Perspective

Informatics response to address the COVID-19 pandemic in a safety net healthcare system

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ABSTRACT

In service of particularly vulnerable populations, safety net healthcare systems must nimbly leverage health information technology (IT), including electronic health records (EHRs), to coordinate the medical and public health response to the novel coronavirus (COVID-19). Six months after the San Francisco Department of Public Health implemented a new EHR across its hospitals and citywide clinics, California declared a state of emergency in response to COVID-19. This paper describes how the IT and informatics teams supported San Francisco Department of Public Health’s goals of expanding the safety net healthcare system capacity, meeting the needs of specific vulnerable populations, increasing equity in COVID-19 testing access, and expanding public health analytics and research capacity. Key enabling factors included critical partnerships with operational leaders, early identification of priorities, a clear governance structure, agility in the face of rapidly changing circumstances, and a commitment to vulnerable populations.

Key words: COVID-19, informatics, public health, electronic health record (EHR), vulnerable populations

LAY SUMMARY

Health information technology (IT) played a key role in the San Francisco Department of Public Health’s response to the COVID-19 pandemic in its safety net healthcare system, enabling important patient care workflows at the city’s public hospital system, refining actionable data for the county health system and the city as a whole, and facilitating research in partnership with academic and community organizations. This article describes how the IT and informatics response focused on serving vulnerable populations most affected by the pandemic.
INTRODUCTION

Mr. F, a Latinx man with hypertension in his late 40s, lived for several years in a single room occupancy hotel through a direct access to housing program for formerly homeless individuals. During the early weeks of the coronavirus pandemic, after numerous residents tested positive for the 2019 novel coronavirus (COVID-19), he moved to an Isolation and Quarantine (I&Q) hotel and tested negative for COVID-19. However, while at the hotel, he experienced headaches, fevers, and dyspnea and was admitted to the local safety net hospital where he was diagnosed with both COVID-19 and diabetes. After a short hospital stay, he improved with supportive care and returned to an I&Q hotel.

The COVID-19 pandemic disproportionately affects populations that rely on care from safety net healthcare systems, including African American, Latinx, and Native American communities, immigrants, and people who experience homelessness or are marginally housed.1–3 The pandemic has required healthcare system transformation that has presented unique challenges for safety net institutions.

The San Francisco Department of Public Health (SFDPH) comprises the San Francisco Health Network (SFHN, an integrated healthcare delivery system) and the Population Health and Prevention Division (the City’s public health system). SFHN serves a predominantly publicly insured and a culturally and linguistically diverse population: nearly 40% Hispanic/Latinx, 25% Asian, and 15% African American.4 SFDPH’s mission to protect and promote health and well-being of all San Franciscans centers around six True North Pillars—safety and security, health impact, service experience, workforce, financial stewardship, and equity.

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Figure 1. COVID-19 positive cases in city and county of San Francisco by race/ethnicity.

Figure 2. COVID-19 positive cases in San Francisco Health Network by race/ethnicity.
SFDPH’s Department Operations Center (DOC) for the COVID-19 response opened on January 21, 2020 to coordinate the citywide San Francisco public health response. On March 6, the mayor declared a local health emergency. After a quick succession of public health orders to restrict medical facility visitation, and half routine medical appointments and ambulatory procedures, San Francisco instituted one of the nation’s first shelter in place orders. Despite early measures, emerging data suggested COVID-19’s predominant impact on San Francisco’s Latinx community (Figures 1 and 2). Despite differences in availability and standards for data collection on race and ethnicity, data clearly show COVID-19’s toll on LatinX populations in both the SFHN and the City as a whole.

In August 2019, SFDPH had implemented a new enterprise electronic health record (EHR) across its acute hospital and trauma center, skilled nursing and rehabilitation hospital, and primary care and ambulatory specialty clinics to leverage information technology (IT) to facilitate achievement of True North goals. Therefore, the SFHN was required to pivot abruptly from ongoing EHR stabilization work toward responding fully to the COVID-19 pandemic.

This article describes the SFDPH health IT and informatics response to the COVID-19 pandemic to maximize healthcare system capacity, meet needs of specific vulnerable populations, expand testing capacity, and expand public health analytics and research capacity. Table 1 lists the public health goals and implemented solutions, while the text below describes key initiatives that highlight the safety net challenges and opportunities.

**SAFETY NET HEALTHCARE SYSTEM CAPACITY**

The communities served by SFHN saw the highest COVID-19 incident rates (Figure 3), and as of June 26, 2020, our hospital had served approximately one-third of the city’s hospitalizations.

SFDPH surge planning included augmentation of its acute care capacity. SFDPH opened a field care clinic by expanding a community health center with parking lot tents equipped with IT infrastructure to provide urgent care in a community served by our hospital. In addition to making care more accessible, this clinic offloaded care to preserve urgent care and emergency capacity at the acute hospital. To meet this need, IT duplicated the existing urgent care clinic’s EHR build and workflows for appointment scheduling, documentation, treatment, and billing. Since deployed medical staff crossed primary care and emergency department disciplines, IT and informatics teams provided stabilization support for staff unfamiliar with urgent care EHR tools and workflows.

In addition, SFDPH planned to expand the city’s capacity for lower acuity care patients with medical and behavioral health needs by standing up a lower acuity continuing care site, thus preserving the city’s COVID-19 surge capacity for acute care should the need arise. In preparation, SFDPH IT adapted the EHR’s field hospital build, housed within our EHR instance, to facilitate admission and core inpatient service documentation, including medication administration, diagnostic testing, and rehabilitation services.

**MEETING THE NEEDS OF SPECIFIC VULNERABLE POPULATIONS**

While many healthcare systems scaled their telehealth capacity to respond to the needs incurred by the pandemic, many safety net health systems lacked infrastructure, EHR capacity, or operational readiness to do so. In addition, barriers to digital access are more prevalent in safety net patient populations.

Healthcare systems with established patient portal functionalities and broad enrollment were able to expand telehealth quickly during COVID-19. At the start of the pandemic, six months post-EHR launch, SFDPH’s portal adoption was at approximately 5%, with enrollment in predominantly English-speaking patients (75%) and those less than 65 years old (80%), and SFDPH had only launched pilot video visit programs. Within 1 week of the emergency health order, SFHN ambulatory leadership asked IT to stand up broad telehealth capacity. SFDPH obtained emergency contract authority for an enterprise video visit client, built telehealth documentation and billing workflow, and developed patient-facing instructional materials targeted to patients with limited health literacy and limited English proficiency.

As part of an effort to reduce congregate living transition and facilitate isolation or quarantine, the city acquired nearly 2000 hotel rooms. Within the EHR, SFDPH IT provided containment departments to allow patient registration (demographics, medical record generation), clinical documentation and disposition in patients requiring isolation or quarantine and expanded mobile health team services by the street medicine teams.

**INCREASING EQUITY IN COVID-19 TESTING ACCESS**

DOC managed testing expansion and access not only for SFHN but also for the city, with a focus on vulnerable populations receiving care from other health systems or not engaged in care. Testing expansion allowed timely care, contact tracing, case investigation and an outbreak response, and operational readiness including surge planning. SFDPH launched multiple alternative testing sites as well as a mobile testing team staffed by public health nurses. IT built EHR departments with expedited registration, fast-track documentation, advance telehealth screening and scheduling, and online scheduling and registration for use by residential care facilities for the elderly. Finally, to facilitate care for vulnerable patients seeking care across health systems, SFHN released results through EHR-facilitated health information exchange. SFHN providers also had access to a reporting database to retrieve SFDPH public health laboratory results from other settings.

**EXPANDING PUBLIC HEALTH ANALYTICS AND RESEARCH CAPACITY**

SFDPH was responsible for data analytics and visualization (DAV) to inform the entire city’s response. Given the rapidly evolving pandemic, each of the DOC branches (Testing, Containment, Outbreak Management, Medical, Community Mitigation & Engagement, Epidemiology and Surveillance, and Environmental Health) led separate but coordinated data collection efforts using multiple IT systems.

The public health analytics goal of the DAV unit was to aggregate these disparate data sources to create metrics and dashboards to drive operational decisions, not only within SFHN but also across the city; to guide policy; and to provide data at the state and federal levels. This synthesis required centralized governance to evaluate operational needs and a detailed understanding of each branch’s workflows, data collection methods, and reporting requirements. The DAV created dashboards to summarize COVID-19 situational sta-
Table 1. Informatics response to the COVID-19 pandemic

| Population                                      | Healthcare/public health goal                                      | Information technology (IT)/informatics solutions                                                                 |
|-------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Safety Net Healthcare System Capacity           | Hospitalized COVID-19+ patients                                    | Added flex beds within the EHR for acute medical/surgical patients and enabled post-anesthesia care unit beds to function as ICU overflow with ventilator and monitor capable beds |
|                                                 | Expand intensive care and acute care capacity                      |                                                                                                              |
| Skilled nursing patients                        | Preserve acute care hospital capacity                              | Expanded designated acute medical beds in the EHR for the skilled nursing and rehabilitation hospital, thus facilitating discharges from the acute care hospital |
| Skilled nursing patients                        | Provide safe acute psychiatric care to those who are COVID-19+     | Built acute psychiatric unit within the EHR to function on acute care medical unit                             |
| COVID-19+ psychiatric patients                  | Preserves acute care hospital capacity                             | Adapted a field hospital EHR build and workflows to expand capacity for lower acuity care for patients with medical and behavioral health needs |
| Community                                        | Preserves acute care hospital capacity                             |                                                                                                              |
| Community                                        | Expand urgent care capacity in the community and reduce emergency care surge at hospital | Built new urgent care department in the EHR to allow for patient registration, triaging, provision of services, print mapping, and billing |
| Meeting the Needs of Specific Vulnerable Populations | Ambulatory                                                        |                                                                                                              |
|                                                 | Provide patients with clear and immediate instructions regarding the transition to decrease in-person care | Transmitted public health announcement via 58,575 text messages, 17621 robocalls and 6149 patient portal messages in English and Spanish about shelter-in-place, hospital visitor restrictions, and guidance on where to seek reliable information about COVID-19 |
| Inpatients                                      | Identify COVID-19+ patients at high risk for morbidity and deterioration | Leverage and validated existing registries for high risk medical conditions to provide actionable reports on hospital dashboards |
| Inpatients                                      | Improve patient experience amidst restrictions in visitor policies | Partnered with the Office of Patient Experience around management of donated devices                           |
| Inpatients                                      | Enable ongoing education of medical students and residents into care of vulnerable inpatients | Developed policies around lifecycle management of devices including physical management (warehousing, tracking, infection control, check-in/out); mobile device management (security, applications, operating systems); device support |
| Residents of skilled nursing and rehabilitation hospital | Monitor for new incident cases of COVID-19                        | Expanded WiFi broadband capacity for hospitalized patients to enable video calls                               |
| Persons experiencing homelessness or living in congregate settings | Protect individuals at high risk of COVID-19 who lack location to shelter-in-place | Partnered with residency and medical student leadership, patient experience to plan, do, study, act (PDSA) workflows to incorporate trainees in efforts to leverage telehealth tools to connect patients and families |
| Persons experiencing homelessness or living in congregate settings | Containment of the COVID-19 pandemic via housing to:                | Developed bulk ordering of COVID-19 tests for all nursing home residents at SFHN nursing home to allow for testing of nearly 800 residents every 2 weeks |
|                                                 | • Provide individuals exposed to COVID-19 a place to isolate        | Built documentation tools to support identification and reporting of patients who are residing in shelter-in-place sites |
|                                                 | • Provide COVID-19+ individuals a place to recover from COVID-19 infection |                                                                                                              |

(continued)
A top priority was maximizing equity in access to testing and care. However, this was challenging due to rapidly changing testing criteria, testing capacity across our SFDPH and external laboratories, and a passive surveillance system relying on health system mandatory reporting. For example, because of reporting gaps in data on race, ethnicity, and language, SFDPH needed to devote additional advanced analytic work to increasing the completeness of these data to reveal the full extent of the disparate impact on Latinx, Black or African-American, and Asian populations within SFHN. Specific

| Table 1. continued |
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| Population | Healthcare/public health goal | Information technology (IT)/informatics solutions |
| **Expanding COVID-19 Testing and Increase Access to Test Results For Safety Net Populations** | • Provide COVID-19+ individuals who living in congregate settings a place to quarantine | Partnered with city agencies on leveraging information technology infrastructure to enable telehealth at containment sites |
| Limited-English proficiency patients | Provide health services at containment sites | Built standard patient instructions in English, Spanish, and Chinese |
| Patients at risk for COVID-19 infection | Efficiently test patients for COVID-19 while protecting other patients and staff from exposure | Built a website to provide multilingual instructions for patients to promote use of telehealth video platform |
| High risk patients within City and County of San Francisco | Test patient populations who are unable to present to a testing site (patients experiencing homelessness, skilled nursing facility residents) | Built alternative testing departments in the EHR located at the acute care hospital and at multiple community health centers to allow for scheduling a COVID-19 testing appointment, specimen collection, and results routing |
| SFHN patients | Provide outside providers ability to know if SFHN patients were tested at SFDPH | Enabled COVID-19 test release via EHR health information exchange |
| **Expanding Public Health Analytics and Research Capacity** | San Francisco Population | Synthesize data sources within our own health system and across city health systems to enable city leadership to manage the pandemic | Developed operational dashboards with COVID-19 situational status and metrics pertaining to operational capacity, testing, cases, hospitalizations, and mortality, including analysis by race/ethnicity, language and neighborhood |
| | Communicate to the public the status of the pandemic | Developed publicly available dashboards and visualization, to inform the public about "the whole picture of coronavirus in our community" |
| San Francisco Population | Facilitate care for COVID-19+ study participants tested in community-engaged participatory research studies aimed to promote health equity in COVID-19 testing and care | Facilitated recording of COVID-19 results and communication with primary care for participants needing care linkages from large scale community-engaged participatory research testing studies |
| SFHN patients | Research novel ways to treat COVID-19 infection | Expedited research module approval and build for randomized controlled trial enrollment for COVID-19 therapies |
| | Provision remote external data monitoring for COVID-19 trials | Expedited approval process and build for remote external data monitoring for therapeutic trials |

COVID-19: coronavirus; EHR: electronic health record; SFHN: San Francisco Health Network.
cally, our analytics team created internal dashboards by matching state test result data with patients within the SFHN EHR for whom we had EHR-recorded sociodemographic data.

This issue informed SFDPH’s community-engaged participatory research priorities in partnership with the University of California San Francisco (UCSF). Researchers in both institutions collaborated with the Community Mitigation & Engagement branch, neighborhood community-based organizations and other city agencies to offer large scale testing in medically underserved neighborhoods with significant Latinx, African-American, Pacific Islander, and Chinese populations. Supported by grants and philanthropic funding, the coordination with DOC ensured participants engaged in care, not only for COVID-19 but also for their overall health. Since testing was not performed within SFDPH’s laboratories, embedded clinician-researchers entered positive COVID-19 results and documentation in the EHR to ensure safe transitions of care.

Figure 3. Distribution of COVID-19 positive cases in San Francisco by neighborhood.

- San Francisco General Hospital and Trauma Center
*data as of 6/28/20
Finally, although our 2019 EHR implementation did not include the full scope of a research module, SFDPH rapidly expanded the governance and build to allow for rapid initiation of COVID-19 therapeutic trials and remote access for external data monitors.

Mr. F had a post hospital discharge follow-up telephone visit with his primary care provider while at the hotel. He still felt quite fatigued. His primary medical clinic ran a report though the EHR of positive COVID-19 patients and developed an outreach plan to do regular follow-up with them. On a subsequent outreach call, he reported feeling worse and returned to the emergency department. He had a low-grade fever and oxygen requirement. On this hospitalization, he consented to participation in a remdesivir clinical trial. He remained hospitalized for several days until he no longer had an ambulatory oxygen requirement. He resides at a hotel today, able to access care from the Street Medicine team.

CONCLUSION

Mr. F’s case typified a patient seen at the SFHN highlighting not only the unpredictable nature of COVID-19 infection but also some of the added challenges faced by certain sociodemographic groups afflicted by COVID-19. As a public county health care system, IT leaders felt compelled to react swiftly to enable the features described to support clinical operations and as a means to address obvious disparities.

In our safety net healthcare and public health system, IT and informatics played an important role in responding to the COVID-19 pandemic. Leveraging a recently implemented EHR, SFDPH IT shifted quickly and fully toward responding to the immediate needs of the pandemic. While this shift helped to meet operational goals, other stabilization and optimization goals needed to be reprioritized, delayed, or temporarily mitigated with non-IT solutions.

Despite deployment of dozens of IT and informatics personnel to support DOC needs, SFDPH successfully met the need to support the city and health network’s COVID-19 response. Key factors to success were identified: (1) inclusion of multiple members of IT and informatics as part of the incident management team; (2) development of clear governance around EHR build approval to support the response; (3) close alignment with operational leaders to fully understand key goals; (4) agility to adapt to changing conditions and priorities; and (5) a fundamental commitment to support care of vulnerable populations and reduce disparities in access to testing and care.

As San Francisco enters various phases of reopening, SFDPH IT remains poised to meet the changing needs of the pandemic including ongoing testing, expansion of ambulatory care services/procedures, and ongoing surveillance and data analytics. Meanwhile, SFDPH will resume optimization activities and the expansion of EHR implementation to include care coordination across the city’s most vulnerable populations, advancing its mission to protect and promote the health of all San Franciscans.

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AUTHOR CONTRIBUTIONS

Each author has participated sufficiently in the work to take public responsibility for appropriate portions of the content. Shobha Sadaviah takes responsibility for the integrity of the work as a whole, from inception to publication. Authorship credit was based on (1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; and (2) drafting the article or revising it critically for important intellectual content; and (3) final approval of the version to be published. Conditions 1, 2, and 3 were all met.

CONFLICT OF INTERESTS STATEMENT

The authors have no competing interests to declare.

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