Using Information Technology to Support Better Health Care: One Infrastructure with Many Uses

The American Recovery and Reinvestment Act (ARRA) of 2009 authorized substantial funding to promote the widespread adoption and "meaningful use" of health information technology (IT), with the goal that all Americans will have an electronic health record (EHR) by 2014. Underlying this ambitious timeline and investment is the belief that health IT, if implemented and used effectively, has tremendous potential to improve patient care.

Equally important is the potential to use electronic health information collected in the course of care delivery – such as health information stored in EHRs, claims data, registries, and inpatient billing systems – to promote what the Institute of Medicine has termed a learning health care system. Such "enhanced uses" of health information encompass a wide variety of clinical and public health activities that are critical for improving patient care. These applications include quality measurement and reporting, new approaches to provider payment and benefit design based on quality rather than simply the volume or intensity of services provided, and public health surveillance. All of these activities ultimately feed back to better decisions in patient care.

Discussions around current federal health IT initiatives have focused primarily on creating incentives for health care providers to make meaningful use of EHRs to improve patient care at the individual practitioner or hospital level. However, the path from meaningful use to enhanced use of health information to achieve these other objectives is less clear, even though they are clearly inextricably linked. Health IT offers the promise of more structured, accessible, secure, and clinically rich information on populations of patients that can collectively provide evidence on a variety of strategies for improving care.

This background paper briefly summarizes how health IT can be used to improve population health and provides examples of efforts being undertaken today to make enhanced uses of health information. It concludes with a discussion of the urgent need – and opportunities – to facilitate the enhanced use of health information on a much wider scale, particularly in light of ARRA and recently enacted health reform legislation.

IMPROVING POPULATION HEALTH THROUGH HEALTH IT

A significant amount of information is generated during the delivery of care. A medical record typically includes basic patient demographics like age and sex, as well as information on diagnoses, procedures and treatments provided, diagnostic test and imaging results, medication use, and provider referrals. Registries developed for tracking patients with certain diagnoses and procedures, and administrative claims data on service utilization, can also be rich resources for information on treatment and cost of care. Linked at the patient level and tracked over time, this information can provide insights into the relationship between interventions and outcomes of care.

Health information has increasingly become electronic, a trend that will be accelerated under ARRA. Among the numerous health IT provisions included in ARRA is the authorization of an estimated $30 billion to encourage eligible physicians and hospitals to adopt EHRs and use them meaningfully. Though these meaningful use requirements have not yet been finalized, the electronic collection and exchange of standardized outcome, utilization, demographic, diagnostic, quality, and cost information

have been proposed by the Centers for Medicare & Medicaid Services (CMS) as key elements.

While this information is critical in the delivery of care for individual patients, it can also be used to answer a number of specific types of population health questions that are essential to achieving a high-value health care system (Table 1).

APPLICATIONS OF ENHANCED USE

A number of initiatives currently underway demonstrate that it is indeed possible to use existing data that is routinely collected as part of care delivery to address important population health questions.

Quality and Performance Measurement

Primary care providers in North Carolina have used practice-level performance data on hemoglobin A1c values to improve care among their Medicaid patients with diabetes and track their diabetes control. They have also used health information to improve asthma care and track their performance on a number of key metrics, lowering hospital admission rates and emergency room admissions among children with asthma by 34 and 8 percent, respectively, and reducing average episode cost by 24 percent.[1]

By reporting only summary quality measures – the numerators, denominators, and exclusions – from their EHRs to a Citywide Quality Reporting System, providers in the New York City Primary Care Information Project (PCIP) will be able to use their locally-installed EHR systems to generate clinical quality measures about the care they deliver to their entire patient population and compare their performance with that of their peers, confidentially and securely.[2]

Evidence Development

Electronic health information has also been used to conduct research, including observational studies of comparative effectiveness. For example, Medco Health Solutions researchers were able to analyze pharmacy and medical claims data to assess the comparative risk of suffering a major cardiac event between patients placed only on clopidogrel (the active ingredient in Plavix) after undergoing a percutaneous coronary invention, relative to patients taking clopidogrel in combination with proton pump inhibitors. The use of claims data made it possible to track nearly 17,000 patients over 12 months to discover that the relative risk of heart attack was 74 percent higher among patients taking both drugs and initiated a series of outreach efforts to alert physicians of these findings.[3]

CMS' use of "coverage with evidence development" (CED) – whereby Medicare coverage of promising therapies and tests is linked to patient participation in clinical trials or registries – has fueled the generation of important longitudinal health information upon which to better understand what treatments work best for which patients.[4] CMS' first registry under the CED policy was for expanded coverage of implantable cardioverter defibrillators (ICDs). With roughly 1,400

Table 1: Examples of enhanced uses of information

Quality Measurement and Reporting	Medical Product Safety Surveillance	Comparative Effectiveness Research
How do my doctors' performance compare to others in the region?	Does this drug increase the risk of heart attack?	Is "virtual" colonoscopy better than invasive colonoscopy?
Where are the best opportunities for our institution to improve performance?	Is this vaccine safe for adults and children?	Does the "medical home" improve outcomes and reduce costs vs. usual care?

hospitals participating nationwide and data on more than 520,000 implants in the United States, treatment and patient outcome information collected through the ICD Registry Program has been used to develop quarterly and annual comparative benchmark reports that help these hospitals compare their performance against national averages and their peers, reduce complications from ICD procedures, and generate the type of data CMS needs to make evidence-based coverage determinations.[5]

Public Health Surveillance

Finally, the post-market safety of new vaccines is being evaluated in near-real-time through distributed networks like the Vaccine Safety Datalink (VSD) project of the Centers for Disease Control and Prevention. Using information from both electronic medical records and administrative databases covering nearly nine million members of eight health plans, selected events are compared during the post-immunization window to historical and personal controls to rapidly yield adverse event information without the use of identifiable patient-level data. The system recently identified increased seizure risk following administration of the measles-mumps-rubella-varicella vaccine, which ultimately led to a recommended change in the use of the vaccine.[6]

In addition to post-market surveillance of vaccines, a number of projects are also conducting surveillance on treatments and outcomes for diseases. The Cancer Care Outcomes Research and Surveillance Consortium (CanCORS) project uses demographic, contact, and medical information collected from five sites to study the "patterns of treatment, decision-making, and outcomes for lung and colorectal cancers." CanCORS also conducts valuable effectiveness research on racial, ethnic, and socioeconomic differences in cancer care.[7]

LESSONS LEARNED

While the questions addressed by these examples differ considerably, the information needed to address them is actually very similar. Actionable answers to these and related questions require accurate measures of individual patients' exposures to health care interventions, the clinical outcomes that followed, and the variables that can potentially distort the relationships between interventions and outcomes. These variables include age and sex, comorbid

conditions, and disease severity. To be most useful, this information must be drawn from well-defined populations in which analysts can be reasonably certain that all relevant variables are captured.

Though health information is widely distributed in the U.S. health care system across physician offices, hospitals, payers (both public and private, federal and state), pharmacies, clinical labs, imaging centers, registries, public health agencies, and other entities, these data can be analyzed within and across sources as long as patient health information is recorded consistently and reported using standardized formats. In other words, because the analysis is at the population level rather than the individual level, only summary data are relevant. For example, using consistent methods, individual providers might report a "denominator" of patients who used a vaccine and a "numerator" of patients who used that vaccine and experienced an adverse event. As such, identifiable data are generally not required to answer these important public health and policy questions, allowing potentially sensitive, identifiable patient-level health information to remain securely behind each data source's own security firewalls. Distributed networks of EHRs, health information exchanges, and all-payer claims databases have all been successfully deployed for this purpose.[8] [9] [10]

Nevertheless, enhanced use of health information largely remains the exception rather than the norm. Health care providers and payers remain hesitant to collect certain types of demographic data – such as information on race/ethnicity, educational attainment, and socio-economic status – in spite of their importance for monitoring health and health care disparities and risk-adjustment. With the adoption of comprehensive EHRs at 1.5 percent among hospitals[11] and 4 percent among physicians,[12] detailed clinical information is currently not widely available in electronic format. In some cases, privacy concerns and insufficient economic incentives have discouraged information exchange. And when health information is exchanged, it often requires extensive cleaning and transformation because it was not initially collected in a way that allowed for standardization.

Indeed, experience to date with using health IT to improve population health has demonstrated the complexity of both health care and the resulting streams of data. While the ultimate goal may be to achieve the level of standardization and availability of data networks described above, they can be difficult

Table 2: Examples of capacity for enhanced use contingent on HIT systems

	Quality Measurement and Reporting	Medical Product Safety Surveillance	Comparative Effectiveness Research
Claims	# of A1c tests ordered	Appropriate testing for patients using high-risk medications	N/A
Claims+ (specific clinical data and limited survey data)	A1c value <7.0%	Medications prescribed when contraindicated by allergy list	Episode-based resource use linked to quality measures for common medical and common surgical conditions
Electronic Health Records & Personal Health Records	A1c value + daily blood glucose deviations	Preventable hospital admissions due to adverse drug event	Quality of life and functional outcomes for common conditions (e.g. AMI, hip replacement, diabetes)

to implement all at once. However, experience has demonstrated that incremental but steady progress towards those goals can add up meaningfully over time for improving patient care. Table 2, for instance, illustrates the additional types of questions that can be answered using claims data supplemented with a key set of lab values and other priority clinical outcome data, compared to using claims data alone.

Incremental steps at the organizational, local, or regional level can also add up to important national resources for evidence development. For example, with an explicit goal of improving population health in disadvantaged communities through health IT, the New York City PCIP has focused its efforts on a deliberately limited set of priority cardiovascular measures that reflect the key health conditions that affect its Medicaid and uninsured populations the most, like heart disease.[13] Within a very short time, PCIP has successfully recruited more than 2,500 primary care providers – serving more than two million patients – to adopt its prevention-oriented EHR system and participate in its pay-for-performance programs.[14]

Targeted efforts like these demonstrate that it is not necessary to embark on high-risk, monolithic, large-

scale technological ventures to make practical progress and realize the public health benefits of health IT. Rather, they point to the importance of clear priorities and objectives and having policies in place that align with those objectives.

Experience to date also suggests that traditional static hierarchies of evidence might require rethinking. Generating results that are valid, timely, actionable, and relevant to decision-makers might require more pragmatism, creativity, and flexibility to better match the health information and analytic methods used with the questions they are intended to answer.[15] [16] For example, observational studies using electronic health information can be ideal for tracking patients over time and observing how their care quality and health outcomes vary as a function of different policies, such as changes in formulary designs and payment models, thus enabling efficient pre/post experimental research designs.[17] [18] And while randomized experiments remain the gold standard for demonstrating efficacy in most cases, observational studies making enhanced use of electronic health information can serve as important complements, particularly where randomization is not feasible or ethical or where the need is for large or representative populations, real-time data, or rapid evidence generation.

Finally, where randomization is important to the effective research question at hand, health IT can be effective in facilitating not only recruitment and enrollment in randomized experiments, but also the very process of randomization. For example, investigators, in the I-SPY 2 TRIAL (**I**nvestigation of **S**erial studies to **P**redict **Y**our **T**herapeutic **R**esponse with **I**maging and molecular **A**na**L**ysis) have used web-based randomization tools in conjunction with IT tools developed through the National Cancer Institute (NCI) Cancer Bioinformatics Grid (caBIG) initiative to assign patients to study arms according to their particular biomarkers and predicted response to treatment. This has enabled researchers to more rapidly deploy and evaluate treatments in precise patient populations.[19]

LOOKING AHEAD

With the enactment of the Patient Protection and Accountable Care Act (PPACA), the demand placed on health care providers, purchasers, and researchers to make enhanced uses of health information has never been higher. For example, PPACA requires the U.S. Department of Health and Human Services (HHS) to establish a Center for Medicare and Medicaid Innovation (CMI) by January 2011 and a shared savings program built around accountable care organizations (ACOs) by January 2012. Without heavy reliance on health information across multiple data sources generated in the delivery of care, including the rapid availability of consistent summary data on performance measures, it is difficult to see how CMI would be able to rapidly test promising payment and delivery models and rigorously evaluate them in time for ACOs to be established. Similarly, PPACA established the Patient-Centered Outcomes Research Institute to facilitate research to compare the effectiveness of health treatments and strategies. Though supported through generous appropriations, the Institute will not be able to rely solely on randomized controlled trials for evidence generation.

Fortunately, the opportunities to facilitate the widespread enhanced use if health information have never been greater. The meaningful use regulation and health IT incentive payments have the potential to encourage both widespread adoption of EHRs and the more standardized collection and exchange of the types of health information required for important population health purposes. The interim final rule on data standards and certification requirements provides the technological foundation to enable this information collection and exchange. The Food and Drug Administration has begun implementation of the Sentinel Program, a large-scale initiative using data aggregated across a distributed network of public and private health plans for post-market surveillance of drugs, biologics, and medical devices. And the HHS Office of the National Coordinator has awarded grants through the Strategic Health IT Advanced Research Program (SHARP) and the Beacon Community Program to learn how health IT might be leveraged to improve not only patient care but population health.

Finally, to provide the necessary level of policy and funding coordination at the federal level, HHS Secretary Kathleen Sebelius and Office of Management and Budget Director Peter Orszag recently created an interagency Health IT Task Force. This task force will be chaired by National Coordinator for Health Information Technology David Blumenthal and comprised of the federal government's chief information officer, chief technology officer, and senior leaders from the six agencies currently making heaviest use of IT. Greater public-private collaboration – like the Quality Alliance Steering Committee's efforts to develop a data aggregation methodology combining both public and private sector performance information to enable the reporting of consistent summary information on quality across multiple health plans – will also be critical to maximize the quality, comprehensiveness, and utility of the health information being analyzed.

Learning from patient care data is essential for improving health and lowering costs. As such, facilitating the enhanced use of health information so that it can occur more routinely and on a broader scale, while addressing concerns about privacy and security, will be fundamental to successfully implementing health reform. A December 2009 Engelberg Center event[20] demonstrated the importance and feasibility of answering a variety of important public health questions using existing health information routinely collected during patient care. The challenge will be to implement health IT in such a way that stimulates not only the meaningful use of health information for patient care, but also enables these important public health applications of that very same data.

ENDNOTES

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