Health Information Exchange Metrics and Evaluation Strategy for California

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Background and Scope

Scope of Work

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 was created to stimulate the adoption of electronic health records (EHRs) and supporting technology, including health information exchange organizations (HIOs). Efforts to advance HIE are motivated by the desire to improve patient outcomes. With HITECH funding available until 2021, the California Department of Healthcare Services (DHCS) is applying to CMS for funding to offset a portion of providers' cost of connecting to HIOs ("onboarding" via the California HIE Onboarding Program or "Cal-HOP") and expects roughly $50 Million in federal and state funds to support improvements in health information exchange.

Blue Shield of California Foundation (BSCF) and the California Health Care Foundation (CHCF) are assisting DHCS with the planning and preparation for the federal funding request to CMS, a request for proposal (RFP) for a management support contractor to support the implementation of Cal-HOP, and the go-to-market strategy for rolling out the funds in the most effective manner. UCSF was contracted by the Blue Shield of California Foundation to focus on development of a measurement approach, including to:

1) Identify a common set of metrics for HIOs to measure and report their activities to increase transparency of data exchange in California.
2) Develop an evaluation strategy to measure progress in data exchange in California in 2021. (The formal study in 2021 will be contracted separately.)

In this report, we present a set of measure domains and concepts to measure HIE status and progress based on synthesized findings from interviews with executives from California HIOs and discussions with DHCS leadership.

Methods

To capture current and planned measurement capabilities among California HIOs, and how these could support the DHCS program to advance HIE in California, we developed a semi-structured interview protocol (described below), which guided hour-long phone interviews. Although California has 11 HIOs, 3 of the organizations use a shared infrastructure (provided by Manifest MedEx) and therefore have the same measurement capabilities. We therefore interviewed a total of 8 organizations. The interviews were transcribed and analyzed to guide the recommended set of measures presented in this report.

Interview Guide

We created a semi-structured interview guide that was reviewed and edited by Manatt to ensure it aligned with Cal-HOP design. The interview guide contained three sections (see Attachment I).

Section One captured background information on each HIO, including: (1) types of organizations providing/making available data and/or receiving/accessing/querying data; (2) types of data exchange and HIE services offered; and (3) connection with other networks.

Section Two captured current measurement capabilities, including: (1) specific measures at various levels (e.g., number of participants, exchange volume, "use" of exchanged information); (2) specific approach to measuring usability and workflow integration; (3) specific approach to measuring outcomes; and (4) reporting capabilities.

Section Three captured measurement capabilities as they relate to Cal-HOP, including: (1) current capabilities with respect to reporting on specific HIE services (e.g., ADT, secure messaging, CURES Reporting); (2) vision for measuring specific program milestones (e.g., signed Cal-HOP participation agreement, onboarding/testing, demonstrated use); (3) key measures that would be meaningful in terms of capturing whether program goals are being fulfilled; and (4) concerns about measure comparability across HIOs in the state.

Data Collection and Analysis

We reached out to interview participants by email, and then scheduled and conducted individual hour-long interviews. We took notes during the interview and recorded the interviews to refer back to for detailed information. We extracted the relevant information by topic and organized our findings to identify measure domains and concepts that could be reported across HIOs as well as general and specific measurement considerations. We assume that HIOs and DHCS (or other state/federal entities) are the only sources of data for measurement and therefore limit the measures to those that can (or could) be reported by these entities. One implication of this is that we are not able to include measures of HIE workflow integration because HIOs do not have the ability to measure relevant behaviors (i.e., measures would need to come from provider organizations).

We then scheduled and conducted a second round of hour-long interviews with each HIO to review the recommendations in our draft report.

Overarching Measurement Considerations

Interviews revealed three overarching considerations relevant to any measurement-focused effort across HIOs.

Consideration 1: Reporting Effort/Burden

Overall, HIOs did not report demand from participants for measurement and reporting. As a result, HIOs have focused measurement on internal operational needs and have mature capabilities in this area. Measures that are more relevant and valuable to DHCS and other entities working to promote statewide HIE exist in some domains (i.e., participation measures, transaction volume measures) but not in others (i.e., "coverage", levels of use, workflow integration, impact on outcomes). While there was recognition of the value of these measures, they require development work by HIOs to produce and there was not a perception that HIOs would directly benefit from such an investment. There was also wariness of "unfunded measurement mandates" that require costly new investment in measurement or in data storage without sufficient funding to cover the costs.

Consideration 2: Consistency across HIOs and Measure Gaming

Even in the domains in which measures exist, there was widespread perception that the specific approach to measurement is not apples-to-apples, and there are incentives to favor approaches that make numbers look "high". As a specific example, in the case of reporting ADT transaction volume, there is variation in the type of ADTs and approach to reporting ADTs (particularly if ambulatory settings are included) that influence transaction counts. Similarly for queries, how a query is counted varies based on whether each component of the query and response is counted separately or whether they are bundled together and counted once. There is a non-trivial amount of effort to specify a measure of ADT transaction volume that is truly apples-to-apples, and then to have all HIOs implement that measure consistently.

Consideration 3: Measures and Granularity of Data for Measurement depend on Exchange Model in Use

All but one HIO offered different models to push/make available data to participants. Two key distinctions, common to HIOs across the country, are: (1) push versus query and (2) viewing via portal or via direct interface (to EHR or other front-end system). The measures that best capture HIE activity vary by push versus query model, and the granularity of data available for measurement depends on whether data is accessed via a portal (or related model such as single sign on) or direct interface. In the case of the former (portal/SSO model), access logs capture detailed data on users, log-ins, and screens viewed/data accessed while in the direct interface model all that can be measured is what data was available (without any ability to know who looked at what). Particularly for measures of use and impact, there is little ability to robustly tie use to

outcomes under the direct interface model unless a provider organization is tracking it and willing to report (which is challenging to implement at scale). Application Programming Interfaces (APIs) that allow read and/or write capabilities into EHRs and other systems are a third emerging approach to how data may be exchanged and associated measures of use may exist at different levels of granuality.

Consideration 4: Barriers to Engagement & Cal-HOP participation

When a Qualified Provider Organization is *not* engaging in exchange or *not* participating in Cal-HOP it will be difficult to know why. HIOs reported that lack of provider engagement or lack of progress can be due to decisions made by the provider organization, cost/technology/other barriers due to the EHR vendor, or decisions made by the HIO itself. While measures can capture overall levels of HIO engagement and Cal-HOP participation, it will be difficult to know the reasons behind those that are not doing so. While we designed some measures to try to suggest these reasons (e.g., by breaking down participation by different provider organization demographics), there may be a need to collect primary data (e.g., via survey) from provider organizations to more directly assess barriers.

Proposed Measures in Four Domains

Proposed measures are grouped into 4 domains. The first domain covers specific measures that capture achievement of, and progression through, the Cal-HOP milestones. The second domain broadens from Cal-HOP tailored measures to a broader set of measures that capture HIE engagement and use at the state level (regardless of whether their connectivity came before or during Cal-HOP). The third domain describes a methodology and set of "outcome" measures that would serve to assess whether advances in HIE are having their intended effect of improving patient outcomes. The fourth domain describes approaches that could be used for measurement in two targeted domains: CCD Conformance and Patinet Matching.

Domain 1: Cal-HOP Specific Measures

Rationale

The proposed California Medi-Cal Cal-HOP was designed to expand Qualified Medi-Cal Providers' connectivity to HIE services via Qualified HIOs. The Program will include an evaluation and such an evaluation will be supported by measures directly tied to Program structure. The Program is funded by a federal matching program for $50 million over two years and ends on September 30, 2021. As currently planned, payments to Qualified HIOs will be based on Qualified

HIOs and Qualified Provider Organizations meeting milestones that comprise the core of the Program. The program pays for onboarding/connection to 1 HIO prospectively from the time of anticipated program launch in May 2019. HIOs and providers will need to meet certain criteria to qualify for the Program. A Cal-HOP Management Support Contractor (MSC) will be hired to support program implementation, monitor progress against performance milestones and submit reports to DHCS, and collect materials from Qualified HIOs. In order to report milestone achievement, Qualified HIOs and Qualified Provider Organizations will collaborate to meet milestones and submit documentation and request for funding to MSC. The MSC will review the invoices and forward recommendations to DHCS for review and approval.

The Program pathway includes incremental progression through four steps:
1) Qualified Provider Organization chooses a Qualified HIO (Provider organizations must designate a single Qualified HIO for achieving Cal-HOP milestones; however providers may participate in multiple HIOs. A single organization cannot be both a Qualified HIO and a Qualified Provider Organization.)
2) **Milestone 1:** Signed Cal-HOP Participation Agreement between Qualified HIO and Qualified Provider Organization
3) **Milestone 2:** Implement Basic Interfaces:
    a. **Milestone 2a.** ADT Submission and Event Notification
    b. **Milestone 2b.** CURES Integration (Does not have to occur via Qualified HIO)
4) **Milestone 3:** Implement Advanced Interfaces (Qualified HIO and Qualified Provider Organizations must select and implement a required number of interfaces out of specified categories).

While the program parameters and participation criteria were still in draft at the time of this report publication, the draft details on Milestones are provided below:

Cal-HOP Participation Agreements (Milestone 1)

The first program milestone is for the Qualified Provider Organization to sign a Cal-HOP specific participation agreement with the Qualified HIO (QHIO). The unit of measure to consider are the agreements being signed at the organization level. Payments will be based on number of interfaced EHR instances and not the number of facilities that participate and connect. During the interviews, respondents reported measuring agreements at the organization level since there is 1 signature/agreement for multiple facilities.

Implementation of Basic Interfaces (Milestone 2)

The second program milestone involves implementation of two basic interfaces: 1) ADT Submission and Event Notifications and 2) CURES integration. While milestone 2 is required,

organizations will be exempt from Milestone 2 if they have already met the requirements prior to the Cal-HOP program or outside of the QHIO.

For ADT, the criteria differ by type of provider organization. For hospitals:

1. Documented live (at least daily) feed of ADT or equivalent messages delivered to the QHIO within 24 hours of an ED visit, hospital admission, and hospital discharge for eligible Medi-Cal patients.
2. If the hospital includes outpatient clinics, documented (at least daily) feed of ADT (or equivalent) messages delivered to the QHIO within 24 hours of an outpatient encounter for eligible Medi-Cal patients.
3. Demonstrated access to and/or use of ADT-based encounter notifications provided by the QHIO via a query/response (pull) mechanism.

For Provider Practice, Clinic, IPA/Medical Group

1. Documented (at least daily) feed of ADT or equivalent messages delivered to the QHIO within 24 hours of an outpatient encounter for eligible Medi-Cal patients.
2. Demonstrated access to and/or use of ADT-based encounter notifications provided by the QHIO via a query/response (pull) or publish/subscribe (push) mechanism.

The second basic interface needed is for CURES integration which can be achieved through the QHIO with querying and retrieval function into the clinical workflow of the Qualified Provider Organization's EHR or through the provider organizations own integrated access to the CURES database from within their EHRs via a mechanism other than the QHIO. Program payments will be adjusted depending on which CURES integration approach is taken. Qualified Provider Organizations will be exempt from CURES integration if they connect outside of the QHIO (e.g., via their EHR vendor).

Implementation of Advanced Interfaces (Milestone 3)

Milestone 3 is optional and if pursued requires implementation of required number of advanced interfaces that fall into 5 categories of interfaces:

1. Data feeds between Qualified Provider Organization and QHIO
2. Data submission/retrieval services with Public Health registries via the QHIO
3. Integration of clinical data from the QHIO into the provider's EHR via web-services API
4. Activation of a new edge server and/or addition of specific data types to an existing edge server used by Qualified HIO
5. Other approved interfaces

Given the Program structure, measures are needed that reflect Program uptake and progress through milestones. It will be additionally important to be able to measure how uptake and progress vary by different provider and contextual characteristics. Such measures will provide insight into where Program design is and is not fostering intended progress.

Proposed Measures

Measure Name	Moderate-Value, Feasible	High-Value, Development Required*
Milestone 1 Uptake	Number of Qualified Provider Organizations with newly signed Cal-HOP participation agreements: - Total - By QHIO - By Organization Type - By Organization Size - By Geography Type (county) - By EHR vendor - By EHR model (cloud vs. locally hosted) - By high vs low Medicaid serving organization (as determined by DHCS; HIOs would value knowing this)	Percent of eligible Qualified Provider Organizations with newly signed participation agreements: - Total - By QHIO - By Organization Type - By Organization Size - By Geography Type - By EHR vendor - By EHR model (cloud vs. locally hosted) - By high vs low Medicaid serving organization *Developing this measure will require a de-duplicated list of Qualified Provider Organizations and their pre-Program participation status (using data from DHCS and HIOs).*

Milestone 2 Uptake	Number of Qualified Provider Organizations with newly-enabled ADT (inbound) and event notification (outbound) interfaces in production according to Cal-HOP specifications:
	- Same categories as above
	- By interface:
	  o Inbound (for ADTs)
	  o Outbound (for alerts)
		Percent of eligible Qualified Provider Organizations with newly-enabled ADT (inbound) and event notification (outbound) interfaces in production:
		- Same categories as above
		- By interface:
		  o Inbound (for ADTs)
		  o Outbound (for alerts)

	Number of Qualified Provider Organizations with newly-enabled CURES interface or connect directly to CURES via their EHRs:	Percent of eligible Qualified Provider Organizations with newly-enabled CURES interface or connect directly to CURES via their EHRs:

	- Same categories as above	- Same categories as above
Progress Milestone 1→2	<u>Number and percent of Qualified Provider Organizations</u> that met Milestone 1 that were eligible for and progressed to Milestones 2a and/or 2b in required timeframe. Could also track those that received timeline exceptions and associated reasons. <u>Average time (in days)</u> to progress from Milestone 1 to Milestones 2a and/or 2b.	
Milestone 3 Uptake	<u>Number of Qualified Provider Organizations</u> with newly-enabled Milestone 3 qualifying interfaces in production according to Cal-HOP specifications: - Same categories as above - By interface category and/or type	<u>Percent of eligible Qualified Provider Organizations</u> with newly-enabled Milestone 3 qualifying interfaces in production: - Same categories as above - By interface category and/or type *Will additionally require information from HIOs on what interfaces organizations had enabled pre-Program. Would be beneficial to know which interfaces each HIO offers as a choice to providers.*
Progress Milestone 2→3	<u>Number and percent of Qualified Provider Organizations</u> that met Milestones 2a and/or 2b that were eligible for and progressed to Milestone 3 in required timeframe. <u>Average time (in days)</u> to progress from Milestones 2a and/or 2b to Milestone 3. *Note: These measures will be limited to what can be measured before the end of the Program in 2021.*	<u>Number and percent of Qualified Provider Organizations</u> that continued to meet Milestones 2 and 3 12 months after program completion (i.e., in 2022). *Note: These measures will require QHIO reporting in 2022, which most reported they would be willing to do.*

* Depending on measure, development required by HIOs and/or entity that would be producing the measures

Measurement Considerations

There is a need to compare consistency in how HIOs track provider organizations overall to assess feasibility of creating a single, state-wide denominator. All HIOs tracked both organization/legal entity signing participation agreement as well as sites that were covered by each participation agreement (which can be a mix of inpatient and ambulatory). For many of the large delivery systems that exist in different geographies, it will not make sense to have a single organization listing – instead it may make sense to split along regional boundaries (e.g., HSAs or HRRs) and by facility type since the same entity can have multiple facility types. There is the added consideration that Cal-HOP participation agreements will be signed at the provider organization-EHR instance level, such that an organization with multiple EHR instances (each requiring its own set of interfaces) would have multiple participation agreements. While HIOs reported that this happens infrequently, if the numerators of the measures in table above are counted at the organization-EHR instance level and the denominators are counted at the organization level, resulting measures will be overestimates. Thus, it likely makes sense to measure both numerators and denominators at either the organization level or the organization-EHR instance level. HIOs indicated that they would be able to report when a provider organization has more than one EHR instance but such information is not likely available for all provider organizations in the state to create an accurate denominator. We therefore recommend creating a denominator at the provider organization level. However, this approach will create some measurement complexity when a provider organization has met a Cal-HOP milestone for one instance but not another. In this case, the provider organization could be given full credit, partial credit, or no credit depending on whether it was decided that the resulting measure should be more liberal or conservative in assessing Cal-HOP impact.

In addition, there's a need to compare consistency in how HIOs track specific categories (e.g., organization size, geography type) to ensure sub-measures are feasible. Our initial assessment reveals that HIOs measure size differently; for example, hospital size is measured by total beds, licensed beds, staffed beds, and volume of data produced, with no measure tracked by all HIOs. For EHR type, not all HIOs track whether the EHR is cloud-based or locally hosted.

We assessed the possibility of creating measures at the individual user level. Including number of users per organization (could use MU EP definition or other) would allow a companion set of measures with users as the unit of analysis. However, many HIOs perceived that their value came from delivering data to both clinical and administrative users, and there is not a robust way of measuring the number (or percent) of administrative users participating in HIOs. Even if users were limited to clinicians, not all HIOs track clinical users (and of those that do, not all track individual NPIs) and so this is not currently feasible at a state level.

Due to the following Program timing considerations, all implementation dates will need to be recorded:

1. Milestone 2 must be completed within 1 year of Milestone 1 being achieved

2. Milestone 2 and 3 (if undertaken) must be completed before September 30, 2021
3. Live connections for Milestone 2 and 3 (if undertaken) must be maintained for 1 year

Finally, the Cal-HOP design considers a milestone achieved if it had not been achieved prior to the start of the program by that provider organization according to Cal-HOP specifications with their selected QHIO. This means that a provider organization could have, prior to the start of Cal-HOP, achieved the milestones with a different QHIO, have achieved part of the milestone but not up to Cal-HOP specifications (e.g., the provider organization could have an ADT feed in place but not at the level of frequency required by Cal-HOP), or have plans to achieve the milestone but put them on hold until the program begins. The measures in the table above do not take into account any of these scenarios and therefore give Cal-HOP full credit for milestone achievement even when the provider organization may have had plans or undertaken related progress prior to the start of the program. However, creating measures that consider all possible pre-Cal-HOP starting points and then attributing only net progress would be extremely complex and labor-intensive, which is why we do not recommend such an approach. If there are common categories that may make sense to capture (e.g., was there a pre-existing ADT feed that was not up to Cal-HOP specifications?), HIOs could be asked to report these as part of baseline data collection and they could be used to create alternate versions of measures described above.

Domain 2: Statewide Implementation and Use Measures

Rationale

Cal-HOP is focused on on-boarding and developing interface capabilities, which are important foundational steps towards state-level connectivity. While measures in the prior section focus on Cal-HOP progress, given that many provider organizations had connectivity prior to the Program, it is important to create measures that capture HIE status at the state level and therefore "count" all organizations with connectivity regardless of whether their connectivity came before or during Cal-HOP. There are two specific categories of measure that are useful to assess state-level status: implementation and use.

Implementation. Once Qualified Provider Organizations have interfaces in place, it will be important to assess the extent to which connectivity mirrors patient travel patterns for care, recognizing that the value of two provider organizations connecting to each other varies by the number of shared patients. There are several approaches to measuring the alignment between connectivity and patient travel patterns and measure options are presented in the following section. Since such measures would require some development effort, we also suggest options that are feasible in the near-term.

Use. Even if connectivity measures indicate that data are flowing between provider organizations that routinely share patients, there is the risk that data are available but not used. Measuring use

is complicated for many reasons (see Consideration 3 above) and so it may make sense to delay pursuit of use measures. In addition, use may not always translate to improved decisions or patient outcomes. As with implementation measures, we suggest both near-term and long-term options based on amount of development work required.

Proposed Measures

Measure Name	Moderate-Value, Feasible	High-Value, Development Required*
Implementation: Overall Coverage	Number of provider organizations participating in a Qualified HIO (i.e., live) - Total - By QHIO - By Organization Type - By Organization Size - By Geography Type - By EHR vendor - By EHR model (cloud vs. locally hosted) - By high vs low Medicaid serving organization	Size-weighted number of provider organizations participating in a Qualified HIO (i.e., measure adjusted for organization size) *Note: HIOs measure organization size differently and so any effort to adjust by size would either require DHCS to generate org size in a standard way (e.g., number of encounters) or ask HIOs to report size in a standard way by organization type* "Potentially Fulfilled Opportunities" Proportion of shared patients seen by organizations participating in the *same* Qualified HIO or HIOs with established inter-HIO connectivity *Shared patient volume denominators could rely on existing measures reported by Medicare, DHCS/Medi-Cal generated measures, or*

		potentially measures from Manifest MedEx (using claims data). Only one HIO currently measures shared patients (defined as 2 encounters over 2 years)
Implementation: Coverage by Maturity	Same as above but with participation definition limited to organizations with bidirectional: - Basic Interfaces (could align with Milestone 2a or 2b) - Advanced Interfaces (could align with Milestone 3)	Same as above but with participation definition limited to organizations with bidirectional: - Basic Interfaces (could align with Milestone 2a or 2b) - Advanced Interfaces (could align with Milestone 3)
Implementation: Transaction Volume	Total volume of monthly transactions by type: - Inbound (Provider→HIO) ADT – split by ADT type - Inbound & Outbound C-CDAs – split by type - Queries for C-CDAs or other documents (Received and Fulfilled) - Secure Messages (Direct & other) - Outbound Notifications/Alerts (excluding outbound ADTs) - Results Delivered *Note: These measures try to capture the most frequent combinations of delivery method and document/information type. More specificity from HIOs will*	*This measure would be improved by ensuring that transactions are "counted" in the same way across HIOs (see Consideration 2 above). However, this would take substantial effort and still produce measures that are considered low-value overall. We therefore do not recommend pursuing development of volume-based transaction measures that involve HIOs having to track volume in a different way specifically for measurement purposes.*

	be required to determine what each of their transaction volume measures "count" and whether above represents the most logical general categories.	
Use	Among users with portal access, proportion with any portal activity (beyond log-in) in the past 30 days	"Fulfilled Opportunities" Proportion of shared patients seen by organizations that either had data delivered (interface model), data queried for, or data viewed (portal model) from the first to the second organization. *Note: Most HIOs felt that this measure would be more valuable if it was narrowed to focus on explicit types of "closed loop" shared patients (e.g., test result ordering and delivery, referral) where there is a clear need for the subsequent entity to receive/view/query for the information.*

* Depending on measure, development required by HIOs and/or entity that would be producing the measures

Measurement Considerations

When requesting feedback on these measures, we discovered that HIOs conceive of (and measure) two key concepts - provider organization size and provider organization HIE maturity - differently. Related to organization size, some HIOs felt that encounter or transaction volumes were the best measures of size, while others felt that core "infrastructure" (i.e., number of beds, number of providers) were the best measures. Thus, to use a standard approach to measuring size, DHCS would likely need to create and apply size measures rather than rely on HIOs to do so. Related to HIE maturity, HIOs reported different conceptualizations of what constituted maturity of a participating provider organization – breadth of services, breadth of data, quality of data (particularly in the CCD context), frequency of data reported, and underlying HIE workflows (e.g., response to alerts). This makes it challenging to develop a single measure of provider organization

HIE maturity. In the near-term, relying on the Cal-HOP definition (i.e., milestone-based) is likely the most feasible approach to create a state-level measure of provider organization HIE maturity. Alternatively, there could be a consensus exercise to define levels of maturity based on inbound vs. outbound data by type (ADTs-basic, CCDAs-intermediate, unstructured data such as notes and rad/path reports-advanced) and exchange method(s) as well as based on organizational support/engagement (would require qualitative assessment but HIOs have developed approaches to measure these dimensions).

While many HIOs were supportive of the concept of incorporating a measure of patient sharing into state-level measures, few had pursued this measurement approach on their own (and those that had encountered concerns from participants about the competitive/strategic implications of the measures). There were also differing opinions on what should count as a shared patient (i.e., only when the sharing was done explicitly via a referral vs. any time a patient received treatment from multiple organizations).

Near-term use measures are limited by Consideration 3 described above, which means that the specific value may not be meaningful. While trends could be useful (i.e., we would expect the measures to go up), if organizations are converting from portal model to direct interface model, we would stop observing their viewing behaviors and, at least the second measure, could drop. In addition, since Cal-HOP is focused on the integration of data directly into the providers' EHR systems, there are only a few exceptions in which a portal is allowable to meet a criterion (e.g., for Milestone 2a, Qualified Provider Organizations may use a portal to access alerts from the HIO instead of accessing alerts through their EHR). For these reasons, we are therefore ambivalent about whether to pursue the near-term use measures.

Similarly, with transaction measures, there was substantial skepticism about their value. As described in Consideration 2, there is a perception that they are often gamed, the units of measure are often not comparable across HIOs (and would be complex and resource-intensive to make them so), and the resulting value is hard to interpret because there is no denominator. We therefore suggest pursuing transaction-based measures using available data with appropriate notes/caveats based on known differences in how transactions are "counted" but we do not suggest substantial effort to ensure that measures are apples-to-apples across HIOs (i.e., use available measures instead of requiring HIOs to reengineering how they count transactions).

We strongly encourage the pursuit of measures that include a meaningful denominator or otherwise take into account patient volume (and ideally shared patient volume). Such measures make clear not only the level of connectivity, but whether connectivity exists where it is most valuable: between organizations that routinely share patients. There is some effort required to pursue such measures but there are several options for how to measure shared patient volume using either publicly available data or data available to DHCS. Such measures are state-of-the-art and there

are examples from other HIOs and measurement efforts that can be used as models. (e.g., Everson et al. JAMIA 2018).

Domain 3: Impact Assessment

Rationale

Ultimately, efforts to advance HIE are motivated by the desire to improve patient outcomes and it is important to assess whether advances in HIE capability are having their intended effect. However, many factors contribute to patient outcomes and so it is difficult to simply rely on associations between aggregate measures of HIE and aggregate measures of outcomes – for example, the number of ADT-enabled organizations in the state and volume of hospital readmissions. In the example, a lack of association does not mean that ADT capabilities are not working, and an association between the two measures does not mean that they are working.

Instead, an emerging approach relies on mapping out a causal pathway between capabilities, implementation/use, and outcomes, and then capturing measures at each point that should travel together. Such an approach would require combining data reported by HIOs (to measure HIE infrastructure and HIE processes) and data held by providers and/or DHCS (to measure clinical process and outcome measures). This could be done at the level of an individual patient (i.e., was their data exchanged, viewed, outcome achieved/not) or at a more aggregated unit of analysis (e.g., at the organizational level with associated patients, county level).

Extending the ADT example, such a measure set would look as follows:

1. Structure	2. Key Processes	3a. Intermediate Outcomes (provider workflow)	3b. Intermediate Outcomes (patient care)	4. Public Benefit Outcomes
Exchange infrastructure and ADT event notification Provider incentives to prevent unnecessary utilization	Capture of triggering event (e.g., ADT delivered)	Receipt and use of alerts Triggering communication to patients	More timely and appropriate follow-up care	Reduced unnecessary utilization Lower health care costs for patients and payers

If this approach is of interest to DHCS, there are many use cases that could be fit into this model and it may make sense to think through which of the outcomes (see Table below) that are already captured and reported by DHCS are most likely to be impacted by new HIE investments. The measures involving "follow-up" seem particularly well-suited to this approach. It would then be possible to work backwards and develop the measures in each of the upstream categories above (1-3), and decide on a methodology to collect and analyze them. In support of this approach, HIOs reported the ability to generate implementation and use measures restricted to specific patient populations.

Outcomes measures in the table below could be grouped as follows such that the upstream causal pathway (and associated measures) would be similar:

- **Prescription (Rx)** – these are measures for which interfaces that notify when prescriptions were picked up or not and that had the opportunities for reminders to maintain medication and to do medication reconciliation would be helpful.
- **System** – these are measures for which different parts of the system need to interact and thus ADTs would help. Parts of the system may be hospital to outpatient; physical to behavioral health; primary care to specialty coordination.
- **Lab** –these are measures for which labs have to be ordered, performed, and results returned to the provider so that the appropriate screening and diagnosis codes can be captured in the medical record and in claims/encounter data.
- **Public Health** – these are measures for which DHCS may be able to report based on the PH Registry (Immunizations) if the registry is complete enough. DHCS is working with PH to assess that now. Important to note that many HIOs have not built infrastructure to support this reporting since it was part of Meaningful Use/EHR Certification criteria (and is therefore supported directly by EHRs). It may therefore not be a good set of measures to tie to HIO infrastructure and processes.
- **Reminders/Ongoing Visits** – these are measures for which reminders or ongoing visits are necessary.
- **Not Impacted by HIE** – a measure that is provider specific, has a small population, would not necessarily be impacted by HIE.

2017 CA Core Measures

NQF#	Measure Steward	Measure Name	Measure Abbreviation	Reporting Program	Category
Behavioral Health Care					
NA	NCQA	Adherence to Antipsychotics for Individuals with Schizophrenia	SAA-AD	Adult Core Set	Rx
0105	NCQA	Antidepressant Medication	AMM-AD	Adult Core Set	Rx

		Management			
1932	NCQA	Diabetes Screening for People with Schizophrenia or Bipolar Disorder Who Are Using Antipsychotic Medications	SSD-AD	Adult Core Set	System
0576	NCQA	Follow-Up After Hospitalization for Mental Illness: Age 21 and Older	FUH-AD	Adult Core Set	System
0004	NCQA	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment	IET-AD	Adult Core Set	System
0576	NCQA	Follow-Up After Hospitalization for Mental Illness	FUH-CH	Child Core Set	System
0108	NCQA	Follow-Up Care for Children Newly Prescribed Attention-Deficit/Hyperactivity Disorder (ADHD) Medication	ADD-CH	Child Core Set	Rx
NA	NCQA	Use of Multiple Concurrent Antipsychotics in Children and Adolescents	APC-CH	Child Core Set	Rx
Care of Acute and Chronic Conditions					
2371	NCQA	Annual Monitoring for Patients on Persistent Medications	MPM-AD	Adult Core Set	Rx
0059	NCQA	Comprehensive Diabetes Care: Hemoglobin A1c Poor Control (>9.0%)	HPC-AD	Adult Core Set	Lab
0057	NCQA	Comprehensive Diabetes Care: Hemoglobin A1c Testing	HA1C-AD	Adult Core Set	Lab
0018	NCQA	Controlling High Blood Pressure	CBP-AD	Adult Core Set	Reminders/ Ongoing Visits
0272	AHRQ	PQI 01: Diabetes Short-Term Complications Admission Rate: Age 18 and Older	PQI01-AD	Adult Core Set	System
0283	AHRQ	PQI 15: Asthma in Younger Adults Admission Rate: Ages 18-39	PQI15-AD	Adult Core Set	System
NA	NCQA	Ambulatory Care: Emergency Department (ED) Visits	AMB-CH	Child Core Set	System

1800	NCQA	Medication Management for People with Asthma	MMA-CH	Child Core Set	Rx
Maternal and Perinatal Health					
1517	NCQA	Prenatal and Postpartum Care: Postpartum Care	PPC-AD	Adult Core Set	System
1517	NCQA	Prenatal and Postpartum Care: Timeliness of Prenatal Care	PPC-CH	Child Core Set	System
Primary Care Access and Preventive Care					
2372	NCQA	Breast Cancer Screening	BCS-AD	Adult Core Set	Reminders/ Ongoing Visits
0032	NCQA	Cervical Cancer Screening	CCS-AD	Adult Core Set	Lab
0033	NCQA	Chlamydia Screening in Women Ages 21-24	CHL-AD	Adult Core Set	Lab
0038	NCQA	Childhood Immunization Status	CIS-CH	Child Core Set	Public Health
NA	NCQA	Children and Adolescents' Access to Primary Care Practitioners	CAP-CH	Child Core Set	Not Impacted by HIE
0033	NCQA	Chlamydia Screening in Women Ages 16-20	CHL-CH	Child Core Set	Lab
1407	NCQA	Immunizations for Adolescents	IMA-CH	Child Core Set	Public Health
1516	NCQA	Well-Child Visits in the Third, Fourth, Fifth, and Sixth Years of Life: Ages 3-6	W34-CH	Child Core Set	System
Dental and Oral Health Services					
2508	DQA (ADA)	Dental Sealants for 6-9 Year-Old Children at Elevated Caries Risk	SEAL-CH	Child Core Set	Not Impacted by HIE
NA	CMS	Percentage of Eligibles Who Received Preventive Dental Services: Ages 1-20	PDENT-CH	Child Core Set	Not Impacted by HIE

This approach would be supported if the state received the measures that require information that is in medical charts as eCQMs from HIOs (via provider EHRs). While the state is not ready to receive now, efforts to pursue this approach could begin by capturing some of the feasibility/readiness issues.

Domain 4: Targeted Measures on CCDs and Patient Matching

CCD Conformance

Rationale

One structure for clinical data exchange is the continuity of care document (CCD). CCD is an electronic document exchange standard for sharing patient summary information. Summaries include the most commonly needed pertinent information about current and past health status in a form that can be shared electronically. While primarily designed to promote communication or interoperability between providers during care transitions, coded data in the CCD can be re-used to aggregate data from different EHRs. The major benefit of CCDs is that it allows the exchange of medical information between providers without loss of meaning and enabling improvement of patient care.

All HIOs currently or plan to exchange CCDs (though there were varied opinions about the long-term reliance on CCDs as new exchange approaches emerge). Prior work has shown that CCDs often fail to conform to specification standards. Identification of conformance failures would identify where additional development work is needed to enable successful exchange. Currently, most California HIOs are not assessing CCD conformance in a systematic way but expressed the desire to be able to do so. There are automated methods available that could be pursued, with associated measures reported at the provider organization, HIO, and/or state levels. Automated analysis includes the use of the Transport Testing Tool (TTT) from the National Institute of Standard and Technology (NIST) (http://transport-testing.nist.gov/ttt/) and the SMART C-CDA Scorecard (http://ccda-scorecard.smartplatforms.org).

TTT returns schema and schematron errors and warnings describing the conformance of a C-CDA document to the XML templates and conformance statements published by HL7. The SMART C-CDA Scorecard performs a set of semantic checks that official validation tools omit. These checks include the validation of RxNorm, Systematized Nomenclature of Medicine (SNOMED), Logical Observation Identifiers Name and Codes (LOINC), and the Unified Code for Units of Measure (UCUM) use within a C-CDA document. The Scorecard computes a series of rubrics, each corresponding to a best practice for C-CDA implementation. The Scorecard assigns a score from zero to five for each rubric, allowing partial credit for documents with incomplete adherence to each rubric. These scores are combined into section-wide scores by dividing the number of points earned by the total points possible. A composite score reported as a percentage (0–100%) is produced by summing the number of points earned across sections and dividing by the total points possible.

It is important to note that conformance is only one dimension of CCD usefulness and HIOs felt that there are often more issues with the content of CCDs as opposed to their structure (i.e., what would be assessed by conformance testing). Thus, it may be valuable to expand CCD assessment beyond conformance and try to develop best practices for CCD content (particularly detail/volume of information included). Since content is often dictated by EHR vendor, it would be important to include provider organizations that have a broad range of vendors.

Based on current DHCS priorities, we are not recommending pursuing measures in the CCD conformance or content domains across HIOs at this point. (Note that C-CDA volume will be captured in domain 2 measures described above.) If there is interest in this approach (particularly given the potential benefits to clinical data exchange efforts under the Clinical Assurance and Administrative Support Division within DHCS), a pilot implementation of the tools (TTT and SMART C-CDA Scorecard) could be pursued with a small number of HIOs as a starting point.

Patient Matching

Rationale

As described in "Promise and Pitfalls: A Look at California's Regional Health Information Organizations", "correctly matching data received from different organizations to the appropriate patient remains a major challenge for not just HIOs, but many payers and providers as well. Although the master patient index (MPI) technologies used by HIOs have improved, certain HIOs have reported that wholly reliable patient matching still requires a considerable degree of manual curation, i.e., manual review of potential duplicate records or uncertain match results. In the absence of sufficient manual effort devoted to this task, multiple identities may exist for individual patients within an MPI, which results in fragmentation of these patients' data and incorrect or incomplete results in response to data queries. Such errors undermine clinicians' confidence in the HIO's data and can reduce their use of the HIO. A similar patient-matching problem exists when clinicians access the state's immunization registry and prescription drug-monitoring program (i.e., CURES) database. This problem undermines the value being provided by HIOs that directly interface to these state databases as a convenience for their users."

It therefore may be helpful to consider measures that assess, both within and across HIOs as well as between HIOs and state-level repositories such as PDMP, immunization registry, and CURES, the quality of data used to identify patients. Such measurement could go even further and assess the quality of the "source data" provided by provider organizations to identify upstream issues that, if addressed, could minimize HIO and state efforts and improve patching matching performance.

Based on interviews with HIOs, there is not substantial activity in assessing the quality of data used for patient matching. Currently, most HIOs are assessing quality of patient matching in an

ad-hoc way. Two HIOs stated that they use Verato to determine how well they are doing at patient matching. (Verato is a cloud-based service that uses Referential Matching. Referential Matching combines big data and cloud technologies with sophisticated new algorithms and a reference database of demographic data that it leverages as an "answer key" during matching.) In both cases, the HIOs do not use Verato to measure the quality of the "source" data (i.e., what they receive from provider organizations) but are able to get files of false negatives and false positives which can inform where the data is likely wrong or if there is enough information to make a match.

Given that patient matching is a high priority for DHCS, but is not funded under Cal-HOP, we are not recommending pursuing measures in the patient matching domain at this point. As with CCD conformance, we suggest that this is pursued as a separate effort with separate funding since it is an issue that impacts both state-level and HIO-level efforts to advance HIE.

Attachment I - Interview Guide

Introductory Text

Thank you for your willingness to participate in this interview. Our goal today is to understand your capabilities related to measurement, and how these could support the DHCS program (in development) to advance HIE in California. We are conducting interviews with California Health Information Organizations (HIOs) and will use the information you share today to develop a measurement framework to capture HIE progress.

This work is supported by a grant awarded to UCSF by the Blue Shield of California Foundation with support from the California Health Care Foundation (CHCF).

At this point, I'd like to make you aware that participation is completely voluntary. In addition, any information you provide will only be used to support the study goals described above. If you have any questions, you may ask us now or at any time during the interview.

For purposes of capturing the correct information, we would like to record this interview. This allows us to ensure that we've fully and accurately captured all your feedback in our notes. These will be destroyed at the end of the project. Is that acceptable?

Section 1: Background
1. What region does your organization serve?
2. What types of organizations participate in your effort, in terms of:
    a. Providing/making available data
    b. Receiving/accessing/querying data
3. What types of data exchange and HIE services do you offer?
4. Who is your vendor(s)?
5. Do you connect with any other networks – within CA or nationally?

Section 2: Current Measurement Capabilities
3. How do you capture the number of participants in your effort? Do you capture these at the level of technical model? Service subscription? Sender vs. Receiver? Other?
    a. Individual users – type categories?
    b. Organizations – type categories?
    c. EHR (or other system) endpoints – type categories?
    d. Patients – type categories?
    e. Other?
4. How do you capture exchange volume? Does it vary by technical model?
    a. Number of queries?

        b. Number of messages delivered?
        c. Other?
5. How do you capture "use" of exchanged information?
        a. Number of active users?
        b. Number of documents viewed?
        c. Other?
6. Do you have an approach to measuring usability, workflow integration, etc?
7. Do you have an approach to measuring outcomes?
        a. Clinical?
        b. Operational?
        c. Financial?
        d. Other?
8. Do you measure anything related to:
        a. Patient matching
            i. Quality of data used for patient matching
        b. Quality of CCDs
            i. What dimensions?
9. To what extent are the measures you described part of standard reporting by your vendor versus something you customized or data you collect separately?
        a. More broadly, how would you characterize the measurement and reporting capabilities of your vendor?
10. What measures do you typically review as part of internal operational or strategic decisions?
11. What measures do you report to participants?
12. Are you engaged in any other type of measure reporting?
13. How, if at all, do you expect your measurement capabilities to change in the next 1-2 years?

Section 3: DHCS Measurement

1. What are your current capabilities with respect to reporting on:
        a. ADT-event notification for hospital, ED, urgent-care, primary care, specialist, treatment, and other clinical encounters
            i. Participation
            ii. Volume
            iii. Use
            iv. Outcomes
        b. Secure messaging (both as a service for provider-provider communication and/or as a HIO-provider data transmission method)
            i. Participation
            ii. Volume
            iii. Use
            iv. Outcomes
        c. CURES data-querying and retrieval function integrated into the provider's EHR via either IEWS or Single Sign On
            i. Participation
            ii. Volume
            iii. Use
            iv. Outcomes

2. How do you envision measuring each of the following program milestones? Would any require measurement capabilities that you don't possess today?
   a. Signed LOI (different from a participation agreement)
      i. At what "unit" would you measure this?
      ii. Would measurement differ by use case?
   b. Onboarding/testing
      i. At what "unit" would you measure this?
      ii. Would measurement differ by use case?
   c. Demonstrated use
      i. At what "unit" would you measure this?
      ii. Would measurement differ by use case?
3. What measures do you think are most meaningful in terms of capturing whether program goals are being fulfilled?
4. What, if any, measures would you advise against including – either because they are misleading, difficult to measure, or of limited value?
5. Do you have any concerns about measure comparability across HIOs in the state?
6. Are there measures, beyond those relevant to the DHCS program, that you think would be valuable to track and report at the state level?

Wrap – up

Thank you for your time. Is there anything else you think we should discuss related to the topics covered in the interview today?

If you have any questions or think of anything else you'd like to add, please contact [lead interviewer].

Thank you again for your time today!