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ARTICLE

Navigating the Covid-19 Pandemic by Caring for Our Health Care Workforce as They Care for Our Patients

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Leaders at Stanford Medicine, located in one of the first U.S. communities to be affected by Covid-19, quickly realized that they were not prepared to meet the escalating needs of their clinical and operational workforce. The pandemic would require existing care-delivery structures across the academic medical system to be expanded and aligned to prioritize workforce protection. Leaders identified an approach driven by connection, collaboration, and caring. They created specialized teams to develop a systemwide Occupational Health service with practices and procedures to assess health care workers and begin robust Covid-19 polymerase chain reaction testing; to centralize operations to maximize utilization of essential clinical and nonclinical staffing resources; to make visible and address psychological safety concerns and basic needs for faculty and staff; to aggressively address personal protective equipment supply chain issues and effectively assess infection risk; and to plan for a safe return of elective procedures and visits.

For a health care organization to deliver high-quality care to patients, whether in normal times or in a crisis, the safety and well-being of health care workers (HCWs) is crucial. Although this may seem obvious, the care of HCWs is at times taken for granted by health care leaders rather than recognized as a priority requiring intentional actions and strategies. As the Covid-19 pandemic began to take hold in March 2020, the Centers for Disease Control and Prevention (CDC) identified Santa Clara County, California, as a community requiring elevated containment strategies.[1] Two at-risk populations were identified: elderly/immunocompromised persons and the health care workforce. At Stanford Medicine, we recognized that we were not prepared to meet the needs of our

clinical and operational workforce within our current structures. An expanded and aligned approach to workforce protection across our system would be required. To coordinate system response efforts, we activated a hospital emergency incident control system (HEICS) and created a governance structure, chaired by physician executives, to oversee the clinical response and to coordinate operational priorities.

The Stanford Medicine system includes Stanford Health Care (SHC), the academic flagship hospital serving adult patients; Stanford Children's Health/Lucile Packard Children's Hospital (SCH/LPCH), an academic hospital serving pregnant women and pediatric populations; SHC ValleyCare (VC), a community hospital in the Tri-Valley located 40 miles from Palo Alto; and the Stanford University School of Medicine faculty and providers assigned to each of the hospitals and ambulatory sites. Stanford Medicine reported consolidated fiscal year 2019 net health care services revenue of $7 billion.[2] Upon HEICS activation, executive, operational, and clinical leaders from these three hospitals, each with quite different patient populations, volumes, acuity, and level of risk in the setting of Covid-19, came together to create shared strategies and one overarching response plan. Our common commitment to support our HCWs while ensuring the highest level of safety for them and our patients became our unifying call to action.

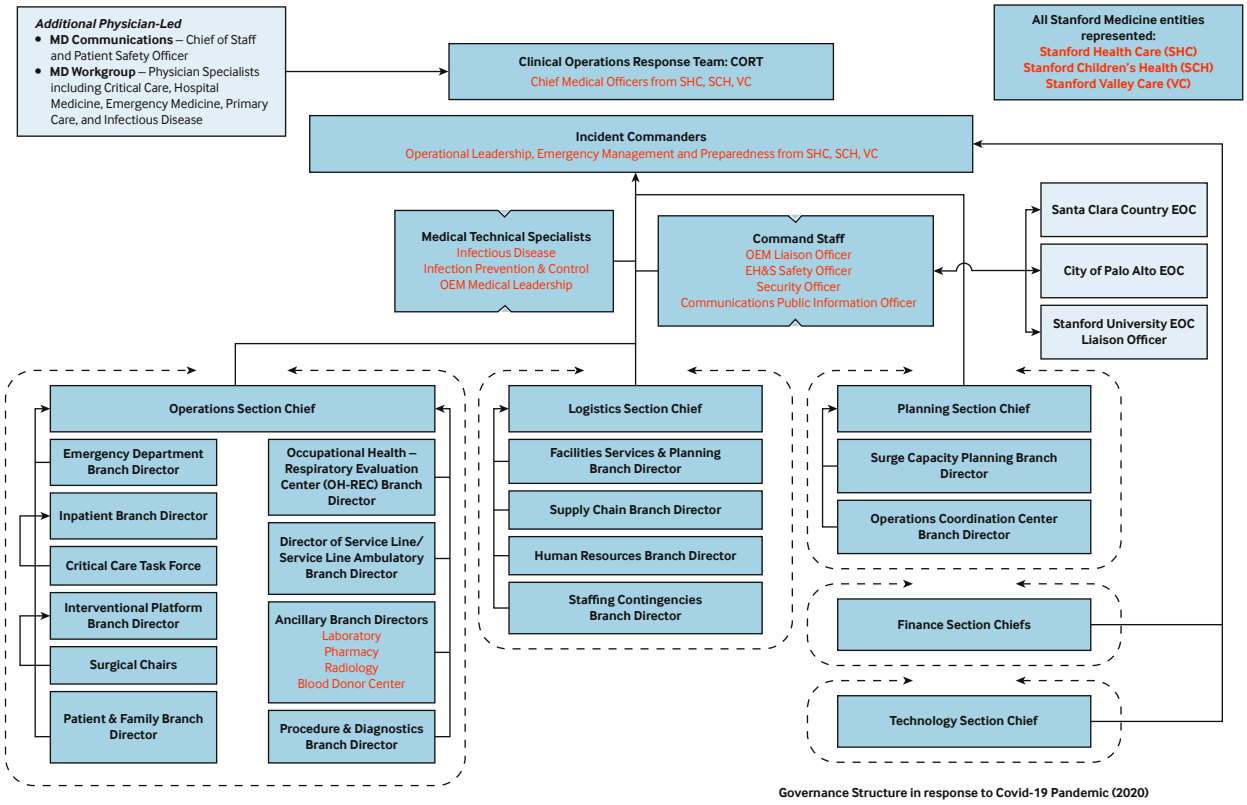
Following the emergence of the Covid-19 outbreak in Wuhan, China, in December 2019, caused by the novel human coronavirus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), infection rates reached pandemic proportions. By the end of March 2020, just as the surge was beginning in the United States, more than 77,000 cases a day were reported worldwide, with nearly 5,000 daily deaths.[3] SARS-CoV-2 was causing a wide range of clinical outcomes, from a complete lack of symptoms to severe respiratory dysfunction requiring ICU-level care.[4]

As the pandemic accelerated, one of the most pressing issues facing HCWs was the risk of transmission in frontline clinical settings. Infection and subsequent removal of significant numbers of HCWs from the workforce because of quarantine and/or treatment when required amplified the strain on health care systems across the globe. In response, Stanford Medicine activated an incident command structure that included the Clinical Operations Resource Team (CORT), comprising senior-level leadership across the health system (Figure 1).

FIGURE 1

Clinical Operations Resource Team (CORT)

CORT, which included senior leaders from across the health system, was instituted when Stanford Medicine activated its incident command structure in response to Covid-19. EH&S = Environmental Health & Safety, EOC = Emergency Operations Center, OEM = Office of Emergency Management.



Source: The authors

This governing body identified early the key foundational elements to keep staff and patients safe:

- a systemwide Occupational (Occ) Health service with practices and procedures to assess HCWs and perform Covid-19 testing,
- centralized operations to maximize utilization of essential clinical and nonclinical staffing resources,
- a mechanism to make visible and address psychological safety concerns and basic needs for faculty and staff,
- a robust supply chain for personal protective equipment (PPE) procurement, and
- a plan for sustained vigilance and safe reactivation of elective procedures and visits.

While on the basis of extremely limited knowledge of this soon-to-be devastating viral infection, CORT focused on the major areas of work that leadership knew would be instrumental: adopting a robust operational approach to keeping our trainees, staff, and physicians safe as they cared for patients affected by Covid-19 and all other illnesses, injuries, and conditions. Task forces and committees were created to address evolving needs as the pandemic progressed (Appendix).

Enhancing the Occupational Health Team

We realized by the first week of March 2020 that maintaining a healthy workforce was critical to our getting in front of Covid-19 and remaining there. Our then-current Occ Health service was structured to provide routine services; we relied on a contracted physician group to provide one medical provider per day to work with a limited number of employed Occ Health nurses and one registered nurse (RN) clinic manager to staff the employee health clinic 5 days a week. The Occ Health services were provided to SHC and SCH/LPCH employees (e.g., nurses, respiratory therapists, medical assistants, technicians, employees in housekeeping and food services) and providers (e.g., physicians employed by the School of Medicine providing patient care) in the inpatient, interventional, and outpatient settings, accounting for a population of approximately 15,000 patient-facing physicians and staff. The clinical space was limited but sufficient to meet the usual needs of HCWs who were required to undergo annual testing, such as for tuberculosis (TB) and N95 mask fitting, and to support limited contact tracing for non–Covid-19 situational exposures such as TB. Because of the limited number of individuals who required such services, a paper-based system for workforce health tracking supported consenting for tests, documenting laboratory results, and other record keeping. These manual systems, along with some limited technology, seemed adequate to maintain the legal mandate of confidentiality of protected health information (PHI) of HCWs separate from their medical records, but we recognized that a paper-based system would be inadequate for the expanded efforts underway.

> *"Although all volunteers [recruited for the Occ Health Respiratory Evaluation Center] had expertise in their usual roles, they needed to perform as an expert team in order to provide high-quality services to their HCW colleagues."*

Although clinical treatment and daily management of faculty and employees infected with Covid-19 would not typically fall under the umbrella of Occ Health services, our leadership team agreed that Occ Health would provide surveillance, testing, and contact tracing as part of our Covid-19 surge support, in addition to supporting the physical and emotional needs of those who became infected but did not require hospitalization.

To rapidly enhance services to support our faculty and health care workforce, we needed to ramp up two primary functions: (1) a clinical service for assessment and testing; and (2) a call center to offer triage, guidance, and support; notification of test results; direction related to returning to work (RTW) safely; and coordination of contact tracing. The new clinic and telephone system would

need to support 15,000 HCWs. Volunteer leaders and staff were pulled from services across the health system to operationalize these new services.

Under the direction of an operational executive leader whose usual role was in the Office of the Chief Quality Officer and a medical leader with previous experience in Occ Health to oversee the clinical function, the Stanford Occupational Health Covid-19 Response Services, consisting of the Respiratory Evaluation Center (OH-REC) and the Telephone Center (OH-TEC), were created in just 3 days. The clinical site was located in the annex of prior ED space, central to faculty and employees from both the adult and the children's hospitals. Nearly every aspect of the OH-REC had to be built from square one. Staff and managers were recruited from volunteers representing many parts of the health system where services were on pause because of shelter-in-place guidelines in our county: primary care clinics, the cancer center, ambulatory specialty clinics, perioperative services, and the interventional platform. Although all volunteers had expertise in their usual roles, they needed to perform as an expert team in order to provide high-quality services to their HCW colleagues.

Thus, we were deliberate in the use of teamwork strategies and tools. First, the volunteer leaders and staff members were required to complete skills-based training including the appropriate use of PPE, donning and doffing the equipment, and proper techniques for swabbing and collecting specimens for Covid-19 real-time reverse-transcription polymerase chain reaction (RT-PCR) testing. We then created a common language to facilitate effective communication by developing scripts to guide nurses and others not previously trained in Occ Health or primary care in asking and answering questions and addressing concerns related to Covid-19, triaging calls to guide those in need of assessment to the OH-REC or ED, relaying test results and providing information about the meaning of the results, and offering guidance related to RTW safely. We conducted daily briefs to plan for the day's work and huddles to develop and refine workflows and protocols that aligned the new Occ Health Covid-19 surge system with CDC, state, and county guidance under the direction of our infection control experts. Because the surge structure was led by the clinical team in collaboration with members of the Office of Emergency Management under the HEICS structure, protocols were aligned among Occ Health, the EDs, and ambulatory testing sites. We debriefed after each day to reflect on what went well, what we learned that day, and what we could do differently the following day to improve overall performance.

As a complex health system caring for patients across the age spectrum in three different institutions, our health care workforce and management teams needed just-in-time support to respond to questions about test results, RTW, and postexposure guidelines. Managers of clinical care units and designated faculty liaisons, chosen by the chairs of the clinical departments in the School of Medicine, became integral members of the Occ Health response team, providing outreach to exposed physicians and staff members to ensure daily self-monitoring, immediate self-isolation for symptomatic workers, and robust contact tracing, and supporting wellness and safety during times of great uncertainty.

IT challenges had to be overcome, including spending several weeks transforming paper-based triplicate forms to electronic records that remained separate from PHI. Data systems in the laboratory where Covid-19 RT-PCR tests were run did not interface with data systems in the clinic

and call center, so hand counting was required even when more than 1,000 employees had been tested. At the same time, innovation occurred frequently to overcome the challenges of scale, such as creating QR codes (quick response barcodes) for worker attestation and consent and real-time locating systems on employee badges to provide more thorough contact tracing.

Staffing for the expanded Occ Health services was largely managed through the contingency labor pool subcomponent of our HEICS structure, which we named the Contingency Staffing Operations Center (CSOC) at SHC. CSOC was a centralized operational effort that maximized utilization of our essential clinical and nonclinical staffing resources across the organization by matching resource offers to requests. A key responsibility of CSOC was to identify essential roles that would be needed to support not only Covid-19 and non–Covid-19 patient care units, but also the OH-REC and OH-TEC, as well as security, temperature screeners, PPE runners to distribute supplies, and the patient companions service, which was created to provide clinically trained personnel (RN or nursing assistants) to sit with patients who were struggling socially because of the isolation required by the viral infection or visitor restrictions. Additionally, these companions were present with patients at end of life, as chaplains were restricted from visitation at the height of the pandemic.

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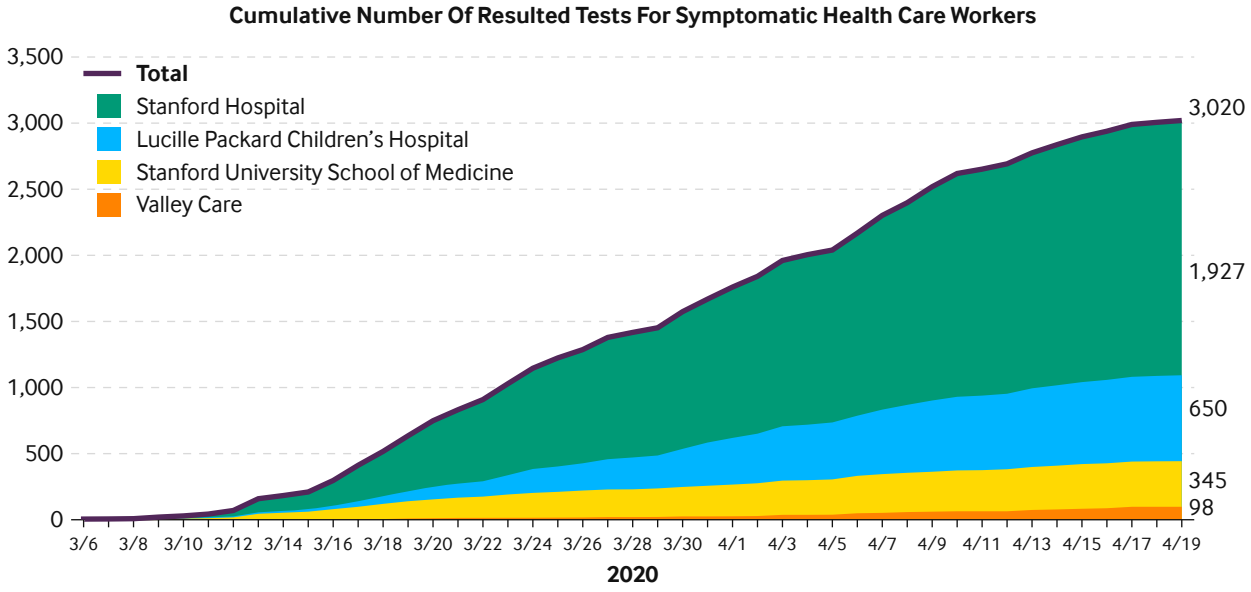
Through the exceptional efforts of numerous individuals, we successfully evaluated and conducted RT-PCR Covid-19 testing on more than 3,000 symptomatic HCWs within 6 weeks of establishing the OH-REC (Figure 2). During the same time period, personnel at the SHC contact centers, including Clinical Advice Services and the Enterprise Contact Center, with their baseline staff and those brought in to staff OH-TEC, fielded more than 25,000 phone calls from symptomatic and anxious HCWs and community members seeking information, advice, and appointments. Covid-19–related Contact Center volume peaked at greater than 4,000 phone calls on a single day within the first 2 weeks. On average, 46% of calls were answered by staff within 30 seconds, and those calls that rolled over to automated messaging were returned within 1 hour and 45 minutes.

FIGURE 2

Testing for Symptomatic Health Care Workers

This shows the cumulative number of the Stanford laboratory–developed RT-PCR test for SARS-CoV-2 collected from symptomatic SHC employees through the first 45 days of the pandemic. The graph is from March 6, 2020 (day 1), to April 19, 2020 (day 45), and shows the number of resulted tests by entity within Stanford Medicine: the total number of cumulative employee tests resulted (purple line), SHC cumulative tests resulted (green), Lucille Packard Children's Hospital cumulative tests resulted (blue), SHC VC cumulative tests resulted (orange), and Stanford University School of Medicine providers cumulative tests resulted (yellow).



Source: John Shepard, MBA, MHA; Jeff Kirk; and Eric Hadhazy, MS, for Stanford Health Care

A challenge of this crisis was the need to alter and continuously update Occ Health workflows and protocols as knowledge about the virus and its transmission evolved, all while managing an exponentially increasing volume of calls and visits. Dynamic changes in knowledge led to the need for dynamic changes in Occ Health guidance and clinical practice, during a time when HCW anxiety was high. As in other health systems that incorporated the principles of a learning organization into daily operations to help navigate the Covid-19 crisis,[5] we used the daily management infrastructure already in place at Stanford to facilitate the communication of new external knowledge to the bedside/OH-REC and to accelerate the spread of new internal knowledge and lessons learned by frontline clinicians. Although we encountered initial constraints in our on-site laboratory testing capacity, Occ Health was able to expand testing from only those providers and staff with major symptoms (i.e., fever, cough, and shortness of breath) to HCWs with any symptoms, no matter how minor, within a month. Deliberate evaluation of the literature, CDC guidance, guidance from our infection prevention and control department (IPCD), and our own testing and tracing data led to this early focus on testing, eventually to include all asymptomatic providers, in parallel with our testing expansion in patient populations.

Never has the partnership between Occ Health and the IPCD been more important than during the Covid-19 pandemic, and the rapidly changing environment over the first weeks of the pandemic required a change from informal, occasional meetings of the two teams to a formal weekly meeting with even more frequent, at times daily, informal discussions. Together, colleagues from these two departments approached problems that had no clear answers as opportunities to apply rapid improvement cycles. They developed policy and protocols together, implemented them, and assessed their impact. For example, local and national guidance regarding when Covid-19–positive HCWs could safely RTW provided more than one option and was at times contradictory. Together, the departments developed an RTW strategy based on results of our internally run RT-PCR Covid-19 tests with an average turnaround time of less than 2 days that safely allowed HCWs who had recovered from Covid-19 to return to the front lines.

Addressing HCW Psychological Safety and Well-Being

Maintaining an adequate health care workforce in this crisis requires not only a sufficient number of physicians, nurses, advanced practice clinicians, residents and trainees, laboratory personnel, and others, but also maximizing the ability of each individual to perform at a high level under trying conditions. Our clinical teams and health care workforce faced challenges that included volume surges, unfamiliar clinical scenarios and deployment to new clinical roles, rapidly evolving practice environments, moral distress, and working in cumbersome PPE that was critical not only to reduce the risk of the individual HCW becoming infected, but also to minimize the risk of becoming a vector and transmitting the virus to family and loved ones. While facing such extreme demands in the workplace setting, these individuals were also coping with the societal shifts and emotional stressors faced by their family members, professional colleagues, and, indeed, all members of the community we serve as we collectively navigated the unpredictable course of the pandemic.

To better understand the specific needs of our HCWs in the setting of the Covid-19 pandemic, leaders of the WellMD Center at Stanford, which has a mission to "advance the well-being of physicians and those they serve," conducted listening sessions with groups of physicians, nurses, advanced practice clinicians, and residents and fellows during the first week of the pandemic.[5] These discussions revealed sources of anxiety that could weaken the confidence of health care professionals in themselves and in our health care delivery system precisely when their ability to stay calm and reassure the public was most needed. Following guidance offered by the WellMD Center, in concert with our Human Resources leaders, we took tangible actions to address the concerns of our HCWs, including their fears about physical, emotional, and family-related needs. Leaders rounded and connected with their teams while adhering to the constraints of social distancing, to ask what clinical teams needed, to provide information about patient volumes and reassurance about the availability of PPE, to listen to concerns and ideas of the workforce, and most of all, to express gratitude to those who were coming to the hospital to work on the front lines each day.

> *When HCWs were notified of a positive test result, every individual was asked if they would like a wellness team referral as an adjunct to the usual medical care they received.*"

We learned that the importance of simple and genuine expressions of gratitude for the commitment of health care professionals and their willingness to put themselves in harm's way for patients and colleagues cannot be overstated. Leadership provided meals; supported HCWs who had childcare concerns; and provided housing at no cost to faculty and staff who did not test positive but desired to live away from family while working with Covid-19–positive patients, had short cycle times between shifts, had long commutes to the hospital, or had other reasons why they needed to live away from family (e.g., family members had high-risk health conditions). No-cost housing was also provided when HCWs required quarantining because of Covid-19 exposure. WellMD, Human Resources, and Occ Health teams partnered to care for HCWs who tested positive for Covid-19. When HCWs were notified of a positive test result, every individual was asked if they would like a wellness team referral as an adjunct to the usual medical care they received. Those HCWs who elected to access this service were contacted by a member of the wellness team, who was able to offer longitudinal emotional support, resources for housing, food, and childcare, and other support depending on the unique needs of the individual. This was especially important for some of our HCWs who were more resource challenged and/or who had significant anxiety about what having Covid-19 meant in terms of complications.

To learn about the unique needs of individual HCWs, we entered into discussions using Schein's "humble inquiry," a concept that emphasizes asking and listening, rather than telling.[6] Because the pandemic was unpredictable in so many ways and anxiety levels were high among many providers and workers, we recognized the importance of strengthening relationships and generating solutions and new ideas from the front lines. The practice of humble inquiry facilitates these outcomes, and we were able to learn many important lessons and gain important insights by hearing what HCWs had to share. For example, young female faculty members expressed concerns about career advancement and their ability to remain professionally productive because of increased responsibilities related to Covid-19.[7,8] Organizational leaders are working with these faculty members to develop strategies to address and mitigate such concerns. Furthermore, we were able to provide opportunities through individual conversations and focus groups for deliberate reflection about experiences related to the pandemic, in an effort to foster learning and post-traumatic growth.[9] Rather than using a crisis-management approach to restore the organization back to normal functioning after the pandemic, our goal is to achieve a higher level of functioning as a result of addressing and learning from adversity.

Ensuring HCW Safety

As the impact of the Covid-19 pandemic began to materialize in late February, we realized that our campus was in the center of an identified early hot spot in the country. The virulence and transmission of the virus was not yet well understood, and we were uncertain of risk not only to patients, but also to health care professionals and our frontline providers. Members of the IPCD

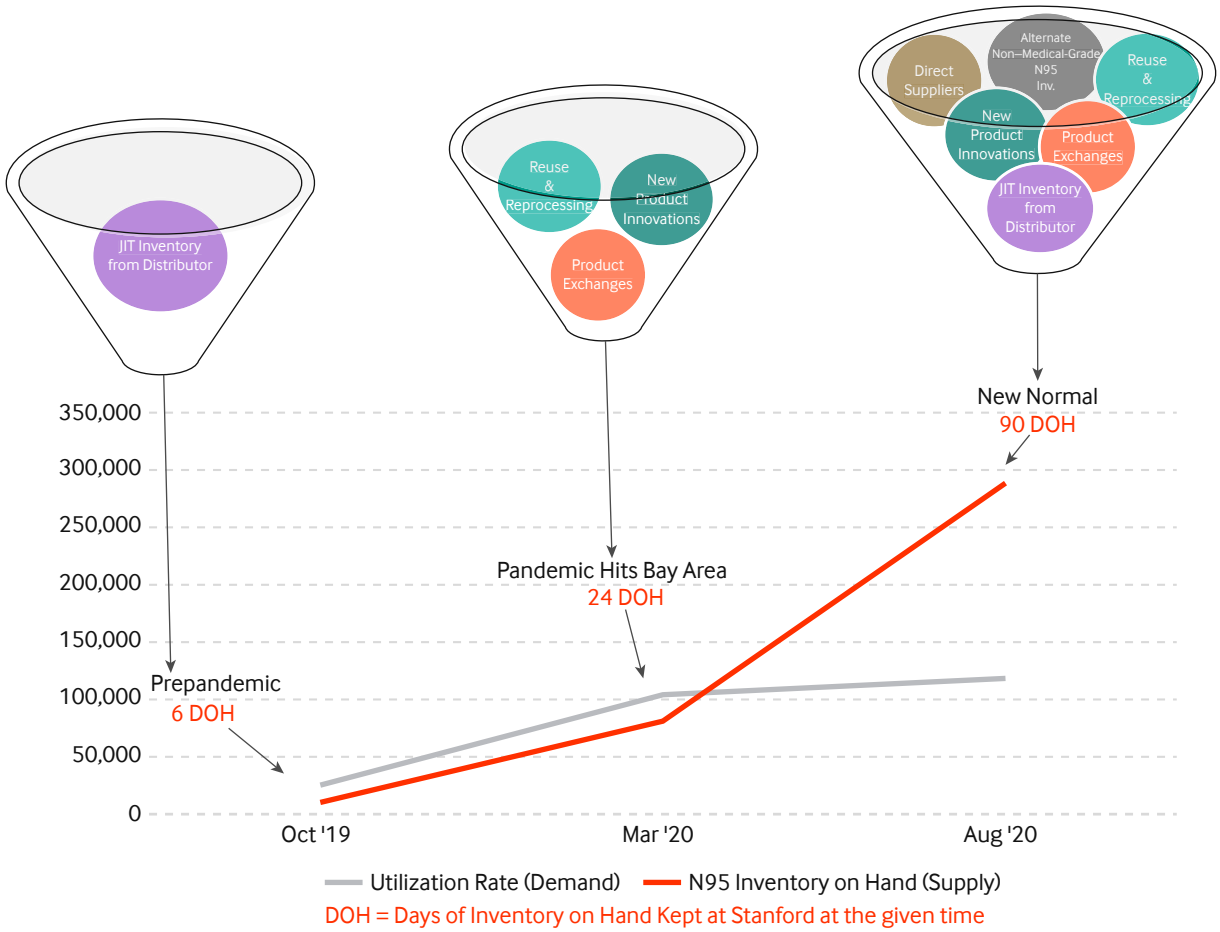
had experienced previous pandemics, and they had been forced to make decisions and implement strategy with limited data. But in the era of Covid-19, the number of decisions, the rapidity with which they needed to be made, and challenges in communicating these decisions were all amplified. In the transition from containment to mitigation, our IPCD team fielded and interpreted new and sometimes contradictory guidance from the local, state, and national levels. At the same time, images and stories flooded social media depicting other nations' experience with and response to the Covid-19 pandemic. Fear and uncertainty seeded doubt and distrust, which were compounded by national shortages of PPE and the lack of widely available testing. It was critically important to reassure our staff that their safety was a critical concern while we transitioned to PPE guidelines that accounted for both staff protection and PPE conservation.

Covid-19's global impact led to the greatest spike in supply needs that Stanford has ever experienced, with utilization of products increasing by as much as 1,900% in a few days. The worldwide demand and short supply disrupted our traditional suppliers and required rapid solutions to protect our HCWs (Figure 3).

FIGURE 3

Supply and Demand of N95s from Prepandemic to "New Normal"

The Just-in-Time (JIT) health care inventory model in use prior to the pandemic represents the primary driver in the procurement funnel that kept inventory aligned with demand. Prepandemic, Stanford's days of inventory on hand was approximately 6 days with the reliance. When the pandemic hit, the demand for N95s immediately jumped by 400%. Stanford instituted alternative strategies to increase total supply and safety stock inventory to support demand fluctuations by increasing the days of inventory on hand and bypassing the traditional JIT model. By expanding supply chain procurement strategies and operations outside of the traditional frameworks and addressing appropriate use and education, we increased our safety stock and inventory, on average, to 90 days on hand without ever exhausting supply. Inv. = inventory.



Source: Stanford Supply Chain (Lawson ERP)

In order to procure supplies and enhance quality control, we completed extensive background checks on manufacturers and developed product guidance for our purchasing team, enabling them to identify safe alternatives. Direct international procurement and diversification of suppliers enhanced our ability to procure adequate supplies, without ever running out. A products innovation task force was formed to enable partnering across Stanford University, leading to on-site

production of supplies that were difficult to procure, such as three-dimensional (3-D) printed products, including swabs for Covid-19 testing. We collaborated with other institutions to create "the Exchange," a national solution that allows hospitals to trade products by engaging an artificial intelligence cloud-based disruption technology organization. The Exchange is an online platform hosted by Resilinc that is designed to connect hospital supply chains to enhance procurement of PPE and acute product needs.

Stanford also developed a donations program that reaped more than 2 million individual products. This program required international relations, community engagement, quality-control processing, warehousing, and logistics, including central intake and a management team. These actions and others resulted in much greater inventory than did our traditional model.

Avoiding Spread and Ongoing Surveillance

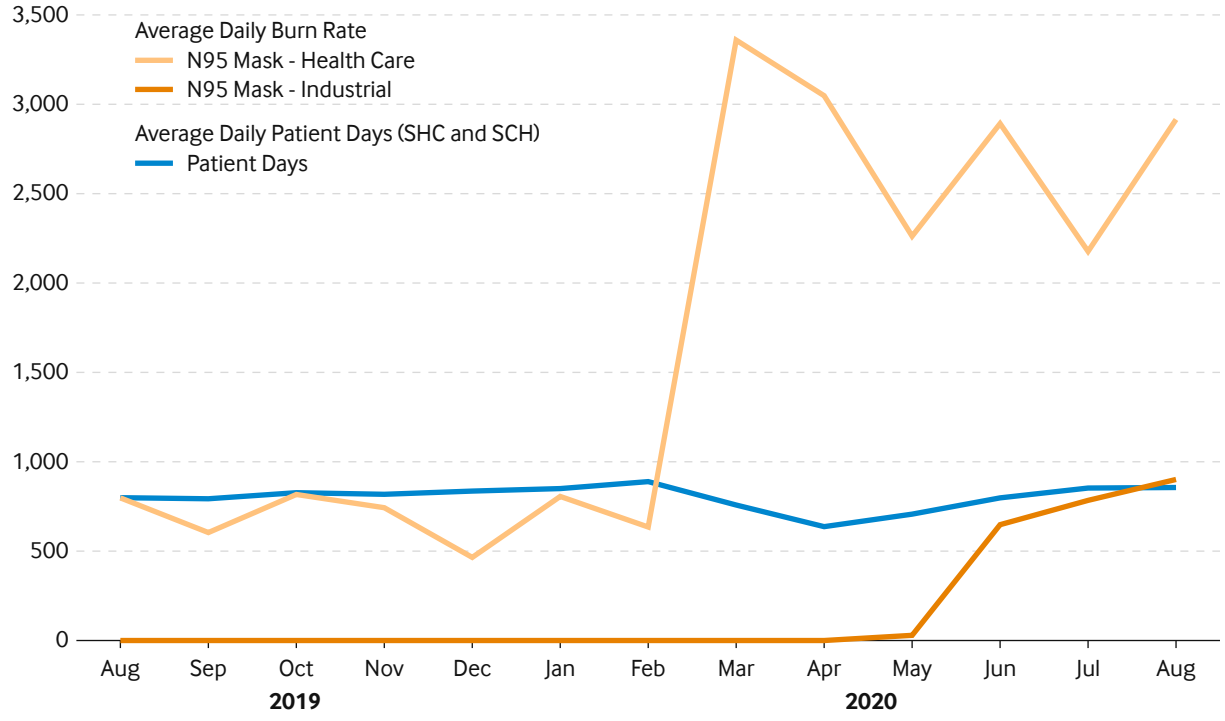
A PPE task force was created and charged with establishing standards for appropriate PPE use by HCWs in various clinical settings and procedures for both known Covid-19–positive patients and patients under investigation as well as for patients without Covid-19 symptoms. The task force developed an algorithm for PPE standards for perioperative workflow based on the urgency of the procedure and the risk of aerosol generation and created a complementary PPE algorithm for the ambulatory setting based on patient symptoms and whether the examination had the potential to generate aerosols. Both conservation of PPE and extended use of mask protocols were implemented.

We tracked our inventory, burn rates (inventory leaving our system), and trending for daily reporting and management (Figure 4). This information, included in a dashboard (Figure 5), provided daily insight and projection as a base understanding for short- and long-term management of our resources.

FIGURE 4

N95 Mask Consumption Rates per Patient Days Comparing August 2019 to August 2020

On average, on the basis of raw usage for the same time period prior to Covid-19, we observed upwards of a 650% increase in utilization for N95 masks, demonstrating the sustained demand through Covid-19 over a period of time. Even when total patient days declined for a short period of time because of the pause in elective procedures, N95 utilization remained high. SCH = Stanford Children's Health, SHC = Stanford Health Care, YoY = year-over-year.



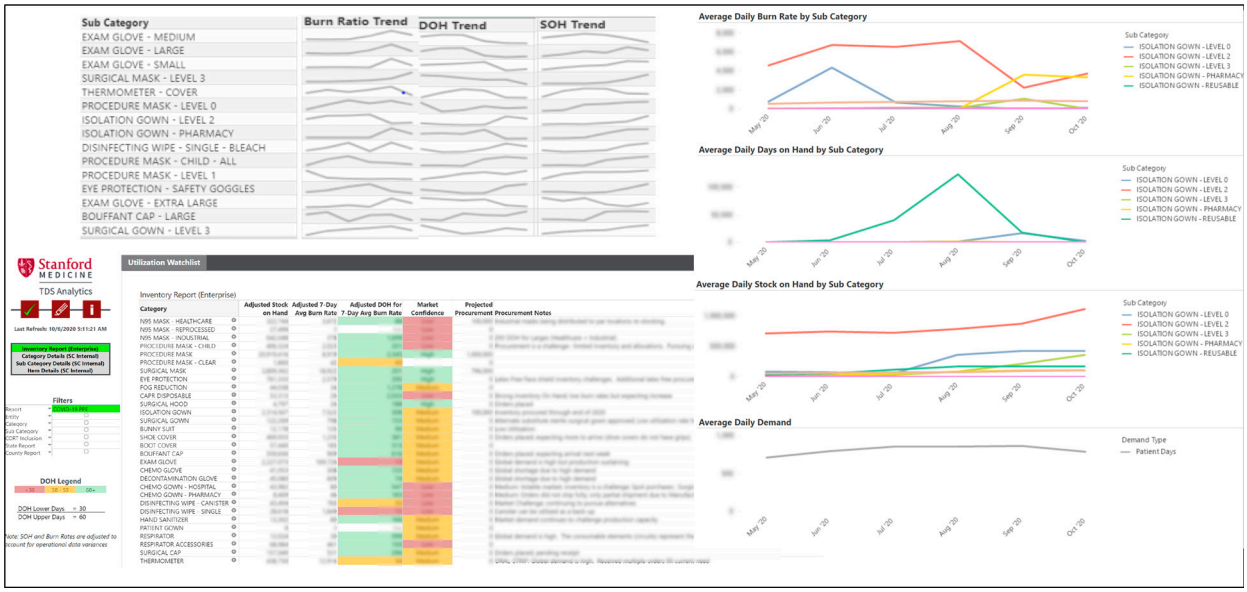
	Burn Rate	Burn Rate per Adjusted Patient Day
June 2019	640 Masks Daily	1.26 N95 per patient per day
June 2020	4,294 Masks Daily	8.16 N95 per patient per day
	671% YoY Increase	**648% Increase**

Source: Stanford Supply Chain (Lawson ERP)

FIGURE 5

Multiple Dynamic Real-time Dashboards To Track PPE Inventory and Utilization

The top left table with graphs represents a few of the subcategories of PPE monitored with burn rate (utilization) to days on hand (DOH) as well as stock on hand (SOH), with further details demonstrated in the graphs at right, which break down the category by the size or type of product. The bottom left table is the overview utilization dashboard providing PPE categories, inventory levels, 7-day average burn rate, and the estimated DOH, with qualitative indicators in red, yellow, or green demonstrating market confidence of the supply chain. Note: portions of the image are intentionally blurred to obscure confidential information. CHEMO = chemotherapy, SC = supply chain.



Source: Stanford Supply Chain (Lawson ERP)

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One of the greatest challenges facing our PPE task force was the timing of, and the criteria to implement, universal masking for HCWs and patients given the likely limitation of PPE and projected greater demand, combined with a lack of long-term reliable suppliers. We closely watched the prevalence of Covid-19 in the surrounding community knowing that the risk of transmission was related to spread not only from patients, but also from fellow HCWs. We created a heat map based on disease prevalence and numbers of persons our employees would encounter in their daily work to estimate the daily risk of Covid-19 transmission to an HCW (Figure 6).[10]

FIGURE 6

Probability of Transmission of SARS-CoV-2 from an Asymptomatic Community-Dwelling Patient by Number of Contacts and Prevalence of Asymptomatic Patients in the Community

The risk to health care workers (HCWs) is determined on the basis of the asymptomatic infection rate in the broad community served by health care organizations (prevalence per 100,000 population) and then considers the daily transmission rate on the basis of the number of contacts with asymptomatic patients at the health care facility and whether the HCW is using personal protective equipment (PPE) or not. Notes: rate of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission per contact is assumed to be 5%. PPE indicates equipment such as procedural masks or N95 respirators. Green shading indicates a daily transmission risk to HCWs of less than 1%, yellow shading 1% to 20%, and red shading higher than 20%.

Asymptomatic SARS-CoV-2 Infections Cases per 100k Prevalence		Number of Contacts													
		Without PPE Use							With PPE Use						
		1	5	10	15	20	25	30	1	5	10	15	20	25	30
50	0.1%	0.003%	0.01%	0.02%	0.04%	0.05%	0.06%	0.07%	0.000%	0.002%	0.00%	0.01%	0.01%	0.01%	0.01%
100	0.1%	0.01%	0.02%	0.05%	0.07%	0.10%	0.12%	0.15%	0.001%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%
250	0.3%	0.01%	0.06%	0.12%	0.19%	0.2%	0.3%	0.4%	0.002%	0.01%	0.02%	0.03%	0.04%	0.05%	0.06%
500	0.5%	0.03%	0.12%	0.2%	0.4%	0.5%	0.6%	0.7%	0.00%	0.02%	0.04%	0.06%	0.07%	0.1%	0.1%
1,000	1.0%	0.05%	0.2%	0.5%	0.7%	1.0%	1.2%	1.5%	0.01%	0.04%	0.07%	0.1%	0.1%	0.2%	0.2%
2,500	2.5%	0.13%	0.6%	1.2%	1.9%	2.5%	3.1%	3.7%	0.02%	0.1%	0.2%	0.3%	0.4%	0.5%	0.6%
5,000	5.0%	0.3%	1.2%	2.5%	3.7%	4.9%	6.1%	7.2%	0.04%	0.2%	0.4%	0.5%	0.7%	0.9%	1.1%
7,500	7.5%	0.4%	1.9%	3.7%	5.5%	7.2%	9.0%	10.7%	0.05%	0.3%	0.5%	0.8%	1.1%	1.3%	1.6%
10,000	10.0%	0.5%	2.5%	4.9%	7.2%	9.5%	11.8%	14.0%	0.07%	0.3%	0.7%	1.0%	1.4%	1.7%	2.1%
15,000	15.0%	0.8%	3.7%	7.3%	10.7%	14.0%	17.2%	20.2%	0.1%	0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
20,000	20.0%	1.0%	4.9%	9.6%	14.0%	18.2%	22.2%	26.0%	0.1%	0.6%	1.3%	1.9%	2.6%	3.2%	3.8%
25,000	25.0%	1.3%	6.1%	11.8%	17.2%	22.2%	27.0%	31.4%	0.2%	0.8%	1.6%	2.3%	3.1%	3.9%	4.6%
30,000	30.0%	1.5%	7.3%	14.0%	20.3%	26.1%	31.5%	36.5%	0.2%	0.9%	1.8%	2.7%	3.6%	4.5%	5.3%
35,000	35.0%	1.8%	8.4%	16.2%	23.3%	29.7%	35.7%	41.1%	0.2%	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%
40,000	40.0%	2.0%	9.6%	18.3%	26.1%	33.2%	39.7%	45.5%	0.2%	1.1%	2.2%	3.4%	4.4%	5.5%	6.6%

Source: Figure used with permission: Graham LA, Maldonado YA, Tompkins LS, Wald SH, Chawla A, Hawn MT. Asymptomatic SARS-CoV-2 transmission from community contacts in healthcare workers. Ann Surg June 2, 2020 [Online ahead of print]. https://journals.lww.com/annalsofsurgery/Citation/9000/Asymptomatic_SARS_CoV_2_Transmission_from.94472.aspx 10.1097/sla.0000000000003968
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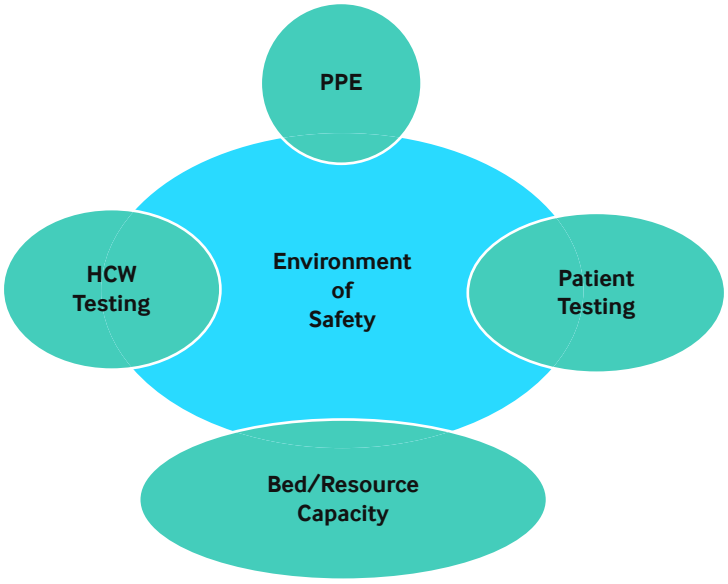
We staged our masking protocols guided by the increasing albeit still quite low prevalence of Covid-19 in the community and our HCW population. Our first principle was to ensure patient safety tied closely to HCW safety. We initially required masking in the hospital environment, followed by the ambulatory clinics and, shortly after, among all non–patient-facing employees.

Ultimately, we have had a very low rate of Covid-19 infections among our HCWs (less than 1%). We believe the keys to success were an intense focus on maintaining an environment of safety, including safe practices such as social distancing, hand hygiene, and creating cohorts of Covid-19–positive patients in specific units; providing testing to both patients and HCWs; and providing rapid training on appropriate use of PPE depending on the clinical situation plus limiting the number of individuals physically present on site (Figure 7).

FIGURE 7

Environment of Safety

The focus on an environment of safety guided our efforts throughout the pandemic. Priorities included early and broad testing of health care workers (HCWs) and patients and maintaining infection control processes and practices including appropriate supply and use of personal protective equipment (PPE), while also managing bed and resource capacity.



Source: Stanford Health Care (Wald SH, MD, MBA)

When conflicts arose in which a provider or group was requesting PPE outside of our recommended guidance, we invited them to present their concerns to the PPE task force. This allowed us to more deeply understand the unique concerns of their clinical environment with respect to Covid-19, to share our knowledge and concerns about PPE appropriateness and supply, and then to brainstorm solutions to ensure HCW and patient safety while being responsible with PPE conservation. This also reassured multiple individuals that their concerns were being acknowledged and addressed.

Limiting Covid-19 Through Infection Control and Contact Tracing

Prior to the Covid-19 pandemic, it was typical for an Occ Health nurse to work directly with clinical unit managers on contact tracing and evaluation of potentially exposed HCWs in the health care setting. These exposures were usually limited in number and in the size of the exposure ring (e.g., TB, measles, varicella) because of limited community transmission. However, in the era of Covid-19, the volume of potential exposures increased substantially.

Because it is difficult to differentiate between workplace exposure and home or community exposure, providers and staff in the OH-REC have been advised by our infection prevention and control experts to evaluate and provide testing for any HCW with symptoms regardless of the

source of exposure. Thus, the Occ Health Covid-19 response has been far broader and wider than anything we had previously experienced.

> *Rather than using a crisis-management approach to restore the organization back to normal functioning after the pandemic, our goal is to achieve a higher level of functioning as a result of addressing and learning from adversity.*"

When HCWs tested positive for Covid-19, we had two primary goals: to care for them and support their physical, emotional, and family needs and to identify all those individuals who may have been exposed to them. To ensure a timely response upon positive notification, we created Covid-19 response teams in each hospital. Working directly with Occ Health and Infection Control, these teams guided and supported managers regarding exposure evaluations, including up-to-date guidance on who was deemed exposed, and about communicating with their staff and providers about potential exposure. They also called exposed individuals directly when the exposure ring was substantial and timeliness was critical to mitigating potential spread. Once contacted, exposed individuals were tracked whether they were symptomatic or asymptomatic to determine if they would need guidance or support. In addition, the teams kept managers current about RTW guidance, as this changed over time as the pandemic evolved and policies were modified as mandated by the county, state, or CDC. Covid-19 response teams from the adult and children's hospitals collaborated to ensure consistency across institutions, given the fact that they previously had different RTW guidance for other illnesses.

In collaboration with the Covid-19 response teams and IPCD, nurse volunteers were assigned to trace the contacts of workers who tested positive. Data were used to monitor for clusters, and early aggressive isolation, testing, and mitigation strategies prevented workplace outbreaks.

We considered contact tracing critical to our overall Covid-19 response, and the comprehensive system that we established facilitated our ability to educate providers/faculty and staff about exposure definitions, ensure timely evaluation to mitigate spread in the health care setting, and continue to maintain the health of our workforce, patients, and families. Our volunteer response teams provided 24-7 support to ensure our managers and HCWs felt safe and cared for as the pandemic evolved; this was accomplished through focus groups and rounding by leaders to check in with frontline HCWs. This was particularly crucial prior to implementing universal masking.

Creating the Testing Capability To Support Safety

Our ability to keep our workforce safe, so that they could, in turn, provide safe care to patients, was facilitated by harnessing the expertise of some of our innovative clinical researchers. On the basis of experience with the 2009 influenza A H1N1 epidemic,[11] Stanford's Clinical Virology Laboratory team developed a multiplex, real-time RT-PCR test for Covid-19, allowing Stanford to be among the first in the country to offer clinical testing.[12,13] Despite many challenges with maintaining adequate supplies, such as test cartridges, testing media, and even swabs for collecting specimens, the

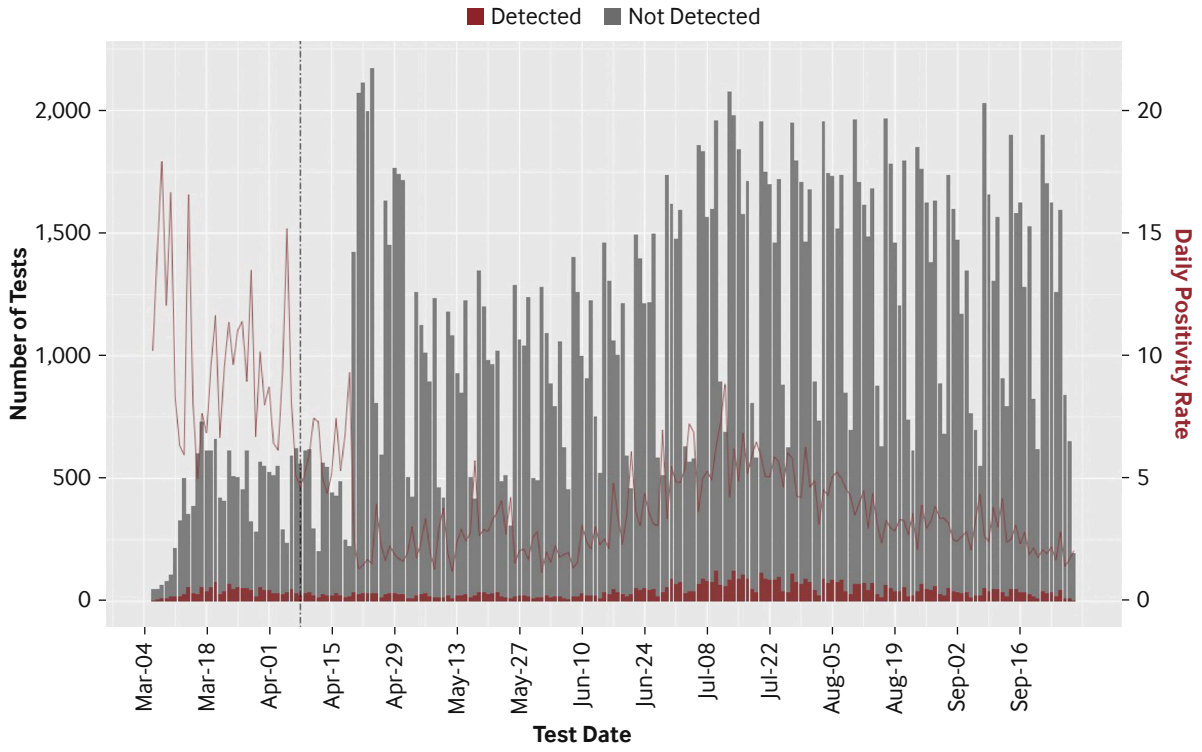
Stanford Clinical Virology Laboratory managed to provide an ever-increasing capacity for RT-PCR testing. Within 10 weeks of launching the test, more than 54,000 RT-PCR assays had been reported, with an average turnaround time of less than 2 days, which was significantly faster than other testing sources with a turnaround time of up to 5 to 7 days.

Because of ongoing challenges with strained supply lines for RT-PCR components, leaders of the Stanford Pathology Department and the Virology team decided to assemble serologic assays using as many components as possible produced at Stanford University. In late March 2020, a group of scientists, bioengineers, and physicians assembled and generated the components for an enzyme-linked immunosorbent assay for the detection of immunoglobulin M or immunoglobulin G to the receptor-binding domain of the SARS-CoV-2 spike protein. Within 2 weeks, the assay was validated and advanced to the clinical test menu. As with the RT-PCR, these tests were made available to several aligned health care systems in California, multiple other western states, and patients as far away as New York. Within Stanford Medicine, serologic testing was offered to asymptomatic HCWs. We were again challenged to keep supply lines open for even the basic components, like plasticware, but have provided serologic testing uninterrupted to more than 25,000 individuals as of early October 2020.[14-19] A dashboard tracking testing numbers has been made publicly available at SHC's Virology Lab Statistics webpage (Figure 8).

FIGURE 8

Virology Laboratory Statistics

This dashboard shows the overall daily volume of Covid-19 diagnostic testing performed at Stanford's Clinical Virology Laboratory in the school's Department of Pathology. We began running these PCR tests in early March, and antibody tests (serology) in April. The vast majority of tests to the left of the dotted line were performed on symptomatic patients from health care organizations, including Stanford. The dotted line indicates the date when criteria for testing were changed, allowing for more testing of asymptomatic patients and employees.



Source: Saurabh Gombar, MD, PhD, Department of Pathology, Stanford University School of Medicine, Stanford, California
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Equipped with RT-PCR and serologic testing, the Stanford Blood Center began collecting convalescent plasma (CP) from recovered patients with Covid-19 for therapeutic use in early April. By late May, more than 100 CP units were available at the Stanford Blood Center, and 75 CP units had been provided to patients at California and out-of-state hospitals as far away as Iowa and Hawaii. SHC has transfused a number of patients through the National Expanded Access Protocol, and as of July 2020, more than 48,000 patients nationwide have been administered CP through this protocol.[20] Anecdotal reports and a recent matched control study suggest therapeutic benefit, at least in some instances.[21]

Resuming Operations

Once it became clear in late April 2020 that we were not going to have a surge of patients with Covid-19 who would overwhelm our resources, we charged a task force to operationalize resuming delayed procedural care: the Procedural Operations Ramp-up Team (PORT). By this time, our supply of PPE had stabilized, allowing for greater confidence in our ability to provide appropriate PPE for patients with Covid-19 and clinicians and to resume surgical procedures. The task force was cochaired by clinical and operational leaders with membership from all key constituencies.

The genesis of our ramp-up was based primarily on concerns related to patient care and the impact of the Covid-19 pandemic on those patients needing urgent or ongoing care that was delayed because of the risk of exposure. As a commentary in *The Economist* noted on April 4, 2020, the official death toll for Covid-19 may not include individuals who succumbed for other reasons, perhaps because hospitals had no room or safe environment in which to treat them.[22] In addition to patient outcomes, the financial burden of the pandemic was considered as we discussed steps to resuming procedures and clinic visits. Just as we strive to balance patient care (quality), patient experience, faculty and staff well-being, and financial performance in our annual strategic and operational planning processes (i.e., maintain a balanced scorecard[23]), we also recognized the benefit of ramping up quickly from an economic perspective. Additionally, we learned there were economic benefits for some of our patients who required procedures or treatment in order to RTW.

> *"Fear and uncertainty seeded doubt and distrust, which were compounded by national shortages of PPE and the lack of widely available testing. It was critically important to reassure our staff that their safety was a critical concern while we transitioned to PPE guidelines that accounted for both staff protection and PPE conservation."*

Our first action was to develop principles that had to be met before resuming procedures, with our highest priority being a safe health care environment. In addition to screening all patients and HCWs for symptoms upon entry to our facilities, reinforcing our universal masking protocol, and enforcing a restricted visitation policy, we made the decision to test as many asymptomatic patient-facing HCWs as possible in the 2-week period leading up to our target date for resuming all elective surgery with the exception of cosmetic surgery. This would allow us to understand the rate of Covid-19 infection among our asymptomatic workforce and would serve as an even more robust mitigation strategy.

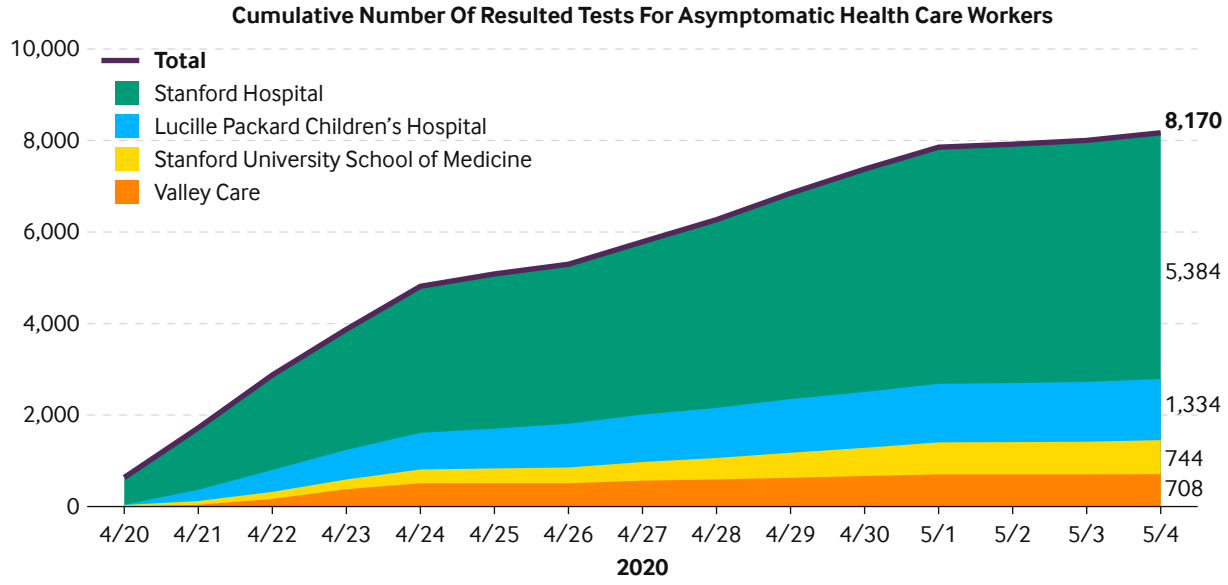
Because of limited space in the OH-REC, we mobilized resources to test asymptomatic HCWs in the ED, using a clinical pod that was not required for routine clinical care because of the decrease in volume of patients presenting to the ED during the pandemic. OH-REC staff, providers, managers, and leaders met with their peers and colleagues from the ED, and, within 48 hours, the workflows, testing protocols, registration processes for HCW employees, and documentation systems required

to meet confidentiality mandates were replicated and operationalized in the ED environment. RT-PCR testing for asymptomatic HCWs was made available on a walk-in, 24-7 basis, and more than 1,000 HCWs were tested on the first day. Over the next several days, we activated two additional testing sites in the ambulatory setting. Within the first week, more than 5,000 asymptomatic HCWs were tested, and, within 2 weeks, more than 8,000 asymptomatic HCWs were tested across all sites, with a positive rate of 0.3% (Figure 9). This very low rate of infection provided additional assurance to our HCWs and patients that the hospital environment was safe.

FIGURE 9

Testing for Asymptomatic Health Care Workers

This shows the number of Stanford laboratory–developed RT-PCR tests for SARS-CoV-2 that were collected from asymptomatic SHC employees in preparation for ramping up nonurgent visits and elective procedures. The graph is from April 20, 2020 (day 1), to May 4, 2020 (day 54), and shows the number of resulted tests by entity within Stanford Medicine: the total number of cumulative employee tests resulted (purple line), SHC cumulative tests resulted (green), LPCH cumulative tests resulted (blue), VC cumulative tests resulted (orange), and Stanford University School of Medicine providers cumulative tests resulted (yellow).



Source: John Shepard, MBA, MHA; Jeff Kirk; and Eric Hadhazy, MS, for Stanford Health Care (SHC)

We had initially planned to use the U.S. Centers for Medicare & Medicaid Services' guidance of tiered surgery priority for nonemergent and elective services and treatment as we resumed operative procedures.[24] We continued to do tier 3 (high-acuity) and some tier 2 (medium acuity) surgery throughout our surge planning. We planned a phased roll-in of tier 2 procedures for 2 weeks starting in July 2020, and, if no issues arose, we would open to tier 1 (low-acuity and elective) procedures. During our 2-week planning phase, three things happened. First, the governor of California eased the shelter-in-place guidelines,[25] including allowing hospitals to resume delayed medical care, with the exception of cosmetic surgery. Second, the markedly low rate of infection

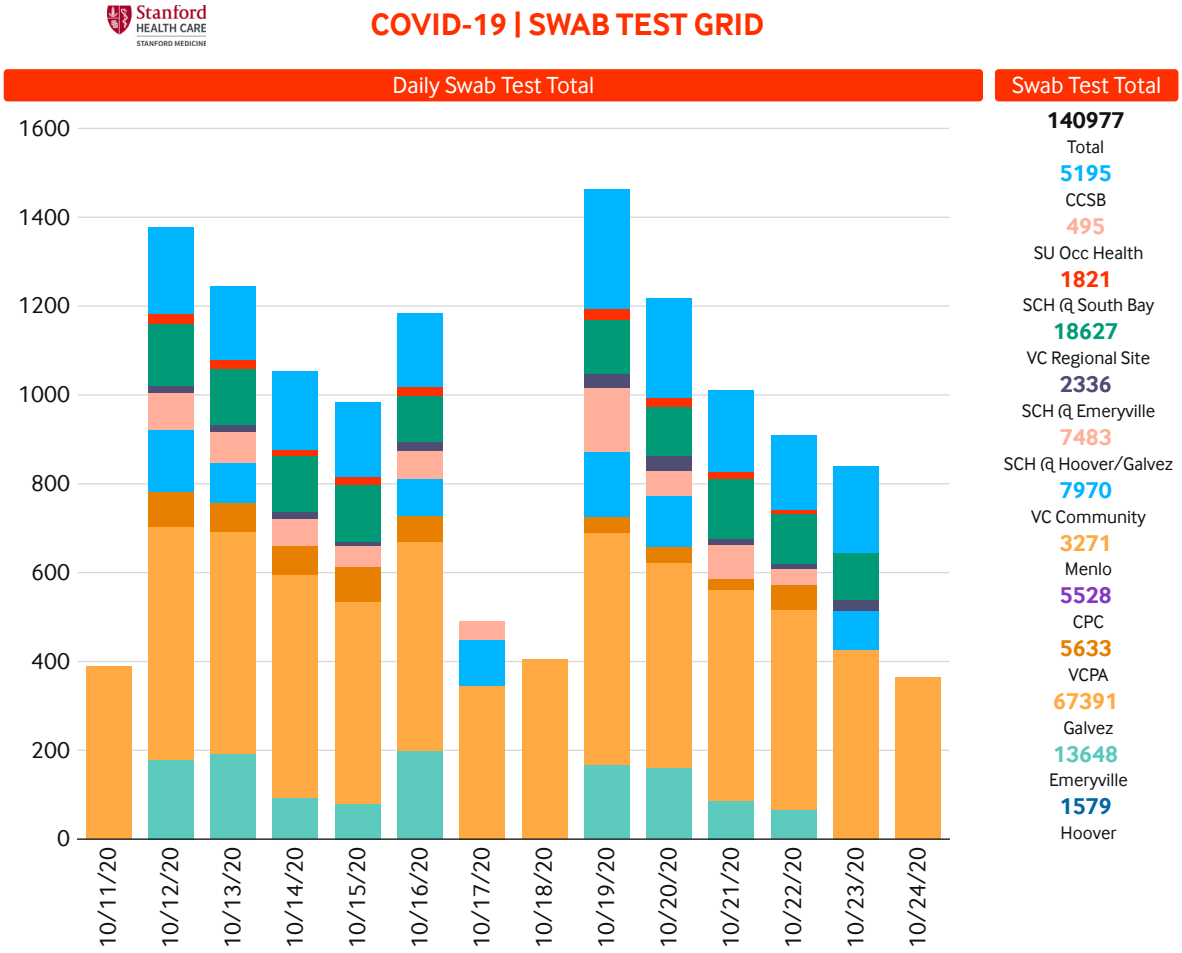
found in our asymptomatic HCWs (less than 0.3%) assured us that the rate of SARS-CoV-2 infection in our community was also low. Third, as we began reaching out to patients, we found that some were reluctant to come in for surgery despite having more symptomatic conditions. Thus, we elected to open our surgery schedule to all patients with the exception of cosmetic surgery.

Next, we needed to ensure that returning to normal volume would not increase the risk of infection for patients and HCWs or negatively impact our ability to care for Covid-19–positive patients. To do this, we felt it was important to test all patients coming in for procedures that were either aerosol generating (e.g., endoscopy) or took place in the operating room. We set the standard that all patients would be tested within 3 midnights of the planned procedure and that no more than 25% of patients would be tested on the day of surgery; this was designed to facilitate patient flow and to conserve our rapid test cartridges. Because of the high rate of false-negative results for the available point-of-care tests at the time of this decision, our quickest turnaround for a day-of-procedure test (RT-PCR) was 90 to 120 minutes, which would present significant challenges to coordinating care. To accommodate testing of the increasing volume of patients, we activated eight ambulatory care drive-through patient testing sites across the Bay area, extending in a radius of about 50 miles from Stanford. We tracked the daily volume of swab tests conducted at each site (Figure 10). As of mid-October 2020, more than 140,000 individuals had been tested across the eight drive-through sites, with a total positive rate of less than 2.5% in aggregate since the sites opened.

FIGURE 10

Daily Drive-Through Testing

This graph shows the daily volume of swab (PCR) tests conducted at each of eight ambulatory care drive-through patient testing sites across the Bay area within a 50-mile radius of Stanford. The sites were opened to accommodate testing of increasing numbers of patients and staff as we ramped up procedures and ambulatory care visits. As of mid-October, more than 140,000 individuals had been tested across the eight drive-through sites, with a total positive rate of 2.5% in aggregate. CCSB = Cancer Center South Bay, CPC = Collaborative Primary Care, Occ = Occupational, SHC = Stanford Health Care, SU = Stanford University, VCPA = ValleyCare Physicians Associates.



Source: Stanford Health Care (Krna C, MBA)

Finally, we set guardrails on our ramp-up to ensure we had adequate resources to care for Covid-19–positive patients if we experienced a resurgence of the disease as the shelter-in-place restrictions slowly lifted. These included monitoring our PPE dashboard (Figure 5), other surgical supplies (i.e., custom packs and ICU beds), ED capability, and blood availability.

The Ambulatory Transformation task force was established in late May 2020 to develop plans for how we prepare for a different future and reimagine the clinical ambulatory footprint in a post–Covid-19 world. In phase 1, we focused on strategies to reactivate the ambulatory business in both the adult and pediatric settings. Guiding principles were established, based on a commitment to safety. Accountability for ensuring safety while reactivating was entrusted to clinic managers and medical directors (in a dyad leadership structure), who in turn relied on physicians and staff to share their experiences and inform continued refinement of the supporting structure and practices. An Ambulatory Activation Guide was created to provide guidance on reactivation of clinics and to enhance the practice through new models of care, leveraging patient-centered design principles and methods to understand our patients' unmet needs in areas such as access and the previsit experience. Each dyad was also asked to complete a checklist and sign a compact signaling safe readiness to resume in-person care as well as raise and address any unique conditions and/or concerns based on the attributes of a clinic. With more than 600 clinics across a geographical footprint of more than 50 square miles, local accountability was essential to ensure consistent safety standards and expectations.

> *"Ultimately, we have had a very low rate of Covid-19 infections among our HCWs (less than 1%)."*

Video visits were an important component of our strategy to reactivate ambulatory care visits; usage soared from less than 2% of all visits by video or phone to as high as 70% by video or phone over a period of approximately 6 weeks. The absolute number of virtual visits has remained fairly constant and as communities began to open up in May 2020, the number of in-person visits rose as well, contributing to a total ambulatory volume of more than 30,000 weekly visits as of mid-June. As of early July 2020, approximately 40% of all visits continue to be offered via video visit channel. The specialties worked over the course of the summer to publish logical goal bands for the percentage of visits moving forward that can continue to be offered through the video visit channel. This longer-term planning will also have implications for our real estate and operational planning as we anticipate the need to have remote-access telehealth visit hubs for our providers to efficiently provide care. As we anticipate future waves of Covid-19, whether related to further reopening or surges due to increased viral activity in the fall and winter, we will continue to embrace technology and to explore further methods to reach patients and provide essential care in the home and community settings.

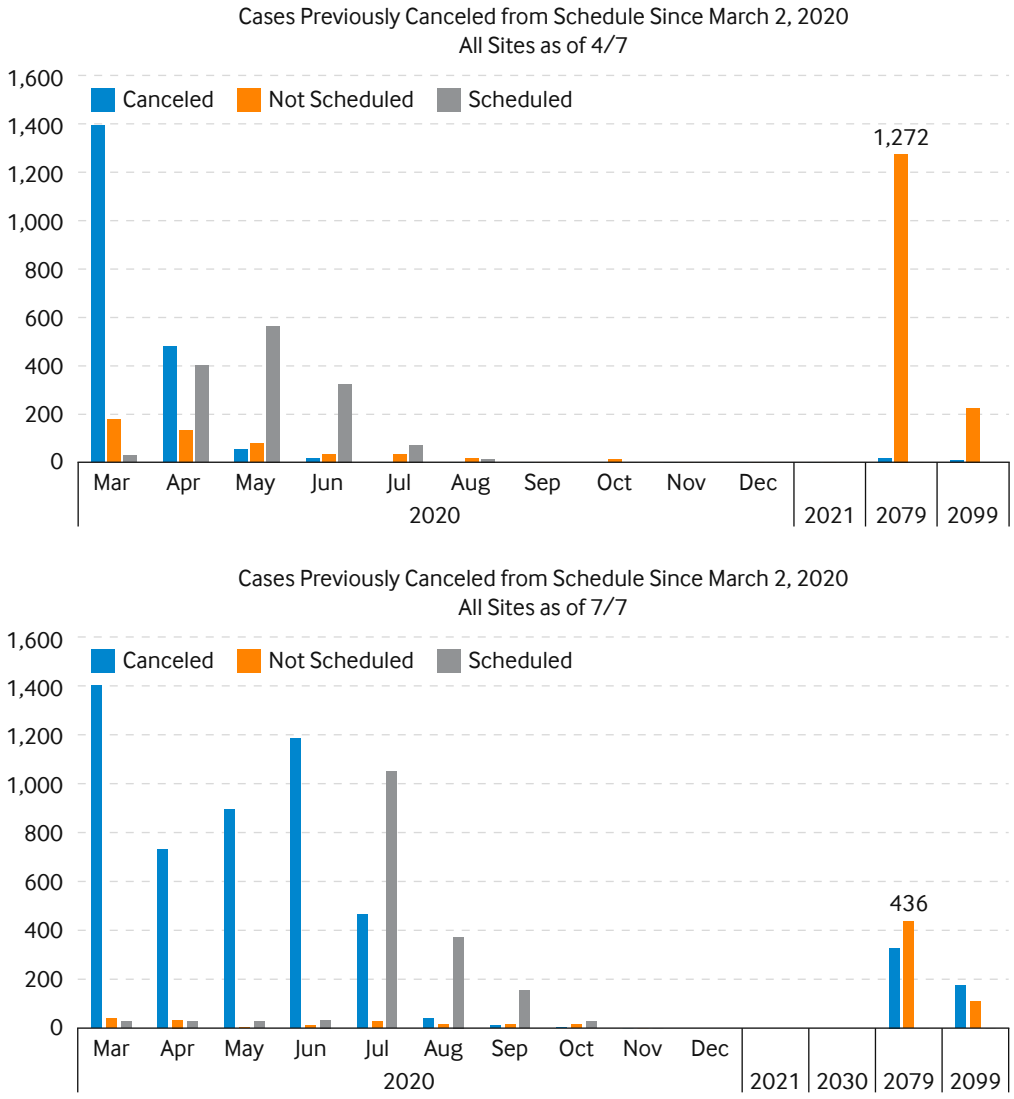
The New Normal

Within 2 weeks of our ramp-up, we reached nearly 90% of our prepandemic surgical volume. Several factors facilitated this. First, we had decided to coordinate a demarcation in our electronic health record for patients who had had to be removed from the near-term schedule in response to the CDC ruling to halt elective cases. We did this by entering the date of surgery as the year 2079. This was easy to implement because of a legacy system workaround that was created 5 years ago for patients who had no clear-cut surgery date. This 2079 code allowed us to see that we had a record of more than 1,500 patients on the schedule at our largest adult hospital (SHC) whose surgery had been delayed because of the pandemic (Figure 11).

FIGURE 11

Surgical Cases and Procedures Cancelled or Postponed Because of Covid-19 and Rescheduled During Ramp-up as CDC Restrictions Were Lifted

This figure shows the number of cases canceled or postponed from the near-term interventional schedule in response to the CDC ruling to halt elective cases. More than 1,500 patients on the schedule at SHC (academic adult hospital) experienced a delay because of the pandemic. The 2099 code was a previous shorthand to allow the clinics to put patients into our electronic depot who were going to have surgery but did not yet have a confirmed date. The historic use of the 2099 electronic nomenclature system allowed us to easily implement 2079 as a designation for cancellations due to the Covid-19 pandemic. The graph at the top shows the status through April 7, 2020, while the graph at the bottom shows the status after 3 months, on July 7, 2020.



Source: Stanford Health Care (Wald SH, MD, MBA)

Second, we were able to quickly identify patients whose procedures had been delayed just recently and, thus, likely had completed a preoperative workup and could be placed back on the schedule with minimal, if any, additional testing (other than a preoperative Covid-19 test). Third, the clear number of backlog cases allowed for greater precision for staffing and budgetary purposes. Fourth, we can now clearly identify patients who are newly scheduled and differentiate them from previously delayed patients. This has been instrumental in facilitating staffing and budgetary decisions for the coming months. Procedural areas such as endoscopy and cardiac catheterization were somewhat slower to ramp up because of patient preferences and logistical challenges. Normally, these patients do not undergo routine testing prior to their ambulatory procedures and, because of the high volume of scheduled procedures, the patient waiting areas can be crowded. More attention needed to be paid to changing scheduling templates and workflows in preparing patients for such procedures and adding Covid-19 testing as part of the preprocedure process. This has been mitigated by limiting visitors, using cars as waiting areas, providing services by video where possible, changing our flow of foot traffic into buildings, and limiting services such as access to the cafeteria.

The connection between the environment of safety for both patients and HCWs and the resumption of procedural volume cannot be overstated. Our patients were clearly aware of the fact that we were testing our workforce for the presence of Covid-19 infection, and we received unsolicited comments that this made them comfortable to proceed with care at Stanford. Our physicians and staff are acutely attuned to the workflows of testing patients and have been insistent on strict adherence to the workflows with the lack of testing considered to be like a never event. Through mid-September 2020, PORT continued to meet weekly to review case volumes by procedure site, the number of patients tested and the number of positive results, the number tested prior to the day of surgery, PPE supply, operating room supply, testing supply, ICU bed supply, and blood supply. These metrics are still collected and reviewed weekly by the leadership of PORT and will be for the foreseeable future. We also review any potential HCW exposure as well as Occ Health data twice weekly. We discuss operational challenges in workflow and develop rapid interventions to address the issues. Transparency of the data, especially rates of positive tests among surgical patients as well as HCW exposures, has allowed us to ramp up with improved trust in the system. Finally, notwithstanding a mandatory use of accrued paid time off for all SHC employees in the spring and summer, our ability to successfully ramp up allowed us to keep our interventional platform frontline workers fully employed, even as many health care delivery systems across the country were implementing layoffs and furloughs.

Lessons Learned

There were a number of areas in which we discovered ways to alter or adjust activities to successfully address the Covid-19 pandemic.

Modifying/Focusing Decision-Making

In a crisis, the reason organizations do well is that everyone has a shared purpose — the "True North" is crystal clear — and accountability structures are streamlined. In our case, the clear purpose was to protect the HCWs and protect the patient, so all decisions were based on that

priority. We streamlined by reducing layers/levels of decision-making and empowering frontline staff to make decisions. We also learned that we had to establish a new pace for decision-making, as new knowledge and information became available seemingly constantly during the early days of the pandemic. We learned to plan only for today, because tomorrow may require a different approach.

> *"Our volunteer response teams provided 24-7 support to ensure our managers and HCWs felt safe and cared for as the pandemic evolved."*

Using a Data-Driven Approach to HCW Safety

Our decision-making process prioritized input from hospital epidemiologists and the infection prevention and control team, with a goal of creating as high a bar as possible for safety. Therefore, we did everything we could to access proper PPE, create robust data systems, and make all policy adjustments on the basis of a deliberative and conservative approach that would protect the workforce. When we adjusted policies, we used data to make decisions and created a set of triggers to determine whether/when we were going to revise policies. When a potential risk or issue was identified through data, we rapidly responded, isolated, and tested HCWs to mitigate issues. Our policies continuously followed the most careful and conservative safety practices, which prevented larger issues of infectious outbreaks or disruptions within the work environment. For example, we required all patients undergoing procedures to have a negative Covid-19 RT-PCR test within 3 midnights of the procedure. Hospitalized patients who had a negative Covid-19 test at the time of admission and then required a procedure more than 3 days after entering the hospital were tested again to meet the 3-midnights policy. This process worked quite well, as evidenced by our low rate of Covid-19 infection among HCWs (less than 1% positivity rate as of October 20, 2020), and we continue to implement conservative safety practices as we move through new phases of the pandemic.

Listening to the Front Line

Pandemics initially are very difficult to manage at the patient and workforce level. We have to learn what will be effective clinically and listen intently to the needs of the workforce. Our approach was to implement oversight and workforce protection Occ Health structures early and in a robust but measured way. We used data, daily briefing and debriefing, and partnership with HCWs to test, innovate, improve, and optimize after the initial Covid-19 testing and telephonic support system implementation. As leaders, we rounded on clinical care units to listen to the frontline management about what they needed, and we trusted their judgment in supporting them. We also used our voluntary safety reporting system to identify and mitigate issues as they occurred. Going forward, we have an excellent road map for another emergency and will continue to build upon the Occ Health structure as the Covid-19 pandemic continues.

Framing the Crisis To Promote Collaboration

CORT as an oversight system was led by physician leaders (Chief Medical Officers of each hospital) and facilitated from a clinical perspective, so operating system issues such as PPE were seen as clinical safety issues rather than primarily as financial or operational issues. By relieving HCWs and managers of the need to focus on the immediate pandemic-related financial impact to the organization, we enable them to focus on safe, effective, and innovative care delivery.

Embracing Innovation and Sustaining Positive Change

Systems that are not working well in normal circumstances perform poorly under the stress of added volume. Specialized teams created early in the pandemic surge to redesign systems and structures later became support teams to help improve other systems and structures that were not able to scale up readily. New structures that emerged (such as surge teams) will now be assessed as go-forward postpandemic systems because they are more adaptable and able to flex when new challenges such as emergencies or pandemics arise.

Developing Covid-19 Testing Resources

With safety as a priority in dealing with a transmissible virus, we recognized that aggressive testing (of staff and patients) had to be matched with availability of supplies and timely laboratory results. As an academic medical center, we reached out to colleagues and established cross-campus collaboration for making needed equipment (e.g., swabs) using 3-D printers. Virologists in our laboratory developed tests using various methods (RT-PCR and serology) and made these tests widely available beyond our campus. Demonstration of a low infection rate among our HCWs was a cornerstone for opening more services at the hospital and became a model for opening other parts of campus (research laboratories) and organizations in the community (schools and local businesses). The state of California, similarly, developed criteria for loosening and tightening restrictions on activities and opening of businesses/facilities on the basis of its rate of new cases and positivity.

Communicating with Individuals and Teams

We were reminded that no amount of communication is enough. Leaders rounded on units and then rounded again, modeling safety practices, such as social distancing, handwashing, and use of masks, to check in with HCWs and express gratitude. All levels of leaders were encouraged to hold Zoom chats and focus groups, to reach out to team members, and to be creative in finding ways to connect and have fun, such as virtual happy hours and virtual fun runs.

> *Systems that are not working well in normal circumstances perform poorly under the stress of added volume. Specialized teams created early in the pandemic surge to redesign systems and structures later became support teams to help improve other systems and structures that were not able to scale up readily."*

We communicated verbally, through daily email communications, and via the website, often using a "You said, we did" format to reassure HCWs that their suggestions and ideas mattered and led to positive change. For example, members of some unit-based teams shared concerns about lack of space in breakrooms on the unit for social distancing while eating and drinking. Leaders heard this concern and worked with facilities to open and secure additional outdoor spaces for use by staff.

Looking Ahead

Although many challenges are encountered and difficulties experienced at the time of a crisis, the Covid-19 crisis engendered a spirit of "all-in" across Stanford Medicine. As we move into new phases of the pandemic, we are mindful that HCWs face the same pandemic-related fear and uncertainty as everyone else, with an added layer of balancing professional responsibility and personal vulnerability in working at the front line. We and other health care organizations have a responsibility to help address these challenges through peer support and mental health services to help HCWs come to terms with the crisis. Leaders also have an opportunity to encourage and model reflection and learning to enhance individual and organizational post-traumatic growth. Organizational post-traumatic growth is the process by which organizations not only are restored, but also achieve a higher level of functioning as a result of addressing and learning from a traumatic event.[9]

We are fortunate at Stanford to have access to many thought leaders, including Edgar Schein, who has taught us that "one can't find a more complex system than health care. In such a setting, relationships really matter." We gained a new level of understanding of this message and learned that a sense of connection was critically important amidst the chaotic, unfamiliar, and rapidly changing environment of the pandemic.

As we continue to move toward a new normal, we have learned that connection, collaboration, a focus on safety, and understanding best practices within the health care workforce are important components of a successful model for navigating a pandemic or other health care crisis. Ensuring the highest level of safety and well-being for our HCWs, as the foundation for caring for patients, will serve us well into the future.

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Appendix

Covid-19 Task Forces and Committees

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References

1. Centers for Disease Control and Prevention. Santa Clara County, California community mitigation. Coronavirus disease 2019 (COVID-19). Updated March 17, 2020. Accessed October 8, 2020. https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/california-santa-clara-county.html.

2. Stanford University. Annual financial report. August 31, 2019 and 2018. December 2019. Accessed October 8, 2020. https://bondholder-information.stanford.edu/pdf/SU_AnnualFinancialReport_2019.pdf.

3. Johns Hopkins University & Medicine. Coronavirus Resource Center. COVID-19 dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). Updated October 7, 2020. Accessed October 8, 2020. https://coronavirus.jhu.edu/map.html.

4. Verity R, Okell LC, Dorigatti I, et al. Estimates of the severity of coronavirus disease 2019: A model-based analysis. Lancet Infect Dis 2020;20:669-77 https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30243-7/fulltext https://www.ncbi.nlm.nih.gov/pubmed/32240634 https://doi.org/10.1016/S1473-3099(20)30243-7.

5. Bohmer R, Shand J, Allwood D, Wragg A, Mountford J. Learning systems: Managing uncertainty in the new normal of Covid-19. NEJM Catalyst. July 16, 2020. Accessed October 19, 2020. https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0318.

6. Schein EH. Humble inquiry: The gentle art of asking instead of telling. San Francisco, CA: Berrett-Koehler Publishers, 2013.

7. Narayana S, Roy B, Merriam S, et al.; Society of General Internal Medicine's Women and Medicine Commission. Minding the gap: Organizational strategies to promote gender equity in academic medicine during the COVID-19 pandemic. J Gen Intern Med October 6, 2020 [Online ahead of print] https://link.springer.com/article/10.1007/s11606-020-06269-0 https://doi.org/10.1007/s11606-020-06269-0.

8. Brubaker L. Women physicians and the COVID-19 pandemic. JAMA 2020;324:835-6 https://jamanetwork.com/journals/jama/fullarticle/2769140 https://www.ncbi.nlm.nih.gov/pubmed/32735329 https://doi.org/10.1001/jama.2020.14797.

9. Olson K, Shanafelt T, Southwick S. Pandemic-driven posttraumatic growth for organizations and individuals. JAMA October 8, 2020 [Online ahead of print] https://jamanetwork.com/journals/jama/fullarticle/2771807. https://doi.org/10.1001/jama.2020.20275.

10. Graham LA, Maldonado YA, Tompkins LS, Wald SH, Chawla A, Hawn MT. Asymptomatic SARS-CoV-2 transmission from community contacts in healthcare workers. Ann Surg June 2, 2020 [Online ahead of print]. https://journals.lww.com/annalsofsurgery/Citation/9000/Asymptomatic_SARS_CoV_2_Transmission_from.94472.aspx https://doi.org/10.1097/sla.0000000000003968.

11. Centers for Disease Control and Prevention. Influenza (flu). 2009 H1N1 pandemic. June 11, 2019. Accessed October 10, 2020. https://www.cdc.gov/flu/pandemic-resources/2009-h1n1-pandemic.html.

12. U.S. Food and Drug Administration. Accelerated emergency use authorization (EUA) summary SARS-Cov2 RT-PCR assay. Stanford Health Care Clinical Virology Laboratory. March 25, 2020. Accessed October 10, 2020. https://www.fda.gov/media/136818/download.

13. Conger K. Testing at the Speed of COVID. Stanford Medicine, Issue 2. Updated October 15, 2020. Accessed October 10, 2020. https://stanmed.stanford.edu/2020issue2/innovate-covid-19-tests-pcr-antibody.html.

14. Long DR, Gombar S, Hogan CA, et al. Occurrence and timing of subsequent SARS-CoV-2 RT-PCR positivity among initially negative patients. Clin Infect Dis June 7, 2020 [Online ahead of print]. https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa722/5854366 https://doi.org/10.1093/cid/ciaa722.

15. Chakraborty S, Edwards K, Buzzanco AS, et al. Symptomatic SARS-CoV-2 infections display specific IgG Fc structures. medRxiv May 18, 2020 [Online ahead of print] https://www.medrxiv.org/content/10.1101/2020.05.15.20103341v1 https://doi.org/10.1101/2020.05.15.20103341.

16. Gombar S, Chang M, Hogan CA, et al. Persistent detection of SARS-CoV-2 RNA in patients and healthcare workers with COVID-19. J Clin Virol 2020;129:104477 https://www.sciencedirect.com/science/article/pii/S1386653220302195?via%3Dihub https://www.ncbi.nlm.nih.gov/pubmed/32505778 https://doi.org/10.1016/j.jcv.2020.104477.

17. Nielsen SCA, Yang F, Jackson KJL, et al. Human B cell clonal expansion and convergent antibody responses to SARS-CoV-2. Cell Host Microbe 2020;28:516-525.e5 https://www.cell.com/cell-host-microbe/fulltext/S1931-3128(20)30503-5?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS1931312820305035%3Fshowall%3Dtrue https://www.ncbi.nlm.nih.gov/pubmed/32941787 https://doi.org/10.1016/j.chom.2020.09.002.

18. Röltgen K, Wirz OF, Stevens BA, et al. SARS-CoV-2 antibody responses correlate with resolution of RNAemia but are short-lived in patients with mild illness. medRxiv August 17, 2020 [Online ahead of print] https://www.medrxiv.org/content/10.1101/2020.08.15.20175794v1 https://doi.org/10.1101/2020.08.15.20175794.

19. Hogan CA, Sahoo MK, Pinsky BA. Sample pooling as a strategy to detect community transmission of SARS-CoV-2. JAMA 2020;323:1967-9 https://jamanetwork.com/journals/jama/fullarticle/2764364 https://www.ncbi.nlm.nih.gov/pubmed/32250394 https://doi.org/10.1001/jama.2020.5445.

20. U.S. Food and Drug Administration. Fact sheet for patients and parents/caregivers: Emergency use authorization (EUA) of COVID-19 convalescent plasma for treatment of COVID-19 in hospitalized patients. August 23, 2020. Accessed October 10, 2020. https://www.fda.gov/media/142386/download

21. Liu STH, Lin HM, Baine I, et al. Convalescent plasma treatment of severe COVID-19: A matched control study. medRxiv May 22, 2020 [Online ahead of print] https://www.medrxiv.org/content/10.1101/2020.05.20.20102236v1

22. The Economist. Covid-19's Death Toll Appears Higher Than Official Figures Suggest. April 4, 2020. Accessed October 31, 2020. https://www.economist.com/graphic-detail/2020/04/03/covid-19s-death-toll-appears-higher-than-official-figures-suggest.

23. Kaplan RS, Norton DP. The balanced scorecard—measures that drive performance. Harvard Business Review. January-February 1992. Accessed October 31, 2020. https://hbr.org/1992/01/the-balanced-scorecard-measures-that-drive-performance-2.

24. Centers for Medicare & Medicaid Services. Non-emergent, elective medical services, and treatment recommendations. April 7, 2020. Accessed October 10, 2020. https://www.cms.gov/files/document/31820-cms-adult-elective-surgery-and-procedures-recommendations.pdf.

25. Office of Governor Gavin Newsom. Press release: Governor Newsom announces plan to resume delayed health care that was deferred as hospitals prepared for COVID-19 surge. April 22, 2020. Accessed October 10, 2020. https://www.gov.ca.gov/2020/04/22/governor-newsom-announces-plan-to-resume-delayed-health-care-that-was-deferred-as-hospitals-prepared-for-covid-19-surge/.