

Frequency of Urgent or Emergent Vitreoretinal Surgical Procedures in the United States During the COVID-19 Pandemic

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 Supplemental content

IMPORTANCE The American Academy of Ophthalmology (AAO) indicated that urgent or emergent vitreoretinal surgical procedures should continue during the coronavirus disease 2019 (COVID-19) pandemic. Although decreases in the frequency of critical procedures have been reported outside the field of ophthalmology, analyses are limited by volume, geography, and time.

OBJECTIVE To evaluate whether the frequency of ophthalmic surgical procedures deemed urgent or emergent by the AAO changed across the United States during the COVID-19 pandemic.

DESIGN, SETTING, AND PARTICIPANTS Vitreoretinal practices from 17 institutions throughout the US participated in this multicenter cross-sectional study. The frequency of 11 billed vitreoretinal *Current Procedural Terminology (CPT)* codes across respective weeks was obtained from each practice between January 1, 2019, and May 31, 2020. Data were clustered into intravitreal injections (code 67028), lasers and cryotherapy (codes 67141, 67145, and 67228), retinal detachment (RD) repairs (codes 67107, 67108, 67110, and 67113), and other vitrectomies (codes 67036, 67039, and 67040). Institutions were categorized by region (Northeast, Midwest, South, and West Coast), practice setting (academic [tax-exempt] or private [non-tax-exempt]), and date of respective statewide stay-at-home orders.

MAIN OUTCOMES AND MEASURES Nationwide changes in the frequency of billing for urgent or emergent vitreoretinal surgical procedures during the COVID-19 pandemic.

RESULTS A total of 526 536 CPT codes were ascertained: 483 313 injections, 19 257 lasers or cryotherapy, 14 949 RD repairs, and 9017 other vitrectomies. Relative to 2019, a weekly institutional decrease in injections was observed from March 30 to May 2, 2020, with a maximal 38.6% decrease (from a mean [SD] of 437.8 [436.3] to 273.8 [269.0] injections) from April 6 to 12, 2020 (95% CI, -259 to -69 injections; $P = .002$). A weekly decrease was also identified that spanned a longer interval, at least until study conclusion (March 16 to May 31, 2020), for lasers and cryotherapy, with a maximal 79.6% decrease (from a mean [SD] of 6.6 [7.7] to 1.5 [2.0] procedures) from April 6 to 12, 2020 (95% CI, -6.8 to -3.3 procedures; $P < .001$), for RD repairs, with a maximal 59.4% decrease (from a mean [SD] of 3.5 [4.0] to 1.6 [2.2] repairs) from April 13 to 19, 2020 (95% CI, -2.7 to -1.4 repairs; $P < .001$), and for other vitrectomies, with a maximal 84.3% decrease (from a mean [SD] of 3.0 [3.1] to 0.4 [0.8] other vitrectomies) from April 6 to 12, 2020 (95% CI, -3.3 to -1.8 other vitrectomies; $P < .001$). No differences were identified by region, setting, or state-level stay-at-home order adjustment.

CONCLUSIONS AND RELEVANCE Although the AAO endorsed the continued performance of urgent or emergent vitreoretinal surgical procedures, the frequency of such procedures throughout the country experienced a substantial decrease that may persist after the COVID-19 pandemic's initial exponential growth phase. This decrease appears independent of region, setting, and state-level stay-at-home orders. It is unknown to what extent vitreoretinal intervention would have decreased without AAO recommendations, and how the decrease is associated with outcomes. Although safety is paramount during the COVID-19 pandemic, practices should consider prioritizing availability for managing high-acuity conditions until underlying reasons for the reduction are fully appreciated.

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The coronavirus disease 2019 (COVID-19) pandemic has emerged as an unprecedented event that continues to result in deaths worldwide while straining facets of society, including health care delivery.¹ Practice patterns specifically within the field of ophthalmology during the COVID-19 pandemic in the United States have been transformed, with heightened infection control practices²; awareness of relatively high occupational hazard, with adjustments in protection³; redeployment of physicians from typical ophthalmologic duties to floors, intensive care units, and emergency departments³; refitting of operating suites to accommodate COVID-19-only units; and the deferral or delay in routine visits, elective surgical procedures, and screening consultations.⁴⁻⁶ The changes in the distribution of ophthalmic care represent an effort to minimize the spreading of COVID-19, but with unknown visual consequences for patients.

The changes across ophthalmology practice patterns with the onset of the COVID-19 pandemic thus far have been profound.^{2,4-6} During the initial exponential phase of this pandemic, the American Academy of Ophthalmology (AAO) released a compilation of urgent and emergent procedures determined to be appropriate during this uncertain time while deferring elective and routine care.⁴ Disciplines outside ophthalmology, such as head and neck oncology,⁷ have found a decrease in critical procedures, with data typically limited to 1 center and several weeks of analysis. The aim of this study was to evaluate the extent of any potential changes in the frequency of urgent or emergent vitreoretinal surgical procedures across multiple centers throughout the US during an expanded time frame. Retina practices serve as a practical template for studying these urgent or emergent procedures within ophthalmology, given the nature, relative acuity, and

Key Points

Question What was the nationwide association of the coronavirus disease 2019 (COVID-19) pandemic with the frequency of vitreoretinal surgical procedures determined as urgent or emergent by the American Academy of Ophthalmology?

Findings In this cross-sectional study of 526 536 procedures across 17 institutions, there was a significant decrease in the use of lasers and cryotherapy, retinal detachment repairs, and other vitrectomies, beginning mid-March 2020 and sustaining at least until May 2020. Reductions were independent of region, practice setting, and state-level stay-at-home orders.

Meaning This study suggests that critical vitreoretinal surgical procedures deemed as urgent or emergent experienced a decrease nationwide that persisted early through the COVID-19 pandemic, warranting ophthalmology practices to prioritize availability safely until explanations for the decrease are fully understood.

range of encompassed diseases. As the severity of COVID-19 infection within the US continues to vary by specific location and time,⁸ another aim of this study was to examine potential regional and practice setting differences.

Methods

Billing data from January 1, 2019, through May 31, 2020, were queried in aggregate and analyzed without access to patient-specific or identifying information from 17 US institutions from 15 states (Table).⁹ Although many retina divisions and groups may exhibit both academic and private features regardless of

Table. Vitreoretinal Practice Setting, Geographical Region, and Stay-at-Home Order Date for Participating US Institutions

Practice	Setting	Region	City, state	Stay-at-home order date ⁹
Edward S. Harkness Eye Institute-NYP and Columbia University	Academic	Northeast	New York, New York	March 22, 2020
New York University	Academic	Northeast	New York, New York	March 22, 2020
MEEI and Harvard University	Academic	Northeast	Boston, Massachusetts	March 24, 2020
NJRetina and Rutgers University	Private	Northeast	New Brunswick, New Jersey	March 21, 2020
Wills Eye Hospital and Mid-Atlantic Retina	Private	Northeast	Philadelphia, Pennsylvania	April 1, 2020
Cole Eye Institute and Cleveland Clinic	Academic	Midwest	Cleveland, Ohio	March 23, 2020
IEEI and University of Illinois	Academic	Midwest	Chicago, Illinois	March 21, 2020
University of Wisconsin	Academic	Midwest	Madison, Wisconsin	March 25, 2020
Retina Consultants Ltd	Private	Midwest	Chicago, Illinois	March 21, 2020
Wilmer Eye Institute and Johns Hopkins University	Academic	South	Baltimore, Maryland	March 30, 2020
Duke University	Academic	South	Durham, North Carolina	March 30, 2020
Bascom Palmer Eye Institute and University of Miami	Academic	South	Miami, Florida	April 3, 2020
Vanderbilt University	Academic	South	Nashville, Tennessee	March 31, 2020
Retinal Consultants of Arizona	Private	South	Phoenix, Arizona	March 31, 2020
Retina Consultants of Houston	Private	South	Houston, Texas	April 2, 2020
Stanford University and Byers Eye Institute	Academic	West Coast	Palo Alto, California	March 19, 2020
University of Washington	Academic	West Coast	Seattle, Washington	March 23, 2020

Abbreviations: IEEI, Illinois Eye and Ear Infirmary; MEEI, Massachusetts Eye and Ear Infirmary; NYP, New York-Presbyterian Hospital.

university affiliation, they were classified in a binary fashion (tax-exempt [academic] or non-tax-exempt [private]). Tax-exempt organization status for each academic retina practice was used to define the practice status through corroboration with Internal Revenue Service public database.¹⁰ Each institution was also categorized by region of its state: Northeast, South, Midwest, and West Coast. The initial date of stay-at-home orders for each respective state was also ascertained from publicly available records.⁹ This cross-sectional investigation was deemed exempt because data were queried and analyzed without access to patient-specific or identifying information by the home institution Columbia University Medical Center Institutional Review Board. All aspects of the study complied with requirements of the US Health Insurance Portability and Accountability Act of 1996 as well as the Declaration of Helsinki.¹¹

Current Procedural Terminology (CPT) codes were identified from those determined by the AAO as urgent or emergent vitreoretinal surgical procedures during the COVID-19 pandemic.⁴ Selected CPT codes included 67107, 67108, 67028, 67036, 67039, 67040, 67110, 67113, 67141, 67145, and 67228.¹² Queries specifically involved the total frequency of these billed CPT codes on a monthly basis in 2019 and a weekly basis in 2020. Codes were grouped into 4 major categories: intravitreal injections (code 67028), lasers and cryotherapy (codes 67141, 67145, and 67228), retinal detachment (RD) repairs (codes 67107, 67108, 67110, and 67113), and other vitrectomies (codes 67036, 67039, and 67040).

Statistical Analysis

All statistical analyses were completed using Stata, version 14.2 (StataCorp), and graphs were created using Prism, version 8 (GraphPad). Paired, 2-tailed *t* test analyses of the procedural frequency during 1-week periods in 2020 were compared with the monthly procedural frequency divided by 4, the approximate number of weeks within each period, in 2019. Numbers in 2019 were further adjusted for national holidays during this period, including Martin Luther King Day and Memorial Day. Analysis of variance testing was performed to compare the percentage decrease from 2019 to 2020 for the week of stay-at-home orders and institutional region. A 2-tailed *t* test was used to compare the mean percentage decrease of procedures based on practice setting. To account for multiple statistical comparisons, a Bonferroni calculation was used to determine an a level of .0024 to be statistically significant. Graphical plotting highlighted the date of March 16, 2020, because it was the opening business day after the first stay-at-home order in the nation—instituted by Puerto Rico (a US territory)—on March 15, 2020, at 18:00 Atlantic Standard Time.¹³

Results

Summary Statistics

All 17 institutions returned completed data for all 11 selected CPT codes from January 1, 2019, through May 31, 2020. These institutions encompassed an aggregate of 526 536 billed operations and procedures during these 17 months: code 483 313

(intravitreal injections), code 19 257 (lasers and cryotherapy), code 14 949 (RD repairs), and code 9017 (other vitrectomies).

Overall Change

The mean weekly frequency of injections per institution (range, 274-328 injections) was significantly lower throughout April 2020, specifically from March 30 to May 3, 2020 (Figure 1), compared with a weekly mean of 437 injections in April 2019 (data for each week are in eTable 1 in the Supplement). The greatest reduction of 38.6% (from a mean [SD] of 437.8 [436.3] to 273.8 [269.0] injections) was observed the week of April 6 to 12, 2020 (95% CI, -259 to -69 injections; *P* = .002). From May 4 to May 31, 2020, the mean decrease ranged between 19.4% and 23.0%, a statistically insignificant difference (eTable 1 in the Supplement).

The 3 remaining procedural groups all demonstrated significantly lower volume on average per institution each week compared with 2019 (lasers and cryotherapy [range, 5.2-6.6 procedures in 2019 and 1.5-3.4 procedures in 2020], RD repairs [range, 3.5-3.9 procedures in 2019 and 1.6-2.5 procedures in 2020], other vitrectomies [range, 2.5-3.1 procedures in 2019 and 0.4-1.7 procedures in 2020]; eTables 2-4 in the Supplement) over a longer time interval extending through the conclusion of the study (March 16 to May 31, 2020) (Figure 1). The maximal decrease reached was 79.6% (from a mean [SD] of 6.6 [7.7] to 1.5 [2.0] procedures) the week of April 6 to 12, 2020, for lasers and cryotherapy (95% CI, -6.8 to -3.3 procedures; *P* < .001; eTable 2 in the Supplement), 59.4% (from a mean [SD] of 3.5 [4.0] to 1.6 [2.2] repairs) the week of April 13 to 19, 2020, for RD repairs (95% CI, -2.7 to -1.4 repairs; *P* < .001; eTable 3 in the Supplement), and 84.3% (from a mean [SD] of 3.0 [3.1] to 0.4 [0.8] other vitrectomies) the week of April 6 to 12, 2020, for other vitrectomies (95% CI, -3.3 to -1.8 other vitrectomies; *P* < .001; eTable 4 in the Supplement) during this same interval.

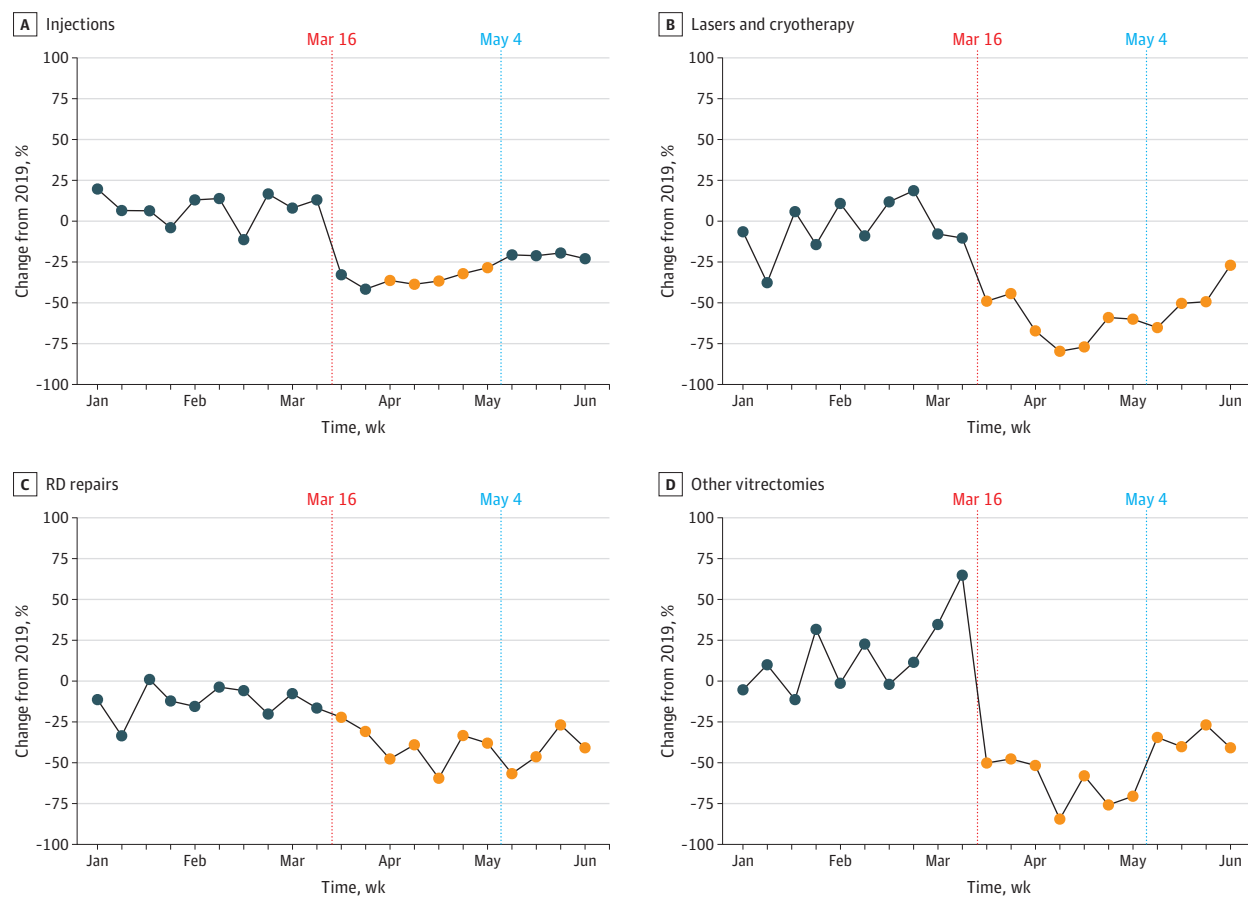
Stay-at-Home Orders

The initial date for stay-at-home orders of each institution's respective state ranged from March 19, 2020 (Stanford University, California), to April 3, 2020 (University of Miami, Florida) (Table).⁹ Practices were subclassified based on week of stay-at-home order implementation: March 16 to 22, 2020 (*n* = 6), March 23 to 29, 2020 (*n* = 4), and March 30 to April 3, 2020 (*n* = 7). No significant difference was observed between change in any procedure group frequency and its corresponding week in 2020 when adjusting for the week of implemented stay-at-home orders for each institution's state.

Region

Institutions accounted for all 4 regions: Northeast (*n* = 5), South (*n* = 6), Midwest (*n* = 4), and West Coast (*n* = 2) (Table).⁹ The percentage change for any of the 4 procedure groups was similar across regions (Figure 2). Four additional permutations of analyses were conducted classifying Johns Hopkins University (Maryland) as Northeast and/or Retinal Consultants of Arizona as West Coast. None yielded statistically significant differences between regions.

Figure 1. Association of Coronavirus Disease 2019 Pandemic Onset With Overall Frequency of Urgent or Emergent Vitreoretinal Surgical Procedures From January 1 to May 31 Compared With the Prior Year



Immediately after the first stay-at-home orders in the United States (March 16, 2020; red dotted vertical line), there was a statistically significant decrease in injections (orange dots; $P < .002$), as well as lasers and cryotherapy procedures

(orange dots; $P < .001$), retinal detachment (RD) repairs (orange dots; $P < .001$), and other vitrectomies (orange dots; $P < .001$) relative to 2019.

Setting

A total of 12 academic (tax-exempt) and 5 private (non-tax-exempt) retina practices were included (Table).⁹ The mean percentage change in procedure frequency based on practice setting designation was similar for each of the 4 procedure groups (Figure 3).

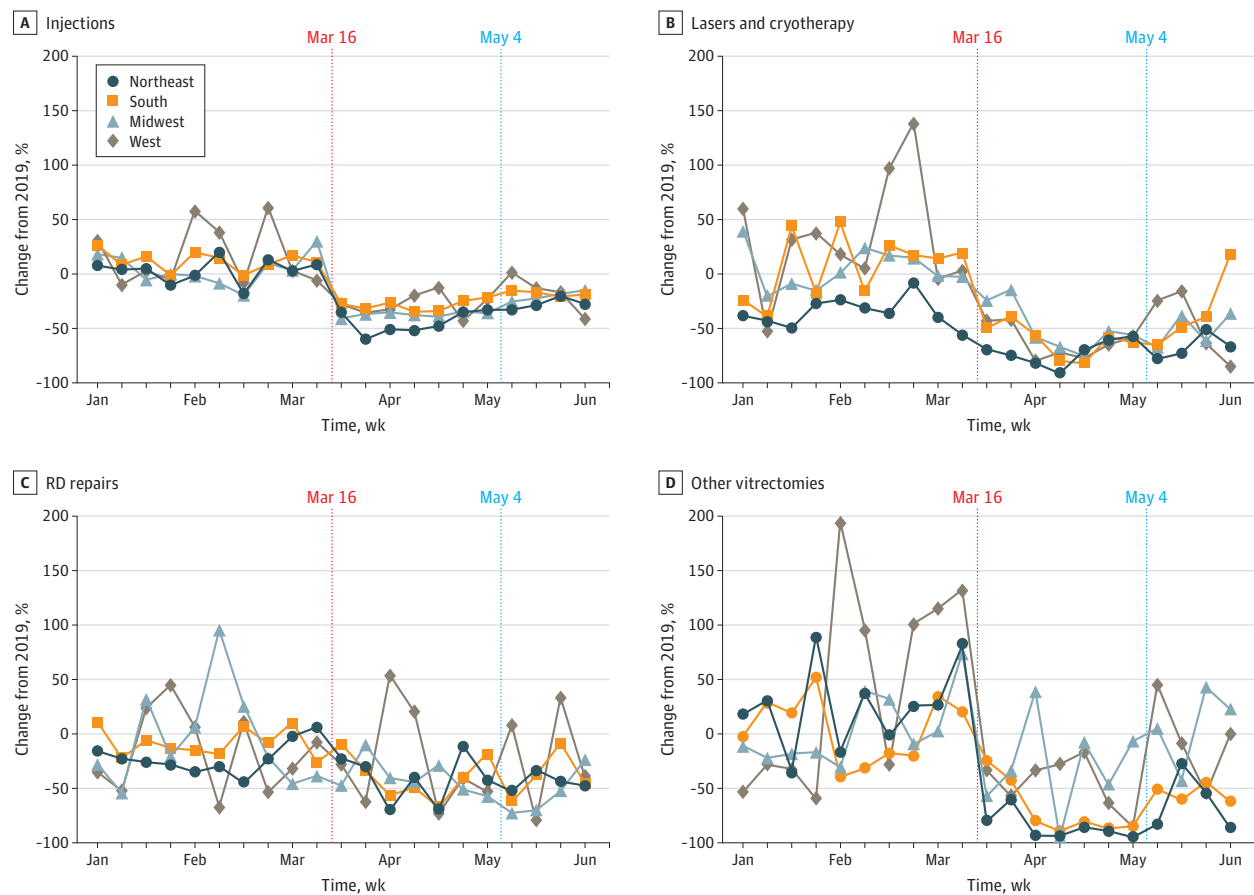
Discussion

After analyzing more than a half million billed urgent or emergent vitreoretinal surgical procedures nationwide, this study provides evidence that the beginning of the COVID-19 pandemic, with its initial exponential growth phase, was accompanied by a widespread reduction in urgent ophthalmic procedures. Although it is unknown to what extent vitreoretinal intervention would have decreased without AAO recommendations, this change suggests that ophthalmologists were engrossed in a transformation that may continue to affect a large subset of US retina practices and their patients. As the pandemic continues with multiple resurgences,⁸ the number of

ophthalmic procedures may remain lower because of the precautions taken in office practices.² This change may potentially result in needed procedures being further delayed or postponed. The implications for this decrease may be meaningful for colleagues outside of retina practice as well—not only practices that are primarily based on elective clinical activities, including cataract and refractive surgery, but also other subspecialties, such as glaucoma, cornea, and oculoplastic surgery, for which many urgent or emergent procedures are also necessary to prevent blindness.

Intravitreal injections are one of the most common ophthalmic procedures in the US¹⁴ and are the most highly represented CPT code in our study. A significant decrease in the frequency of intravitreal injections was found in April 2020. Unlike the other procedure groups, this decrease did not persist into the later weeks of May 2020, nor was it impacted in early March 2020. One possible explanation is that patients who were already being regularly treated for chronic conditions, such as neovascular age-related macular degeneration or diabetic macular edema, were more diligent about maintaining their treatment schedule to preserve their vision, as

Figure 2. Change in Frequency of Urgent or Emergent Vitreoretinal Surgical Procedures by Region From January 1 to May 31 Relative to Prior Year



Although an overall decrease in the proportion of procedures from 2019 is evident after the onset of the pandemic, all 4 regions (Northeast [$n = 5$], South [$n = 6$], Midwest [$n = 4$], and West Coast [$n = 2$]) follow a similar trend for

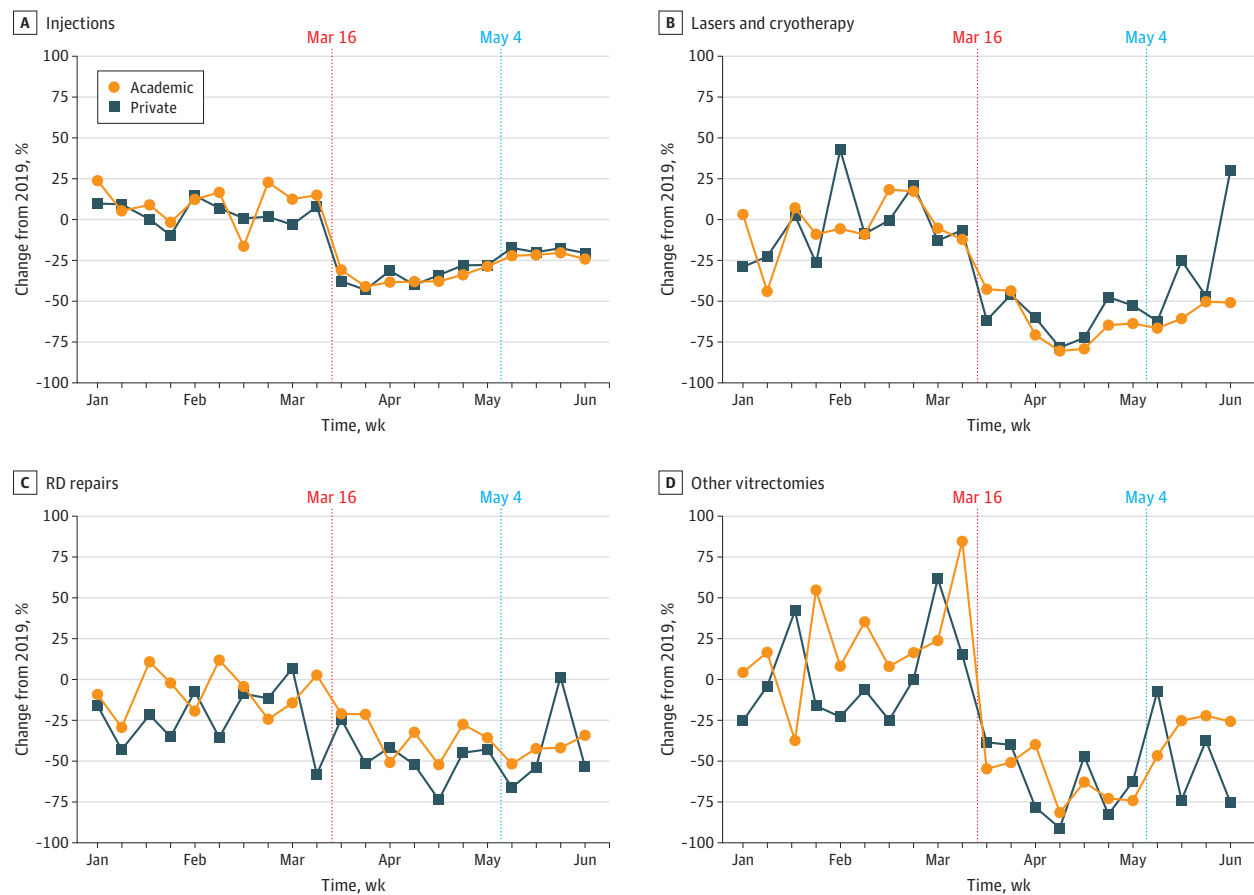
injections, lasers and cryotherapy procedures, retinal detachment (RD) repairs, and other vitrectomies.

were their physicians. Alternatively, the health systems allowed for their return more easily than new patients with retinal detachment, for example. Instead, new patients may encounter obstacles from these same networks that tried to limit clinic volume as part of COVID-19 precautions. The heterogeneity of indications and the relative urgency for injections pose a challenge in interpreting this decrease and in comparing with other procedure groups with any granularity. Ultimately, numerous variables may be associated with the frequency of intravitreal injection therapy, regardless of COVID-19, including health system factors, socioeconomic factors, condition-related factors, therapy-related factors, and patient-related factors, according to the World Health Organization.¹⁵ It remains unclear how much the fear of contracting COVID-19, for example, may deter patients from seeking appropriate, timely retinal care during this pandemic. Some of this concern is substantiated by age-related macular degeneration (among an older population already at high risk for COVID-19), a complement-mediated disease, having been reported to confer higher mortality risk from COVID-19 infection.¹⁶

Although RD repairs and procedures for retinal tears decreased during the COVID-19 pandemic, it is uncertain whether

this decrease is fully explained by patients who avoided evaluation and treatment from a fear of COVID-19 infection.¹⁷ Multiple specialties, including emergency medicine, neurosurgery, pediatric orthopedics, and cardiology, have experienced decreases in clinical volumes, with attribution to fear of the virus as well as other specialty-dependent explanations.^{7,18-21} One of these studies examining approximately 15 000 cases of myocardial infarction demonstrated a decreased rate in myocardial infarction hospitalization within the first 5 weeks of the pandemic, followed by an increase in hospitalization with worse mortality rates.²¹ This latency in care was likely associated with these negative patient-centered outcomes. In contrast, our vitreoretinal data suggest a decrease that appeared to persist beyond 5 weeks. Other explanations could include a decrease in elective procedures, such as cataract surgery and laser capsulotomy in the pandemic, resulting in fewer posterior vitreous detachments or vitreoretinal complications. Static and dynamic vitreoretinal tractions are commonly known to precipitate tears and detachments of the retina. It is possible that people at large have adopted a more sedentary lifestyle with COVID-19 that may have resulted from the stay-at-home orders and working from home. Although quite speculative,

Figure 3. Frequency by Practice Setting of Urgent or Emergent Vitreoretinal Surgical Procedures From January 1 to May 31 Relative to Previous Year



Although an overall decrease in the proportion of procedures from 2019 is evident after the onset of the pandemic, both academic (tax-exempt [n = 12]) and private (non-tax-exempt [n = 5]) practice settings follow a similar trend for

injections, lasers and cryotherapy procedures, retinal detachment (RD) repairs, and other vitrectomies.

fewer retinal tear or detachment presentations may be explained partially by a decrease in flow currents²² and tractional forces²³ within the vitreous cavity that may otherwise be present with normal activity. Ultimately, patients may be more afraid to be seen for minor symptoms or even unable to be seen because their local practices are closed. Although many routine ophthalmologic visits have shifted care to telemedicine,²⁴ many visits with vitreoretinal practice are less amenable given the nature and spectrum of disease (eg, a reliance on visualizing the fundus). Visual outcomes and implications from all these changes are largely unknown, adding to concern.

This study included regional subanalysis with the intention to account for differences in geography as well as variation in regional public health policy and practices,²⁵ perhaps increasingly relevant with the ongoing political divisiveness in association with COVID-19 across the US.²⁶ However, all regions appeared to be similar in their significant decreases among all 4 groups of urgent or emergent surgical procedures. It is challenging to evaluate how generalizable these results will be for other countries, as well as over time in the US, with known resurgences of COVID-19. As of early December

2020, the US continues to have increases in new record daily counts of COVID-19 cases and associated mortality.⁸

The decrease in procedures identified in our study occurred independent of practice setting, in both academic and private practices based on tax-exemption status. Both practice settings noted a similar decrease while likely maintaining best efforts of adhering to the AAO recommendations. This observation is surprising because, while comprehensive visits with routine evaluations across ophthalmology would be expected to cease, time-sensitive disease management inherent to vitreoretinal medicine also decreased across academic and private practice. Furthermore, the burden did not appear to shift from private to academic practice, for example. This finding could be limited because the included private practices are relatively more academic or in areas without well-established academic practices, or because additional COVID-19 requirements mandated by academic institutions prevented this shift. This observation could also support the concept that the line between academic and private practice can be hazy. The financial pressure on US health care systems and their costs remain burdensome,^{27,28} which are further compounded by the pandemic with untoward consequences.²⁹ The Centers for Medicare & Medicaid Services

have proposed additional reductions in reimbursement for ophthalmologic evaluation and management to begin in 2021.³⁰ Many academic centers and other hospital systems have increasingly adopted clinical models that are hybrid with or similar to private practice, including consolidation of smaller, neighboring practices.²⁸ Meanwhile, some private ophthalmologic practices have consolidated and been sold to private equity firms.³¹ The association of these changes with patient care and outcomes will be important to monitor, especially as the COVID-19 pandemic persists, but remains beyond the scope of this investigation.

Limitations

This study has some limitations, including that the analysis was restricted to the first several months of the COVID-19 pandemic, as well as exclusion of some CPT codes. Although accounting for macular surgery (codes 67041 and 67042) may have captured some cases of severe macular hole or vitreomacular traction warranting expedited surgery, many or most of these cases are typically considered subacute retinal conditions. *Current Procedural Terminology* codes for low-frequency but emergent surgical procedures, such as intraocular foreign body removal, were also excluded. Conversely, code 67036 may have captured nonurgent conditions in some cases. Laterality was not accounted for and thus may partially confound results for certain procedures (eg, intravitreal

injections that may be given bilaterally). Although using mean monthly data in 2019 as a baseline for comparing weekly data in 2020 could be interpreted as a weakness, this approach was expected to enhance accuracy given known procedural variability on a weekly or daily basis.

Conclusions

It remains unclear what the ultimate long-term effects will be from the decrease in urgent or emergent surgical procedures across the US, and whether the decrease will be sustained during the COVID-19 resurgences. The clinical outcomes from these decreases cannot be determined at this time. Although it is likely that they had some association with outcomes, the magnitude has not been measured. There is speculation that much of delivered health care could be unnecessary,³² corroborated in some instances by several studies within ophthalmology.³³⁻³⁶ In summary, the frequency of urgent or emergent vitreoretinal procedures substantially decreased in the US during the COVID-19 pandemic. This decrease appears to be independent of other factors, including region, practice type, or state-level stay-at-home orders. Future investigation will be required to assess the full duration of this decrease and the long-term visual impact. Research is currently ongoing to assess this end point.

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Author Contributions: Drs Breazzano and Nair had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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