

# Impact of reduced elective ophthalmic surgical volume on U.S. hospitals during the early coronavirus disease 2019 pandemic



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**Purpose:** To estimate the financial impact of coronavirus disease 2019 (COVID-19)-related shutdowns on ophthalmic surgery performed at hospital outpatient departments (HOPDs) in the United States.

**Setting:** Nationally representative sample of U.S. hospital payment and cost data.

**Design:** Retrospective review and economic impact analysis.

**Methods:** The Nationwide Ambulatory Surgery Sample (NASS) was used to identify ophthalmic surgical procedures and associated charges, which were performed at HOPDs. The highest volume elective ophthalmic procedures were identified. The total hospital cost and payment amount was calculated for each procedure using the Hospital Outpatient Prospective Payment System (OPPS) maintained by the Centers for Medicare & Medicaid Services. Net facility income (estimated payments less OPPS rates) was determined for each elective surgical procedure category and stratified by hospital teaching status.

**Results:** In 2017, elective cataract, strabismus, and keratoplasty surgeries were performed 1 230 992 times at HOPDs. The total cost of these elective surgeries was 2350 million U.S. dollars (USD), with a total hospital payment of 3624 to 3786 million USD. This led to an estimated net income of 1278 to 1440 million USD overall to U.S. hospitals in the NASS dataset from elective ophthalmic surgery (approximately 107 to 120 million USD per month), with a larger proportion performed in teaching hospitals.

**Conclusions:** The cessation of elective ophthalmic surgeries at HOPDs during COVID-19 resulted in a significant loss of income for hospitals in the United States and teaching experiences for trainees at academic medical centers.

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An outbreak of a new coronavirus causing COVID-19 disease at the end of 2019 resulted in unprecedented stay-at-home orders and restrictions on business operations worldwide. To help limit viral exposure to populations throughout the United States, the Centers for Medicare & Medicaid Services (CMS) recommended cancellation of elective surgery on March 13, 2020, as part of a national response that included self-isolation and social distancing.<sup>1</sup> Soon after, on March 18, 2020, the American Academy of Ophthalmology (AAO) released practice guidance advising ophthalmologists to cease providing any treatment other than urgent and emergent care.<sup>2</sup>

After a period of almost 2 months, CMS released new guidelines on May 6, 2020, allowing for the gradual resumption of elective procedures at the discretion of hospital leadership.<sup>3</sup> This nearly 8-week period with limited elective surgical volume has contributed to substantial reductions in

hospital revenue and net income.<sup>4,5</sup> Ophthalmology was identified as the field with the greatest reduction in procedural volume in 1 report, with total encounters down by 79.8% compared with the same period in 2019.<sup>6</sup>

To help offset these losses, Congress allocated 175 billion U.S. dollars (USD) in funding to provide financial relief to the healthcare system.<sup>7</sup> Although this allocation was essential to help mitigate the economic impact of initial shutdowns, this amount will not completely cover losses from stopping elective ophthalmology practice and surgery. According to a survey of private practices conducted by the AAO, 89% of ophthalmology practice owners applied for payroll protection, although, even with financial assistance, 73% stated that their practices will be smaller, financially unhealthy, or both by the end of the year.<sup>8</sup> However, the extent to which hospital-based ophthalmology practices have been affected in net income or revenue is not known.

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The Healthcare Cost and Utilization Project (HCUP) is often used for revenue predictions from decreased surgical volume; however, it provides estimates of the aggregate cost of inpatient procedures and not actual hospital revenues and profits.<sup>9–13</sup> Thus, the aim of this investigation was to estimate the impact of COVID-19 shutdowns on elective ophthalmic surgeries at hospital outpatient departments (HOPDs) for total cost to provide the service, insurance payments, and net income and to further stratify this by hospital teaching status. By using a nationally representative sample of payments and costs, our hope is to provide information that will be helpful in guiding physicians and other stakeholders in developing future evidence-based plans for delivery of ophthalmic care and education of ophthalmology residents and fellows.

## METHODS

This study was exempted from institutional review board review because the dataset is publicly available and contains deidentified information. All study procedures adhered to the tenets of the Declaration of Helsinki.

### Description of Dataset

This investigation used the Nationwide Ambulatory Surgery Sample (NASS) dataset. The NASS is maintained by the Agency for Healthcare Research and Quality and is the only nationally representative ambulatory surgery database presently available. The NASS provides the largest all-payer database of major ambulatory surgery encounters performed in HOPDs. The dataset contains resource-use information and clinical data such as patient demographics, diagnostic and procedural codes, total hospital charges, source of insurance payment, and facility characteristics.<sup>14</sup> This investigation used the 2017 NASS dataset, which is the most recent year available.

The 15 most common ophthalmic surgeries by Current Procedural Terminology (CPT) code were extracted from the NASS dataset and are listed in order of decreasing surgical volume. Each procedure was categorized as urgent/emergent vs routine based on a practice guidance document provided by the AAO on March 26, 2020.<sup>15</sup> The 3 most common elective ophthalmic surgery categories were cataract surgery (CPT codes 66984 and 66982), strabismus surgery (CPT codes 67311, 67312, 67314, 67316, and 67318), and keratoplasty surgery (CPT codes 65756, 65730, 65710, 65750, and 65755). Although it was among the most commonly performed CPT procedures, Nd:YAG laser capsulotomy (CPT 66821) was not included in analysis of elective surgeries because it does not require operating room or anesthesia support services. The other remaining procedures were categorized as urgent/emergent and, thus, excluded from estimates of economic impact.

### Analysis of Cost and Hospital Payments

Cost for each outpatient surgery was estimated by using the Hospital Outpatient Prospective Payment System designed by CMS. Mean cost for each CPT code is calculated by the CMS, which is updated annually based on many factors including supply changes and medical inflation and published in the Hospital Outpatient Prospective Payment System Final Rule. CMS states that these values are meant to reflect the average total cost for that specific surgical procedure among all hospitals, inclusive of bundled services.<sup>16</sup>

CMS reimbursement data were then used to estimate payments to hospitals for each outpatient surgical case. The specific payment determined by CMS is based on ambulatory procedure classifications, CPT codes, and a status indicator.<sup>17</sup> If more than

1 procedure is performed during surgery, the status indicator determines the payment method. The status code J1, for example, means that the case receives a bundled payment, and thus, additional procedure codes do not increase payment amount; payments were bundled in this manner for all of the analyzed for cases of cataract, strabismus, and keratoplasty in the NASS dataset.

To calculate the total allowed charges for all payers, the different rates of reimbursement based on payer status were estimated. We used previously published crosswalks converting payments from Medicare to Medicaid and private insurance.<sup>18–24</sup> The final payment adjustment values for outpatient cases, using conservative and high estimates, are as follows (where the number represents a multiplier for reimbursements from each payer class): (1.) Conservative estimate: 1.0 Medicare; 0.8 Medicaid; 2.5 private insurance; and 0.65 other, self-pay, missing, or no charge. (2.) High estimate: 1.0 Medicare; 1.0 Medicaid; 2.65 private insurance; and 1.0 other, self-pay, missing, or no charge.

### Statistical Analysis

The total cost and adjusted payments for the above-identified 3 most common elective ophthalmic surgeries were calculated. Net income was determined by subtracting total cost from the total adjusted hospital payment amount for each individual case; an aggregate sum was calculated using each of these independent income values. Data analysis was accomplished using IBM SPSS Statistics for Windows software (version 23.0, IBM Corp). Costs and income based on each hospital's designation as a teaching hospital were also stratified.

## RESULTS

There were 1 401 110 cases among the 15 most common ophthalmic surgeries performed in HOPDs in the 2017 NASS dataset, most of which were categorized as cataract surgery, strabismus surgery, or keratoplasty (Table 1). Among these 3 groups in the entire NASS dataset (inclusive of all CPT codes), there were 1 230 992 cases total: cataract with insertion of intraocular lens (IOL) (N = 1 161 840), strabismus (N = 52 835), and keratoplasty (N = 16 317). The total aggregate cost of these 3 groups of elective ophthalmic surgeries was 2350 million USD. Using adjustments based on payer mix, the estimated total hospital payment was between 3624 and 3786 million USD. This would provide an annual net income of between 1278 and 1440 million USD or approximately 107 to 120 million USD per month in 2017, assuming surgical volume does not vary significantly on a monthly basis (Table 2).

Estimates of cost, payments, and net income stratified by elective surgery type are reported in Table 3. Cataract surgery comprised the largest share of payments (56.6%; Figure 1). Teaching hospitals accounted for a larger share of the total annual net income figure, contributing 773 to 878 million USD compared with 505 to 562 million USD for nonteaching hospitals, a trend that was consistent among the 3 categories of elective eye surgery that were studied (Tables 2 and 3).

## DISCUSSION

We estimate a loss of approximately 302 to 316 million USD in hospital payments per month of COVID-19–related shutdowns for elective ophthalmic surgeries performed at HOPDs. This represents a monthly 107 to 120 million USD

**Table 1. List of the 15 most common surgical procedures in the National Ambulatory Surgery Sample database, in decreasing order of prevalence and stratified by status as elective surgery.**

Indication	Elective?	CPT Code	N
Extracapsular cataract removal with insertion of IOL prosthesis (1 stage procedure)	Yes	66984	1 071 483
Extracapsular cataract removal with insertion of IOL (1 stage procedure), complex	Yes	66982	90 357
Nd:YAG laser capsulotomy	Yes	66821	64 952
Repair of retinal detachment with vitrectomy, any method	No	67108	37 532
Strabismus surgery: 1 horizontal muscle	Yes	67311	33 796
Complex retinal detachment repair	No	67113	24 943
Laser treatment of retina, vitrectomy, mechanical, pars plana approach with endolaser panretinal photocoagulation	No	67040	19 726
Keratoplasty;; endothelial	Yes	65756	10 796
Strabismus surgery: 1 vertical muscle	Yes	67314	10 410
Strabismus surgery: 2 horizontal muscles	Yes	67312	8629
Vitrectomy, mechanical, pars plana approach with focal endolaser photocoagulation	No	67039	8237
Exchange of IOL	No	66896	6043
Keratoplasty: penetrating (except in aphakia or pseudophakia)	Yes	65730	5521
Repair of retinal detachment: scleral buckling	No	67107	4642
Removal of lens material pars plana with or without vitrectomy	No	66852	4043
Total procedure count			1 401 110

CPT = Current Procedural Terminology; IOL = intraocular lens

reduction of net income among these surgical cases on a nationwide basis.

Elective surgical procedures have garnered increased national discussion during the era of COVID-19 because of their importance in contributing to hospital revenues.<sup>6,7</sup> Previous estimates of the projected economic impact of elective surgery cessation outside of ophthalmology use the

HCUP database, which is limited by lack of information on hospital revenue, thus precluding calculations of net income (defined as revenue less expenses).<sup>9-13</sup> Thus, in this study, previous patterns of procedural costs and hospital payments were used to estimate the monthly loss in hospital income because of the most common elective ophthalmic surgeries performed at HOPDs across the United States.

**Table 2. Total hospital charges, insurance payments, procedure costs, and net income for elective cataract, strabismus, and keratoplasty surgeries in hospital-owned outpatient departments in the United States.**

	All Hospitals (Million USD)	Teaching Hospitals (Million USD)	Nonteaching Hospitals (Million USD)
Total hospital charges*	10 026	5871	4155
Total insurance payments <sup>†</sup>	3624, 3786	2135, 2240	1489, 1546
Total cost of procedures <sup>‡</sup>	2350	1264	986
Net income	1278, 1440	773, 878	505, 562

USD = U.S. dollars

\*Taken from the Nationwide Ambulatory Surgery Sample dataset.

<sup>†</sup>Ranges in insurance payments are based on conservative (lower) to higher charge adjustments based on differences in payment rates based on payer type for each procedure, as follows: (1) Conservative estimate: 1.0 Medicare; 0.8 Medicaid; 2.5 private insurance; and 0.65 other, self-pay, missing, or no charge. (2) High estimate: 1.0 Medicare; 1.0 Medicaid; 2.65 private insurance; and 1.0 other, self-pay, missing, or no charge.

<sup>‡</sup>Estimated from the Centers for Medicare & Medicaid Hospital Outpatient Prospective Payment System.

**Table 3. Most common elective ophthalmic surgeries performed in hospital-owned outpatient ambulatory surgery centers in the United States, both overall (top) and stratified by status as a teaching hospital (bottom).**

All Hospitals						
	Description	N	Total Hospital Charges* (Million USD)	Total Insurance Payments† (Million USD)	Total Cost of Procedures‡ (Million, USD)	Net Income (Million USD)
1	Cataract surgery	1 161 612	9156	3361, 3500	2184	1180, 1318
2	Strabismus surgery	47 064	514	173, 191	105	67.9, 85.7
3	Keratoplasty	19 178	436	112, 118	72.6	39.3, 45.7
Teaching Hospitals						
	Surgery Type	N	Total Hospital Charges* (Million USD)	Total Insurance Payments† (Million USD)	Total Cost of Procedures‡ (Million, USD)	Net Income (Million USD)
1	Cataract surgery	643 940	5117	1897, 1981	1125.3	683, 767
2	Strabismus surgery	42 827	439	158, 175	95	63, 79
3	Keratoplasty	16 950	382	98.4, 104.0	64.2	34.5, 40.1
Nonteaching Hospitals						
	Surgery Type	N	Total Hospital Charges* (Million USD)	Total Insurance Payments† (Million USD)	Total Cost of Procedures‡ (Million, USD)	Net Income (Million USD)
1	Cataract surgery	517 671	4000	1464, 1519	969	496, 550
2	Strabismus surgery	4237	74	14, 16	9.4	4.9, 6.5
3	Keratoplasty	2228	535	132, 139	8.4	4.8, 5.5

USD = U.S. dollars

\*Taken from the Nationwide Ambulatory Surgery Sample dataset.

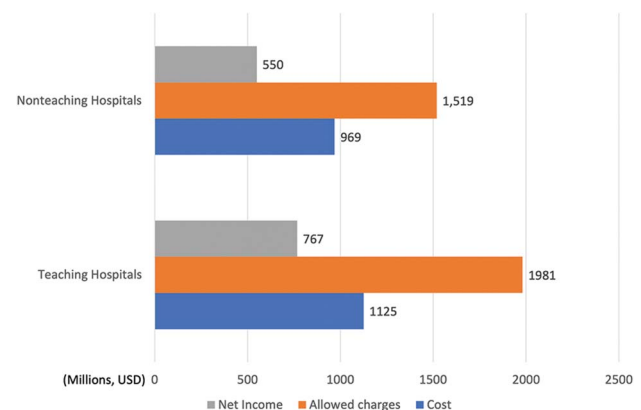
†Ranges in insurance payments are based on conservative (lower) to higher charge adjustments based on differences in payment rates based on payer type for each procedure, as follows: (1) Conservative estimate: 1.0 Medicare; 0.8 Medicaid; 2.5 private insurance; and 0.65 other, self-pay, missing, or no charge. (2) High estimate: 1.0 Medicare; 1.0 Medicaid; 2.65 private insurance; and 1.0 other, self-pay, missing, or no charge.

‡Estimated from the Centers for Medicare & Medicaid Hospital Outpatient Prospective Payment System.

Cataract surgery is the most common ophthalmic procedure performed in HOPDs and contributes the greatest share of both cost and income for hospitals compared with other elective surgery types. When stratified by teaching hospital status, we found that cataract, strabismus, and keratoplasty were performed more often in teaching hospitals than in nonteaching hospitals, reflecting the important role these procedures have in the surgical training of residents and fellows. Professional societies and commentators have grappled with how to transition back to routine patient care in ophthalmology given the importance of routine elective surgery for both the financial health of hospitals and education of trainees.<sup>25</sup> By presenting data on trends in elective surgical volumes and operating revenue, we hope that this study will guide informed decisions on reopening ophthalmic surgical practices, especially with the possibility of hypothesized second wave of coronavirus reemergence in the United States.

Along with decreased clinical and surgical volumes in ophthalmology practices across the country, there have been reports of decreased volume of patients presenting to the emergency department with eye emergencies, likely fearing exposure to coronavirus and a desire to adhere to strict government stay-at-home orders.<sup>9,26</sup> Even as restrictions are relaxed across the United States, some

hospitals will continue to have ongoing COVID-19-related resource needs, such as personal protective equipment and nursing staff for hospitalized inpatients. In addition, organization-wide policies in place at hospitals—such as those pertaining to elective reopening strategies, personal protective equipment, and coronavirus testing across multiple units and departments—might



**Figure 1.** Aggregate cost, allowed charges, and net income from cataract surgery, stratified by hospital teaching status in hospital-owned outpatient departments in the United States (USD = U.S. dollars).

be slower to open backup because of the diverse needs of those different areas. It is likely that facilities where COVID-19 patients are not cared for will be the first areas where elective eye surgery can safely resume amid ongoing outbreaks.<sup>27</sup> This poses an additional challenge for re-opening of HOPDs in hospitals where COVID-19 patients are being treated. For example, at our own institution, ambulatory surgery centers (ASCs) were permitted to resume surgery before our HOPD because of hospital-wide policy considerations, such as the care of COVID-19 inpatients at the main hospital and available resources. Guidance from the AAO, American Society of Cataract and Refractive Surgery, and the Outpatient Ophthalmic Surgery Society summarized specific considerations pertaining to ASCs, such as willingness of outside hospitals to accept urgent transfers from the ASC when needed.<sup>28</sup> As a result, it is possible that although ASCs might be able to resume operations more quickly, resumption of outpatient elective ophthalmic care for HOPDs might resume in a more gradual fashion, as initial guidance by the AAO suggested.<sup>29</sup>

The resident and fellow training experience will likely change depending on the type of patient encounter that was cancelled during the COVID-19 shutdowns. For example, although outpatient clinic appointments cancelled due to COVID-19 cannot be made up, at least some of the surgical volume that was cancelled can be expected to recover as patients return to have surgery as hospitals reopen. However, the assumption that each surgery that was cancelled at an HOPD during this period will return to that specific HOPD might not be accurate. For example, elderly patients in whom elective cataract surgery was scheduled due to impaired activities of daily living (such as driving at nighttime) might elect not to pursue surgery in the near term due to stay-at-home recommendations for that vulnerable population. In addition, patients might prefer to pursue elective surgery, particularly cataract surgery, at an ASC as opposed to a hospital setting where coronavirus patients might be cared for, even when the facility takes all necessary precautions.

As a result, the impact on resident and fellow surgical training will persist in the coming months and likely impact certain trainees more than others. For example, a trainee who graduated in June 2020 and had completed most of their rotations prior to the pandemic will likely be less affected than trainees in earlier stages of their surgical education. The Accreditation Council for Graduate Medical Education recognized and affirmed that programs have the latitude to make decisions about graduating residents in light of decreased volumes during COVID-19 shutdowns. Although the Accreditation Council for Graduate Medical Education minimum number for ophthalmology residents is 86 cataract surgery cases as primary surgeon, 10 strabismus cases as primary surgeon, and 5 keratoplasty as surgeon or assistant, a given resident who has not met all case minima might still be “deemed by the program director to be surgically competent and be allowed to complete the program, as scheduled.”<sup>30,31</sup> However,

residency program directors still need to determine competency on an individual basis and have confidence that graduating residents have demonstrated the ability to independently perform “the medical diagnostic, and surgical procedures considered essential for the area of practice.”<sup>31</sup>

Because the COVID-19 pandemic continues, the potential for ongoing or intermittent reduction in elective surgery in an HOPD might limit opportunities to achieve competency in procedures such as cataract surgery, which is foundational for resident ophthalmic surgical education. Considering potential backlogs in cataract surgeries that have been reported in recent projections, methods of supplementing the resident and fellow surgical experience have garnered active discussion.<sup>32</sup> For example, increasing the amount of time trainees can spend in structured wet-lab didactic sessions, video-based learning, and surgical simulation—techniques used with success in many programs prior to the pandemic—might play a greater role with continued disruptions in elective surgery.<sup>33–35</sup> Training programs might consider exploring practice settings that have traditionally not hosted rotating trainees. This might include locations such as satellite offices or ASCs owned by the hospital system that might be quicker to reopen than an HOPD or might be preferred by patients wish to avoid hospital settings due to perceived risk of COVID exposure.

There are several important limitations to consider when interpreting results from this study. First, the using the NASS database provides data on hospital-owned outpatient facilities only, as opposed to ASCs or inpatient ophthalmic surgeries. The Agency for Healthcare Research and Quality estimates that the 2017 NASS dataset represents 72.5% of all ambulatory surgery encounters performed in HOPDs among all surgical fields.<sup>36</sup> However, information about the percentage share of HOPD ambulatory surgical volume represented in the NASS dataset for ophthalmology practices specifically is not provided. According to one longitudinal analysis, most cataract surgeries occur in ASCs (64%), followed by HOPDs (38%).<sup>37</sup> This means that we are likely underestimating total insurance payments, costs, and incomes across the United States as a whole.

Furthermore, cataract surgery has unique cost structures that might contribute to additional financial losses sustained by HOPDs that are not captured in estimations based on Medicare payments and expenses in this study. Premium technologies such as femtosecond lasers (used in an estimated 8 percent of cataract surgery) and intraoperative aberrometry, for example, require expensive leased equipment that typically incurs a monthly cost.<sup>38</sup> When these equipment are unused, the monthly cost remains unchanged. Data on the specific cost and reimbursement associated with femtosecond-assisted cataract surgeries or surgeries using intraoperative aberrometry technology are not included in the NASS dataset. As a result, we are likely underestimating the overall revenue



loss by underestimating the costs incurred by practices during the study period.

Another aspect unique to cataract surgery is the professional fee revenue generated by premium IOL insertion, such as toric IOLs and presbyopia-correcting IOLs. The most recent nationwide survey available found that toric and presbyopic (ie, multifocal) IOLs comprise 9% and 8%, respectively, of all IOLs used.<sup>39</sup> Patients typically pay out-of-pocket costs for these IOLs, which generate more revenue for a practice than a standard IOL placement. Because the NASS dataset does not include noncovered charges or associated costs, the estimates provided in this study are likely underestimating the loss of income to HOPDs that provide premium IOL implantation to their patients.

Furthermore, estimated potential financial losses in this study were calculated under 3 important assumptions. First, it was assumed that trends in ophthalmic surgery have been steady since 2017 and that monthly revenue can be estimated by dividing the annual payment and cost data. Second, the estimated losses reported in this study assume that all procedures in these 3 categories were cancelled during the COVID-19 shutdowns. In reality, there were some elective surgeries that did in fact proceed on a case-by-case basis over the course of COVID-19 shutdowns; thus, the income losses might be modestly overestimated. Finally, revenues were estimated with adjustments based on payer mix without having exact data. One final limitation is the actual cost of delivering a service in an HOPD might not match what CMS suggests, and these cases could be performed at small negative or positive margins.

This study did not include all elective ophthalmic procedures and, thus, did not include estimated loss of revenue from other less commonly performed procedures from NASS such as elective glaucoma and oculoplastic surgery. Further investigation of reduction in surgical volumes of urgent/emergent ophthalmic surgeries and in-office procedures is warranted as well. This investigation also did not investigate the impact of reduced surgical volume on patients' quality of life metrics; this is an area that merits further study.

In conclusion, outpatient elective ophthalmic surgeries at HOPDs generate significant income for those hospitals in the United States. We estimate that their cessation of elective eye surgery during the COVID-19 pandemic caused sizable net income losses to hospitals across the United States on an aggregate basis, ranging from 107 to 120 million USD per month. Furthermore, a substantial number of these cases are performed at teaching hospitals, meaning the lost volume of cases will diminish the surgical experience and education of residents, fellows, and other trainees. Further study is necessary to determine the extent to which privately owned ASCs have been affected by cessation of elective outpatient ophthalmic surgery. Local, state, and federal stakeholders and professional organization should consider these results when deciding allocation of relief funds and reopening plans for hospitals.

### WHAT WAS KNOWN

- COVID-19 has caused unprecedented cessations of elective ophthalmic surgery in the United States.
- Previous estimates of the economic impact of COVID-19 shutdowns do not provide data on hospital revenue, which precludes calculation of estimated reductions of net income to hospitals.
- It is unclear the extent to which cessation of elective ophthalmic surgery has impacted the financial health of hospital outpatient departments (HOPDs) or learning opportunities for trainees at teaching hospitals.

### WHAT THIS PAPER ADDS

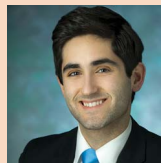
- Using the most recent nationally representative dataset available, there was an estimated loss of 107 to 120 million U.S. dollars per month of COVID-19–related shutdowns when accounting for reduced surgical volume of elective ophthalmic surgery such as cataract surgery, keratoplasty, and strabismus surgery at HOPDs.
- Most surgical cases in this dataset were performed at teaching hospitals, reflecting the additional cost of lost educational opportunities for trainees during the COVID-19 pandemic.

### REFERENCES

1. Centers for Medicare & Medicaid Services. Non-emergent, elective medical services, and treatment recommendations. 2020. Available at: <https://www.cms.gov/files/document/31820-cms-adult-elective-surgery-and-procedures-recommendations.pdf>. Accessed April 7, 2020
2. American Academy of Ophthalmology. Recommendations for urgent and nonurgent patient care. 2020. Available at: <https://www.aao.org/headline/new-recommendations-urgent-nonurgent-patient-care>. Accessed May 6, 2020
3. Centers for Medicare & Medicaid Services. Opening up America again. Centers for Medicare & Medicaid Services (CMS) recommendations. Re-opening facilities to provide non-emergent non-COVID-19 healthcare: phase I. 2020. Available at: <https://www.cms.gov/files/document/covid-flexibility-reopen-essential-non-covid-services.pdf>. Accessed May 8, 2020
4. Harris S, Sondel J, Schneider GS. Cash-starved hospitals and doctor groups cut staff amid pandemic. *The Washington Post*. April 9, 2020. Available at: [https://www.washingtonpost.com/health/starved-for-cash-hospitals-and-doctor-groups-cut-staff-amid-pandemic/2020/04/09/d3593f54-79a7-11ea-a130-df573469f094\\_story.html](https://www.washingtonpost.com/health/starved-for-cash-hospitals-and-doctor-groups-cut-staff-amid-pandemic/2020/04/09/d3593f54-79a7-11ea-a130-df573469f094_story.html). Accessed 3 June 2020
5. Office of the Inspector General. Hospital experiences responding to the Covid-19 pandemic: results of a National Pulse Survey March 23-27, 2020. U.S. Department of Health and Human Services. 2020. Available at: <https://oig.hhs.gov/oei/reports/oei-06-20-00300.asp>. Accessed 3 June 2020
6. Strata Decision Technology. National patient and procedure volume tracker, 6.1.2020. Available at: [https://www.stratadecision.com/wp-content/uploads/2020/06/National-Patient-and-Procedure-Volume-Tracker-and-Report\\_Weekly-Update\\_June1\\_2020.pdf](https://www.stratadecision.com/wp-content/uploads/2020/06/National-Patient-and-Procedure-Volume-Tracker-and-Report_Weekly-Update_June1_2020.pdf). Accessed June 4, 2020
7. Center for Medicare & Medicaid Services. National health expenditure data. 2019. Available at: <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical>. Accessed April 3, 2020
8. Repka MX. "AAO COVID-19 survey shows revenue losses for private practices." *Healio ophthalmology, practice management*. Available at: <https://www.healio.com/news/ophthalmology/20200521/ao-covid19-survey-shows-revenue-losses-for-private-practices>. Accessed June 4, 2020
9. Barnett ML, Mehrotra A, Landon BE. Covid-19 and the upcoming financial crisis in health care. *N Engl J Med* 2020. Available at: <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0153>. Accessed June 4, 2020
10. Khullar D, Bond AM, Schpero WL. COVID-19 and the financial health of US hospitals. *JAMA* 2020 [Epub ahead of print May 4, 2020]. doi: 10.1001/jama.2020.6269
11. McDermott KW, Elixhauser A. Statistical Brief #233: Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals, 2014. HCUP Stat Brief. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality. 2017. Available at: <https://www.hcup-us.ahrq.gov/>

- reports/statbriefs/sb233-Operating-Room-Procedures-United-States-2014.pdf. Accessed May 3, 2020
12. Anoushiravani AA, O'Connor CM, DiCaprio MR, Iorio R. Economic impacts of the COVID-19 crisis: an orthopaedic perspective. *J Bone Joint Surg Am* 2020;102:937–941
  13. Weiss AJ, Elixhauser A, Andrews RM. Statistical Brief #170: Characteristics of Operating Room Procedures in U.S. Hospitals, 2011. HCUP Stat Brief. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality. 2014. Available at: <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb170-Operating-Room-Procedures-United-States-2011.jsp>. Accessed May 1, 2020
  14. HCUP Nationwide Ambulatory Surgery Sample (NASS). Healthcare Cost and Utilization Project (HCUP). Rockville, MD: Agency for Healthcare Research and Quality; 2017. Available at: <https://hcup-us.ahrq.gov/nassoverview.jsp>. Accessed May 26, 2020
  15. American Academy of Ophthalmology. List of urgent and emergent ophthalmic procedures. 2020. Available at: <https://www.aao.org/headline/list-of-urgent-emergent-ophthalmic-procedures>. Accessed May 6, 2020.
  16. Center for Medicare & Medicaid Services. Hospital outpatient PPS. 2017. Available at: <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS>. Accessed April 10, 2020
  17. Center for Medicare & Medicaid Services. OPSS final rule. 2019. Available at: <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Downloads/CMS-1695-FC-2019-OPSS-FR-Claims-Accounting.pdf>. Accessed April 10, 2020
  18. Bai G, Anderson GF. Variation in the ratio of physician charges to Medicare payments by specialty and region. *JAMA* 2017;317:315–318
  19. Biener AI, Selden TM. Public and private payments for physician office visits. *Health Aff (Millwood)* 2017;36:2160–2164
  20. Cooper Z, Craig SV, Gaynor M, Van Reenen J. The Price Ain't Right? Hospital Prices and Health Spending on the Privately Insured. Cambridge, MA: National Bureau of Economic Research; 2015. (NBER Working Paper No. 21815). Available at: <http://www.nber.org/papers/w21815>. Accessed May 1, 2020
  21. Ginsburg PB. Wide Variation in Hospital and Physician Payment Rates Evidence of Provider Market Power. Washington, DC: Center for Studying Health System Change; 2010. (HSC Research Brief No. 16). Available at: <http://www.hschange.org/CONTENT/1162/>. Accessed May 3, 2020
  22. TrendWatch Chartbook. 2018. American hospital association. Available at: <https://www.aha.org/guidesreports/2018-05-22-trendwatch-chartbook-2018>. Accessed March 31, 2020
  23. White C, Whaley C. Prices paid to hospitals by private health plans are high relative to Medicare and vary widely: findings from an employer-led transparency initiative. Available at: [https://www.rand.org/pubs/research\\_reports/RR3033.html](https://www.rand.org/pubs/research_reports/RR3033.html). Accessed May 5, 2020
  24. Bai G, Anderson GF. Market power: price variation among commercial insurers for hospital services. *Health Aff (Millwood)* 2018;37:1615–1622
  25. Parke DW II. Ophthalmology after coronavirus disease 2019 (COVID-19): transition back to patient care. *JAMA Ophthalmol* 2020; [Epub ahead of print May 4, 2020]. doi: 10.1001/jamaophthalmol.2020.200
  26. Hamroush A, Qureshi M, Shah S. Increased risk of ocular injury seen during lockdown due to COVID-19. *Cont Lens Anterior Eye* 2020;43:216
  27. Coimbra R, Edwards S, Coimbra BC, Tabuenca A. Resuming elective surgical services in times of COVID-19 infection. *Trauma Surg Acute Care Open* 2020;5:e000511
  28. American Academy of Ophthalmology. Ophthalmic ASC checklist for reopening. 2020. Available at: <https://www.aao.org/practice-management/article/ophthalmic-asc-checklist-reopening>. Accessed August 13, 2020
  29. American Academy of Ophthalmology. Important coronavirus updates for ophthalmologists. 2020. Available at: <https://www.aao.org/headline/special-considerations-ophthalmic-surgery-during-c>. Accessed 4 June 2020
  30. Accreditation Council for Graduate Medical Education. Required minimum number of procedures for graduating residents in ophthalmology. 2013. Available at: [https://www.acgme.org/Portals/0/PFAssets/ProgramResources/240\\_Oph\\_Minimum\\_Numbers.pdf](https://www.acgme.org/Portals/0/PFAssets/ProgramResources/240_Oph_Minimum_Numbers.pdf). Accessed August 13, 2020
  31. Potts JR. Accreditation Council for Graduate Medical Education COVID-19: special communication to surgical program directors, including case log guidance. 2020. Available at: <https://www.acgme.org/Portals/0/Documents/COVID-19/SurgCOVID19LTC.pdf>. Accessed June 30, 2020
  32. Aggarwal S, Jain P, Jain A. COVID-19 and cataract surgery backlog in Medicare beneficiaries. *J Cataract Refract Surg* 2020; [Epub ahead of print July 17, 2020]. doi: 10.1097/j.jcrs.0000000000000337
  33. Gillan SN, Saleh GM. Ophthalmic surgical simulation: a new era. *JAMA Ophthalmol* 2013;131:1623–1624
  34. Chick RC, Clifton GT, Peace KM, Propper BW, Hale DF, Alseidi AA, Vreeland TJ. Using technology to maintain the education of residents during the COVID-19 pandemic. *J Surg Educ* 2020;77:729–732
  35. Mishra K, Boland MV, Woreta FA. Incorporating a virtual curriculum into ophthalmology education in the coronavirus disease-2019 era. *Curr Opin Ophthalmol* 2020;31:380–385
  36. Introduction to the HCUP Nationwide Ambulatory Surgery Sample (NASS) 2017. Rockville, MD: Agency for Healthcare Research and Quality; 2017. Available at: [https://hcup-us.ahrq.gov/db/nation/nass/2017\\_NASS\\_Introduction.pdf](https://hcup-us.ahrq.gov/db/nation/nass/2017_NASS_Introduction.pdf). Accessed June 8, 2020
  37. Stagg BC, Talwar N, Mattox C, Lee PP, Stein JD. Trends in use of ambulatory surgery centers for cataract surgery in the United States, 2001-2014. *JAMA Ophthalmol* 2018;136:53–60
  38. American Society of Cataract and Refractive Surgery (ASCRS). ASCRS clinical survey 2018. Available at: <http://supplements.eyeworld.org/eye-world-supplements/december-2018-clinical-survey>. Accessed August 13, 2020
  39. American Society of Cataract and Refractive Surgery (ASCRS). ASCRS clinical survey 2015. Available at: <https://www.eyeworld.org/supplements/ASCRS-Clinical-Survey-2015.pdf>. Accessed 13 August 2020

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