



Evaluation Results from the SoCalHIE Pilot:
An Implementation of DIRECT Messaging
and Provider Directory Services
for Health Information Exchange
in North San Diego County

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1 Executive Summary

The first phase of the SoCalHIE pilot was conducted to demonstrate the technical and operational feasibility of the DIRECT messaging standards and HPDPlus provider directory standards in a real-world setting. The pilot took place in a diverse medical community in southern California, and the participants included three hospitals and six outpatient provider groups ranging in size from one to over 50 physicians. The initial use case for the pilot entailed the transmission of clinical summaries for emergency department (ED) visits from the treating hospitals to the patients' primary care physicians.

For this pilot, we deployed an infrastructure that consisted of two independent health information service providers (HISPs) that could exchange DIRECT messages. We also deployed an HPDPlus provider directory that could be accessed by users of either HISP via a web-services interface. The development, deployment and configuration of the software required six months. The features of the DIRECT messaging model provided flexibility in the configuration of DIRECT addresses and message-processing workflows to reflect different preferences of the various participating organizations. We operated the infrastructure over a 10-week pilot period, at the conclusion of which we collected data from the community stakeholders as well as from software logs regarding the effectiveness of DIRECT messaging as a means for health information exchange.

The implementation and operation of the technical infrastructure demonstrated that the DIRECT standards for secure message exchange are relatively straightforward to deploy and provide ready interoperability between compliant systems with no need for custom integration work. The most significant gap we observed in the DIRECT standards was the minimal specifications for reporting successful message transmissions or errors from one HISP to another. The HPDPlus Provider Directory standards provided a solid foundation for the deployment of a shared provider directory, but certain ambiguities and omissions in the HPDPlus specifications resulted in inconsistent implementations among the deployed systems and necessitated custom development to achieve interoperability.

During the 10-week pilot period, the ED users sent over 200 messages to community physicians, averaging over three messages per day, and 2.8 messages per ED user. The relatively limited usage of DIRECT messaging in the EDs was due to an insufficient degree of integration between the DIRECT messaging application and the existing EHR and clinical workflow in the ED. These results underscored the need to incorporate DIRECT messaging into clinical environments in a manner that minimizes additional workflow steps for users. From the technical perspective, however, the infrastructure was very robust and only a handful of technical support requests were submitted during the pilot.

In response to structured surveys, the end users and the site leaders at the participating organizations expressed a desire to continue participating in SoCalHIE. A number of the site leaders expressed that the DIRECT point-to-point model has distinct advantages over more centralized models for HIE in terms of reduced cost, greater simplicity, and less governance overhead. At the same time, certain end users predicated ongoing use of DIRECT messaging on improved integration of the system with their current EHR and workflows. Also, a number of stakeholders (both end users and site leaders) expressed a desire for more information-exchange use cases to be supported by the DIRECT infrastructure, as well as for the participation in DIRECT messaging of a greater proportion of provider organizations in the medical community. We are working to address these issues in the next phase of the project.

The first phase of the SoCalHIE pilot demonstrated that it is feasible to exchange health information in real-world settings using DIRECT messaging and to provide shared electronic access to provider addressing information using HPDPlus standards. We hope to expand on these learnings in the next phase of the project, which will focus on greater integration of DIRECT messaging with EHRs and broader use of DIRECT messaging for routine exchanges of patient information. Although challenges remain to incorporate DIRECT messaging optimally into clinical workflows and to reach a critical mass in the adoption of this technology, the results of the pilot provide grounds for cautious optimism that DIRECT messaging can be a viable part of the solution for health information exchange.

2 Overview of SoCalHIE Pilot

2.1 Objectives

The goals of the SoCalHIE pilot implementation are to assess the practical feasibility of the DIRECT model for health information exchange (HIE). The DIRECT model entails the use of standard email protocols to securely share patient-specific information among health care provider organizations. It also entails the use of electronic provider directories to locate the provider organizations and individual providers with whom information may be shared.

The DIRECT model is predicated on several assumptions:

- (1) The technical standards designated for secure email exchange by the DIRECT Project are efficient, reliable, and interoperable.
- (2) The sharing of patient information via secure email messages is advantageous to health care provider organizations and consistent with their business needs and workflow processes.
- (3) Providers and provider organizations trust the DIRECT model as a secure means of exchanging patient health information that complies with their legal and contractual obligations.
- (4) The technical and operational infrastructure required to exchange health information via secure email messaging is financially sustainable.

The initial phase of the SoCalHIE pilot was intended to evaluate the first two of these assumptions via the real-world implementation and operation of a small-scale DIRECT messaging infrastructure in a medical community. Although small-scale, the pilot infrastructure was designed to enable a realistic evaluation of the potential benefits, technical challenges, and workflow issues associated with the use of DIRECT messaging for HIE.

2.2 Setting

The SoCalHIE Pilot consisted of an implementation and evaluation of DIRECT messaging in the Palomar Health District, the largest non-profit, publicly-supported healthcare district in California. The Palomar Health District is centered in Escondido, CA and serves communities in a 2,200-square-mile area of North San Diego and South Riverside counties. The implementation entailed the deployment of DIRECT messaging software at a small but diverse set of provider organizations in this community, as well as deployment of a shared electronic provider directory that could be accessed from the messaging software. The participating organizations were:

1. Palomar Health, an integrated delivery network consisting of three hospitals (288, 107, and 95 beds)
2. Arch Health, multi-specialty medical group with almost 50 providers
3. Arthritis Care and Research Center, a solo-physician specialty practice
4. Escondido Pulmonary Medical Group, a six-physician pulmonology practice of which three physicians participated in the pilot
5. Graybill Medical Group, a multi-site, multi-specialty group with over 50 providers
6. North County Internists, a group practice of six primary care providers
7. Palomar Medical Group, a group practice of 11 providers

All of the outpatient practices refer patients to the Palomar Health hospitals for inpatient and emergency department (ED) services. In certain cases, physicians from these practices also have privileges and consult at the hospitals. In addition, certain of the practices refer patients to each other for specialty consultations.

All of the outpatient practices currently use one of several electronic health record (EHR) systems, including NextGen, AllScripts, and GE Centricity. At the time of the pilot, none of the sites were yet using versions of these EHRs that included integrated DIRECT messaging capabilities.

2.3 Use Cases

The primary use case that was implemented and exercised during the pilot period was the transmission of ED Visit-Summary Documents from the Palomar Health hospitals to the patients' community physicians who practiced at sites using DIRECT messaging. The transmitted visit summaries were generated directly from the hospitals' EHRs and sent as Portable Document Format (PDF) file attachments in DIRECT messages addressed to the community physicians.

Prior to the SoCalHIE pilot, the "standard of care" at Palomar Health EDs was to send these documents by fax. The ED providers entered patient data directly into templates within the hospitals' EHR system and added the name(s) of the patient's community physician(s) in the "cc" field of these templates. The I.T. system then faxed an automatically generated visit-summary document to these physicians if their names and fax numbers were available in the EHR system. In discussion with the practices, they described this process of receiving faxed ED Visit Summary Documents as unreliable, with documents often not sent, sent only after delay, or illegible upon receipt. The goal of substituting DIRECT messaging for this fax method was to (1) expand the set of community physicians who could receive ED visit summaries by providing access to the shared addressing information in the Provider Directory, (2) accelerate the delivery of ED visit summaries to community physicians by eliminating certain error-prone steps in the fax-based process, (3) creating a more systematic audit trail of communications with community physicians regarding patients seen in the ED, and (4) improving the legibility of ED visit summaries received by community physicians.

Note that, during the pilot, only PDF documents were transmitted in DIRECT messages. Specifically, Palomar Health did not transmit any visit summary documents formatted as Continuity of Care Documents (CCDs) or other structured formats because the EHRs in use at the community practices were not able to process such formats.

In addition to the ED visit-summary use case, we also encouraged the participating outpatient practices to use DIRECT messaging for exchanging referral requests and consult notes. However, during the 10-week pilot period, the participating sites did not begin to use DIRECT messaging in this way.

Towards the end of the pilot period, we implemented an additional use case, in which community practices could request and receive documents from the Medical Records Departments at the Palomar Health Hospitals via DIRECT messaging. Due to limited experience with that use case, we do not include an evaluation of it here, although it will be addressed in future reports.

2.4 Duration

The system-implementation phase of the pilot began in September 2012 and concluded in February 2013 with the deployment of the infrastructure to all of the participating sites. The system-usage phase began in March 2013 and was evaluated until mid-May 2013 (10 weeks). In this report, we assess the technical feasibility and operational effectiveness of DIRECT messaging with respect to both of these phases. Note that the DIRECT messaging infrastructure continues to be used by participating organizations in the Palomar Health district, although the initial evaluation has concluded.

3 Implementation of the DIRECT Infrastructure

3.1 Design and Architecture

The design and architecture of the DIRECT infrastructure for SoCalHIE is shown in Figure 1.

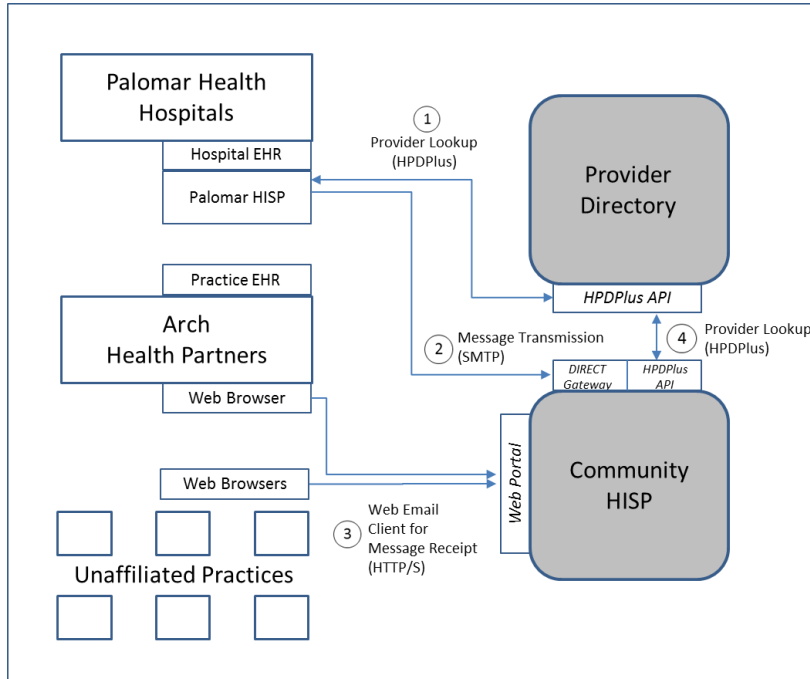


Figure 1. Architecture of the DIRECT messaging infrastructure for SoCalHIE. The numbered steps indicate the interactions among the components required for the delivery of a visit summary from a Palomar Health emergency department to a community physician.

The infrastructure includes two Health Internet Service Providers (HISPs). A HISP is a software module that provides services for sending and receiving DIRECT messages. One HISP (“Palomar HISP”) was located within, operated by, and tightly integrated with the information systems at Palomar Health. This HISP was used by the ED providers at the Palomar Health hospitals. The second HISP (“Community HISP”) was a commercial product. This HISP was primarily used by the community practices.

The Palomar HISP is a web-based email-like application, called Secure Messenger, to provide DIRECT messaging capabilities to end users. Users sign in to Secure Messenger using the same credentials they use to log into the hospital EHR. Secure Messenger is integrated with the hospital EHR, which allows users to import patient documents directly from the patients’ EHR records into secure messages as file attachments. Secure Messenger is also integrated with a DIRECT Secure Transfer Agent (STA), enabling users to send secure messages per the DIRECT standard to other HISPs, as well as receive acknowledgements from other HISPs.

Users at the community practices used a commercial HISP to send and receive DIRECT messages. This HISP includes a web-based email client application that enables users to formulate and send DIRECT messages, as well as receive and review DIRECT messages. The user interface for the HISP is very similar to that of other web-based email clients, such as Gmail or Yahoo Mail. Among its useful features, this UI has a “delegation” feature that enables providers to delegate access to their DIRECT message mailboxes to other staff members. This is similar to a feature in email clients such as Outlook whereby access to one’s inbox may be delegated to another user (e.g., a

manager to an administrative assistant). In the community HISP, once a “delegate” user logs in, he can view the mailboxes of any of his delegators, and send, receive, organize, print or otherwise manage messages on behalf of the delegators. Conveniently, the HISP can be configured to send an alert to a recipient’s regular (non-secure) email address when a new DIRECT message is received at the user’s DIRECT address. These alerts can also be sent to the regular email address of any delegated users with authority to manage the user’s DIRECT mail account.

In addition to the DIRECT messaging HISPs and email clients, we also deployed a community-wide provider directory (PD) compliant with the HPDPlus web-services API. The software for the PD was provided and hosted by another vendor. Both DIRECT messaging clients were integrated with the PD, enabling users at Palomar Health or any of the community practices to look up of DIRECT addresses and other contact information for all the providers and organizations participating in the SoCalHIE pilot.

3.2 Configuration Details

3.2.1 Configuration of Community Practice Users

The community HISP was assigned the internet domain name “direct.socalhie.org” and this name was the default for all DIRECT addresses hosted by the HISP (such as “jim.sachs@direct.socalhie.org”). However, for each participating practice, we attempted to provide a practice-specific domain name instead, so that their providers would have distinctive and descriptive DIRECT addresses (such as “jim.sachs@direct.cardioclinc.org”). Despite certain technical challenges in this process (described below), we were able to implement custom domain names for all but one practice.

When configuring their DIRECT mailboxes and end-user accounts, practices set up different models for routing and managing DIRECT messages based on their specific requirements and preferences. For example, North County Internists and Arch Health chose different configurations:

- For North County Internists, mail was sent directly to the mailboxes of the individual physicians. The physicians’ medical assistants or nurses were set up as delegated users with access to all of these mailboxes, and typically handled all incoming messages on behalf of the physicians.
- Arch Health chose to have all DIRECT messages handled by their Medical Records staff (with the rationale being that they already handle documents sent and received by fax and other pre-existing methods). Therefore, Arch Health forwarded all of its incoming DIRECT messages (regardless of which physician they were addressed to) to a single organization-wide mailbox. The Medical Records staff members were set up as delegated users with access to this shared mailbox. This configuration was enabled by the delegate-user and address-aliasing features of the community HISP.

Table 1 below summarizes the setup of accounts for the practices. The implementation model of “Organization mailbox” is similar to that adopted by Arch Health, and of “Provider mailbox” is similar to that of North County Internists.

Table 1. Implementation of SoCalHIE at the six different community practices.

Practice	# Participating providers	Mail-processing configuration	# delegate accounts	Delegates
Arch Health	47	At organization mailbox	5	Medical Records staff
Arthritis Care	1	At provider mailbox	1	Clinical staff
Escondido Pulmonary	3	At organization mailbox	3	Practice management
Graybill	57	At organization mailbox	6	Medical Records staff
North County Internists	6	At provider mailboxes	5	Clinical staff
Palomar Medical Group	11	At provider mailboxes	4	Practice management

The provider directory included entries for all seven participating organizations, and for all of their participating providers. Provider entries included each provider’s DIRECT address, organizational affiliation, physical address, phone number, and fax number.

Prior to the pilot going live, we provided training on-site or online using web-conferencing for each site. We also provided sites with a brief guide (“cheat sheet”) on the use of the community HISP software. The guide included contact information to reach our helpdesk.

3.2.2 Configuration of Palomar Health ED Users

We created accounts for providers (both physicians and PAs) and for documentation scribes from the Palomar Health ED in the Secure Messenger system. In all, 83 DIRECT accounts were created for the ED users, and all of these accounts corresponded to DIRECT addresses with the domain name “direct.palomarhealth.org”. As Secure Messenger has no delegation capability, each user had to manage his or her own account. In practice, this was not a difficulty, because Secure Messenger was used exclusively for *sending* DIRECT messages, so no processing of incoming messages was required.

Each of the providers and scribes also had an entry in the provider directory. We included entries for scribes as well because they were sending ED visit summaries directly to the practices, so it was important for message recipients to be able to consult the provider directory to confirm these senders’ identities.

We also prepared a written training guide for ED users, which consisted of annotated screenshots that could be used very quickly in the ED to learn about the Secure Messenger software. The document was posted on the online learning portal at Palomar Health and also made available via a link from the EHR software. The document included the contact information for the Palomar Health helpdesk.

4 Evaluation of DIRECT Technology and Standards

4.1 Interoperability

A key element of the DIRECT model for secure email exchange and the HPDPlus model for provider directory access is the specification of standards to support interoperability among independently developed applications and products. Specifically, HISPs conformant to the “Applicability Statement for Secure Health Transport” can ostensibly exchange secure email messages with no further integration or customization required. Provider

Directory client applications conformant to the HPDPlus specifications can ostensibly request and retrieve provider information from conformant server applications with no further integration or customization. Validating that the standard specifications for HISPs and Provider Directories indeed conferred such “plug and play” interoperability was the first goal of the SoCalHIE pilot.

4.1.1 Compatibility of HISPs

Although the two HISPs used in our pilot were developed by different vendors, we found an excellent level of “plug and play” interoperability between them for the exchange of secure email messages. The successful exchange of DIRECT messages required only that the top-level digital certificate of each HISP was loaded into the other HISP as an accepted “trust anchor,” and that appropriate entries were created for the relevant DIRECT health domain names in the public Domain Name System (DNS). The ready interoperability of messaging applications compliant with the DIRECT Applicability Statement is likely due to two factors:

1. The use of mature industry standards as the foundations for secure messaging in the DIRECT Applicability Statement. Such use ensured that software libraries compliant with the specified standards are widely available and interoperable. These specified standards include:
 - SMTP as the email transport mechanism
 - MIME and IETF RFC 5322 as the encoding mechanisms for email content
 - S/MIME as the mechanisms for the encryption and digital signing of email content
 - DNS as the mechanism for the storage and lookup of digital certificates corresponding to DIRECT addresses
 - X.509 as the standard for representing contents of digital certificates
2. The availability of a standard “reference implementation” (RI) of the DIRECT Applicability Statement. The DIRECT Project sponsored the development of an open-source implementation of the specified standards, and this implementation was used to at least some extent by both HISPs involved in our project. The actual sharing of certain code between the HISPs likely facilitated interoperability.

4.1.2 Integration of Provider Directory with Email Clients

In the pilot, both of the DIRECT email clients were interfaced to a remotely hosted Provider Directory supplied by a third vendor. The directory stored information about all of the provider organizations and all of the individual providers participating in the SoCalHIE pilot, including the providers’ DIRECT addresses. The email clients enabled users to search for and retrieve information from the Provider Directory via web-services calls conformant to the HPDPlus specifications. HPDPlus defines a data model and a protocol stack for such queries and responses, with the express goal of supporting access from arbitrary email clients to arbitrary Provider Directories without custom integration or configuration.

In the course of implementing interfaces from two email clients to one Provider Directory server, all from different vendors, we learned that the HPDPlus specifications are helpful for achieving standardization, but not yet mature enough to ensure plug and play interoperability. Specific gaps include:

1. Ambiguous requirements regarding the specific provider-directory queries that must be supported. The HPDPlus specifications span half a dozen distinct standards documents and none of these documents unambiguously specify which use cases and queries must be supported by HPDPlus-compliant implementations. As a result, there were incompatibilities between the use cases that the email clients

assumed to be supported and the use cases that the provider directory actually supported. Reconciliation of these incompatibilities required custom coding on the parts of both the email client developers and the Provider Directory developers.

2. Inconsistent requirements regarding the HPDPlus web-services API. The HPDPlus specifications stipulate that the full DSML v2 query syntax must be supported by compliant implementations, but also stipulate that only certain use cases and queries need to be supported, including sample DSML v2 queries for these queries. As a result, the Provider Directory developer had implemented only that part of the DSML v2 syntax needed to support the specific sample queries in the specification, although one of the email clients assumed that any DSML v2-compliant syntax could be handled by the server. The result was the inability of the server to respond to certain of that client's requests, although both client and server were arguably HPDPlus compliant. Again, custom implementation on the part of the Provider Directory developer was required to overcome this incompatibility.
3. Allowance for use of the relational model to store the Provider Directory database, although the query language is based on the LDAP object-oriented model. The HPDPlus specification includes an explicit relational database model for the storage of Provider Directory information, the use of which the specification allows (and even encourages) as an alternative to the object-oriented LDAP model on which the remainder of HPDPlus is based. Specifically, the DSML v2 query language specified by HPDPlus is closely tied to the LDAP query language, and transformations between the two are readily available in many commercial and open-source LDAP implementations. However, no such transformations exist between DSML v2 and SQL, the query language of the relational model. Hence, any developers of HPDPlus Provider Directories that use the relational model must build their own DSML-to-SQL translations (mappings). Given the extensive scope of the DSML language, implementation of mappings for the entire DSML syntax would be very time consuming and practically infeasible. Therefore, any HPDPlus implementations that use the relational model for storage will be unlikely to support the full DSML syntax, and therefore will not be fully compliant with the HPDPlus specification (ultimately, limiting interoperability with implementations that are fully compliant with DSML v2).
4. Under-specification regarding authentication to the Provider Directory. The HPDPlus specifications explicitly state that compliant implementations need not include the authentication and security methods specified by the underlying LDAP model. As a result, HPDPlus clients and servers may implement differing authentication mechanisms, including one-way TLS authentication, mutual TLS authentication, or SOAP-based authentication. This under-specification resulted in an incompatibility between one of the pilot email clients (which had implemented SOAP-based authentications) and the Provider Directory server (which had implemented mutual TLS authentication). Again, custom implementation was required on the part of the Provider Directory developer to harmonize the authentication mechanisms.

A newer version of the HPDPlus specification is currently under development within the Office of the National Coordinator which may address some or all of these gaps.

4.2 Functionality

Although we found the DIRECT Applicability Statement to provide excellent interoperability among compliant HISPs, we also noticed certain functional gaps in this DIRECT specification, particularly related to error reporting by remote and local HISPs.

4.2.1 Deficiencies in Error Reporting by Remote HISPs

The Applicability Statement requires only a minimum of feedback be sent from a receiving HISP to the sending HISP upon receipt of a DIRECT message. Specifically, the receiving HISP is required to send back an SMTP “Message Disposition Notification” (MDN) when it has successfully received and validated a message per the DIRECT security protocol. This minimum requirement means that the sending system is not necessarily notified about a number of other significant messaging conditions:

- Whether the HISP was able to deliver the message to the intended final recipient (i.e., DIRECT address) after the HISP validated the message, or whether such a recipient (address) even exists. This type of error is applicable when the receiving HISP hosts the recipient’s DIRECT addresses directly.
- Whether the receiving EHR was able to process the message correctly and deliver it to the intended final recipient. This type of error is applicable when the HISP forwards received messages to an integrated EHR
- Whether and why the receiving HISP was *not* able to validate a message per the DIRECT security protocol. For example, if a receiving HISP does not trust the sender’s DIRECT address, the transaction will fail silently per the current DIRECT standard and the sender will never be notified of this situation. Similarly, if the receiving HISP cannot access the digital certificate corresponding to the sender’s DIRECT address or that digital certificate has expired, there is no standard mechanism to notify the sending HISP.

In general, a number of error conditions can occur after the remote HISP receives a DIRECT message which prevent the delivery of the message to the intended recipient. The current DIRECT specifications provide no standard way for the sending HISP to know whether such an error occurred or what kind of error it was, resulting in a “silent failure.” This model is inadequate for certain important types of clinical messaging, including the delivery of laboratory results, which must conform to federal CLIA regulations for guaranteed delivery. Fortunately, the Standards and Interoperability work group has specified an extended version of the Applicability Statement that adds requirements to provide delivery notification, which we are testing in the next phase of the SoCalHIE pilot.

4.2.2 Deficiencies in Error Reporting by Local HISP

The DIRECT Applicability Statement does not, in general, specify the communication protocol between a sender’s client (“edge”) application and a sender’s local HISP. Such client applications may be email clients, EHR messaging modules, or even HL7 interfaces that use DIRECT messaging as their transport mechanisms. The DIRECT standards allow client applications to communicate with their local HISP via POP3, IMAP, SOAP, or entirely proprietary client-server interfaces.

Communications between client applications and their local HISP is required for clients to submit messages to the HISP for secure transmission and to pick up messages that were received by the HISP via secure messaging. Client-HISP communication is also required for the HISP to notify the client when certain errors specific to the DIRECT messaging protocol have prevented the transmission of a secure message. Such errors can include:

- The recipient’s digital certificate cannot be located and accessed by the local HISP
- The recipient’s digital certificate is not among those trusted by the local HISP as a valid recipient of DIRECT messages
- The sender’s private signing key cannot be located and accessed by the local HISP

The Applicability Statement includes no enumeration of such errors, nor specification of an API for clients to request or local HISPs to report such errors. An improved model would logically specify a set of DIRECT-specific errors so that the developers of HISPs could include the reporting of such errors through a standard API (or, at

least, through standard error codes and related information). This model could be implemented as part of the reference implementation, for example, and would provide client applications with much better error information from local HISPs than currently available.

4.3 Trust

The Applicability Statement allows digital certificates to be assigned to individual DIRECT addresses (such as “jim.sachs@direct.cardioclinc.org”) or to organization-wide DIRECT health domain names (such as “direct.cardioclinc.org”). The SoCalHIE pilot selected the latter strategy, because it requires the creation and management of many fewer digital certificates, while not compromising security significantly, since the private keys corresponding to the digital certificate are managed by the HISP in either case.

For purposes of creating the domain-specific digital certificates, each HISP was its own Certificate Authority (CA), i.e., each HISP created a self-signed digital certificate, the private key of which was used sign the organizations’ own certificates. This two-level chain of trust required that the two HISPs only possessed each other’s CA certificates in order to support a valid chain of trust for any participating user to send or receive a message. This simplification worked smoothly in our limited implementation involving only two HISPs, each of which used only one Certificate Authority (themselves). Because we (Sujansky & Associates) had created both CA certificates and used them to create all of the organization certificates, we trusted the processes involved in the management of these certificates, as well as the identity proofing and authentication of end users.

In larger implementations, there will likely be additional HISPs managed by other parties. Also, additional Certificate Authorities may create digital certificates for those organizations using the HISPs we are managing. In this model, the HISPs will have to include and manage many more trust anchors, and we will have to determine which of many trust anchors are sufficiently trustworthy to include in our HISPs. No DIRECT implementations have yet managed the full complexity of this multi-HISP model, although SoCalHIE is considering participation in a state-wide pilot project to explore the challenges and possible solutions inherent in such a model. We are also exploring the role of HISP-accreditation services, such as DirectTrust.org.

4.4 Addressing

One common task we encountered in configuring the participating practices was creation of custom sub-domains for each organization (e.g., “direct.ncinternists.com” for North County internists, whose existing domain name was “ncinternists.com”). The Direct messaging protocol requires a relatively complex set up of DNS entries to support the secure messaging capability, including “A”, “NS”, and “CERT” entries for each sub-domain name that is used as the domain component of a DIRECT address. For the purpose of creating custom sub-domain names, each site needed to add the relevant sub-domain name to their DNS server and add specific DNS entries that mapped the sub-domain to the community HISP’s server address (so that DIRECT messages addressed to the sub-domains would be delivered to the community HISP, which handled all DIRECT messaging traffic for the practices).

In certain cases, this process proved challenging. The smaller practices use low-cost commercial hosting services that provide limited DNS customization capabilities (such as “Active-Domain.com”). The larger organizations hosted their own DNS servers, enabling them to more freely create the required entries, but necessitating more technical skill and effort on their parts. For all the pilot sites, the DNS set up was complex requiring several rounds of communication with the sites’ network support teams. For three of the smaller practices, we were unable to create the custom sub- domains to match their existing domain names because their internet hosting provider did not support this function. In these cases, we had to create new primary domains (e.g., ncinternists.net) and then create the related DIRECT sub-domain (e.g., direct.ncinternists.net).

5 Evaluation of System Usage and Stakeholder Perceptions

5.1 Usage

5.1.1 Volume and Sources of Message Exchange

The results in this section describe patterns in the messages sent from the Palomar Health EDs to the community practices during the pilot period.

Table 2 shows that a total of 230 messages were sent over the pilot study period. Of the 83 users in the ED, 47 sent at least one message. On average, each user sent 2.8 messages. There was a high degree of variability in the number of messages sent across users, ranging from 0-22. This variability is indicated by the standard deviation in Table 2 and illustrated in Figure 2. There were 3.3 messages sent per day on average, although a much greater number of encounters took place in the EDs.

As shown in Figure 3, the variability in volume of messages also occurred in the temporal dimension. There was an increase in usage after April 3rd that coincides with a memo sent by the ED Director encouraging use of Secure Messenger for distributing ED Visit Summaries. This increase in usage was temporary, however, and declined after about 10 days.

The relatively limited usage of DIRECT messaging in the Palomar Health EDs was due to an insufficient degree of integration between the DIRECT messaging application and the ED's EHR and clinical workflow (as discussed in Section 6.2). The results in this regard underscored the need to incorporate DIRECT messaging into clinical environments in a manner that minimizes additional workflow steps and time consumption.

Table 2. Descriptive statistics about usage of SoCalHIE by users in Palomar Health's emergency departments.

<i>Number of messages sent by ED Users</i>	
Mean	2.8
Median	1
Standard deviation	4.02
Minimum by a single user	0
Maximum by a single user	22
Total number of messages	230
Number of users who sent at least one message	47
Number of users who did not send any messages	36
Total number of users	83

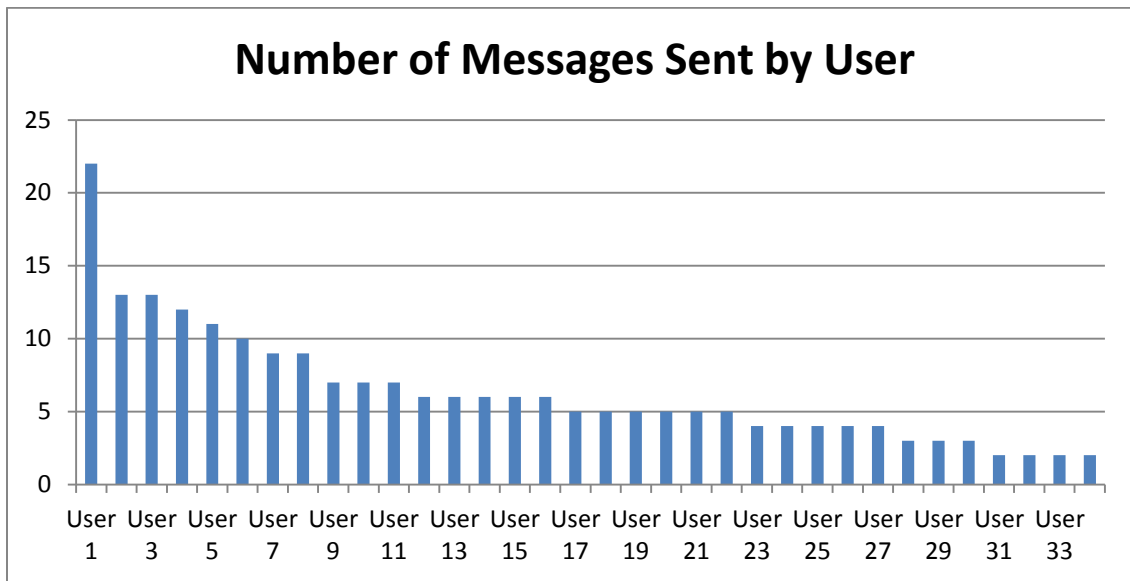


Figure 2. The number of messages sent per user across the entire study period.

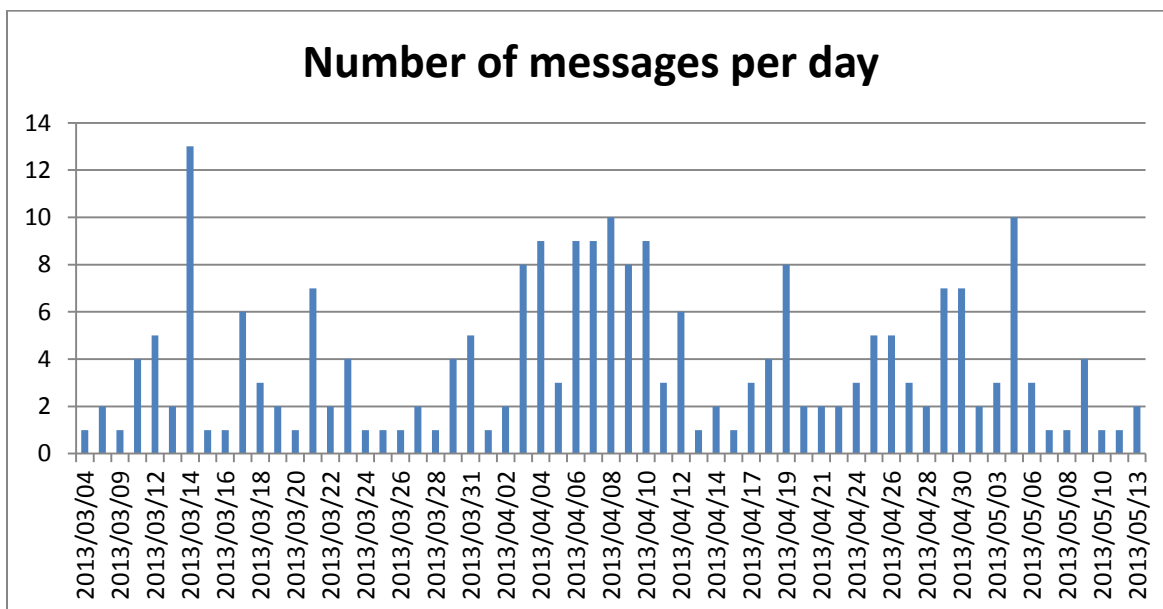


Figure 3. The number of messages sent by all ED users by date.

Table 3 shows the pattern of messages received by the practices. As can be seen, there was not a significant variation in the number of messages received by a practice per provider. The Arthritis Care and Research Center did not receive a single message during the study period, probably because there is only one sub-specialist at this practice who is very unlikely to be a PCP for patients seen in the ED.

Table 3. ED Visit Summary messages received by participating practices. *The third column shows the number of providers from each practice that participated in the pilot.

<i>Practice</i>	<i>Number of messages</i>	<i>Number of providers*</i>	<i>Average number of messages per provider</i>
Arch Health	99	47	2.1
Arthritis Care and Research Center	0	1	0
Escondido Pulmonary	2	3	0.7
Graybill	96	57	1.7
North County Internists	9	6	1.5
Palomar Medical Group	24	11	2.2
Across All Groups	230	125	1.8

The statistics of messages received by provider are shown in Table 4. On average, each provider received 1.8 messages containing an ED Visit Summary, and about 45% of all providers received at least one message. The variation in the volume of messages received was less across community providers (see standard deviation and the range of 0-12) than the variation in volume of messages sent across ED users.

Table 4. Descriptive statistics on ED Visit Summary messages received by providers.

<i>Messages received by providers</i>	
Mean number of messages received per provider	1.8
Median number of messages received per provider	0
Standard deviation	2.85
Minimum number of messages received by a single provider	0
Maximum number of messages received by a single provider	12
Total number of messages received	230
Number of providers who received at least one message	56
Number of providers who received zero messages	69
Total number of providers	125

5.1.2 Technical Support Issues Encountered During Pilot

In this section, we describe the technical support issues that were logged in our helpdesk database. Users entered the issues themselves via our helpdesk portal or emailed them to our support team directly. In the latter case, we added the issues to the support database manually. The occurrences and categories of these issues during the pilot period are summarized below in Table 5.

Table 5. A summary of the issues reported during the use of SoCalHIE.

<i>Issue category</i>	<i>Occurrences</i>
Password reset requests	3
No document or incorrect document attached	8
Document sent to incorrect recipient	1
Issue with printing and formatting of documents	2
Help with use of software	2

The most frequently occurring issue was one of missing document attachments, i.e. messages received from the ED that lacked an attached ED visit summary document. This issue turned out to be a defect in the Secure Messenger application that, once corrected, resolved the issue.

In addition to the user-reported issues, there were two episodes of the Secure Messenger server being unavailable for a few hours, as well as one episode of the HPDPlus Provider Directory server being unavailable for several hours. The sources of these sporadic outages were not identified, but were likely associated with system re-boots within the hosting environments. As the pilot is used more extensively in a production environment, procedures will need to be implemented to minimize the risk of such disruptions, as they did result in the dissatisfaction of a few ED users.

5.2 Site Leaders’ Perceptions

We interviewed seven leaders (e.g., CIO, Practice Manager, Managing Partner) from five of the seven SoCalHIE participating sites to assess their impressions of the pilot. We conducted the interviews on a teleconference line and populated the online questionnaire (Appendix) with their responses. The questionnaire addressed the following topics:

- Motivation for participating in the DIRECT messaging pilot
- Perceived benefits of using DIRECT messaging during the pilot
- Interest in ongoing use of DIRECT messaging

The factors that motivated sites to participate in SoCalHIE are shown in Table 6. All site leaders agreed that having the ability to electronically exchange health information with more practices in the community was a motivator. All but one also agreed that the enhanced security of DIRECT for communicating PHI and the convenience of the system to their business partners were also motivating factors. One respondent also indicated that the point-to-point and lighter weight model of Direct messaging (compared to a typical hub-and-spoke HIE) was a significant motivation for that site to participate.

Table 6. The number of site leaders who indicated the reason in column 1 was their motivation for participating in SoCalHIE.

Motivation for participation	Number of respondents agreeing (out of 7 interviewed)
Ability to electronically exchange patient information with more organizations in your medical community	7
Enhance the security and privacy when communicating patient records	6
Provide a service/convenience to practices and organizations that refer patients to you	6
Improve efficiency of operations	5
Desire to use technology that is not tied to a specific vendor	5
Meet meaningful use requirement	4
Facilitate the process of referring patients	4
Facilitate the process of getting information from other providers who have treated your patients	4

While two of the sites (Palomar Health and Arch Health) already had some ability to electronically exchange information with each other (e.g., via HL7), none of the sites was part of a broader HIE or considered participating in any other HIE.

None of the sites encountered challenges in getting organizational approval for participation in SoCalHIE¹. The management personnel required to approve participation included the practice manager, the CIO or IT Director, and the Managing Physician Partner. At Palomar Health, the ED Director also approved the usage in that department.

In their responses regarding factors that impacted their participation (Table 7), the level of security was viewed as positive by all sites. None of the factors we inquired about were viewed as negatives.

Table 7. Responses of the site leaders regarding factors that influenced their participation in the pilot.

	Point-to-point exchange of information with selected organization rather than community-wide sharing	Level of security provided by Direct messaging	Effort and cost to your organization of participation in the pilot	The other organizations that were participating in SoCalHIE
Positive	6	7	5	4
Neutral	1	0	2	3
Negative	0	0	0	0

The site leaders gave an average score of 5.9 (standard deviation of 2.85) and a median of 7 on a 10-point scale (10=very effective, 1=not at all effective) regarding how effective secure messaging was for electronic exchange of health information. Only two of the respondents reported scores below 5: the ED director and the representative of a practice that received very few messages.

In response to the question “What were the major benefits your organization experienced in using SoCalHIE?” we received the following paraphrased comments:

We frequently got the information very quickly within hours - sometimes it takes days with regular methods.

Although we have an interface to the hospital, we were looking to SoCalHIE to be a fail-safe to catch things that might not be sent through [the interface]

Big benefit - Reduce faxing, which is unsecure

Getting information from referring providers

ED sent us the report – so that we don't have to go looking for.

Not much because of the limited nature.

The following are representative responses to the question, “Were there any significant problems your organization encountered in using SoCalHIE?”:

¹ Although at one site, certain physicians opted not to participate, because they had recently gone through the difficult implementation of an EHR system, and did not want to pilot another electronic technology at this time.

At the beginning, [the document] was sent as a plain text file. It was cumbersome [to read].

Doctors forgot to attach notes sometimes.

More steps for the physicians

Getting ED physicians to use it - level of integration was not adequate

Medical records staff saw it as an extra step compared to electronic faxes, which go to the right folder. With DIRECT, they had to move messages to the folder.

Cumbersome - selecting the documents to send

Too cumbersome and time consuming to get a message out. Some server issues - going down

There weren't any significant problems.

In response to the question “Is your organization interested in continuing to use SoCalHIE beyond the pilot period?”, the seven respondents gave an average score 3.7 (on a five-point scale with 5 indicating very interested). Figure 4 shows the histogram of the site leaders’ responses to this question. The respondent who gave the score of 1 mentioned that he was not interested in continuing with the software in its current state. However, even this person indicated great interested in using SoCalHIE if the software integration could be improved so as to reduce the time and effort of sending documents.

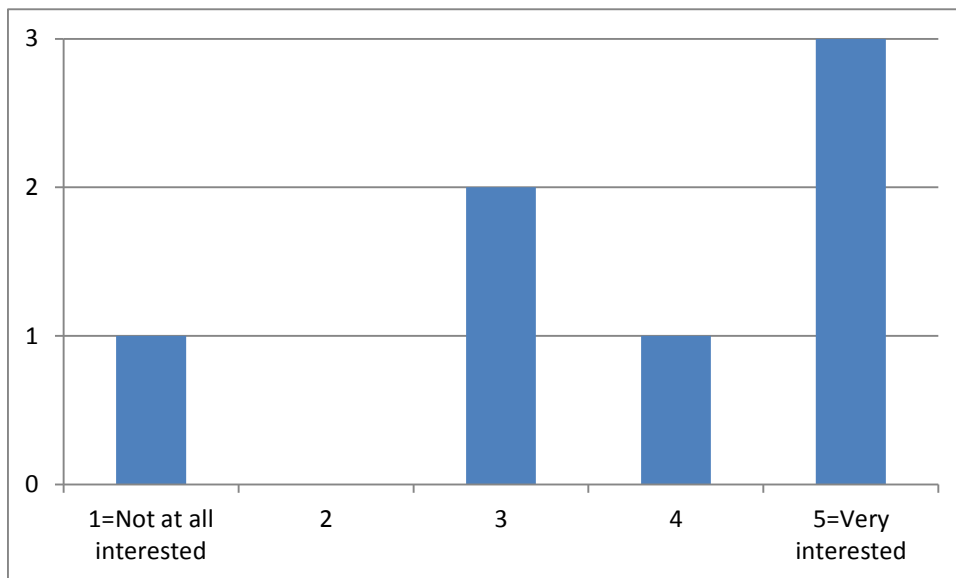


Figure 4. Scores indicating how interested the respondent’s organization was in continuing to use SoCalHIE. The horizontal axis shows the score and the vertical axis shows the number of respondents who selected that score as their response.

The next question further explored this issue and asked what might change their level of interest. In order of decreasing importance², the site leaders' ranked the factors as:

- (1) Tighter integration of Direct with EHR (average rank of 1.3 on a four-point scale),
- (2) Ability to use DIRECT messaging for other types of documents (average rank 1.4),
- (3) More providers participating in the network (average rank 2.0), and
- (4) Reduced cost of participation (average rank 2.7).

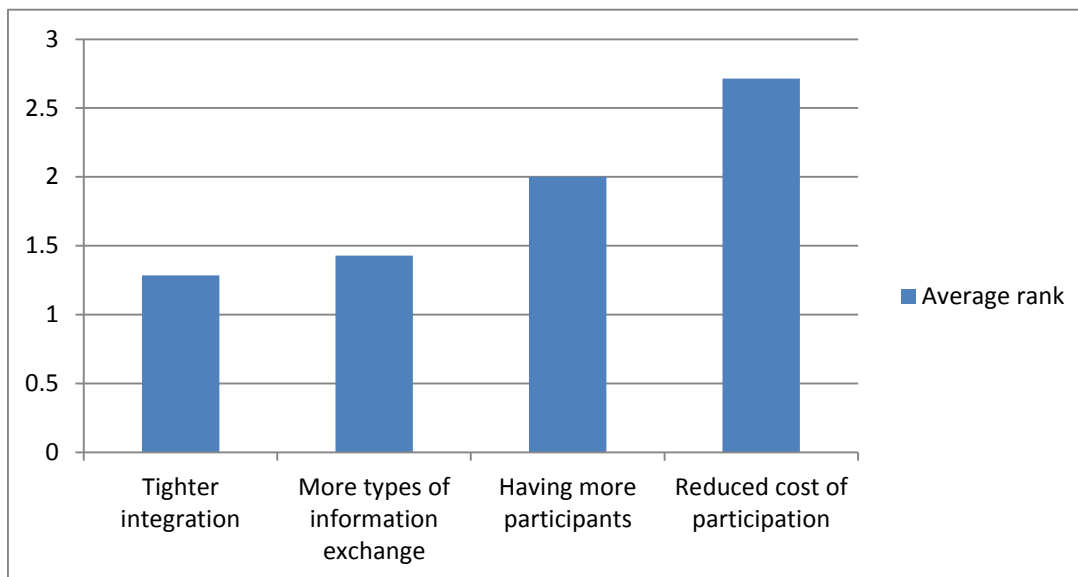


Figure 5. Average of rankings that site leaders assigned to factors that might increase their interest in continued participation in SoCalHIE. Note that a lower number indicates a *higher* rank, i.e., a more important factor in a site's desire for continued participation.

The following are the excerpts from an open-ended question to provide any additional helpful comments and suggestions:

Value of DIRECT messaging

Great idea

Very valuable.

This is the future. This is the way we will communicate with each other in the future, rather than HIE orgs, many of which will not survive.

Point-to-point exchange is very attractive.

² The first three respondents assigned a score to each response. Those users gave everything a score of 1, implying they were all important. From the fourth respondent on, we asked to rank each item's importance. This allowed us to get better discrimination of the relative importance of each item. While the magnitude of the average scores changes, the ordering does not change whether we use the scores from the first three respondents or not.

Desire to expand the network and use cases

Trying to pull in more of the hospital-based physicians, so they can communicate with PCPs.

More organizations, particularly imaging centers. Send report one time.

More parts of the hospital - H&P, discharge summary, op notes. Send automatically, rather than [only in response to] requests.

Can be used to get information from the community physicians to the hospital

One use is for the primary care docs to send feedback to us on a patient of theirs we saw.

Integration

Tighter integration with EHR

[For specialty] referrals - need better integration.

Needs to work seamlessly with Clarity

[Was] a little more IT work than expected.

5.3 End Users' Perceptions

At the end of the pilot period, we also conducted a survey of all users of the SoCalHIE messaging applications. Surveyed users included those who had login accounts on either Secure Messenger or the community HISP. Note that we did not survey providers with addresses listed in the Provider Directory, but who had all of their messages forwarded to an organization-wide mailbox. The surveyed users were invited to participate by email, and the survey was conducted via an online form (Google Docs Form). The survey instrument is included in the Appendix.

In all, we received 24 responses. Of these, 16 were from the ED users (19% responses rate), and eight were from the community practices (27% response rate). The survey results for these two groups of users are discussed separately, because of their very different experiences. Specifically, the ED respondents used the *Secure Messenger* application and primarily *sent* messages, and the community-practice respondents used the *community HISP* application and primarily *received* messages.

5.3.1 Responses from Users in Hospital EDs

Of the 16 ED users who responded, nine were providers and seven were other clinicians (such as PAs) and scribes. The chart in Figure 6 summarizes their perception of using Secure Messenger. Most users found the software was not easy to use (average score was 2.19 on a scale of 1 to 5), did not save them time (1.5), did not fit in their workflow (1.44), and did not allow them to send documents in a timely manner (2.07). The respondents were more positive about their confidence that the documents were reaching the intended recipients (2.75), and that the software allowed them to be in compliance with information-sharing regulations (2.94).

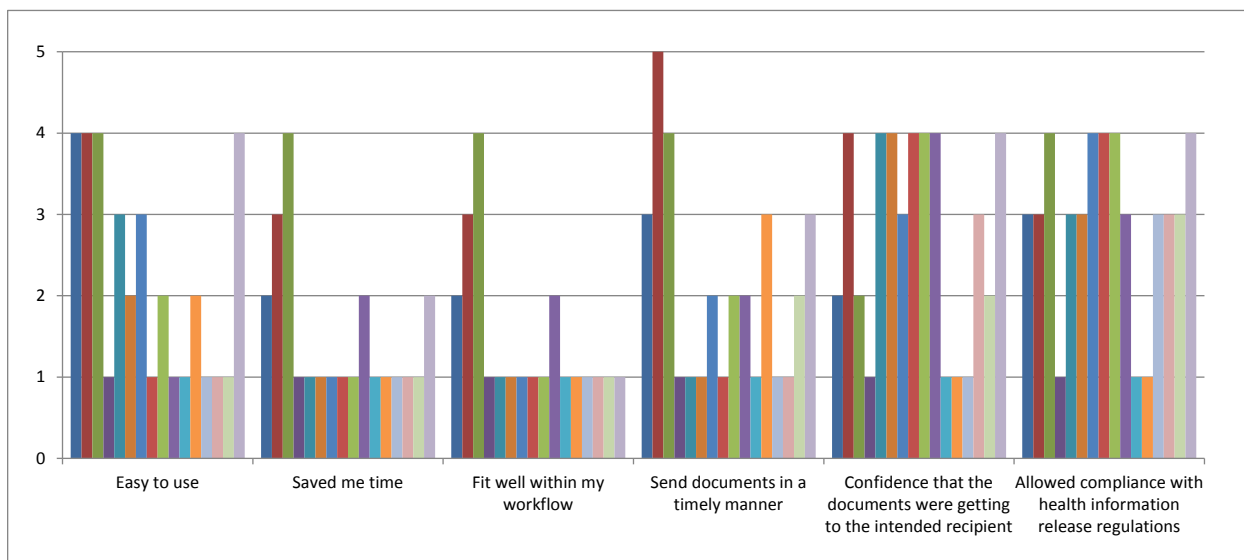


Figure 6. ED user's perception of using Secure Messenger to send visit summary documents. A score of 5 indicates the user strongly agreed with the statement, and a score of 1 indicated the user strongly disagreed with the statement.

The following comments from the respondents illustrate certain of the specific issues they encountered:

Using the program was easy enough, but it was kind of a hassle having to repeatedly login, not know whether a patient's primary [care physician] was participating in the pilot program, etc.

The process was time consuming in the ED. We routinely complete 16-25 charts a shift many of which should be forwarded to the PMD. Oftentimes we cannot complete charts real time due to demands of patient care, making difficult to forward the chart. Ideally it should automatically be sent to the provider listed in the chart [after being signed].

The system did not save me time because I now had to stop work flow to open another browser to send the message rather than adding the physician as a "cc" on the ED Note.

This system does not fit well into the use of scribe because the physician must sign the note first in order for it [to] be sent, and most would not sign notes until after their shifts.

The chart in Figure 7 shows the perceptions of the ED users about the Provider Directory. The users found searching within the directory moderately easy (average score of 2.44 on a scale of 1 to 5), and they were confident that they found the correct provider or organization (2.94), that the information about the provider and organization was correct (2.94), and that they were able to find all the information they needed about the recipient (3.13).

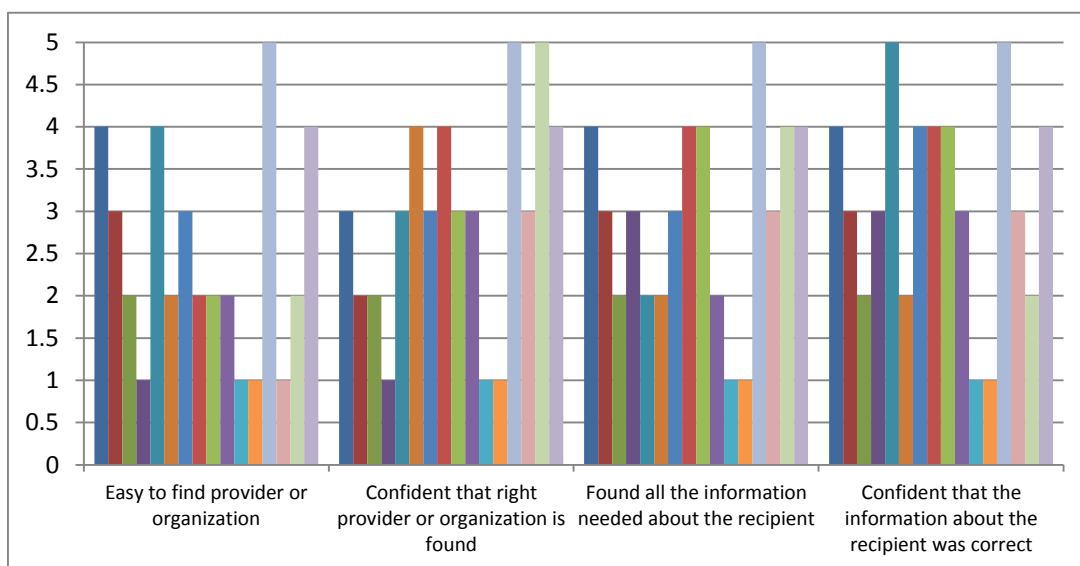


Figure 7. ED user's perceptions of using the Provider Directory (HPD) from within Secure Messenger. A score of 5 indicates the user strongly agreed with the statement, and a score of 1 indicated the user strongly disagreed with the statement.

We received very few narrative comments about the Provider Directory from the respondents. Two of their representative comments are produced below:

Many times unable to find providers

There is a lot of risk of sending to the wrong provider- often the patient gives the wrong [primary care provider] or you can accidentally send it to the wrong provider selected

Of the 16 users, 13 gave a score of 1 or 2 on whether they were interested in continuing to use SoCalHIE³, with an average score of 1.8 (with a score of 1 meaning “not at all interested”). On a 3-level ranking, the respondents indicated their level of interest would increase if the software were better integrated with their EHR system (average rank was 1.4 on a scale of 1 to 3, with 1 being the most important factor). Having more providers and organizations participating would also increase their interest, although to a smaller extent (average score was 2.2), and having more document types to be exchanged would have almost no impact on their interest (average score 2.8).

5.3.2 Responses from Users in Community Practices

From the community practices, we received responses from eight users (two providers, two other clinicians, one medical records staff member, two administrative staff members, and one IT staff member). We received responses from five of the six participating practices.

³ In reporting these results, we have reversed the scoring system from the questionnaire to correct a design oversight in the survey. In the questionnaire, a score of 1 indicated, the user was very interested. In the results reported here, the (corrected) score of 1 indicates the user was not at all interested. We made this correction to present the results in a consistent scale for the user responses and the site-leader responses.

Of the eight respondents, four had used the software for receiving messages, two had had their messages handled by a delegated user, and three did not use the software themselves nor did their delegates use it. However, we received scores from seven of the eight users, with certain opinions presumably based on the training we provided at the beginning. The users at the practices found that the software was easy to use (average score of 3.71 on a scale of 1 to 5), saved them time (3.29), fit well with their workflow (3.29), allowed them to send documents in a timely manner (3.43), gave confidence that the documents were getting to the intended recipient (3.29), and allowed compliance with health information release regulations (3.43).

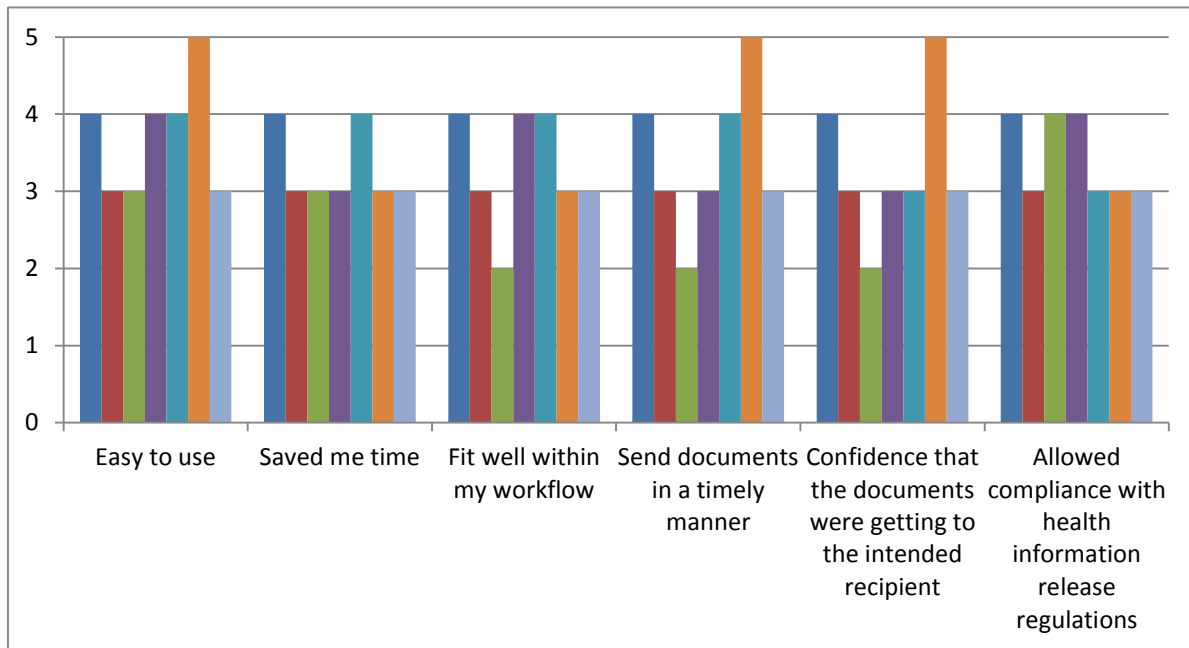


Figure 8. Perceptions of users from the practices about the community HISP. A score of 5 indicates the user strongly agreed with the statement, and a score of 1 indicated the user strongly disagreed with the statement.

Since users at the community practices did not send messages, we have not included their detailed responses to questions about the Provider Directory.

In response to the question about their interest in continuing to use the software, the average score was 3 (with maximum interested represented by a “1” and minimum interest by a “5”). Two of the users gave a score of 1 indicating they were very interested in continuing to use the software, two users gave a score of 5 indicating they were not at all interested, and three users gave a score of 3. The respondents’ interest in continuing to use the software would be increased by the following factors (in decreasing order of importance):

- (1) integration of the software with the EHR (average score of 1.29 on scale of 1 to 3 with 1 being highest importance),
- (2) having more document types available for exchange (1.57), and
- (3) having more providers and practices participating (1.71).

6 Discussion

6.1 Feasibility and Adoption

The pilot demonstrated that DIRECT messaging is a feasible mechanism for exchanging patient health information within a community of physicians. Specifically, it showed that technology compliant with the DIRECT messaging standards and the HPDPlus provider-directory standards can be implemented and used at a wide variety of provider organizations to deliver clinical encounter summaries from hospital emergency departments to community practices. During the pilot period, over 200 such encounter summaries were securely delivered via DIRECT messaging to five different community practices.

Although this number represents a small proportion of all the ED encounters at the Palomar Health hospitals during this time, it does substantiate that DIRECT messaging can support secure interoperability among provider organizations with no custom integration. The experience also showed that the HPDPlus standards are a good foundation for standardizing access to provider directories, although these standards are not yet “plug and play” and still require custom integration work.

The site leaders and users were generally enthusiastic about the electronic exchange of health information via secure messaging. Participation in the pilot was significant, given the novelty of the technology, the small proportion of the overall community initially able to exchange DIRECT messages, and the single use case that we piloted. Based on survey responses, we expect that adoption will further increase and will increase at an accelerated rate as more providers in the community participate in DIRECT messaging and a broader set of use cases is supported.

At the same time, the pilot experience and our stakeholder surveys clearly indicated that DIRECT messaging technology must be much more tightly integrated into existing information systems and existing workflows at provider organizations before it will be embraced by all end users. This issue is discussed in the next section.

6.2 Integration with EHR Systems

As consistently noted in survey responses, increasing the integration with EHR systems was the most important factor that would increase the level of ongoing interest in DIRECT messaging for users as well as site leaders.

Among the emergency department users, we observed that simply allowing the attachment of patient documents from an EHR to messages formulated in a secure email application did not sufficiently streamline the messaging process for clinician users. Specifically, the additional steps needed to log into a separate email application, locate the patient documents, and locate the recipient’s address were prohibitive in the busy ED environment. For the ED users, they had to log into a separate system to send the message, which took time and disrupted their workflow. Further disruption to the scribes’ workflow was caused by the requirement to only send messages once the document had been signed by the ED provider. Another issue that the ED users encountered in the pilot was the relatively small number of community providers participating in the pilot. Thus, the users had to conform to this alternative approach to sending documents for only a small group of providers.

Among the community practice users, we observed that a stand-alone secure email client that was not integrated with the practice’s EHR also created certain workflow disruptions, even relative to existing processes based on fax technology. For users at one practice, the integration issue for this use case was encountered primarily in uploading received document attachments into the EHR. A common technology that practices already use to receive documents is electronic faxing. Due to the long-standing use and universal availability of this technology,

electronic faxing features are now integrated into many EHR systems, rendering faxing a preferred technology over secure messaging for certain users.

However, with the upcoming integration of DIRECT messaging into EHR products (as required by Meaningful Use Stage 2 EHR certification requirements), we believe these integration issues will be addressed within the next 12 – 18 months. In fact, many vendors already have added DIRECT messaging capabilities to the most recent versions of their EHR products, although the sites participating in the SoCalHIE pilot have not yet upgraded to these newer versions.

6.3 Advantages of Direct Messaging for Health Information Exchange

We heard explicitly in our survey of site leaders that DIRECT messaging is a valued approach to enabling health information exchange (HIE) in their diverse medical community. DIRECT messaging offers important advantages due to its lower-cost technology and its point-to-point communication model. This model contrasts with more traditional top-down, hub-and-spoke architectures for HIEs, which require centralized patient indexes and/or centralized patient data repositories.

First, DIRECT messaging has fewer governance issues. This is because in DIRECT messaging, the sender decides with whom and when they want to share data. A traditional HIE requires a governance organization that decides on the priorities of the HIE, how data may be used, who participates in the HIE, etc. Further, as EHR vendors begin integrating DIRECT messaging capabilities natively into their products, there will be even less requirement for a central resource (i.e., a HISP) to administer and govern. In the pilot, the reduced need for participation in a centralized governance structure and need for participation in a cost-sharing arrangement made it simple for each site to obtain approval to participate in the pilot, as noted in the interviews with site leaders.

Second, a DIRECT messaging HIE can be operationalized more quickly than a traditional HIE. In our case, the required software development and integration was performed and the network was operationalized in fewer than six months by a team of two part-time software engineers and a project manager. There were several reasons for this rapid start including quicker approvals and less time spent creating a central governance structure as described above, as well as less time spent on creating a centralized technology infrastructure and interfacing all of the participants' local I.T. systems to this infrastructure (which was not required).

Third, DIRECT messaging scales very easily for additional use cases. In SoCalHIE, we were easily able to add a new use case towards the end of the pilot period in which the Medical Records Department at Palomar Health receives requests for documents from community practices and fulfill those requests using DIRECT messaging. This enhancement required a very minor change to the Secure Messenger software to enable the display and attachment of additional documents from the EHR, and approval of the project from Palomar Health's leadership.

In comparison, traditional HIEs require years of set up before they are operational. This is because of the challenges in setting up a governance structure for a collaborative project among potential competitors. The software development and deployment processes are also much more complex in such a model.

At the same time, possible drawbacks of DIRECT messaging relative to traditional HIE models include (1) data exchange is not automated and requires manual initiation, (2) providers have to be aware that records exist at other organizations so that they know where to request them, and (3) there may be lags in obtaining records if they have to be requested and explicitly sent from another organization.

7 Next Steps

Given the experience from the initial pilot project, there are a number of planned initiatives to further evaluate the value and sustainability of DIRECT messaging as a model for HIE.

7.1 Tighter Integration with EHRs

There are several avenues for more tightly integrating DIRECT messaging technology with the EHRs in use at participating sites.

- Palomar Health: To streamline the transmission of patient information to community practices, we are implementing an automated message-delivery system. The system will be a stand-alone interface module that will be fed by an HL7 stream at the Palomar Health hospitals, will examine the HL7 feed to determine the appropriate community physicians who should receive the information, will look up these providers' addresses and DIRECT messaging capabilities in the HPDPlus Provider Directory, and will formulate and send the patient information to these providers as document attachments to a DIRECT message. The initial use case for this module will support the delivery of lab test results that Palomar Health performs for community providers on an outreach basis.
- Palomar Health: We also plan to assist Palomar Health in exploring the use of its hospital EHR's native DIRECT messaging capabilities. This EHR provides a vendor-specific HISP as an optional product module, which is already integrated with the EHR's messaging system and document-delivery system. If it is possible for the community HISP to interoperate with the EHR vendor's HISP, use by Palomar Health of its EHR's native DIRECT capabilities may provide better EHR integration for Palomar Health for certain use cases.
- Graybill Medical Group: Graybill plans to upgrade its EHR system to the most recent version, which offers built-in DIRECT messaging capabilities and HPDPlus provider-directory integrations. As Graybill proceeds with this upgrade, we plan to integrate these capabilities with the community HISP and community provider directory that have already been deployed.
- North County Health Services (NCHS): NCHS is a group of not-for-profit clinics that is interested in joining the SoCalHIE and specifically integrating its EHR with the DIRECT messaging infrastructure already deployed. We have started conversations with NCHS and its EHR vendor regarding the technical and logistical steps required for such integration.

7.2 Addition of More Provider Organizations

We anticipate the addition to SoCalHIE of several more provider organizations in the Palomar Healthcare District.

- Neighborhood Healthcare (NHcare): NHcare is a system of community clinics with nine sites in the North San Diego County area. NHcare recently signed up for two of its sites to participate in SoCalHIE, and will be brought on board in July 2013. As NHcare gains experience with DIRECT messaging, it may add additional sites.
- North County Health Services (NCHS): As mentioned above, NCHS is a not-for-profit outpatient health system with 10 sites in the Palomar Health medical community. NCHS has expressed strong interest in joining SoCalHIE, and plans to participate in the near future, even before its EHR can be integrated with DIRECT messaging capability.
- Independent Providers: We have collected a list of independent outpatient providers in the Palomar Health medical community (both primary care physicians and specialists) with whom the organizations

already participating in the SoCalHIE commonly exchange patient information. We will offer use of the community HISP to these providers. Although this “retail” recruitment effort will take time, we expect that some portion will agree to participate on a trial basis, which will encourage others to follow as the total size of the DIRECT messaging network increases.

7.3 Support for Additional Use Cases

The initial emergency-department use case has been temporarily suspended, pending greater integration of DIRECT messaging with the Palomar Health EHR. However, we have since added a new use case entailing the distribution of clinical documents from by the Palomar Health medical records department in response to requests from community practices.

We have also started the implementation of a module to support the reporting of outpatient lab results via DIRECT messaging (as noted above). We envision that this module will also be applicable for the automated reporting and distribution of other types of clinical documents, such as inpatient discharge summaries and radiology results.

Lastly, we plan to further encourage the use of the existing DIRECT infrastructure for the exchange of referral requests and consult notes among the participating organizations and the independent providers that we will be adding to SoCalHIE.

7.4 Models for Financial Self-Sustainability

The long-term goal of the SoCalHIE pilot is to demonstrate not only the feasibility and utility of DIRECT messaging as a model for HIE, but also its financial self-sustainability. This is a longer-term initiative that will require the addition of substantially more provider organizations to SoCalHIE, both to increase the number of potentially paying participants and to increase the value of SoCalHIE to each participant. The modeling of operational costs and potential fee structures will continue over the next 12 months.

8 Conclusions

In this first pilot of SoCalHIE, we demonstrated that it is feasible to use DIRECT messaging for sharing health data electronically. While the users and sites were enthusiastic about the concept, greater adoption of the technology is limited because of the lack of integration of the messaging software with the EHR systems. This likely will be addressed in newer versions of EHR products.

In this next phase, we will work towards (1) improved integration of the messaging and EHR systems at Palomar Health, (2) increase the number of participating sites, (3) increasing the types of documents being exchanged and the purposes for which they are exchanged (e.g., diagnostic test result reporting, consult requests and reports), and (4) begin exploring the financial self-sustainability of the DIRECT messaging infrastructure.

Acknowledgements

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Appendix

The appendix includes

1. Survey questionnaire for site leaders
2. Survey questionnaire for users

SoCalHIE Survey of Site Leadership

What is the name of your organization?

What was your motivation in participating in the SoCalHIE pilot

- Improve efficiency of operations
- Enhance the security and privacy when communicating patient records
- Provide a service/convenience to practices and organizations that refer patients to you
- Meet meaningful use requirement
- Ability to electronically exchange patient information with more organizations in your medical community
- Desire to use technology that is not tied to a specific vendor
- Facilitate the process of referring patients
- Facilitate the process of getting information from other providers who have treated your patients
- Other:

Has your organization participated in or considered participating in a health information exchange

- Yes
- No

If yes, please name the project and any key differences between that and SoCalHIE.

Please focus on issues that made either project succeed or fail

Briefly describe the approval process in your organization for participating in SoCalHIE

Please include the titles of approvers. Were there challenges in getting approvals for participating in this project.

Were any of the following a factor in your participation in SoCalHIE?

Select all that apply

	Positive	Negative	Neutral
Point-to-point exchange of information with selected organization rather than community-wide sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of security provided by Direct messaging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Effort and cost to your organization of participation in the pilot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The other organizations that were participating in SoCalHIE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How effective do you think secure messaging was for exchanging patient health information?

1 2 3 4 5 6 7 8 9 10

Not at all effective Highly effective

What were the major benefits your organization experienced in using SoCalHIE?

Were there any significant problems your organization encountered in using SoCalHIE?

Is your organization interested in continuing to use SoCalHIE beyond the pilot period?

1 2 3 4 5

Not at all interested Highly interested

Please rank the factors that would increase your level of interest in continuing to use SoCalHIE

Pick one from each rank. One is the most important and 3 is the least important.

	1	2	3	4
Reduced cost of participation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having more providers and organizations participate in SoCalHIE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tighter integration of Direct (the secure messaging technology) messaging with your EHR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to use Direct messaging for more types of health information exchange (e.g., diagnostic reports, consults)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please provide us with additional comments that you think may be helpful to us.

Submit

Never submit passwords through Google Forms.

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SoCalHIE Survey of Users

Thank you for taking the time to complete this anonymous survey. Please answer all of the required questions below. It should take you about 5 minutes to complete the survey.

To which organization do you belong *

- Arch Health
- Arthritis Care and Research Center
- Escondido Pulmonary Medical Group
- Graybill
- North County Internists
- Palomar Medical GROUP
- Palomar HEALTH

Please describe your role in the organization *

Please pick the best fit

- Provider (MD, PA, NP)
- Other clinician (RN, MA, scribe)
- Medical Records Staff
- Other Administrative Staff
- Other:

Please select how you used the secure messaging software *

- Exclusively for sending messages to others
- Exclusively for receiving messages from others
- For sending and receiving messages
- I did not use the software directly - my messages were handled by a delegate
- Neither I nor my delegate used the software
- Other:

Please select the types of documents or messages you exchanged *

	Sent only	Received only	Sent and received	Neither sent nor received
ED visit summary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inpatient discharge summary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Referral request	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consult note	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
History and physical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lab report	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radiology report	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Operative notes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Request for documents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
General inquiry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please list any other types of documents or messages you sent or received?

Please rank your experience in using the SoCalHIE secure messaging software *

Compare to how you performed the same activity prior to using SoCalHIE

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The software was easy to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using SoCalHIE secure messaging saved me time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The software fit well within my workflow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The software allowed me to send or receive documents in a timely manner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had confidence that the documents were getting to the intended recipient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The software allowed me to be compliant with health information release regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you ranked any answer as disagree or strongly disagree, please provide an explanation

Did you search for a provider or organization in the Provider Directory? *

If you performed a look up of a provider or organization when sending a secure message, you used the Provider Directory

- Yes
- No

Please rank your experience in finding provider or organization information when using the Provider directory

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I was able to find easily the provider or organization I was looking for	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was confident that I had found the right provider or organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found all the information I needed about the recipient such as secure email address, phone number, mailing address	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was confident that the information about the recipient was correct	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you rated any item above as Disagree or Strongly disagree, please elaborate

Why did you and your delegate not use the software?

- I never received a message

- I never needed to send a message
- I did not have time
- I did not think the software was valuable
- Other:

How interested are you in continuing to use SoCalHIE? *

1 2 3 4 5

Very interested Not at all interested

Please rank the factors that would increase your level of interest in continuing to use SoCalHIE

Pick one from each rank. One is the most important and 3 is the least important.

	1	2	3
Having more providers and organizations participate in SoCalHIE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having more types of documents or messages being exchanged	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having the software be more integrated with your EHR or other software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please let us know any other improvements to the system that would increase its usefulness

Please provide us with additional comments that you think may be helpful to us.

PLEASE CLICK ON THE "SUBMIT" BUTTON BELOW

Thank you for taking the time to complete the survey.