Value-based payment
VSAC	Value set authority center
VTE	Venous thromboembolism

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