

Impact of the COVID-19 Pandemic on Resident Physician Clinical and Educational Work Hours at a Large Sponsoring Institution

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ABSTRACT

Background The COVID-19 pandemic affected graduate medical education (GME) by decreasing elective procedures and disrupting didactic learning activities in 2020. Editorials have hypothesized that resident physicians worked fewer hours, therefore losing valuable experience, but we are not aware of studies that have objectively assessed changes in hours worked.

Objective This study aims to identify differences secondary to the COVID-19 pandemic in resident work hours across all specialties at 3 geographically dispersed, integrated academic hospitals in a large sponsoring institution.

Methods We obtained de-identified work hour data from all residency programs at Mayo Clinic in Arizona, Florida, and Minnesota. Resident work hours were compared between 2020 and 2019 from March to May.

Results Work hours for 1149 and 1118 residents during the pandemic and control periods respectively were compared. Decreases in resident work hours were seen, with the largest decrease demonstrated in April 2020 when 19 of 43 programs demonstrated significantly decreased work hours. Residents worked more hours from home in April 2020 compared to the previous year (Arizona: mean 1 hour in 2019 vs 5.2 hours in 2020, $P < .001$; Florida: mean 0.7 hour in 2019 vs 6.5 hours in 2020, $P < .001$; Minnesota: mean 0.8 hour in 2019 vs 10.2 hours in 2020, $P < .001$).

Conclusions The COVID-19 pandemic was associated with a decrease in work hours in some, but not all, specialties. The decrease in on-site work was only partially offset by an increased number of hours worked from home.

Introduction

The COVID-19 pandemic has dramatically affected residency programs, with many program directors restructuring call and rotation schedules in early 2020. Restructuring resident staffing was thought to preserve the health care workforce and reduce COVID-19 transmission risk.¹ Therefore, many programs rotated residents between in-person work and reserve staff working from home.¹

Numerous editorials theorized a subsequent decrease in resident work hours, raising concerns about causal deficits in training.^{2,3} Currently, the impact of changes to resident scheduling has been studied only through surveys of program directors and residents. When surveyed, three-quarters of surgical residents reported a pandemic-related decrease in work hours.^{2,4-6} Research shows that residents and program directors *perceive* training has been impacted negatively by pandemic-induced schedule restructuring.^{2,4-6} Similar perceptions were noted historically after the Accreditation Council for Graduate Medical

Education (ACGME) work hour restrictions in 2011 were enacted, as residents reported decreased educational opportunities secondary to a decrease in hours worked, and faculty reported first-year attendings required more supervision after implementation of work hour restrictions.⁷⁻¹⁰ This historical information endorses current concerns that work hour decreases secondary to pandemic-related changes to resident clinical schedule may negatively impact resident education.⁷

To better understand whether educational quality was affected by COVID-19-related residency schedule changes, we must first determine if a decrease in work hours occurred. However, to our knowledge, no publication has objectively measured the effect of COVID-19 on the resident experience. As one of the nation's oldest and largest graduate medical education sponsoring institutions, with more than 1800 trainees, Mayo Clinic is well-suited to measure the pandemic's impact on resident work hours. This study compares resident work hours across specialties at 3 integrated academic health centers in 2020 to the previous year, 2019, unaffected by COVID-19.

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Editor's Note: The online version of this article contains further data from the study.

Methods

De-identified resident work hour records from the 3 Mayo Clinic campuses (Mayo Clinic in Arizona [MCAZ], Mayo Clinic in Florida [MCFL], and Mayo Clinic in Minnesota [MCMN]) were obtained from an institutional residency management system managed by the Mayo Clinic School of Graduate Medical Education from March to May for the pandemic (2020) and control (2019) periods. All sites are tertiary academic centers. MCAZ and MCFL serve major metropolitan areas (Phoenix and Jacksonville, respectively), while MCMN is in a smaller city (Rochester). Of note, none of the 3 hospitals studied were at or over capacity secondary to COVID-19 during the time periods studied.

Mean work hours were calculated per work period (supplementary data FIGURE 1), specialty, and site. Mean hours worked from home were calculated by site and year. Residents self-reported work hours in an online system, reporting hours worked from home separately. Hours worked from home included clinical (eg, telemedicine, patient calls, completing notes), educational (eg, conferences, online modules), and administrative work.

Student's *t* test was used to compare the control and pandemic periods. Work hours were compared within programs by site, as pandemic-related schedule changes differed between specialties and hospitals. Significance was determined with $\alpha < .05$, and all hypothesis tests were 2-sided. To achieve an anticipated moderate effect size of $d = 0.5$ with a power of 0.8 and 2-sided alpha error of 0.05, 64 residents per group was required.

This study was approved by an institutional COVID-19 Research Task Force and deemed exempt by the Mayo Clinic Institutional Review Board.

Results

Work hours were recorded for 43 residency programs: 22 at MCMN, 11 at MCAZ, and 10 at MCFL. Work hours for 1118 residents in the control period (MCMN: 832, MCAZ: 139, MCFL: 147) and 1149 residents in the pandemic period (MCMN: 850, MCAZ: 148, and MCFL: 151) were analyzed. Residents per program was similar during the control and pandemic periods (supplementary data FIGURE 2).

Governor executive order mandated people to stay-at-home in Arizona (March 30–May 15, 2020), Florida (April 1–May 1, 2020), and Minnesota (March 25–May 18, 2020). During this time, elective procedures were deferred and people limited interactions, excluding essential activities (eg, working as a resident physician).^{11–13}

Objectives

To quantify the impact of the COVID-19 pandemic on residents' work hours.

Findings

Not all programs' work hours were affected the same way; most had a decrease in work hours, while a few others remained the same or increased.

Limitations

Work hours were self-reported, study was conducted in an academic center only, and some programs had a small sample size.

Bottom Line

The effects on medical education by the ongoing pandemic are still unknown, but in this study we attempted to quantify the real effects by understanding work hour changes.

Mayo Clinic in Arizona

In April, 4 programs had a decrease in average weekly hours worked: anesthesiology, otolaryngology, general surgery, and urology (FIGURE 1, TABLE 1). General surgery residents had the largest reduction in hours (48 hours/week vs 63 hours/week, $P < .001$). Residents at MCAZ worked more hours from home in the pandemic compared to the control period in April and May (April: 5.2 hours/week vs 1 hour/week, $P < .001$; May: 2.4 hours/week vs 0.9 hour/week, $P < .001$; TABLE 2).

Mayo Clinic in Florida

In April, 4 programs had a decrease in average weekly hours worked: dermatology, diagnostic radiology, internal medicine, and neurology (FIGURE 1, TABLE 3). Dermatology residents had the largest reduction in hours (40 hours/week vs 50 hours/week, $P = .013$). In March, a decrease in average weekly hours worked was seen in diagnostic radiology (46 hours/week vs 51 hours/week, $P = .045$) and family medicine (50 hours/week vs 56 hours/week, $P = .003$; TABLE 2). Residents at MCFL worked more hours from home in the pandemic compared to control period in March, April, and May (March: 1.7 hours/week vs 0.5 hour/week, $P = .001$; April: 6.5 hours/week vs 0.7 hour/week, $P < .001$; May: 3.4 hours/week vs 0.3 hour/week, $P < .001$; TABLE 2).

Mayo Clinic in Minnesota

In March, decreased average weekly work hours were seen in neurological surgery (57 hours/week vs 60 hours/week, $P = .032$), neurology (53 hours/week vs 57 hours/week, $P = .014$), and urology (52 hours/week vs 54 hours/week, $P = .007$; FIGURE 1, TABLE 4). In April, 11 of 22 programs had reduced average weekly hours, including anesthesiology, diagnostic radiology,

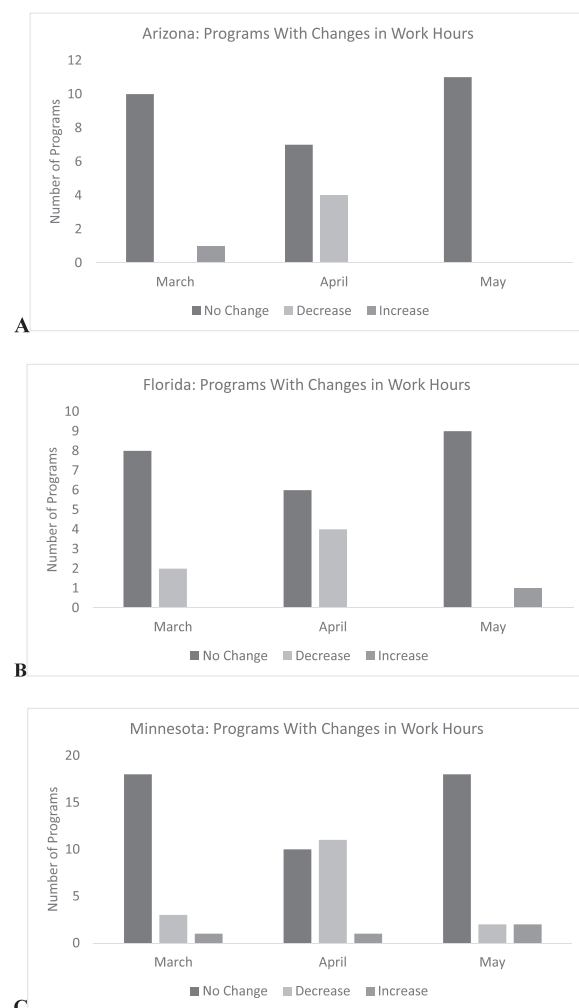


FIGURE 1
Residency Programs With No Change, Increase, or Decrease in Mean Hours Worked a Week Over Work Hour Period in Mayo Clinics in Arizona (A), Florida (B), and Minnesota (C)

internal medicine, neurology, oral and maxillofacial surgery, ophthalmology, orthopedic surgery, physical medicine and rehabilitation, radiation oncology, general surgery, and urology (FIGURE 1). Anesthesia had the largest reduction in hours worked in April (31 hours/week vs 51 hours/week, $P<.001$). In May, decreased average weekly work hours were demonstrated in anesthesiology (46 hours/week vs 50 hours/week, $P=.026$) and orthopedic surgery (50 hours/week vs 58 hours/week, $P=.024$; FIGURE 1, TABLE 3). Residents at MCMN worked more hours from home in the pandemic compared to control period in March, April, and May (March: 2.4 hours/week vs 0.8 hour/week, $P<.001$; April: 10.2 hours/week vs 0.8 hour/week, $P<.001$; May: 3.4 hours/week vs 1 hour/week, $P<.001$; TABLE 2).

Discussion

Our results demonstrate that residents worked fewer hours during the early pandemic, in months corresponding to pandemic-related government restrictions. We additionally demonstrated that specialties were affected by a decrease in work hours differently based on the hospital. Finally, we demonstrate that residents worked significantly more clinical hours from home in early pandemic months.

We demonstrate that residents in almost half of all residency programs across 3 hospitals worked fewer hours in April. While regions enacted governmental restrictions differently, April was the only full month impacted by restrictions in Arizona, Florida, and Minnesota. Minnesota's governmental stay-at-home restrictions lasted the longest, which may explain why a larger proportion of programs at MCMN were affected compared to MCAZ or MCFL. Further, the number of COVID-19 cases in the month of April at MCAZ, MCFL, and MCMN were fewer than reported in other areas of the United States (FIGURE 2).¹⁴ This may explain why we demonstrate no increase in hours worked in certain specialties expected to be impacted heavily by COVID-19, such as emergency medicine, anesthesiology, and internal medicine.

While we demonstrate that residents worked fewer hours in April 2020, not all specialties were impacted, and for those that were, it was not consistent across sites. We offer the following possible explanations. First, as reported in the literature, call and rotation restructuring was approached differently in different locations.^{1,3} Mayo Clinic provided program flexibility in their approach to pandemic-related call and rotation restructuring. Each program, in collaboration with specialty leadership, was provided autonomy to restructure schedules to effectively balance patient care and educational activities. As such, the authors are aware of several methods for restructuring, including transitioning to a team-based approach from a preceptorship model; removing residents from off-service/campus rotations or electives; and assigning residents to designed on- or off-call groups that rotated daily, weekly, or biweekly. To the authors' knowledge, at these 3 Mayo Clinic campuses residents were not deployed to aid other departments. More studies are required to characterize the types of schedule restructuring that occurred most frequently and were most efficacious for resident learning.

Second, the transition to virtual work may have differed among specialties. In a descriptive article about psychiatry residents, some residents maintained a stable clinical workload during COVID-19 by quickly transitioning to telemedicine.¹⁵ Mayo Clinic

TABLE 1
Mayo Clinic in Arizona

Residency Programs	Work Hours (March)	Work Hours (April)	Work Hours (May)
Anesthesiology	NS	55→51 ($P=.014$)	NS
Dermatology	41→44 ($P<.001$)	NS	NS
Diagnostic radiology	NS	NS	NS
Internal medicine	NS	NS	NS
Neurology	NS	NS	NS
Orthopedic surgery	NS	NS	NS
Otolaryngology	NS	60→48 ($P<.001$)	NS
Plastic surgery	NS	NS	NS
Radiation oncology	NS	NS	NS
General surgery	NS	63→48 ($P<.001$)	NS
Urology	NS	59→54 ($P=.020$)	NS

Note: Description of significant differences in mean hours a week worked by residents from March through May in the control and pandemic periods. NS is no significant difference between control and pandemic period. If a significant difference in hours worked was found between control and pandemic period, the box is filled with the control period mean hours → pandemic period mean hours (P value).

residency programs with no decrease in hours worked may have rapidly pivoted to telemedicine, allowing residents to conduct visits virtually when unable to see patients face-to-face during the early pandemic.

Third, specialties may have experienced differing patient volumes based on their typical practice: inpatient, outpatient, or mixed. We noted that surgical residency programs at MCAZ and MCMN were impacted more than non-procedural specialties, likely secondary to mandated postponement of elective procedures. Further, a decrease in working hours was not demonstrated in mainly outpatient specialties, such as pediatrics, family medicine, and psychiatry.

TABLE 2
Mean Hours a Week Worked From Home by Residents (Averaged Across all Programs) From March Through May in Control and Pandemic Periods

Program	Control Mean (SD)	Pandemic Mean (SD)	P Value
Mayo Clinic in Arizona			
March	1.3 (4.4)	1.8 (6.4)	.16
April	1.0 (3.5)	5.2 (12.7)	.001
May	0.9 (3.1)	2.4 (7.9)	.001
Mayo Clinic in Florida			
March	0.5 (2.7)	1.7 (7.3)	.001
April	0.7 (2.6)	6.5 (13.8)	.001
May	0.3 (1.4)	3.4 (9.5)	.001
Mayo Clinic in Minnesota			
March	0.8 (2.7)	2.4 (7.5)	.001
April	0.8 (2.8)	10.2 (16.1)	.001
May	1.0 (3.8)	3.4 (9.5)	.001

We further hypothesized that residents would work more hours from home during the pandemic. We saw that, in early pandemic months, residents on all 3 campuses worked from 2 to 10 times more hours from home. While we feel this increase likely reflects residency programs enabling residents to complete clinical and educational work, such as conference attendance or telemedicine, from home, activities completed from home can vary significantly between residents and specialties, limiting interpretation of this increase in work hours. Regardless, several studies have described residency programs' transition to virtual educational conferences during the pandemic.^{16,17} The quality of this virtual education remains unknown. Internal medicine and emergency medicine residents, when surveyed, showed a preference for in-person over virtual learning and reported decreased levels of engagement in online compared to in-person lectures.¹⁸ Further work evaluating the effectiveness of virtual education in the COVID-19 era, especially for procedural specialties, is needed.

As demonstrated with regulation of work hours, a decrease in clinical work hours can impact educational and clinical experiences.⁷⁻⁹ Historically, regulated decreases in work hours were associated with the shifting of responsibilities to senior residents and concerns about graduating residents' competency.^{7,10} Similar effects may be caused by this demonstrated decrease in work hours during the early pandemic. As hours worked as a resident may not equate to resident competency gained, future work should determine how hours worked correlates with the quantity and quality of educational experiences during this period.

While this study evaluates only one sponsoring institution, each campus is distinct. This study draws

TABLE 3

Mayo Clinic in Florida

Residency Programs	Work Hours (March)	Work Hours (April)	Work Hours (May)
Anesthesiology	NS	NS	NS
Dermatology	NS	50→40 ($P=.013$)	NS
Diagnostic radiology	51→46 ($P=.045$)	52→48 ($P=.025$)	NS
Family medicine	56→50 ($P=.003$)	NS	NS
Internal medicine	NS	56→54 ($P=.009$)	NS
Neurological surgery	NS	NS	54→68 ($P=.002$)
Neurology	NS	57→49 ($P=.017$)	NS
Radiation oncology	NS	NS	NS
General surgery	NS	NS	NS
Urology	NS	NS	NS

Note: Description of significant differences in mean hours a week worked by residents from March through May in the control and pandemic periods. NS is no significant difference between control and pandemic period. If a significant difference in hours worked was found between control and pandemic period, the box is filled with the control period mean hours → pandemic period mean hours (P value).

from residency programs of varying sizes located in the Midwest, Southwest, and Southeast United States. This study does not provide the perspective of residents working in hospitals at or over capacity secondary to COVID-19 and therefore may not be generalizable to

all resident training experiences. Further, as work hours are self-reported by residents at Mayo Clinic sites, we are unable to confirm the accuracy of these hours. Finally, while the residency programs at Mayo Clinic are some of the largest in their respective fields, the

TABLE 4

Mayo Clinic in Minnesota

Residency Programs	Work Hours (March)	Work Hours (April)	Work Hours (May)
Anatomic pathology	NS	NS	NS
Anesthesiology	NS	51→31 ($P<.001$)	50→46 ($P=.026$)
Dermatology	NS	NS	NS
Diagnostic radiology	NS	45→42 ($P=.015$)	NS
Emergency medicine	NS	NS	NS
Family medicine	NS	NS	NS
Internal medicine	NS	51→48 ($P=.026$)	NS
Neurological surgery	60→57 ($P=.032$)	NS	NS
Neurology	57→53 ($P=.014$)	59→49 ($P<.001$)	NS
Obstetrics and gynecology	NS	NS	NS
Oral and maxillofacial surgery	NS	51→34 ($P<.001$)	NS
Ophthalmology	NS	55→47 ($P=.001$)	NS
Orthopedic surgery	NS	57→43 ($P=.001$)	58→50 ($P=.024$)
Otolaryngology	NS	NS	NS
Pediatric medicine	NS	NS	NS
Physical medicine and rehabilitation	NS	46→39 ($P=.003$)	NS
Plastic surgery	NS	58→43 ($P=.001$)	NS
Psychiatry	NS	NS	NS
Radiation oncology	50→53 ($P=.013$)	48→52 ($P=.008$)	48→53 ($P=.005$)
General surgery	NS	63→48 ($P=.006$)	NS
Urology	54→51 ($P=.007$)	56→51 ($P<.001$)	NS
Vascular surgery	NS	NS	52→65 ($P=.008$)

Note: Description of significant differences in mean hours a week worked by residents from March through May in the control and pandemic periods. NS is no significant difference between control and pandemic period. If a significant difference in hours worked was found between control and pandemic period, the box is filled with the control period mean hours → pandemic period mean hours (P value).

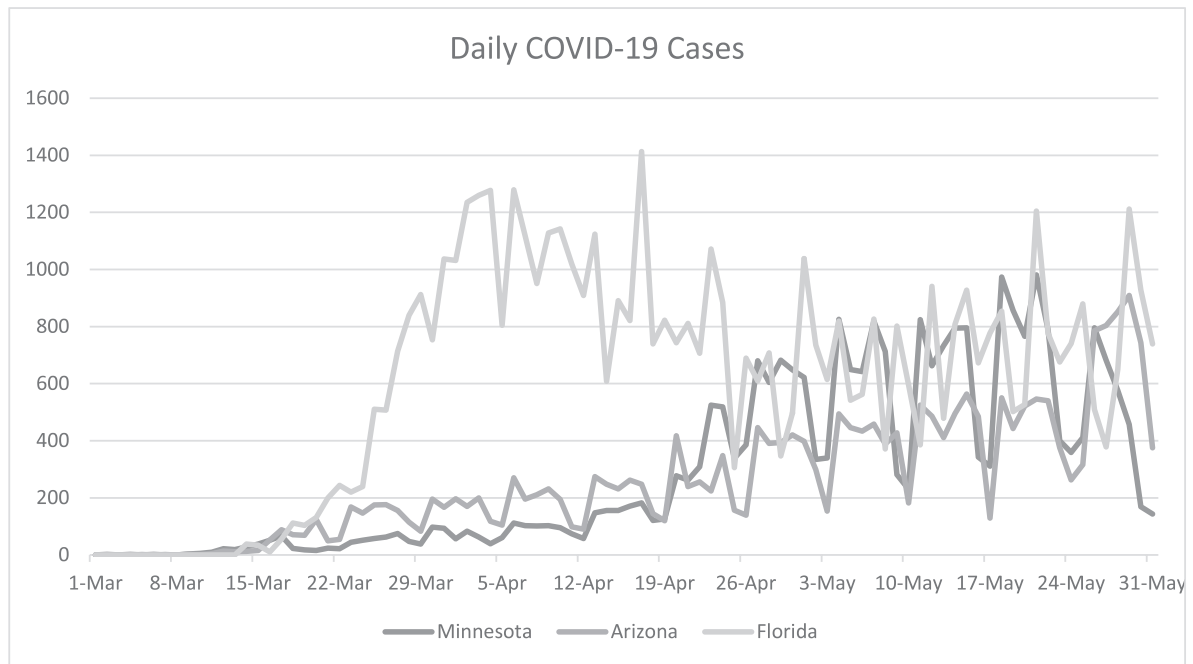


FIGURE 2
Numbers of Newly Diagnosed Daily COVID-19 Cases in Arizona, Minnesota, and Florida in Spring 2020¹⁴

individual size of some programs is relatively small and may be underpowered.

These results mark a step to quantify the impact of the pandemic on resident clinical experience and education. The demonstration of decreased work hours during the period impacted by governmental restrictions may guide program directors to supplement in-person clinical work with virtual educational experiences in future governmental shutdowns. Further, the varying impact on work hours across hospitals and specialties indicate a need for future studies that identify factors that allow residents to maintain work hours during a pandemic.

Conclusions

The COVID-19 pandemic decreased resident work hours in April 2020 across Mayo Clinic campuses in Arizona, Florida, and Minnesota. This impact on hours worked was distributed similarly across medical and surgical specialties. Residents worked more hours from home during the pandemic period, likely attenuating the anticipated decrease in hours worked.

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