

Changes in Surgical Pathology Case Volume and Amendment Rates During the COVID-19 Pandemic

Cynthia K. Harris, MD,¹ J. Y. Kwong, MT(ASCP)^{CM,2},
M. H. Cohen, MLS(ASCP)^{CM,2}, Denise K. Bland, MHA,²
Geoffrey G. Fell, MS,^{3,*} Vania Nosé, MD,¹ and Veerle Bossuyt, MD¹

From the ¹Department of Pathology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA; ²Department of Pathology, Massachusetts General Hospital, Boston, MA, USA; and ³Department of Statistics, Dana-Farber Cancer Institute, Boston, MA, USA.

ABSTRACT

Objectives: Surgical pathology volume decreased during the peak of the coronavirus disease 2019 (COVID-19) pandemic. We looked at the 4 months with the greatest reduction in surgical pathology volume during the COVID-19 pandemic and compared them with those same months in 2019 to determine changes in specimen volume. We compared the amendment rates during those periods and types of amendments issued (identification [ID], report defect [RD], diagnostic information [DI]).

Methods: All pathology reports between March to June 2019 and March to June 2020 were extracted from the pathology information system. All amendments issued were extracted over the same period and then subclassified by two pathologists.

Results: There was a 52.1% reduction in surgical pathology volume between the 4-month periods in 2019 and 2020 ($P = .04$). The amendment rate was 0.9% in 2019 compared with 1.4% in 2020, representing a 65.5% increase in amendments overall. There was a 53.3% reduction in amendments issued for ID, a 3.8% reduction in RD, and a 23.2% increase in amendments issued for DI. The change in amendments was not statistically significant.

Conclusions: These findings suggest that a reduction in workload would not improve error rates. The circumstances of the pandemic highlight the many factors contributing to error rates in surgical pathology.

INTRODUCTION

In mid-March 2020, a state of emergency was issued for the city of Boston in response to the coronavirus disease 2019 (COVID-19) pandemic; shortly after, all elective surgeries and procedures were halted, causing an immediate and dramatic reduction in the volume of surgical pathology specimens.¹ This rapid reduction offers the unique opportunity to examine the effect of volume on error rates in surgical pathology. After a report is finalized, any additional modifications to the report are issued as addenda or amendments. Addenda are typically used for the reporting of supporting ancillary studies, such as additional immunohistochemistry, while amendments are used to correct errors or report additional information that modifies the original diagnosis.²⁻⁴ Amendments are often used as a surrogate for measuring error rates in surgical pathology, since they are issued to correct or revise an existing report.⁵⁻⁷ In this

KEY POINTS

- There was a statistically significant reduction in surgical pathology volume in March to June 2020 of the coronavirus disease 2019 (COVID-19) pandemic, relative to March to June 2019 (52.1% reduction; $P = .04$).
- The change in amendments as a function of total specimen volume during the study periods was not significant.
- Our findings do not support the conclusion that a reduction in workload would improve error rates. The unique nature of the COVID-19 pandemic, however, may limit the generalizability of our results.

Am J Clin Pathol July 2022;158:142-147
[HTTPS://DOI.ORG/10.1093/AJCP/AQAC017](https://doi.org/10.1093/AJCP/AQAC017)

Received: October 29, 2021

Accepted: January 13, 2022

Advance publication: February 23, 2022

Corresponding author: Cynthia K. Harris, MD; cynthiaharris@mgh.harvard.edu.

study, we compared the volume and types of specimens received during the months of March, April, May, and June for the years 2019 and 2020 and looked at the rate that amendments were issued during these months to evaluate the association between surgical pathology volume and error rates.

MATERIALS AND METHODS

A retrospective chart review was performed on all surgical pathology cases signed out at our institution in Boston during a 4-month period (March to June) in 2019 and 2020. Both internal surgical pathology cases and outside surgical pathology consults were included in the search. A complete list of all amendments issued during those same periods of time was also generated. Data were extracted from the electronic pathology information system.

All amendments issued during these periods were reviewed by two pathologists (C.H. and V.B.) and classified in one of three categories: “identification,” “report defect,” or “diagnostic information.” An “identification” amendment consisted of an error in patient or specimen identification, including patient name, date of birth, medical record number, tissue site, and laterality. A “report defect” consisted of missing or erroneous information such as typographical errors, dates of procedures, and ordering providers’ names. Amendments issued for “diagnostic information” included any changes to the diagnosis, gross description, or synoptic report, including additional immunohistochemical stains and molecular test results that modified the diagnosis.²

Summary measures were estimated for all categorical variables, including frequencies and percentages. All comparisons were performed using a paired t-test for all groups that did not depart from normality, and a Wilcoxon rank-sum paired test was used otherwise. A P value of less than .05 was considered statistically significant.

This study was approved by Partners Healthcare Institutional Review Board (IRB protocol 2021P002005).

RESULTS

There were 31,156 surgical specimens signed out during the 4-month period in 2019, compared with 14,929 surgical specimens signed out

during that same 4-month period in 2020, representing a 52.1% reduction in volume between the 2019 and 2020 four-month period ($P = .04$). The reductions in specimen volume for March, April, May, and June of the 2 years were 31.9%, 81.7%, 67.4%, and 22.6%, respectively. During the 4-month period in 2019, 266 amendments were issued, representing an amendment rate of 0.9%, compared with 211 amendments in 2020 (a 1.4% amendment rate). The amendment rate showed a 65.5% increase overall between 2019 and 2020, with the highest increase seen in March (111.5% increase from 2019 to 2020) **TABLE 1**, **FIGURE 1**.

The composition of the amendments issued during these two periods was as follows. In 2019, 10.2% of amendments were identification, 57.1% were report defects, and 32.7% were diagnostic information. In 2020, 4.7% of amendments were identification, 55.0% were report defects, and 40.3% were diagnostic information. There was a 53.3% reduction in identification amendments ($P = .14$), a 3.8% reduction in report defects ($P = .27$), and a 23.2% increase in diagnostic information amendments ($P = .96$) **TABLE 2**. The change in total amendments issued during these two periods was not statistically significant ($P = .46$).

The relative proportion of specimen types signed out during these two periods showed some variation. In 2019, outside consults comprised 11.5% of the total volume of specimens signed out between March and June 2019 vs 15.5% of the total volume of specimens signed out during that period in 2020. The representation of the various surgical pathology subspecialties in 2019 and 2020 remained largely the same, with most variations less than 5%. The only subspecialties to demonstrate a change in relative volume greater than 5% were dermatopathology (12.2% decrease in April, 5.6% decrease in May), gastrointestinal pathology (15.7% decrease in April, 9.2% decrease in May), obstetric pathology (10.9% increase in April, 6.2% increase in May), and outside consults (19.8% increase in April). Only gastrointestinal pathology, however, showed a change in volume greater than 5% when averaged over the 4-month period (5.5% decrease) **TABLE 3**.

To examine what variations were experienced within each subspecialty, we looked at the average number of slides (initial H&Es as well as any subsequent H&E levels, special stains, or immunohistochemical stains) examined per specimen **TABLE 4**. Relative to 2019, the number of slides per specimen overall increased in 2020 ($P = .002$). The maximum increase in a specialty’s average slides examined per specimen was 4.

TABLE 1 Surgical Specimen Volume for Studied Months in 2019 and 2020 and Year-Over-Year (YoY) Change in Specimen Volume Between 2019 and 2020^a

| Month | Speciman Volume | | YoY % Change | Amendments | | YoY % Change | Amendments/ Volume, % | | YoY % Change |
|-------|-----------------|--------|--------------|------------|------|--------------|--------------------------|-------|--------------|
| | 2019 | 2020 | | 2019 | 2020 | | 2019 | 2020 | |
| March | 7,273 | 4,951 | -31.9 | 66 | 95 | 43.9 | 0.9 | 1.9 | 111.4 |
| April | 8,117 | 1,489 | -81.7 | 62 | 20 | -67.7 | 0.8 | 1.3 | 75.8 |
| May | 8,290 | 2,705 | -67.4 | 61 | 26 | -57.4 | 0.7 | 1.0 | 30.6 |
| June | 7,476 | 5,784 | -22.6 | 77 | 70 | -9.1 | 1.0 | 1.2 | 17.5 |
| Total | 31,156 | 14,929 | -52.1 | 266 | 211 | -20.7 | 0.009 | 0.014 | 65.5 |

^aAmendments issued during studied months in 2019 and 2020, represented as both number of amendments and as percentage of amended cases per volume with respective YoY.

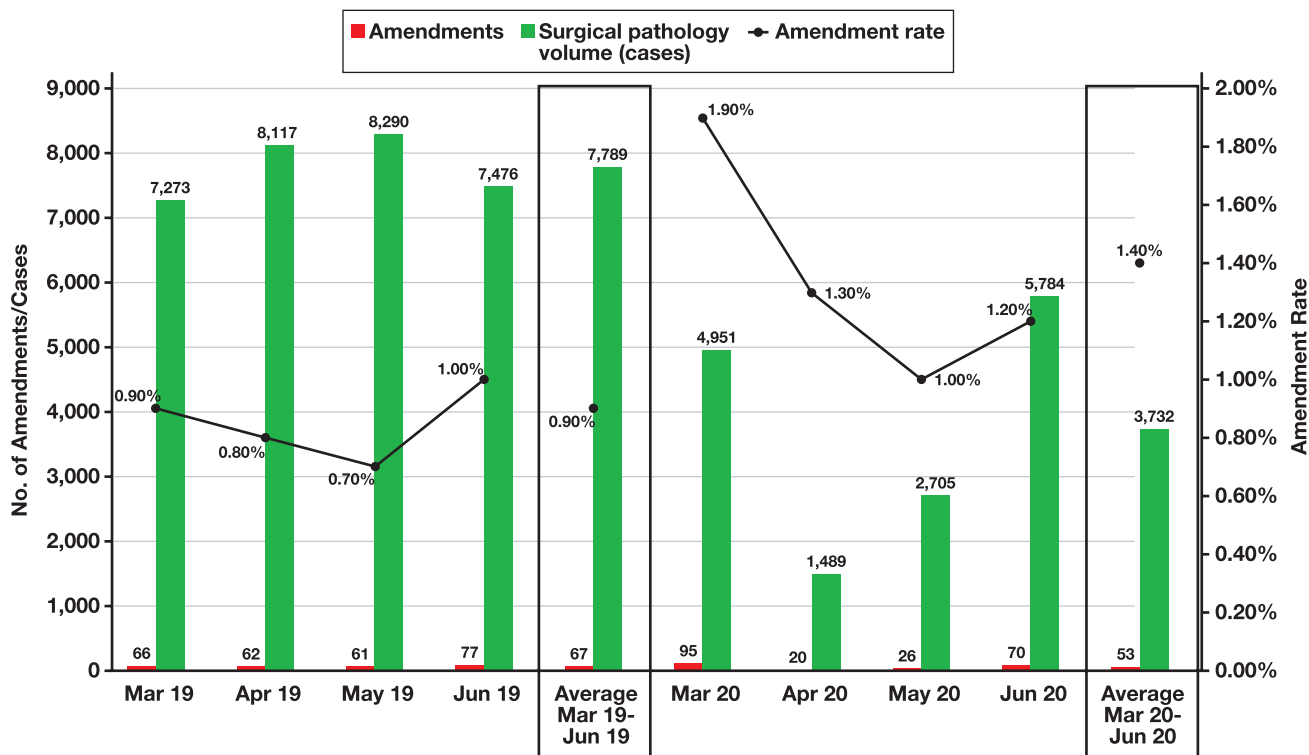


FIGURE 1 Number of amendments and case volume each month (y-axis, left). Rate of amendments each month (y-axis, right).

TABLE 2 Amendments Issued During 4-Month Periods in 2019 and 2020, Divided Into the Categories of Identification, Report Defect, and Diagnostic Information, Represented as Both Number of Amendments and Percentage of Total Amendments Issued^a

| Month | Identification, No. (%) ^b | | YoY % Change ^c | Report Defect, No. (%) ^b | | YoY % Change ^c | Diagnostic Information, No. (%) ^b | | YoY % Change ^c |
|-------|--------------------------------------|------------|---------------------------|-------------------------------------|-------------|---------------------------|--|------------|---------------------------|
| | 2019 | 2020 | | 2019 | 2020 | | 2019 | 2020 | |
| March | 4 (6.1) | 4 (4.2) | -30.5 | 46 (69.7) | 50 (52.6) | -24.5 | 16 (24.2) | 41 (43.2) | 78.0 |
| April | 4 (6.5) | 0 (0.0) | -100.0 | 37 (59.7) | 11 (55.0) | -7.8 | 21 (33.9) | 9 (45.0) | 32.9 |
| May | 11 (18.0) | 1 (3.8) | -78.7 | 29 (47.5) | 16 (61.5) | 29.4 | 21 (34.4) | 9 (34.6) | 0.5 |
| June | 8 (10.4) | 5 (7.1) | -31.3 | 40 (51.9) | 39 (55.7) | 7.3 | 29 (37.7) | 26 (37.1) | -1.4 |
| Total | 27 (0.102) | 10 (0.047) | -53.3 | 152 (0.571) | 116 (0.550) | -3.8 | 87 (0.327) | 85 (0.403) | 23.2 |

^aYear-over-year (YoY) for amendments issued for three subcategories of amendments, as a function of their percentage of total amendments.

^bPercentage of identification, report defect, or diagnostic information to amendments.

^cPercentage change of the fraction of identification, report defect, or diagnostic information to amendments.

A comparison of the proportion of *Current Procedural Terminology (CPT)* codes used during these periods revealed an increased percentage of higher-level CPT codes (88307-L5 and 88309-L6) in 2020 relative to 2019 and a decreased percentage of lower-level CPT codes (88304-L3 and 88305-L4) in 2020 relative to 2019 **TABLE 5**. This finding was not statistically significant ($P > .99$).

The decrease in overall specimen volume between 2019 and 2020 was statistically significant ($P = .04$). The change in total amendments as a function of total specimen volume was not statistically significant ($P = .08$).

DISCUSSION

This study sought to determine if error rates, as measured by amendment rates, are correlated with surgical case volume. As has

been previously noted, surgical case volume is a problematic measure of overall pathologist workload; nevertheless, many pathologists do feel that caseload is a useful estimation of workload.⁸ Similarly, while the amendment rate is not an exact measure of overall error rate,⁶⁻⁹ some have argued that amendments are a good approximation of the true error rate.¹⁰

Studies examining the relationship between workload and errors have been conducted in other areas of medicine, such as hospital-based nursing and resident coverage of intensive care units, but to date there are few published studies of the association between workload and error rate in surgical pathology.^{8,11,12} Moreover, although a connection between the workload in surgical pathology and error frequency intuitively seems linked,⁸ one of the few studies on the topic within the field of surgical pathology showed no correlation between workload and amendment

TABLE 3 Surgical Pathology Subspecialties and Outside Consult Cases as a Percentage of Overall Surgical Case Volume in Each of the Months of the Study Period and for the Overall Study Period, With Year-Over-Year (YoY) Change

| Subspecialty | % of Total Specimen Volume | | | | | | | | | | | | | |
|----------------------------|----------------------------|------|-------|------|------|------|------|------|---------|------|------------------|------------------|------|------|
| | March | | April | | May | | June | | Overall | | YoY % Difference | YoY % Difference | | |
| | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | | | | |
| Breast | 3.6 | 3.8 | 3.9 | 3.0 | 3.6 | 4.0 | 3.9 | 3.5 | 3.7 | 3.6 | -0.4 | 3.7 | 3.6 | -0.1 |
| Bone and soft tissue | 5.4 | 5.5 | 5.7 | 3.6 | 5.5 | 5.5 | 5.7 | 6.5 | 5.6 | 5.7 | 0.8 | 5.6 | 5.7 | 0.1 |
| Cardiovascular | 2.9 | 2.7 | 2.2 | 4.5 | 2.5 | 3.7 | 2.2 | 3.2 | 2.5 | 3.3 | 1.0 | 2.5 | 3.3 | 0.8 |
| Dermatopathology | 16.2 | 13.4 | 16.9 | 4.7 | 16.2 | 10.6 | 15.4 | 19.0 | 16.2 | 14.2 | 3.6 | 16.2 | 14.2 | -2.0 |
| Eye ^a | 2.5 | 1.8 | 2.1 | 1.5 | 2.4 | 1.6 | 2.1 | 1.6 | 2.3 | 1.7 | -0.5 | 2.3 | 1.7 | -0.6 |
| Gastrointestinal | 26.1 | 24.3 | 26.4 | 10.7 | 26.9 | 17.6 | 28.3 | 23.5 | 26.9 | 21.4 | -4.8 | 26.9 | 21.4 | -5.5 |
| Genitourinary ^a | 4.0 | 5.0 | 4.0 | 4.8 | 3.7 | 5.4 | 3.9 | 4.5 | 3.9 | 4.8 | 0.6 | 3.9 | 4.8 | 0.9 |
| Gynecologic | 7.3 | 6.5 | 7.8 | 5.1 | 7.5 | 6.8 | 7.2 | 7.2 | 7.4 | 6.7 | 0.0 | 7.4 | 6.7 | -0.7 |
| Head and neck | 10.0 | 8.8 | 9.7 | 4.9 | 9.6 | 8.2 | 9.5 | 7.5 | 9.7 | 7.8 | -2.0 | 9.7 | 7.8 | -1.9 |
| Hematopathology | 2.3 | 3.2 | 2.3 | 6.2 | 2.2 | 4.3 | 2.2 | 3.1 | 2.2 | 3.7 | 0.9 | 2.2 | 3.7 | 1.5 |
| Neuropathology | 2.5 | 2.4 | 1.9 | 3.0 | 2.1 | 3.2 | 2.1 | 2.1 | 2.1 | 2.5 | 0.0 | 2.1 | 2.5 | 0.4 |
| Obstetric | 2.7 | 4.7 | 3.0 | 14.0 | 3.3 | 9.5 | 3.1 | 4.2 | 3.0 | 6.3 | 1.1 | 3.0 | 6.3 | 3.0 |
| Pulmonary | 2.1 | 2.4 | 2.1 | 2.3 | 2.1 | 2.3 | 2.1 | 2.6 | 2.1 | 2.4 | 0.5 | 2.1 | 2.4 | 0.3 |
| Renal | 1.0 | 0.5 | 0.7 | 0.6 | 0.8 | 0.7 | 0.6 | 0.4 | 0.8 | 0.5 | -0.2 | 0.8 | 0.5 | -0.3 |
| Consults | 11.4 | 14.9 | 11.3 | 31.1 | 11.7 | 16.5 | 11.4 | 11.4 | 11.5 | 15.5 | 4.0 | 11.5 | 15.5 | 4.0 |

^aYoY difference found to be statistically significant using a paired t test ($\alpha = 0.05$).

TABLE 4 Average Number of Slides (Initial H&E, Subsequent H&E Levels, Special Stains, or Immunohistochemical Stains) Examined per Specimen in All Subspecialties During the Study Periods in 2019 and in 2020

| Subspecialty | Average No. Slides/Specimen | |
|----------------------|-----------------------------|------|
| | 2019 | 2020 |
| Breast | 19 | 22 |
| Bone and soft tissue | 5 | 7 |
| Cardiovascular | 6 | 7 |
| Dermatopathology | 8 | 8 |
| Eye | 4 | 7 |
| Gastrointestinal | 5 | 7 |
| Genitourinary | 11 | 13 |
| Gynecologic | 9 | 11 |
| Head and neck | 7 | 11 |
| Hematopathology | 36 | 40 |
| Neuropathology | 8 | 11 |
| Obstetric | 6 | 6 |
| Pulmonary | 13 | 16 |
| Renal | 17 | 21 |

rate.^{8,10,13} That study, however, had relatively minor variations in case volume. By conducting our study during the first peak of the COVID-19 pandemic, we had the unprecedented opportunity to examine the impact of a dramatic reduction in case volume (52.1% decrease) on error rate (as measured by amendment rate).

In our study, we identified a relatively large but not statistically significant increase in amendment rates in response to a statistically significant decrease in case volume. We found that despite the 52.1% reduction in surgical volume, the rate of amendments increased from 0.9% to 1.4%. The composition of amendments issued also changed, with a 53.3% reduction in amendments issued for identification errors, a 3.8% reduction in report defects, and a 23.2% increase in amendments issued for diagnostic information. Although these changes in the rate and type of amendments seem relatively large, they were not statistically significant, cautioning against overinterpreting short-term or individual variation in amendment rates as measures of error in pathology.

The possibility of a bimodal relationship between volume and error has been proposed, with the argument being that at high workloads pathologists make more errors due to the pressure to move quickly through cases, while at low workloads pathologists' experience may be too limited to accurately evaluate all types of tissue.¹³ Given the temporary dip in volume at our otherwise high-volume institution, the increased rate of amendments during this period did not reflect a lack of attending pathologist experience; rather, we attribute the increased rate of amendments to several factors unique to our hospital's experience during the COVID-19 peak.

First, during the peak of the first COVID-19 wave, our institution instructed all nonessential personnel to work from home, including our department's transcription staff. As a result, in 2020, the reports were largely, perhaps even exclusively, typed by the staff pathologist

TABLE 5 Comparison of the Proportion of *Current Procedural Terminology (CPT) Codes* Used Out of the Total Number of Specimens Examined During the Study Periods in 2019 and in 2020

| CPT Code | % of Total Specimens | |
|----------|----------------------|------|
| | 2019 | 2020 |
| 88300-L1 | 0.0 | 0.1 |
| 88302-L2 | 0.4 | 0.2 |
| 88304-L3 | 3.2 | 2.8 |
| 88305-L4 | 53.4 | 43.4 |
| 88307-L5 | 29.0 | 32.9 |
| 88309-L6 | 14.0 | 20.6 |

directly into the electronic pathology system and then signed out. In 2019, many of the reports were handwritten by the staff pathologist, typed by transcription staff, and then reviewed electronically by the pathologist prior to sign-out. This marked change in process and some attendings' unfamiliarity or discomfort with direct electronic entry of diagnoses may have contributed to the relatively small reduction in report defects (3.8%) during this time, as opposed to a more robust improvement in the rate of report defects issued for things such as typographical errors.

The amendment rate for identification errors decreased by 53.3% during the study period. Identification errors can be introduced at the time of specimen collection or at the time of accessioning. Unlike the change in workflow for diagnosis entry detailed above, our department's workflow for specimen accessioning did not change during the COVID-19 pandemic.

Diagnostic information amendments increased by 23.2%. This increase in diagnostic information amendments may also be partly attributable to two additional factors specific to the COVID-19 pandemic. First, our department has a strong practice of showing cases, both formally and informally, for additional perspectives and consultations. During the peak of the COVID-19 pandemic, only attendings explicitly on service were permitted into the hospital, substantially decreasing the number of attendings available for consultation. Second, the COVID-19 pandemic was an unprecedented time, rife with stresses both within and outside of the medical field.^{14,15} Although not documented within the field of surgical pathology, high levels of emotional stress (different from workload) have been associated with increased medical errors.^{16,17} Our attendings, however, were not directly surveyed on their stress levels during either of the studied periods.

There were changes to pathology staff during the studied periods. In comparing the 2019 study period to 2018, there were six pathologists who were in their first year of signing out at our institution (two pathologists had several years of prior sign-out experience at other institutions and four pathologists were in their first year of signing out). Similarly, in comparing the 2020 study period to 2019, there were six pathologists who were in their first year of signing out at our institution (one pathologist had several years of prior sign-out experience at another institution and five pathologists were in their first year of signing out). All attendings had been

signing out at our institution for more than 6 months before the start of the study periods.

During the March to June 2020 period, the service schedule was adjusted continuously as the circumstances dictated. The variability in coverage is difficult to accurately reconstruct in retrospect. Some pathologists covered multiple services simultaneously, for either a day or a week at a time. However, pathologists at our institution often covered two services simultaneously prior to the COVID-19 pandemic as well, including during our 2019 study period. The implications of this cross-coverage on the overall sign-out experience in 2020 vs 2019 are challenging to determine.

With the halting of elective procedures, there was an increased proportion of specimens from urgent and emergent procedures. These kinds of surgeries tend to yield more complex specimens. Common measurements of case complexity include number of slides examined per specimen and CPT codes used.^{18,19} There was a significant increase in case complexity, as reflected in the increased number of slides examined ($P = .002$), but not in the CPT codes used ($P > .99$).

Our findings do not support the conclusion that a reduction in workload would improve error rates, similar to a prior published study on workload and error rate.¹⁰ Nevertheless, several factors limit the generalizability of our results. By situating our study during the first peak of the COVID-19 pandemic, we examined a period of unprecedented emotional stress coupled with a reduction in available resources for attending pathologists (lack of transcription staff and reduced availability of expert pathologists for consultation). Perhaps our most suggestive finding is the reduction of amendment rates for identification errors in a near one-to-one relationship with surgical specimen volume reduction, indicating that there may be a more straightforward association between volume and identification error rate. This finding was not statistically significant, but this was a single-center study, and the number of amendments issued during our study period may be too small to detect a statistical difference.

This study provides novel and important information in the limited field of pathology workload and error frequency. It highlights that the complex factors influencing error rates in pathology and the need for caution in using amendment rates as an indication of quality or competence. Most important, the changes in amendment rates associated with the unprecedented circumstances of the COVID-19 pandemic highlight the need to support quality and safety in surgical pathology, particularly under disruptive circumstances.

REFERENCES

- Goldberg C. "A heck of a time to get cancer": hospitals defer all but the most urgent treatments. *WBUR News*. April 3, 2020. www.wbur.org/news/2020/04/03/elective-procedure-hospital-cancer-treatment. Accessed August 15, 2021.
- Spiczka A, Waibel L, Garcia E, et al. Revised reporting (issuing addenda and amendments) in pathology. *Am J Clin Pathol*. 2021;155:553-564.
- Nakhleh RE, Nosé V, Colasacco C, et al. Interpretive diagnostic error reduction in surgical pathology and cytology: guideline from the College of American Pathologists Pathology and Laboratory Quality Center and the Association of Directors of Anatomic and Surgical Pathology. *Arch Pathol Lab Med*. 2016;140:29-40.
- Nakhleh RE, Nosé V, Renshaw A, et al. In reply. *Arch Pathol Lab Med*. 2016;140:9-10.
- Roy JE, Hunt JL. Detection and classification of diagnostic discrepancies (errors) in surgical pathology. *Adv Anat Pathol*. 2010;17:359-365.
- Cooper K. Errors and error rates in surgical pathology: an Association of Directors of Anatomic and Surgical Pathology Survey. *Arch Pathol Lab Med*. 2006;130:607-609.
- Parkash V, Fadare O, Dewar R, et al. Can the misinterpretation amendment rate be used as a measure of interpretive error in anatomic pathology? Implications of a survey of the directors of anatomic and surgical pathology. *Adv Anat Pathol*. 2017;24:82-87.
- Raab SS, Grzybicki DM. Anatomic pathology workload and error. *Am J Clin Pathol*. 2006;125:809-812.
- Renshaw AA, Gould EW. Comparison of disagreement and amendment rates by tissue type and diagnosis: identifying cases for directed blinded review. *Am J Clin Pathol*. 2006;126:736-739.
- Renshaw AA, Gould EW. Correlation of workload with disagreement and amendment rates in surgical pathology and nongynecologic cytology. *Am J Clin Pathol*. 2006;125:820-822.
- Rogers AE, Hwang WT, Scott LD, et al. The working hours of hospital staff nurses and patient safety. *Health Aff (Millwood)*. 2004;23:202-212.
- Landrigan CP, Rothschild JM, Cronin JW, et al. Effect of reducing interns' work hours on serious medical errors in intensive care units. *N Engl J Med*. 2004;351:1838-1848.
- Vollmer RT. Regarding workload and error rates in anatomic pathology. *Am J Clin Pathol*. 2006;126:833.
- Abbott A. COVID's mental-health toll: how scientists are tracking a surge in depression. *Nature*. 2021;590:194-195.
- Kumar A, Nayar KR. COVID 19 and its mental health consequences. *J Ment Health*. 2021;30:1-2.
- Salam A, Segal DM, Abu-Helalah MA, et al. The impact of work-related stress on medication errors in Eastern Region Saudi Arabia. *Int J Qual Health Care*. 2019;31:30-35.
- Oriet D, Trigolet M, Kessler DO, et al. Stress: a factor explaining the gap between simulated and clinical procedure success. *Pediatr Emerg Care*. 2021;37:e1192-e1196.
- Cloetingh D, Schmidt RA, Kong CS. Comparison of three methods for measuring workload in surgical pathology and cytopathology. *Am J Clin Pathol*. 2017;148:16-22.
- Stagner AM, Tahan SR, Nazarian RM. Changing trends in dermatopathology case complexity. *Arch Pathol Lab Med*. 2021;145:1144-1147.