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Research and Applications

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The emerging role of clinical informatics fellows in service learning during the COVID-19 pandemic

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ABSTRACT

Objective: The study sought to describe the contributions of clinical informatics (CI) fellows to their institutions' coronavirus disease 2019 (COVID-19) response.
Materials and Methods: We designed a survey to capture key domains of health informatics and perceptions regarding fellows' application of their CI skills. We also conducted detailed interviews with select fellows and described their specific projects in a brief case series.
Results: Forty-one of the 99 CI fellows responded to our survey. Seventy-five percent agreed that they were "able to apply clinical informatics training and interest to the COVID-19 response." The most common project types were telemedicine (63%), reporting and analytics (49%), and electronic health record builds and governance (32%). Telehealth projects included training providers on existing telehealth tools, building entirely new virtual clinics for video triage of COVID-19 patients, and pioneering workflows and implementation of brand-new emergency department and inpatient video visit types. Analytics projects included reports and dashboards for institutional leadership, as well as developing digital contact tracing tools. For electronic health record builds, fellows directly contributed to note templates with embedded screening and testing guidance, adding COVID-19 tests to order sets, and validating clinical triage workflows.
Discussion: Fellows were engaged in projects that span the breadth of the CI specialty and were able to make system-wide contributions in line with their educational milestones.
Conclusions: CI fellows contributed meaningfully and rapidly to their institutions' response to the COVID-19 pandemic.

Key words: clinical informatics, medical informatics, graduate medical education, questionnaires and surveys

INTRODUCTION

The 2019 novel coronavirus (coronavirus disease 2019 [COVID-19]) pandemic has broadly impacted the educational opportunities of medical students, residents, and fellows. In academic health centers, didactics have moved to distance learning while many experiential learning opportunities have shifted to simulation or virtual-rounding methods.[1,2] After the Association of American Medical Colleges called for the suspension of direct patient contact responsibilities for medical students in March 2020, medical schools quickly adjusted to create alternative learning opportunities fulfilled the evolving needs of both learners and healthcare centers during the time of the pandemic.[3] In graduate medical education, there has been alteration in experiences across many specialties, including the reprioritization of clinical assignments—for instance, in procedural specialties in which case volume notably decreased, trainees were called to serve in the acute and intensive care setting.[4,5] Innovative educational solutions to mitigate the loss of in-person education have also risen to the forefront and have included the increased use of teleconferences for academic meetings, telehealth for patient care and precepting, and online instruction in various forms. However, the specific impact of COVID-19 on the educational experiences of trainees completing a clinical informatics (CI) fellowship remains unclear. While opportunities to network, understand systems, and meet face to face with stakeholders to advance traditional projects may have decreased, the rapid transformation that many health systems have made to their workflows have largely been facilitated by technology and advances in digital health. These recent changes have created an environment ripe for physician informaticians in training to translate their skills into tangible efforts to assist in a public health emergency. To better assess the impact of the COVID-19 pandemic on CI fellowship, we conducted a survey of current CI fellows to characterize their participation and proposed impact during the COVID-19 pandemic response.

MATERIALS AND METHODS

Survey design

The survey was designed via consensus discussion with all coauthors and was written to capture activity in key domains of health informatics, as well as perceptions regarding fellows' application of their CI skills. The initial survey draft was sent for review to recent CI fellowship graduates for acceptability testing. The final version was agreed upon by all authors and was distributed via email and internal messaging board platforms (Supplementary Appendix 1). Survey participants provided information regarding their fellowship program name, year in training, previous categorical residency training (or combined specialty training), and their proposed plans after fellowship (eg, academic, private practice, consulting, industry, other, undecided). Questions included year in training, specialty, plans after fellowship, and additional questions focused on involvement in project work and the creation of deliverables to the fellows' home institutions.

After the initial survey was complete, if the participant was willing to discuss their project in further detail, a detailed interview was conducted for inclusion in a brief case series.

This study was approved and received exempt status under the institutional review boards of both the University of California, San Francisco (20-30632), and Beth Israel Deaconess Medical Center (2020P000467).

Survey distribution

An electronic survey, developed on the Web-based REDCap (Research Electronic Data Capture), was distributed to all clinical informatics fellows (both Accreditation Council for Graduate Medical Education [ACGME] and non-ACGME) currently enrolled in an informatics training program across the United States. All CI fellows subscribed to the American Medical Informatics Association Clinical Informatics Fellow internal listserv received an email from the study investigators with a URL link to the survey. Additionally, CI fellows received up to 2 electronic reminders to complete the survey. Alumni of CI fellowship programs and directors were excluded. The survey period was from April 15 to May 8, 2020.

Survey analysis

Measures of frequency, including count, percent, and frequency were calculated to further analyze the data. All statistical analyses were conducted using STATA version 16 (StataCorp, College Station, TX).

RESULTS

Of the 99 fellows enrolled in CI fellowship programs across the United States, 41 fellows from 22 U.S. institutions responded to the survey (response rate = 41%). All 41 surveys were included for analysis.

Demographics

Demographic characteristics of survey respondents are showcased in Table 1. The most represented clinical specialty among the CI fellows was internal medicine (34%) followed by pathology (22%) and pediatrics (15%), with the remaining 30% from fields including psychiatry, emergency medicine, urology, and preventive medicine. Of the respondents, 63% were first-year fellows and 34% were second-year fellows, respectively.

Clinical informatics fellows' contributions

Overall, fellows appeared to be very engaged in their institutions' processes with 75% responding either "agree" or "strongly agree" to the prompt "I have been able to apply my clinical informatics training and interest to my home institution's COVID-19 response."

Table 1. Demographic characteristics of clinical informatics fellows during the COVID-19 pandemic (n = 41)

Year of training	
First	26 (63.4)
Second	14 (34.1)
Did not respond	1 (2.5)
Clinical specialty	
Internal medicine	14 (34.1)
Pathology	9 (22.0)
Pediatrics	6 (14.6)
Emergency medicine	3 (7.3)
Other[a]	9 (22.0)

Values are n (%).

COVID-19: coronavirus disease 2019.

[a]Includes surgery, family medicine, obstetrics/gynecology, preventive medicine, psychiatry, urology, and not otherwise specified.

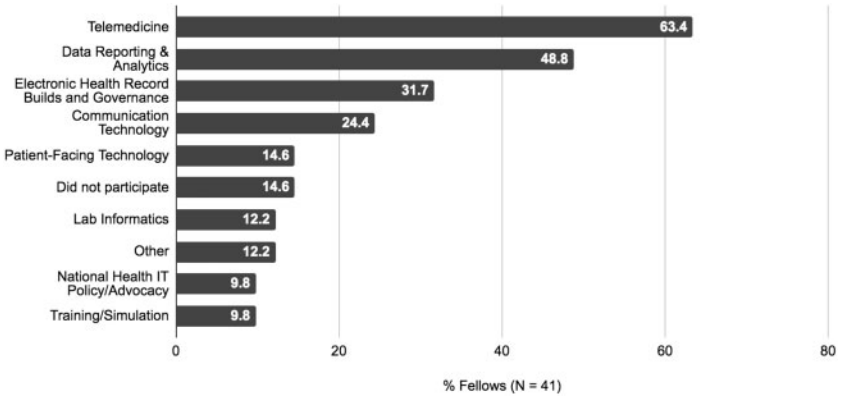

Figure 1. Fellows' project types in their home institution's COVID-19 (coronavirus disease 2019) response: multiple efforts by fellows were included. The majority of fellows (63%) were involved in telemedicine implementation at their institution, followed by data reporting and analytics (49%) and electronic health record builds and governance (32%). Examples of "other" included creating crisis management tools, helping with provider workflow management, and performing clinical work. IT: information technology.

Table 2. Scholarly efforts and postfellowship career plans

Variable	Responses[a]
Fellow efforts leading to scholarly products (n = 54)	
System-wide operational guidelines/workflows	26 (78.8)
Abstract	13 (39.4)
Manuscript	13 (39.4)
Local or national presentation	13 (39.4)
Other	2 (6.1)
Postfellowship career plans (n = 57)	
Academics	18 (45.0)
Private practice	7 (17.5)
Consulting	7 (17.5)
Industry	5 (12.5)
Other	4 (10.0)
Undecided	16 (40.0)

Values are n (%).

[a]Multiselect response on survey permitted.

Figure 1 portrays the distribution of project types the fellows were involved in; many fellows reported being involved in more than 1. The most common project types were telemedicine (63%), reporting and analytics (49%), and electronic health record (EHR) builds and governance (32%). The least common project types were National Health Information Technology Policy or Advocacy (10%) and Training or Simulation (10%).

In response to the prompt "My efforts during the COVID-19 response may lead to the following," 79% of participating CI fellows reported that their work would lead to changes in system-wide operational guidelines and workflow at their institution. As shown in Table 2, anticipated academic output included the drafting of abstracts for submission (39%), manuscripts for publication (39%), and local or national presentations (45%). Nearly half of the CI fellows reported plans to pursue a career to academics (45%), while two-fifths of respondents reported being undecided about future career plans at this point in time (40%).

To further characterize how clinical informatics fellows individually contributed to each of their projects, we conducted a semi-structured interview with participants who were willing to be contacted. A brief case series was created to highlight some of the contributions mentioned by fellows in these interviews.

Project case series

Telehealth

Telehealth was recognized as a key strategy in many health systems to provide triage or continuity of care while social distancing. Accordingly, the majority of the fellows participated in a telehealth-related project. These projects included expanding traditional telehealth offerings by training providers on existing telehealth tools, building entirely new virtual clinics for video triage of COVID-19 patients, and pioneering workflows and implementation of new emergency department (ED) and inpatient video visit types.

Fellows had a direct role in designing and implementing the telehealth training curricula, including the design of COVID-19 video triage protocols. At one institution, fellows led an effort around testing and implementing peripheral equipment (remote vitals, Bluetooth stethoscope) to optimize transmission of diagnostic information during tele-ED, tele-wards, and tele–intensive care unit visits. At another institution fellows developed documentation language for eConsults. The fellows at another institution led an effort to characterize the trainee experience after the transition to a completely digital pathology slide review process.

Order sets and templates

Diagnosis and management of COVID-19 provided many challenges to frontline providers due to rapidly changing protocols. Shifting from travel-based screening because of widespread community transmission, along with polymerase chain reaction (PCR) test kit shortages, led to reprioritized testing criteria. Fellows had high participation and directly contributed to note templates with embedded screening and testing guidance, adding COVID-19 tests to order sets, and validating clinical triage workflows.

Fellows were particularly valuable in this area as they provided subject matter expertise in their clinical realm, in-depth experience of their local workflows, and basic-to-advanced capability to build out the required care pathways, order sets, or documentation tools. At one institution, the fellow served as a key interface between mental health administration and EHR architects to define digital check-in workflows and questionnaires. At another institution, the fellow created and validated new EHR content for COVID-19 screening, testing, and discharge.

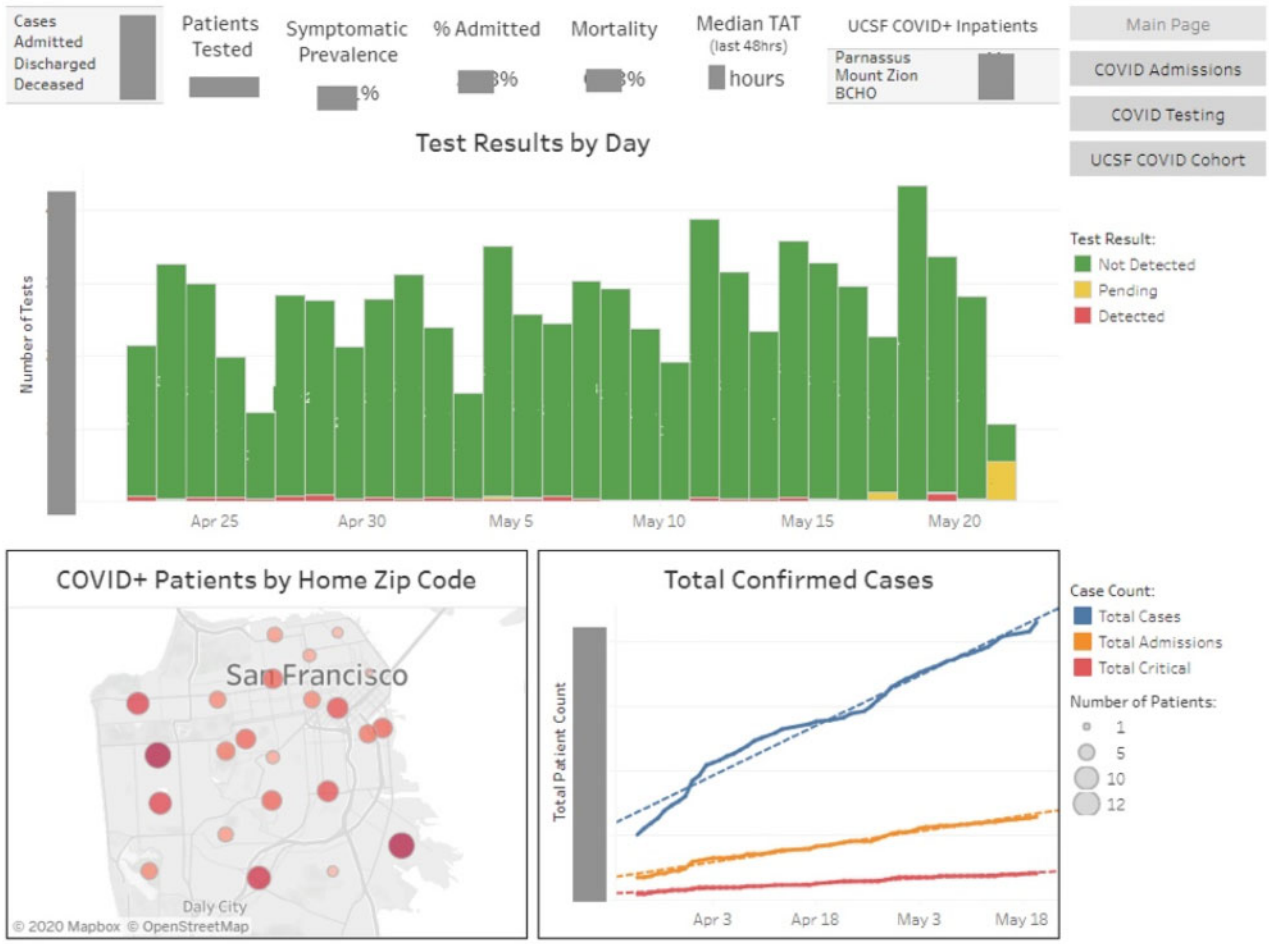

Figure 2. Hospital medicine dashboard for tracking test results, confirmed case numbers, and patient zip codes. Survey results indicated that 49% of clinical informatics fellows reported involvement in coronavirus disease 2019 (COVID-19)–related data reporting and analytics efforts at their home institutions. Data dashboards such as Figure 2 were created by fellows to assist with tracking of COVID-19 testing, new cases, hospitalizations, surgical case volume, and other valuable metrics.TAT: turnaround time; UCSF, University of California, San Francisco.

Reporting, analytics, and data visualization

In a rapidly evolving situation, accessible and actionable information is key. Many fellows took on projects providing reports and dashboards to institutional leadership at all levels, including the incident command center, department head, or clinic lead. At one institution, the fellows developed multiple dashboards to disseminate COVID-19–related information for inpatient surge planning, as well as surgical case scheduling and prioritization. At another institution, the fellows led tracking of ED volume and COVID-19 case count reporting. Figure 2 shows images from a hospital medicine dashboard for tracking test results, confirmed case numbers, and patient zip codes. Survey results indicated that 49% of clinical informatics fellows reported involvement in COVID-related data reporting and analytics efforts at their home institutions. Data dashboards such as the in Figure 2 were created by fellows to assist with tracking of COVID testing, new cases, hospitalizations, surgical case volume, and other valuable metrics.

At another institution, fellows identified "digital breadcrumbs" of interpersonal interactions (EHR event data, Wi-Fi access logs, and Bluetooth device connections) to enhance their hospital's contact tracing efforts and alert patients and staff to potential infectious exposures (Figure 3).

Communication and secure messaging

In an era of social distancing and remote work, it was imperative to develop new and Health Insurance Portability and Accountability Act–compliant communication for communication between patients, providers, and staff. At one institution, the fellows piloted a Virtual Provider Workroom using the Voalte Me/Messenger messaging platform (version 3.9.7; Hill Rom, Batesville, IN) to include clinicians, schedulers, and clinic directors. This allowed multiple clinic providers to communicate with each other about clinical questions ("Is conjunctivitis currently considered a COVID-19 presenting symptoms?") as well as logistical questions ("How do I order an antibody test?" and "Can you schedule my patient for a follow up video visit in three days?").

COVID-19 test result management

Real-Time-PCR testing is the cornerstone of COVID-19 diagnosis. Assessing the test performance characteristics, and ensuring timely notification of results to patients, providers, and staff is important for disease management, and reducing pandemic spread. The fellows with a pathology background were particularly well equipped to lead efforts around COVID-19 test evaluation and results manage-

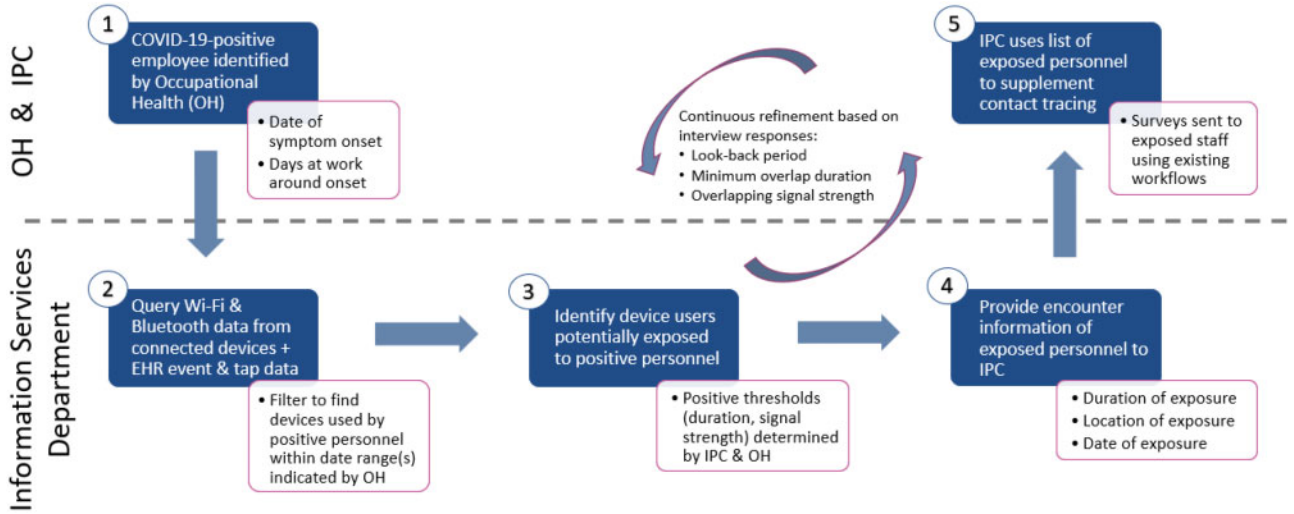

Figure 3. Workflow for digital contact tracing for coronavirus disease 2019 (COVID-19) using electronic health record (EHR) event data, Wi-Fi access logs, and Bluetooth data. Fellows identified "digital breadcrumbs" of interpersonal interactions to supplement their hospital's contact tracing efforts in identifying staff with potential infectious exposures. IPC: infection prevention and control; OH, occupational health.

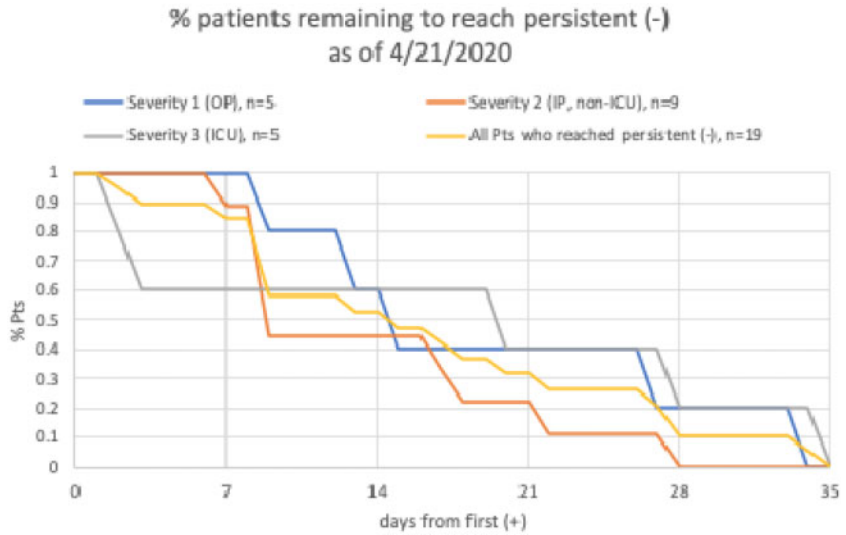

Figure 4. Sensitivity chart of polymerase chain reaction sample types, time to negative relative to encounter types. One clinical informatics fellow reported comparing the sensitivities of polymerase chain reaction sample types (eg, nasopharyngeal swab) and assessed the time to consistent negative results. ICU: intensive care unit; IP: inpatient; OP, outpatient.

ment. At one institution, the fellow compared the sensitivities of PCR sample types (eg, nasopharyngeal swab) and assessed the time to consistent negative results (Figure 4). At another institution, the fellows coordinated convalescent plasma donation for clinical trials. At another institution, the fellows performed a deep-dive analysis on the patient result notification process and identified and proposed solutions to gaps around miscommunicated results.

COVID-19 public health informatics

Fellows also participated at the public health level. One institution provided an elective rotation at the county department of public health. The fellows redesigned the results routing workflow to reconcile and accommodate results from multiple labs and decreased the latency of alerting the contact tracing team to a positive result. The fellows also assisted in database management to improve timeliness and accuracy of case counts for county and state reporting.

DISCUSSION

The COVID-19 pandemic created an environment in which CI fellows could leverage their accumulated training to aid in their institution's surge response beyond anticipated clinical needs. To meet new demands for care delivery, quality, and safety in the COVID-19 pandemic, healthcare institutions rapidly implemented EHR modifications, telehealth, mobile applications, and other digital solutions[6–11]—all requiring CI expertise across multiple medical disciplines. The distribution of represented clinical specialties among survey respondents mirrors that closely of previous surveys of CI fellows nationwide, as evidenced by a American Medical Informatics Asso-

ciation postgraduation job survey from the 2017-2018 academic year—thereby suggesting a similarity between the sample of fellows surveyed in this study and the overall population.[12] Alongside experienced faculty members, these CI fellows also supplemented, and pivotally influenced, these COVID-19–related technology efforts.

The foundation of core ACGME competencies and recommended CI domains of practice like project management, data and analytics, order set development, and user interface design.[13,14] allowed rapid implementation and contribution from fellows, as early as their first year of fellowship. Our results show that these contributions were operationally impactful, academically productive, and facilitated the service learning of CI fellows, fulfilling several ACGME CI competencies across multiple domains.

The lack of standards for diagnosis and treatment of COVID-19 also led to increased collaboration across institutions. Fellows brought great value to their institutions' surge responses by contributing both their personal experience and time and their collective knowledge of the fellowship network.

In the era of COVID-19, fellows demonstrated how they could integrate into operational workflows, providing a template for future rotations, even after COVID-19 issues resolve. The breadth and depth of projects successfully launched presents a potential avenue through which CI fellows' activities can be evaluated. In a post-COVID era, we are hopeful that informatics fellows will continue to provide this type of innovation and expertise.

Limitations

Our study has important limitations. The number of fellows nationally is small, and only 41% responded to our survey, though this mirrors challenges faced in surveying learners in other aspects during the COVID-19 pandemic.[15] Additionally, the surveys were distributed early in the pandemic response timeline, and fellows' roles may have changed, including during the recovery phase at some institutions. Fellows who played minor roles in COVID-19 response activities or were unable to participate may also have been less inclined to fill out the surveys, potentially inflating the contributions of fellows from our sample. Furthermore, CI fellows, who are located throughout the country and inherently represent a diverse group of specialties, may have been redeployed to perform necessary clinical duties in their healthcare center.

CONCLUSION

Our study is among the first to examine CI fellows' contributions nationally during the COVID-19 pandemic and features a cross-institutional perspective. CI fellows possess the skills and desire to contribute meaningfully and rapidly to their respective institution's response to a crisis such as the COVID-19 pandemic. Fellows engaged themselves in projects focused on (but not limited to) telemedicine, data reporting and analytics, and EHR builds. The contributions of the fellows surveyed spanned the breadth of the CI specialty and influenced system-wide contributions in line with their educational milestones. Future work on evaluating the trajectory of CI fellows will help delineate the life span of these efforts and their influence on career development. Their work during this time serves as a model for service learning in medical education, which may continue to be beneficial in a post-COVID-19 era of training.

AUTHOR CONTRIBUTIONS

MSa and RK conceptualized the study. All authors contributed equally to the overall design of the study. MSu was responsible for the survey design and survey distribution, and coordinated communications among the research team. All authors interpreted the data. MSa and MSu wrote the first draft of the manuscript, and all authors reviewed, edited, and contributed to subsequent revisions. Regarding data access, responsibility, and analysis, MSu, MSa, and PR had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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CONFLICT OF INTEREST STATEMENT

RK reports licensing income from Voalte, a subsidiary of Hill Rom, Inc.

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