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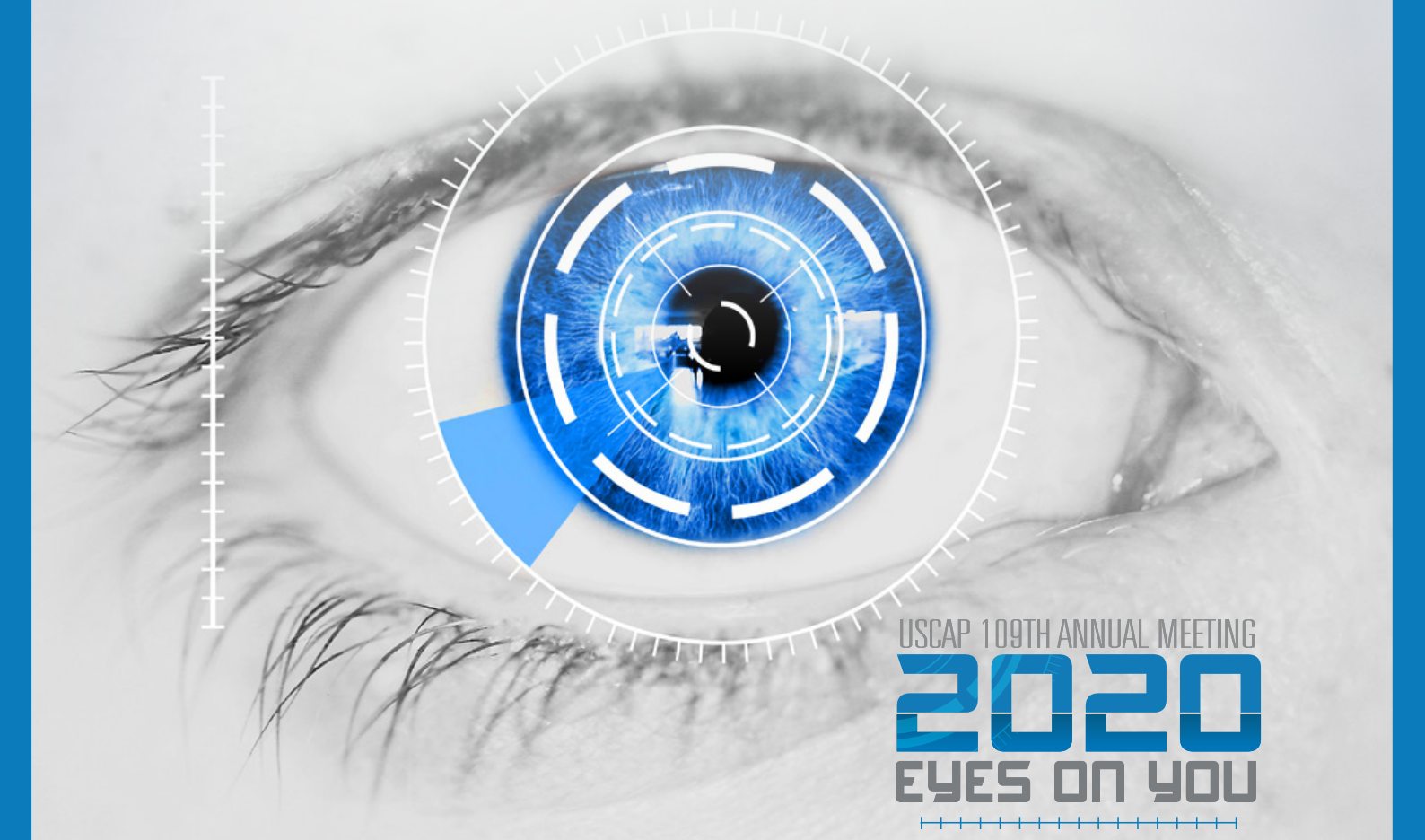
ABSTRACTS

QUALITY AND PATIENT SAFETY

(1981-2063)



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1981 Utilizing Stat-Freeze Freezing Spray to Make Placental Membrane Rolls is an Effective and Faster Technique in Comparison to the Conventional Method

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Disclosures: Hiba Al Dallal: None; Jessica Hata: None; Dibson Gondim: None

Background: The placenta is a very common specimen in surgical pathology. The highly mucoid/edematous nature of the placental membrane makes it challenging to produce an adequate placental membrane roll without overnight formalin fixation. Adequate rolls, where all layers of the membrane are preserved, are crucial for the accurate staging of acute chorioamnionitis. Maternal decidua is often abundant in well-made rolls, allowing for the diagnosis of decidual vasculopathy, chronic deciduitis, and laminar decidual necrosis. In general, a tight roll of the amniotic membranes is first fixed in formalin overnight then later sectioned and embedded. This process is time-consuming and delays potentially important diagnoses. In this study, we propose a new approach in which a membrane roll is briefly frozen by Stat-Freeze freezing spray to enable immediate sectioning. The membrane rolls are then submitted for routine formalin fixation and paraffin embedding with the remainder of the placenta blocks. We aim to evaluate if brief freezing will obscure pathological findings or induce uninterpretable artifacts.

Design: We evaluated 28 random fresh placentas. After routine gross examination and processing, performed in keeping with standard laboratory procedures, extra samples of fetal membranes were individually obtained via the Stat-Freeze freezing (STAT) technique. A tight roll of the membranes was frozen using Stat-Freeze freezing spray and immediately sectioned and submitted for routine formalin fixation and paraffin embedding. The STAT method slides were compared to the permanent slides (the gold standard method). The study slides were reviewed by different pathologist who was blinded to the original case diagnosis.

Results: To compare the conventional and STAT methods of placenta evaluation, two groups were established: 1) the STAT method had identical findings to the conventional method; and 2) the STAT method had inferior findings. A one-sample binomial test of proportions with 95% confidence intervals (CI) showed that the proportion of observations from the STAT method had identical results 100% of the time (P=1.00, 95% CI=0.87-1.00, P-value <0.001). Kappa statistic was also used to assess interrater reliability between raters; Kappa showed perfect agreement, K=1.00, 95% CI=1.00-1.00, P<0.001.

Conclusions: We conclude that Stat-Freeze freezing method diagnoses correlated well with the conventional method, without significantly different interobserver variability.

1982 Implementation of Live View Slide Scanning for Frozen Section Analysis across a 6-Hospital Academic Health System

Khaled Algashaamy[1], Gloria Campos[2], Andre Pinto[3], Andrew Rosenberg[4], Merce Jorda[4], Monica Garcia-Buitrago[5], Jennifer Chapman[6]
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Disclosures: Khaled Algashaamy: None; Gloria Campos: None; Andre Pinto: None; Andrew Rosenberg: None; Merce Jorda: None; Monica Garcia-Buitrago: None; Jennifer Chapman: None

Background: Our pathology department services a combined 2110 bed health system and practices subspecialty based clinical sign-out in an academic setting. Service locations include 6 hospitals that are geographically separated (distances 0.2 to 12 miles). Coverage of frozen section (FS) services has historically required the physical presence of a pathologist at each site. In an effort to simultaneously improve efficiency and quality while decreasing cost to provide coverage, we have recently completed the implementation of a 5 scanner system (Aperio LV1 scanner, Figure 1) for routine use in intraoperative FS analysis among our 6 hospitals.

Design: According to College of American Pathologists (CAP) recommendations, validation included review of 15 cases per scanner (75 cases for the platform) following a wash-out period of 2 weeks. Pathologists interpreting scanned FS (validation) slides were blinded to initial FS diagnosis. Training and competency for the use of the scanner was done using a standardized check-list (Figure 1).

Results: Since implementation, 1265 FS have been performed using slide scanning. Access to scanned FS slides is available within 15 seconds of slide creation. The process does require that a grossing technologist be present at the remote site to create and load FS slides into the scanner. Our interpretative error rate (defined as any FS interpretation discordant with final interpretation per slide, excluding sampling errors) has decreased from 2.6% to 1.12% since implementation, well below published benchmarks for acceptable FS error rate. Scanners have decreased our requirement for number of Pathologists needed to cover FS services from 6 to 2, and allowed for physical centralization of faculty. Remote access to FS slides is not limited to one pathologist thus consensus reviews are easily achievable in difficult cases.

Figure 1 - 1982

Conclusions: Real time digital pathology scanners are now used throughout our health system for real time live view digital pathology for intraoperative FS analysis during normal business and on-call hours. We have found this to be a reliable mechanism by which intraoperative consultation services are provided from remote (centralized) locations, creating an institutional cost savings. Slide scanning has simultaneously increased quality and diagnostic accuracy by providing a mechanism of subspecialized FS review and intrapathologist consultation in real time.

1983 Cost Effectiveness of the Use of Helicobacter Pylori Immunohistochemical Stains

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Disclosures: Khaled Algashaamy: None; Julio Poveda: None; Monica Garcia-Buitrago: None

Background: Helicobacter Pylori infection is a commonly diagnosed entity by pathologists in academic and community settings. Since 2016, upfront immunohistochemical studies have been not recommended by CMS in Florida. Our institute started performing immunohistochemical studies for Helicobacter Pylori (HP) organisms when there was clinical suspicion of infection or questionable organisms on hematoxylin and eosin (H&E) slides.

Design: We performed a retrospective search of the pathology database at The University Of Miami of all gastric biopsies performed between 2013 and 2019. This database was then isolated into two smaller categories, period A included cases from 2013 to 2016 where immunohistochemical studies were ordered upfront and period B included cases from 2016 to 2019 where immunohistochemical stains were ordered based on clinical suspicion of infection or questionable organisms seen on hematoxylin and eosin (H&E) slides.

Results: We analyzed 10351 gastric biopsies, 5130 (49%) cases in period A and 5221 (51%) cases in period B. In period A, 5126 (99%) cases had upfront immunohistochemical studies for HP. Of those, 4476 (87%) cases were interpreted as negative and 650 (13%) cases were interpreted as positive for HP organisms. Only 4 (0.08%) cases did not have upfront immunohistochemistry performed, 2 (50%) of which had HP organisms identified on H&E examination. In period B, 5221 cases were examined by our staff pathologists, of which 2923 (56%) cases had immunohistochemical studies performed. Of those 206 (7%) cases were positive while the remainder 2717 (93%) were negative for HP organisms. Of the remainder 2298 cases without immunohistochemical studies, 524 (22.8%) showed HP organisms while 1774 (77%) did not show organisms on H&E examination. Overall, detection rates for identification of HP organisms were 12.7% (652/5130) and 14% (730/5221) in periods A and B, respectively.

Conclusions: Our data demonstrates similar rates of detection of Helicobacter Pylori infection when immunohistochemical studies were ordered upfront versus only in selected cases. Immunostaining can be reserved for diagnostically challenging cases, in patients with high index of suspicion or with prior history of infection. Comparison of periods A and B shows a 43% reduction in utilization of

immunohistochemistry. This cost effective approach of prioritizing staining to diagnostically relevant studies will allow a better use of the laboratory resources.

1984 Standardization of Intraoperative Consultation of Sentinel Lymph Node in Breast Cancer Patients 2016-2019

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Disclosures: Rebeca Alvarez: None; Cheung Chhieng: None; Mark Kilgore: None

Background: Intraoperative cytologic evaluation of axillary sentinel lymph nodes by touch/smear preparations is commonly used to aid in treatment decisions for breast cancer patients. Prior to February 2018 there was no official standard of practice for how sentinel lymph node cytologic evaluations were processed at our institution. The purpose of this study is to observe how creating a standard operating procedure for cytologic evaluations of axillary sentinel lymph nodes effects accuracy.

Design: Breast cancer patients having sentinel lymph node biopsies between 2016-2019 were identified and separated into two groups. The first group was patients biopsied before the implementation of a standard operating procedure, between January 2016 and February 2018. The second group was patients having a sentinel lymph node biopsy after implementation of the standard operating procedure, February 2018 to June 2019. The intraoperative diagnoses rendered on the cytologic preparations were then correlated with the final diagnoses for both groups.

Results: 1609 intraoperative consultations were performed on axillary sentinel lymph nodes from breast cancer patients. The prevalence of sentinel lymph nodes positive for carcinoma in the first group was 12.6% and in the second group was 13.0%. The percentage of positive nodes with a false negative intraoperative result in the first group was 51.8% and in the second group were 33.9. In both groups the predominant reason for a false negative result was sampling error with group one having 91.1% of cases with false negative results attributable to sampling error, and group 2 having 90.5% of cases attributable to sampling error. Interpretative error contributed to 8.9% of false negative results in group 1 and 9.5% of false negative results in group 2.

Conclusions: When a standard operating procedure for how to process axillary sentinel lymph node cytologic preparations was implemented there was a decrease in false negative rates from 51.8% to 33.9%. These findings suggest that implementing a standard procedure may help cytologic evaluation of axillary sentinel lymph nodes become a more sensitive test, while possibly also decreasing the specificity, more specifically, a significant reduction of false negative diagnoses in patient with positive lymph nodes.

1985 An Algorithmic Approach to Molecular Testing Improves the Time to Diagnose Acute Promyelocytic Leukemia

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Disclosures: Sepideh Asadbeigi: None; Yaolin Zhou: None

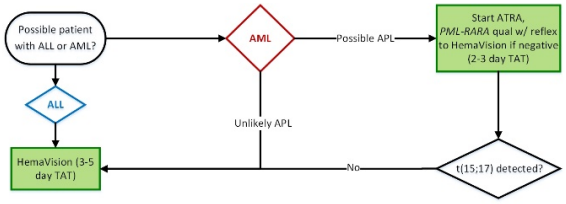
Background: Acute Promyelocytic Leukemia (APL) is a medical emergency that requires treatment with all-*trans*-retinoic acid (ATRA). Our in-house molecular pathology laboratory offers a highly sensitive two-step multiplex, nested RT-PCR HemaVision assay that detects 28 leukemia translocations including t(15;17) *PML-RARA* and APL variants t(11;17)(q23;q21) *ZBTB16-RARA* and t(5;17)(q35;q21) *NPM1-RARA*. Following the death of a patient in April 2015 who was positive by HemaVision but negative by FISH, we worked in a multidisciplinary manner to improve the diagnosis of APL at our institution.

Design: We expedited HemaVision tests and issued results directly to clinicians. Pathologists used “cannot rule out APL” on peripheral smear reviews and recommended ATRA if clinical suspicion was high. In April 2018, we further validated a fast TAT *PML-RARA* qualitative test that reflexes to the full HemaVision panel if negative (Figure 1).

Results: Workflow changes in April 2015 and offering *PML-RARA* qual in March 2018 decreased TAT (5.6 to 2.3 days, P<0.0001; 2.3 to 0.9 days, *p*<0.001). We detected t(15;17) in 29 HemaVisions (4.2% of 687 orders, Jan 2012 - Apr 2018) and 3 *PML-RARA* qual orders (20% of 15, Apr 2018 - Apr 2019). Four of 28 patients (14.3%) were FISH-negative, but positive by HemaVision. No APL variants were identified.

Two patients did not have definitive blasts in the peripheral smear, and two had rare blasts. All 28 patients with >1% peripheral blasts (mean 47%) showed classic morphology (bilobed nuclei n=27, auer rods n=22, or both n=21). Confirmed APL patients had elevated D-dimer (n=31, mean 8943 ng/mL DDU) and thrombocytopenia (n=32, mean platelet 33.1 K/mm3). PT, INR, and PTT values were variable. Compared to 18 control patients who had suspected APL but tested negative for *PML-RARA*, true APL patients had higher D-Dimer (*p*=0.0145), lower fibrinogen (*p*=<0.0001), and lower WBC (*p*=<0.0001) (Figure 2).

Figure 1 - 1985



AML Translocation	Genes Involved
t(15;17)(q24.1;q21.2)	*PML-RARA*
t(11;17)(q23.2;q21.2)	*ZBTB16-RARA*
t(5;17)(q35.1;q21.2)	*NPM1-RARA*
inv(16)(p13.11;q22.1)	*CBFB-MYH11*
t(8;21)(q21.3;q22.12)	*RUNX1-RUNX1T1*
t(9;11)(p21.3;q23.3)	*KMT2A-MLLT3*
t(11;19)(q23.3;p13.11)	*KMT2A-ELL*
t(10;11)(p12.31;q23.3)	*KMT2A-MLLT10*
t(11;17)(q23.3;q12)	*KMT2A-MLLT6*
t(3;5)(q25.32;q35.1)	*NPM1-MLF1*
t(6:11)(q27;q23.3)	*KMT2A-AFDN*
t(6;9)(p22.3;q34.13)	*DEK-NUP214*

B-ALL Translocation	Genes Involved
t(9;22)(q34.12;q11.23)	*BCR-ABL1* (M, m, μ)
t(1;19)(q23.3;p13.3)	*TCF3-PBX1*
t(12;21)(p13.2;q22.12)	*ETV6-RUNX1*
t(4;11)(q21.3-q22.1;q23.3)	*KMT2A-AFF1*
t(11;19)(q23.3;p13.3)	*KMT2A-MLLT1*
ALL, AML, MPN/MDS	**Genes Involved**
t(9;12)(q34.12;p13.2)	*ETV6-ABL1*
T-ALL	**Genes Involved**
TAL1 (40 kb deletion 1p32)	*STIL-TAL1*

Note: Hemavision includes total of 28 translocations, some of which are listed here.
Some translocations can be present in multiple types of leukemias (e.g., *BCR-ABL* in AML)

Figure 2 - 1985

Mean Laboratory Values at the Time of Admission for Patients with Suspected APL

Laboratory Parameter	Confirmed *PML-RARA* (n=32)	Negative for *PML-RARA* (n=18)	Two-tailed *p* -value
WBC (K/mm3)	12.01	61.23	<0.0001*
Platelet (K/mm3)	33.10	78.50	0.0252*
PT	15.86	14.36	0.2518
INR	1.45	1.22	0.0558
PTT	27.36	36.46	0.2138
Fibrinogen (Mg/dL)	180.28	391.39	<0.0001*
D-Dimer (<230 ng/mLDDU)	8943.55	2497.00	0.0145*
Leukopenia (<4 K/mm3)	18/32 = 56%	1/18 = 0.5%	0.0006*
Leukocytosis (>11K/mm3)	8/32 = 25%	15/18 = 83.3%	<0.0001*
Thrombocytopenia (<140 K/mm3)	32/32 = 100%	17/18 = 94%	0.35

* statistically significant difference

Potential Cut-off Values for Laboratory Screening of APL

Potential Cut-off	Sensitivity	Specificity	Positive Predictive Value
D-Dimer of >2K	83.87%	50%	74.29%
D-Dimer of >5K	51.61%	94.44%	94.11%
Fibrinogen ≤200 Mg/dL	78.12%	83.33%	89.28%
Fibrinogen ≤300 Mg/dL	93.75%	72.22%	85.71%
WBC <15 K/mm3	75%	83.33%	88.88%
WBC <4 K/mm3	56.25%	94.44%	94.73%

Conclusions: If APL is suspected, treatment with ATRA may need to be initiated based on clinical findings while definitive laboratory results are pending. Our workflow changes decreased time to molecular diagnosis from 5.6 days to 0.9 days (p<0.0001). We additionally found that elevated D-Dimer >5K ng/mLDDU and WBC <4K/mm3 were specific for APL (94.44% specificity) and showed high positive predictive values (94.11% and 94.73%). Fibrinogen <300 Mg/dL was also fairly sensitive (93.75%). Incorporating laboratory cut-offs into our existing algorithm may further improve screening for APL at our institution.

1986 Results of College of American Pathologists PD-L1 Immunohistochemistry Proficiency Testing in Lung Adenocarcinoma

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Disclosures: Andrew Bellizzi: None; Mohamed Salama: None; David Rimm: *Consultant*, Biocept, NextCure, Odonate; *Advisory Board Member*, Amgen, AstraZeneca, Cell Signalling Technology, Cepheid, Daiichi Sankyo, GSK, Konica/Minolta, Merck, Nanostring, Perkin Elmer, Roche, Ventana, Ultivue; *Grant or Research Support*, AstraZeneca, Cepheid, Navigate BioPharma, NextCure, Lilly, Ultivue, Ventana, Akoya/Perkin Elmer, NanoString; *Speaker*, BMS; *Stock Ownership*, PixelGear, Rarecyte

Background: Checkpoint inhibitors have revolutionized cancer therapy. PD-L1 immunohistochemistry (IHC) is either a companion or complementary diagnostic for many drug/disease combinations. The College of American Pathologists (CAP) offers a number of IHC surveys, with increasing emphasis on emerging predictive markers. We present our initial two-year experience with a CAP PD-L1 IHC survey in lung adenocarcinoma (LUAD).

Design: The survey was distributed as a 10-core unstained tissue microarray (TMA) slide, which labs stained/evaluated for PD-L1. In year 1, the TMA contained 8 LUADs and 2 Hodgkin lymphomas; in year 2 all cases were LUAD. For each core, participants scored extent (i.e., TPS) and intensity of tumor cell staining (0-3+); in year 2 immune cell (IC) staining was also assessed. Data on clone, assay type (FDA-approved kit, laboratory developed test/modified FDA kit [LDT]), and test volume were collected. Lab performance was specifically analyzed for 3 cores of LUAD that did not reach 80% consensus for TPS category.

Results: Ninety-six (96) laboratories participated in the 2017 survey and 153 in 2018; in 2018 the frequency of assay use (in descending order) was 45% for 22C3 FDA, 16% SP263 FDA, 13% 22C3 LDT, 7% SP263 LDT, 4% E1L3N LDT, 4% SP142 FDA, 3% 28-8 FDA, 2% SP142 LDT, 1% 28-8 LDT, and 5% other/not specified. Overall, 68% reported use of an FDA-approved assay and 27% reported use of an LDT.

The Table reports the percent of labs agreeing with the majority TPS assessment for each of the survey cores.

Labs using 22C3 or E1L3N were more likely, while those using SP142 or other/not specified or reporting 1+ staining were less likely to score the "challenging cores" as ≥50% (p<0.001, Fisher's exact). FDA vs LDT (p=0.58, chi-squared) and test volume (≤50 vs >50 tests annually) (p=0.47 chi-squared) had no bearing on performance. In year 2, only 2 cores achieved 80% consensus for IC staining (if results are combined into <1% vs ≥1% bins).

2017			2018		
Core	TPS	% Agree	Core	TPS	% Agree
1	no majority*	NA	1	<1%	96
2	<1%	99	2	<1%	98
3	<1%	99	3	≥50%	**57**
4	≥50%	99	4	≥50%	**63**
5	<1%	97	5	≥50%	97
6	≥50%	100	6	<1%	97
7	≥50%	**79**	7	<1%	97
8	<1%	98	8	<1%	99
9	≥50%	84	9	≥50%	94
10	<1%	90	10	≥50%	80

*Hodgkin lymphoma with 24% of labs reporting <1%, 42% reporting 1-49%, 34% reporting ≥50% TPS

Conclusions: A CAP PD-L1 IHC survey highlights clone-specific performance variation. While there was generally very good agreement for TPS, IC scoring was irreproducible. In 2020 the survey will expand to 2 mailings a year to include both LUADs and PD-L1-relevant non-LUADs (e.g., gastroesophageal adenocarcinoma, urothelial carcinoma, etc). We will add an assessment of the combined positive score (CPS) and clarify instructions for IC scoring, hoping to improve concordance.

1987 Emerging Technology in Breast Tumor Localization: A Single Institution Analysis of Reflector-Guided Localization Using SAVISCOUT® in Non-Palpable Breast Carcinoma Compared to Traditional Wire Localization

Nicholas Bercovici[1], Dina Kandil[2], Jennifer Clark[2], Vladislav Makarenko[3], Anne Larkin[1], Jennifer LaFemina[1], Gopal Vijayaraghavan[1]
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Disclosures: Nicholas Bercovici: None; Dina Kandil: None; Jennifer Clark: None; Vladislav Makarenko: None; Anne Larkin: None; Jennifer LaFemina: None; Gopal Vijayaraghavan: None

Background: Reflector-guided localization and excision of breast lesions is an emerging technology recently developed as an alternative to the traditional image-guided wire localization (WL) technique. Although both modalities assist in excision of non-palpable lesions, the SAVISCOUT® (SS) offers the advantage of using non-radioactive radar localization without a restriction on the length of time it remains in the breast or patient inconvenience resulting from displacement, breakage and wait times following wire placement. The purpose of this study is to compare surgical outcomes of non-palpable breast cancer excisions using the novel SS and traditional WL methods.

Design: A retrospective review of the electronic health record was performed to identify patients who underwent localization surgery for breast cancer from July 2018 to July 2019. Cases were stratified into SS and WL groups. Data was collected to include specimen volume, tumor size, final diagnosis, margin status and distance to closest margin. Statistical analysis was performed to compare both groups.

Results: A total of 356 cases were reviewed. Of these, 185 patients had breast carcinoma, including 129 invasive ductal carcinoma (IDC), 36 ductal carcinoma in-situ (DCIS), and 20 invasive lobular carcinoma (ILC). Of the 185 patients, 89 had SS excisions, and 96 had WL. Tumor size ranged from 1-72 mm in greatest dimension (mean 16 mm) in the SS group, and 1-64 mm in the WL group (mean 14 mm, P=.366). Mean specimen volume was 114.08 cm^3 (±85.57) in the SS group compared to 168.85 cm^3 (±151.57) in the WL group (P=.003). Amongst the SS group, 8/89 (9%) cases had positive margins, compared to 13/96 (13.5%) in the WL group (X^2, P=.329). In the SS group, margins were positive for IDC in 50% (4/8) of cases, DCIS in 37.5% (3/8), and ILC in 12.5% (1/8); and in the WL group, IDC in 23% (3/13), DCIS in 38.5%, and ILC in 38.5% (5/13). In the SS group, 50% (4/8) of cases with positive margins had re-excision compared to 69.2 % (9/13) in the WL group (X^2, P=.378).

Conclusions: Our study shows that patients who underwent localization excisions using SS had lower positive surgical margin rates (9%) compared to those with similar sized breast carcinomas who underwent WL localization excisions (13.5%), with significant reduction (~32%) in the volume of excised tissue. Our data indicates that SS localization provides superior surgical outcome over traditional WL in patients with breast cancers amenable to breast-conserving surgery.

1988 Lack of Uniformity in Reporting Autoimmune Metaplastic Atrophic Gastritis among a Diverse Group of Pathologists

M. Suzanne Bloomquist[1], John Powell[1], Ramya Masand[1], Deepti Dhall[2], Dipti Karamchandani[3], Shilpa Jain[1]
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Disclosures: M. Suzanne Bloomquist: None; John Powell: None; Ramya Masand: None; Deepti Dhall: None; Dipti Karamchandani: None; Shilpa Jain: None

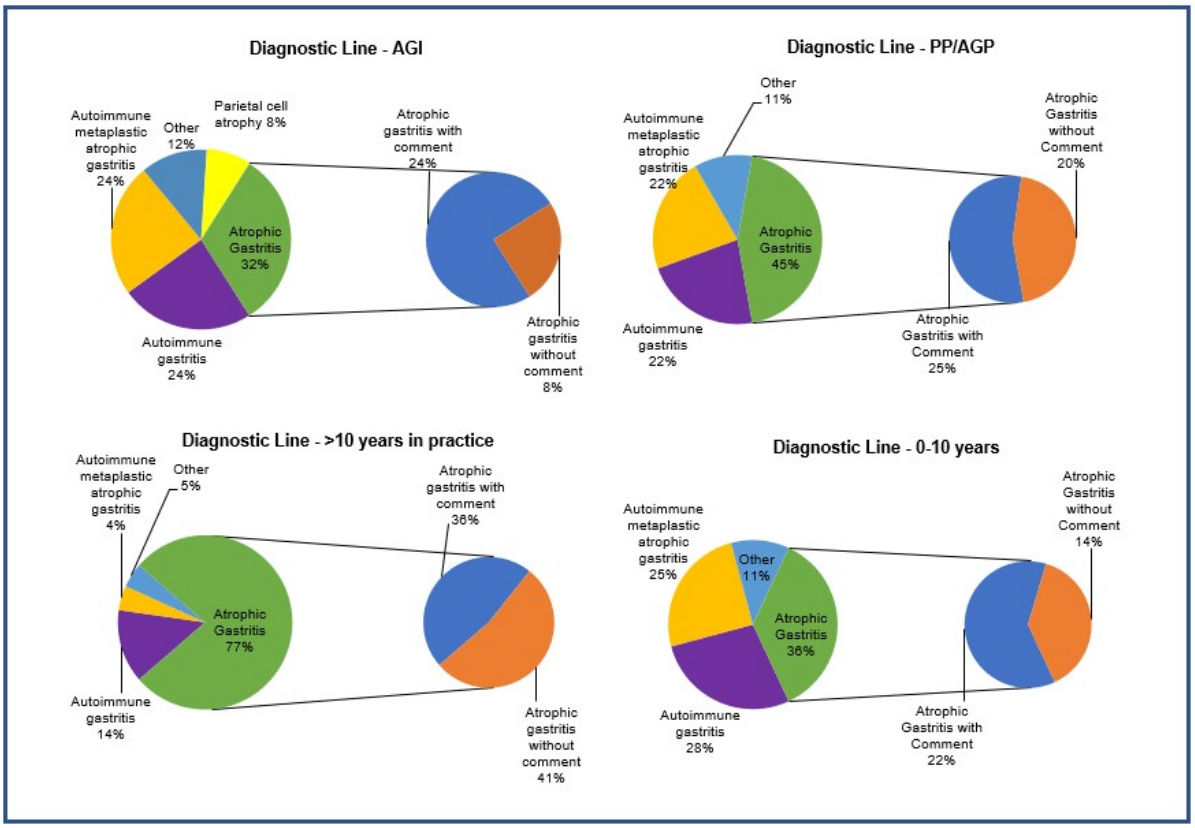
Background: Atrophic gastritis is defined by destruction of gastric glands with two main etiologies: *H. pylori* (HP) and autoimmune metaplastic atrophic gastritis (AMAG). The diagnosis of AMAG requires parietal cell atrophy, metaplasia, possible enterochromaffin-like (ECL) cell hyperplasia, and positive serology. A precise pathology report is crucial to coordinate appropriate patient care by gastroenterologists. This study is performed to compare reporting patterns of AMAG among pathologists.

Design: An anonymous web-based survey was circulated among a diverse group of pathologists with 20 questions and selected figures regarding reporting patterns when diagnosing AMAG. The results were compared using Fisher's exact test.

Results: 78 respondents completed the survey: 25 academic GI subspecialists (AGI) (32%), 22 academic general pathologists (AGP) (28%), 17 private pathologists (PP) (22%), and 14 trainees (18%, excluded).

The majority of respondents indicate site specific biopsy is preferred (95%) and require parietal cell atrophy to diagnose atrophic gastritis in oxyntic mucosa (AGP: 81%; PP/AGI: 64%). Atrophy was either "never" or "rarely" diagnosed in antrum by AGP and PP; however, 20% of AGI responded "frequently." The trend showed ECL cell hyperplasia in oxyntic mucosa may be diagnosed more accurately by AGI (92%) and AGP (95%) vs. PP (70%) (p=0.07), based on a queried image. G (gastrin) cells in antrum on neuroendocrine immunostain was diagnosed as ECL cell hyperplasia more commonly among PP and AGP (43%), than AGI (12%) (p=0.003). The definition of metaplasia in AMAG lacks consensus, even among AGI. Most respondents do not grade atrophy (84%), classify metaplasia as complete or incomplete (88%), or diagnose G cell hyperplasia (80%). Immunostains (*H. pylori*, neuroendocrine, and gastrin) are used by 72% of AGI versus 22% of AGP and 11% of PP. The term "atrophic gastritis" is reported more frequently by respondents with >10 years of clinical experience (p=0.04), while <10 years in practice use more specific diagnostic terminology (see Figure).

Figure 1 - 1988



Conclusions: The interpretation of neuroendocrine markers in antrum and body is crucial to the diagnosis of AMAG and requires caution. In cases of discrepancy, simultaneous use of gastrin stain is recommended. This study highlighted a need for uniform criteria and terminology in reporting AMAG to improve communication with clinicians, leading to initiation of appropriate testing and follow-up.

1989 Pathologist Rate Variation in Diagnostic Category and Cancer Subtype Using Funnel Plots/Control Charts and an in silico Kappa with Assessment of Maximal Gross Core Length in 3,359 Lung Core Biopsy Specimens

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Disclosures: Michael Bonert: None; Mozibur Rahman: None; Charles Jian: None; Christian Finley: None; JC Cutz: None; Asghar Naqvi: None

Background: Diagnostic rate (DR) variation can be assessed from rate data using funnel plots and an in silico kappa. Tissue quantity affects the diagnostic process; systematic quantification of tissue quantity in relation to diagnostic classifications may provide insight.

Design: All in house lung core biopsy specimens (LCBS) accessioned Jun 2012-Dec 2017 were retrieved. Using custom computer code, specimens were categorized using a hierarchical free text string matching algorithm (HFTSMA), and grouped into mutually exclusive categories (negative (NEG), suspicious (SUSP), malignant (MAL)). DRs were calculated and visualized on funnel plots/control charts (FPs/CCs) centered on the group median diagnostic rate (GMDR), and normed by the highest volume pathologist. In silico kappas (ISKs) were generated using the DRs and a maximal diagnostic overlap assumption (MDOA). The maximal gross core length (MGCL) was retrieved using a custom text processing tool (CTPT).

Results: Data could be extracted for 3,359 LCBS. The HFTSMA and CTPT could classify ~99% of them. A random audit of 300 specimens showed the categorized cases had approximately a 1-2% error. Fifteen pathologists read 43-591 LCBS and together interpreted 3,232. The median call rates/normed ranges were 25%/22-29% for adenocarcinoma (ADN), 13%/10-17% squamous cell carcinoma (SCC), 4%/3-8% for small cell carcinoma (SmC), 7%/4-10% for granulomas (GRN), 40%/36-45% for NEG, 1%/1-5% for SUSP and 56%/50-59% for MAL. The number of statistical outliers ($p<0.05|p<0.001$) in relation to the GMDR on the FPs/CCs were 2 ($p<0.05$)|0 ($p<0.001$) of 15 for ADN, 3 ($p<0.05$)|0 ($p<0.001$) of 15 for SCC, 1|1 of 15 for SmC, 3|0 of 14 for GRN, 1|0 of 15 for NEG, 6|4 of 15 for SUSP, and 4|0 of 15 for MAL. The ISKs for presence of ADN, SCC, SmC, GRN, NEG, SUSP and MAL were: 0.86, 0.82, 0.73, 0.69, 0.88, 0.45, 0.87. The MGCL 25%/50%/75% was 0.2 cm/0.5 cm/1.0 cm. SUSP and NEG were associated with small values of MGCL; approximately 50% of these cases had a MGCL <=0.3 cm.

Conclusions: The DR variation in the practice suggests cancers are identified and subclassified reproducibly. Optimizations may be possible in SUSP, GRN and SmC. The in silico kappas mirror findings in the FPs/CCs. MGCL correlates with diagnostic classification and may allow recommendation of a target length; however, it should be compared to total core length. Observational data can be used to assess diagnostic reproducibility and may help identify areas for quality improvement.

1990 A Redirection of Laboratory Resources for a Better Value Based Surgical Pathology

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Disclosures: Caroline Bsirini: None; Akram Ayoub: None; Aaron Huber: None; Christa Whitney-Miller: None

Background: In the past decade**,** a drastic change has faced health care in general and laboratory medicine in particular with increased emphasis on value based care and improved efficiency (“doing more for less”). Surgical pathology laboratory is amongst the most labor intense laboratories. But yet surgical pathology laboratory efficiency and cost effectiveness are rarely mentioned in the literature. Our goal was to evaluate these elements in our surgical pathology laboratory in a cost-benefit analysis, using extra blocks submitted for small bowel/colon specimens as an initial step.

Design: We searched our 2018 surgical pathology database for small bowel/colon specimens resected for benign reasons (e.g.: trauma, inflammatory bowel disease (IBD), necrotizing enterocolitis, diverticular disease, pseudomembranous colitis, bowel obstruction, ischemia, perforation, etc). Cases with clinicoradiologic or pathologic impression of a mass, IBD with a previous biopsy diagnosis of dysplasia, adenomas and syndromic patients were excluded from the analysis. We defined the ideal number of block submission based on the specimen surgical diagnosis, gross findings and specimen length. We additionally analyzed the labor and financial cost of blocks’ submission (table) and compared this to our reimbursement for an 88307.

Results: We evaluated a total of sixty-four benign small bowel/colon resections (n=64) for number of extra blocks submitted, based on our estimation of ideal number of block submission per diagnosis/case. The estimated average cost per block was 12.20$. More than 30% of the total submitted blocks were deemed extra or unnecessary (174/506) and more than 60% of the cases (39/64) had extra blocks

submitted ranging from one to twenty-six extra-blocks per case. These extra-blocks consisted mainly of unnecessary extra lymph nodes and extra small bowel/colon representatives (such as 1 section per 5cm for IBD cases instead of the standard 1 per 10cm). Using $262 as reimbursement for an 88307 (benign colon), 5 cases were financial short falls. However, importantly none of these extra-blocks altered or added to the final pathology diagnosis.

Essential elements for creating blocks/reviewing slides	Total cost per block
Histotechnical staff labor (including embedding/sectioning)	$ 5.33
Reagents/reagent rentals and other consumables	$ 2.00
Pathology assistant labor	$ 1.44
Slide coordinator labor	$ 0.14
Charged slide	$ 0.28
Cassette	$ 0.18
Previewing by fellow	$ 0.83
Previewing by attending	$ 2.00
Total cost/ block	**$ 12.20**

Conclusions: Our study demonstrates that submitting extra blocks might be a waste of resources with no additional clinical or pathologic contribution. In an era of value based surgical pathology, human and financial resources should be invested and redirected toward delivering a more valuable outcome.

1991 Maintaining Histologic Quality in a Low-Resource Setting using a Novel Fixation Method

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Disclosures: Kedesha Callender: None; Wesley Greaves: None; Nicholas Alexander: None; Petal Julien: None; Ruth Chulhan: None; Melanie Johncilla: None

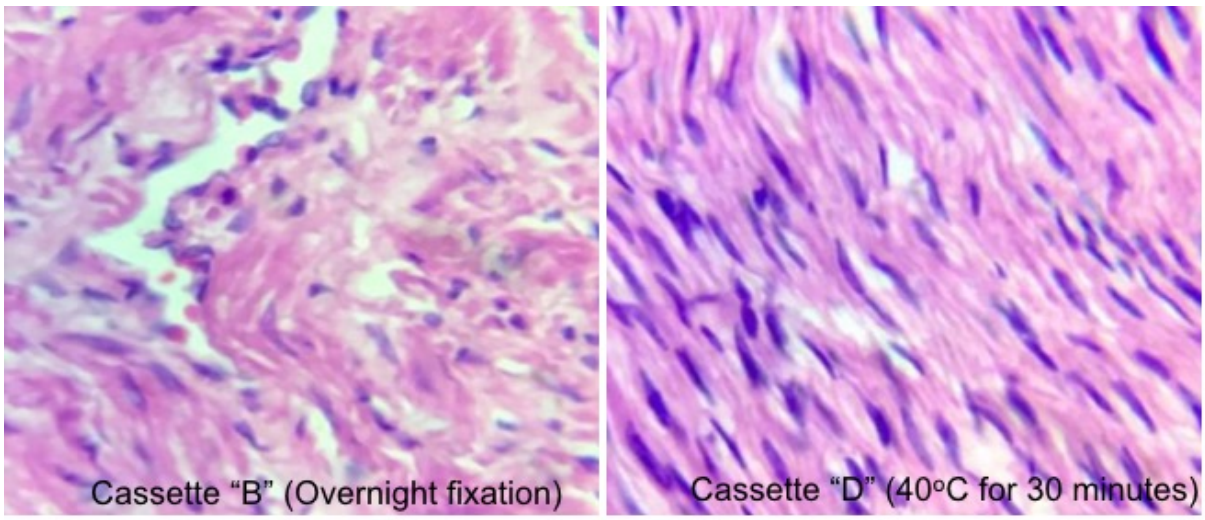
Background: In Trinidad, pathologic examination of specimens from surgeries performed at hospitals all over the country is often outsourced to private laboratories. Because of location of the surgery and lack of efficient specimen transport, there is often a significant delay from the time of surgery to specimen arrival. As such, the specimen is left either unfixed or not suitably grossed for appropriate fixation. The pathologist is often faced with a dilemma: process a suboptimally fixed specimen or further delay the case. The former often leads to poor histology, a major challenge in most resource-restricted settings. A novel method for rapid tissue fixation that does not compromise safety or histologic quality is needed. The rate of penetration and fixation of formalin is slow. The factors that influence fixation are pH, temperature and time. The aim of this study was to use increasing temperatures to increase the rate of formalin penetration, while maintaining lab safety and histologic quality.

Design: 8 sections of unfixed myometrium were used for the study. One section was submitted unfixed in a cassette “A” and placed in 0.9% saline until processing. Another section was placed in 10% formalin for 24 hours at room temperature; in a cassette “B”. The remaining sections were placed in cassettes “C-H” and each placed in a Ziploc freezer bag containing 400mL of 10% formalin with 2 drops of red food coloring and then in an automated water bath at a specific temperature: C-35°C, D-40°C, E-45°C, F-50°C, G-55°C and H-60°C,for 30 minutes. For each temperature the formalin exposure was monitored every 5 minutes. The sections were then processed and stained by H&E. The H&E slides were graded on 5 parameters by 2 blinded pathologists: cellular outline, cytoplasmic detail, and nuclear detail, morphology and stain quality on a scale of 1-3 where 1-Excellent, 2- Satisfactory and 3-Unsatisfactory.

Results: All methods of formalin fixation superior quality to an unfixed specimen (Table 1). Pathologist 1 rated D (40ºC for 30 minutes) as having the same quality as B (overnight fixation) and pathologist 2 rated it as having superior cytoplasmic detail and overall morphology (Figure 1). Formalin exposure did not exceed 0.095 ppm, far less than the limit of 0.75 ppm and the water bath remained clear, indicating no spillage of formalin.

Pathologist	Criteria	A	B	C	D	E	F	G	H
Pathologist 1	Cellular Outline	1	1	1	1	1	1	1	2
	Cytoplasmic Detail	1	1	1	1	1	1	1	2
	Nuclear Detail	1	1	1	1	1	1	1	2
	Overall Morphology	1	1	1	1	1	1	1	2
	Overall Staining	2	1	2	1	2	2	2	2
Pathologist 2	Cellular Outline	2	1	1	1	2	2	1	1
	Cytoplasmic Detail	2	2	2	1	2	2	1	1
	Nuclear Detail	2	1	1	1	2	2	2	2
	Overall Morphology	2	2	2	1	2	2	2	1
	Overall Staining	2	1	1	1	2	2	2	1

Figure 1 – 1991



Conclusions: This novel and low-cost method allows for rapid processing of samples without sacrificing either the safety of laboratory personnel or histological quality.

1992 Variable Expression of Myelin and Lymphocyte Protein 2 (Mal2) and Miz1 in a Cohort of Six Different Human Carcinomas

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Disclosures: Joeffrey Chahine: None; Kyungmin Ko: None; Pamela Tuma: None; Bhaskar Kallakury: None

Background: Myelin and Lymphocyte Protein 2 (Mal2), a protein that functions in polarized protein sorting, is frequently overexpressed in many epithelial-derived human cancers and has been linked to poor prognosis in patients with colorectal and pancreatic cancers. Yet, its role in tumorigenesis is not widely known. Mal2 resides on chromosome region 8q24, a region frequently amplified in multiple epithelial-derived human cancers along with c-Myc, a well-known oncogenic driver whose overexpression dysregulates gene expression leading to downstream decreased expression of Mal2 via inactivation of the Miz1 (zinc finger protein) transcription factor. Our prediction is that lower grade lesions from human epithelial-derived cancers display high Mal2 expression that will diminish as cancers progress into higher grade lesions and metastases with a concomitant increase in c-Myc expression.

Design: We tested this hypothesis on carcinomas of Cholangio (CC, n=24), Hepatocellular (HCC, n=18), Renal Cell (RCC, n=31), Breast (BC, n=33), Colorectal (CRC, n=26), and Pancreatic (PC, n=30) origin whose formalin fixed paraffin embedded tissue sections containing benign and tumor lesions were immunostained using the Dako Autostainers Link 48 along with Mal2 rabbit polyclonal (ABCAM), Miz-1 monoclonal ZBTB17(NOVUS), c-Myc monoclonal Y69 (ABCAM) and Ki-67 monoclonal Mib-1(Dako) antibodies. Nuclear and/or cytoplasmic immunoreactivity was scored based on the intensity and percentage of positive cells in both the benign epithelium and adjacent tumor component in each case.

Results: Expression of Mal-2 and Miz-1 is generally down-regulated in carcinomas of Cholangio, Hepatocellular, and Renal Cell origins, while it is up-regulated in Colorectal Carcinoma, and shows intact expression in carcinomas of Breast and Pancreatic origins. (Results in Table)

	CC	HCC	RCC	BC	PC	CRC
Mal-2 Down-Regulation	15/24 (P=0.15)	11/18 (P=0.24)	13/31 (P=0.51)	2/33 (P=1.0)	4/30 (P=0.99)	3/26 (12%)
Intact Expression of Mal-2	9/24 (38%)	7/18 (39%)	16/31 (52%)	27/33 (82%)	26/30 (87%)	11/26 (42%)
Mal-2 Up-regulation	/	/	2/31 (6%)	1/33 (3%)	/	12/26 (P=0.72)
Miz-1 Down-Regulation	22/24 (P<0.001)	17/18 (P<0.001)	16/31 (P=0.41)	1/33 (P=1.0)	10/30 (P=0.98)	1/26 (4%)
Intact Expression of Miz-1	2/24 (8%)	1/18 (6%)	14/31 (45%)	25/33 (76%)	11/30 (37%)	17/26 (65%)
Miz-1 Up-Regulation	/	/	1/31 (3%)	4/33 (12%)	9/30 (30%)	8/26 (P=0.98)

Conclusions: These results indicate a concordant down-regulation of both MAL2 and Miz-1 in CC, HCC, and RCC supporting a tumor suppressor role in these cancers, unlike their expression pattern in BC, PC and CRC. We are currently extending these studies to a larger cohort of CC, HCC, and RCC in an attempt to precisely determine MAL2, Miz1 and c-Myc expression, evaluate correlations with tumor grades/stages and decipher their role in tumorgenesis.

1993 Significance of ER-/PR+ Breast Cancer Cases: Re-evaluation of Biomarker Status and Clinical Correlates

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Disclosures: Hui Chen: None; Tieying Hou: None; Lei Huo: None; Yun Wu: None; Wei-Lien Billy Wang: None; Constance Albarracin: None

Background: Estrogen receptor (ER) and progesterone receptor (PR) are predictive/prognostic markers in breast cancer, with ER being stronger in predicting response to endocrine therapy. While ER+/PR+ and ER+/PR- tumors are common, ER-/PR+ cases are rare and raise the possibility of technical issues when encountered. It has been reported that the available commercial clones of PR may generate different results by targeting different PR isoforms. Herein, we report the incidence of ER-/PR+ breast cancers with two commercial platforms for PR, and explore their pathologic and molecular features.

Design: A retrospective review of 1830 breast cancer cases with ER and PR from 11/2017 to 1/2019, included 1545 cases tested on Leica system (ER 6F11 Ab and PR PGR1294 Ab) and 285 cases tested on Ventana system (ER SP1 Ab and PR 1E2 Ab). Hormone receptor expression in tumor nuclei was analyzed as negative (<1%), low positive (1-9%) and positive (10%). Cases with ER-/PR+ results using PR 1E2 Ab were repeated with both PGR1294 and 1E2 Abs. One ER-PR+ by 1E2 case was tested by next generation sequencing using Oncomine comprehensive panel v3 (ThermoFisher).

Results: ER was negative in 20.4% (315/1545) with 6F11 Ab and 21.5% (60/285) with SP1 Ab. Overall ER- rate was 20.5% (375/1830). Among ER- cases, PR+ rate was 2.9% (11/375), significantly higher in cases tested by PR 1E2 (8/60, 13.3%) than with PGR1294 (3/315, 1.0%, $p < 0.001$). In the 8 ER-/PR+ cases tested using PR 1E2, repeat ER with 6F11 all remained negative; repeat PR positivity was significantly higher using 1E2 (7/8, 87.5%) than using PGR1294 (1/8, 12.5%, $p = 0.01$). The 8 cases were all ductal and grade 3. AJCC stage ranged from II (3), III (1) to IV (4). HER2 was positive in 2 and negative in 6 cases. Ki67 index ranged from 10-60% (mean 38%). Mutation profile on one case showed *TP53* and *RB1* somatic mutations with no detectable *PIK3CA* mutation, which is aligned with triple negative subtype. Two of two patients who received and completed neoadjuvant chemotherapy without hormonal therapy had partial to complete response.

Conclusions: Among ER- cases, PR staining with 1E2 Ab gave rise to more PR+ cases than with PGR1294. Clinical and molecular features of some of the ER-/PR+ cases suggested that they may be biologically more similar to non-luminal tumors. Additional larger scale studies are necessary to determine the management of such tumors.

1994 Comparative Analysis of Wide-Area Transepithelial Sampling (WATS) Versus Endoscopic Biopsy in Diagnosing Dysplasia in Barrett's Esophagus

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Disclosures: Ashley Dunkle: None; Michael Andersen: None; Mikhail Lisovsky: None; Louis Vaickus: None; Bing Ren: None

Background: Barrett's esophagus (BE) is a precursor of dysplasia, which can progress to esophageal adenocarcinoma (EAC). Currently, dysplasia is diagnosed histologically with an endoscopic random four-quadrant forceps biopsy. A new sampling technique, wide-area transepithelial sampling (WATS), uses abrasive circumferential brushing of BE mucosa with 3D tissue analysis to diagnose dysplasia. A previous study (n=160) reported a 4.1 times higher yield of detection of high-grade dysplasia (HGD) and EAC by WATS than endoscopic biopsy (EB) alone (Vennalaganti et al, 2018). Our hospital started WATS sampling concurrently with four-quadrant EB for BE in 2017. In this study, we compare diagnostic results of esophageal dysplasia between WATS and EB.

Design: Patients with BE who received both WATS and EB during the same procedure at our institution between June 2017 and July 2019 were identified. WATS analyses were performed at an outside facility (CDX Diagnostics, Suffern, NY 10901). We compared the diagnostic results of WATS and EB within the same procedure, including no dysplasia (ND), indefinite for dysplasia (ID), low-grade dysplasia (LGD), and HGD. Odds ratio and Fischer's Exact Test were used for analysis (Prism 8.2.1).

Results: Among 119 cases, WATS identified 21 cases (18%) of dysplasia (defined as HGD, LGD, and ID) and EB identified 11 cases (9%) of dysplasia (p = 0.0861). Both WATS and EB agreed in the diagnosis of dysplasia in 7 cases (6%) (2 both HGD, 2 both ID, 3 WATS ID and EB HGD) and ND in 94 cases (79%) (see Figure 1). There was a discrepancy in the diagnosis of dysplasia between WATS and EB in 18 cases (15%). In 14 cases, WATS reported dysplasia (1 HGD, 12 LGD, 1 ID) and EB reported ND. In 4 cases, EB reported dysplasia (2 HGD, 2 ID) and WATS reported ND (see Figure 2). WATS and EB performed together identified 25 cases of dysplasia, whereas EB alone identified 11 cases (OR=2.61, 95% CI=1.22-5.80, p=0.0178).

Figure 1 - 1994

		Endoscopic Biopsy				
		HGD	LGD	Indefinite	No Dysplasia	Total
WATS	HGD	2	0	0	1	3
	LGD	0	0	0	12	12
	Indefinite	3	0	2	1	6
	No Dysplasia	2	0	2	94	98
	Total	7	0	4	108	119

Legend
= Agreement
= Discrepancies
= Agreement, different dysplasia type
= Totals

HGD = High-Grade Dysplasia, LGD = Low-Grade Dysplasia, WATS = Wide-Area Transepithelial Sampling

Figure 1: Comparison of Agreement in Diagnosis of Dysplasia Between Endoscopic Biopsy and WATS

Figure 2 - 1994

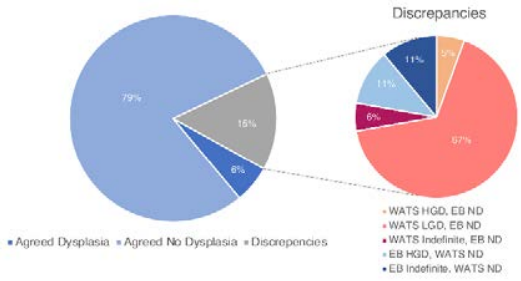

Figure 2: Concordance in Dysplasia Diagnosis Between WATS and EB
(WATS = Wide-Area Transepithelial Sampling, EB = Endoscopic Biopsy, HGD = High-Grade Dysplasia, LGD = Low-Grade Dysplasia, ND = No Dysplasia)

Conclusions: In our study, WATS and EB performed together identified more cases of dysplasia than EB alone (p=0.00178). Overall, WATS detected more LGD that EB did not (n=12), and EB identified cases of HGD that WATS did not (n=2). WATS may identify more cases of early dysplasia due to the broad surface area of tissue evaluated compared to the discrete, randomly selected EB that is subject to sampling error. Further follow-up of these cases is needed to assess the clinical significance of these diagnoses on patient outcomes.

1995 Diagnostic Value of Different Cytopreparation Techniques in Thyroid FNAs and Predictive Power of ROSE

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Disclosures: Muhammad Elahi: None; Ioannis Ioannidis: None; Aileen Grace Arriola: None

Background: At our institution, after air-dried and alcohol-fixed smears are prepared during ROSE for thyroid FNAs, we use the remaining rinse to prepare both a ThinPrep (TP) and cell block (CB) slide. This study examines the diagnostic value of each preparation type and whether ROSE results correlate with the final utility of each preparation type.

Design: We retrospectively reviewed thyroid FNA cases from the period of 1/1/17-6/30/17 from our institutional records. A total of 194 cases were included in the study, out of which 185 and 190 had CB and TP prepared, respectively. ROSE results were reviewed and categorized as being adequate or not adequate. Diff-Quick (DQ) and Papanicolaou-stained (PS) smears, TP, and CB slides were reviewed for diagnostic value and cellularity. DQ and PS alone, TP, and CB were categorized as being contributory or not to the final diagnosis. TP and CB cellularity were recorded as 0, <100, 100-500, or >500 cells. Categorical data was analyzed with the chi-square test with a significance level of <0.05.

Results: A statistically significant difference regarding the contribution of CBs and TPs to the final diagnosis was observed; CBs were non-contributory in the majority of cases (55%,101/185 CBs) in contrast to TPs which were non-contributory in less than half of cases (40%,76/190 TPs) (p=0.0046). Ninety-eight percent (98%, 99/101) of the non-contributory CBs were due to low cellularity (0 cells, n=60; <100 cells, n=39) and this trend was similar in non-contributory TP cases, with 92% (70/76) showing low cellularity (0 cells, n=20; <100 cells, n=50). Even though adequate ROSE could "predict" the contribution of DQ smears to the final diagnosis (p=0.000063), the same did not apply in the case of PS smears alone, TP, and CB (p=0.11, p=0.7, and p=0.37, respectively). Immunohistochemical (IHC) stains that contributed to the diagnosis were performed on only 1 CB (medullary thyroid carcinoma).

Table: Review of the diagnostic value of different cytopreparation types is useful in order to optimize specimen handling for thyroid FNA cases.

Diagnostic Value of Different Cytopreparations	Adequate on ROSE	Inadequate on ROSE	P-value (chi-square)
All Smears (DQ+PS) Diagnostic alone (174) Not diagnostic alone (15) N/A (5)	156 9	18 6	0.0036
DQ Smears Diagnostic Alone (159) Not diagnostic alone (30) N/A (5)	146 19	13 11	0.000063
PS Smears Diagnostic Alone (87) Not diagnostic alone (102) N/A (5)	80 85	7 17	0.11
Cell block (Total 185 prepared) Contributory (79) Not contributory (101) N/A (5)	67 91 --	12 10 --	0.7
ThinPrep (Total 190 prepared) Contributory (112) Not contributory (76) N/A (2)	99 64 --	13 12 --	0.37

Conclusions: In most cases, combined DQ and PS smears are adequate to reach a final diagnosis and the addition of CB preparation does not increase the diagnostic yield of thyroid FNAs. Between CB and TP, the latter contributes towards the diagnosis of more cases with a statistically significant difference. These results support the elimination of routine CB preparation in thyroid FNAs at our institution, which would reduce the preparation cost and turn-around-time, and only selectively use it for cases where IHC stains are required as assessed during ROSE.

1996 Mandatory Second Review of Prostate Biopsies Prior to Radical Prostatectomy: An Institutional Review

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Disclosures: Muhammad Elahi: None; Ioannis Ioannidis: None; Aileen Grace Arriola: None; Nirag Jhala: None

Background: Second review of outside pathology studies is an important measure implemented by many institutions as a quality assurance measure. Our institution performs a mandatory second review of outside prostate biopsies (PBx) for patients referred for radical prostatectomies (RP). Previous studies have shown that this practice can lead to changes in Gleason score (GS) in up to 14% of cases and detect morphologic features that would affect patient management, such as extraprostatic extension. In this retrospective study, we determine the impact of PBx second review in patient care and characterize the nature of diagnostic discrepancies, type of originating institution (academic, private or community), and correlation with RP GS.

Design: All consecutive PBx cases submitted for second review between 1/1/18-5/30/19 were included in the study. Outside institution diagnosis (ODx) and in-house diagnosis (Idx) were reviewed and global grade group (GGG), highest volume grade group (VGG), and highest-grade group (HGG) for Odx and Idx were recorded. RP GS, type of originating institution, and nature of discrepancies were also documented. Statistical analysis was performed, and significance was determined utilizing chi-square test with alpha set at 0.05.

Results: One hundred forty-four PBxs were submitted for second review from academic institutions (n=6), private reference labs (n=121), and community hospitals (n=17). Odx vs. Idx discrepancies were identified in 57(40%) cases, which included differences in GGG, VGG, and HGG in 22/57(39%), 26/57(46%), 25/57(39%) cases, respectively. Table 1 gives a detailed overview of all discrepancies. Most discrepancies were downgrades (91% GGG, 88% VGG, 95% HGG). Second review avoided unnecessary RP in 2 of 4 cases that were downgraded to GG1 based on GGG. Diagnostic discrepancies were more frequently identified in cases coming from private reference labs compared to academic institutions (53/121, 44% vs. 0/6, 0%; p-value=0.04). Finally, Idx of discrepant cases was closer to RP GS versus Odx regardless of the different parameters analyzed (54% vs. 18% GGG, 46% vs. 19% VGG, 50% vs. 18% HGG).

Table 1. Distribution of diagnostic discrepancies of prostate biopsies submitted for second review.

In-house GGG	**Outside Institution, Global GS Grade Group (GGG)** **Number of cases**					
	GG1	**GG2**	**GG3**	**GG4**	**GG5**	**Total #**
GG1		3	1			4
GG2			7	1		8
GG3	1			6		7
GG4			1		2	3
GG5						0
Total #	1	3	9	7	2	22
	Outside Institution, Highest Volume Grade Group (VGG) **Number of cases**					
In-house VGG	**GG1**	**GG2**	**GG3**	**GG4**	**GG5**	**Total #**
GG1		4	1			5
GG2	1		7	4	1	13
GG3		1		5		6
GG4					1	1
GG5				1		1
Total #	1	5	8	10	2	26
	Outside Institution, Highest Grade Group (HGG) **Number of cases**					
In-house HGG	**GG1**	**GG2**	**GG3**	**GG4**	**GG5**	**Total #**
GG1		3	1			4
GG2			6	3		9
GG3				6		6
GG4	1				2	3
GG5						0
Total #	1	3	7	9	2	22

Conclusions: Second review of prostate biopsies especially those interpreted at a private facility, is an important quality assurance parameter and is strongly recommended. This has substantial implications in further patient management including prevention of unwarranted surgeries.

1997 The Cost of Lost Patient Specimens in the Clinical Laboratory

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Disclosures: Teri Wells: None; Steven Kroft: None; Alexandra Harrington: None

Background: A lost specimen is defined as one that cannot be found in the expected location after reaching the laboratory, with most of these losses occurring in the pre-analytical phase of testing. With hundreds of bloods, fluids, and tissues moving through the laboratory

each day, specimens can be misplaced or unintentionally discarded as multiple individuals and departments handle the specimen. We chose to study the cost of lost specimens in our laboratory over a 1.5-year study period.

Design: We retrospectively reviewed all reported lost specimens in our clinical laboratory from Jan 1, 2018 through July 31, 2019 for the following: time spent searching for specimens, number of specimens found and able to be tested, recollection requests, and the impact score. Impact scores were assigned as:

0: No patient impact

1: Testing was resulted after expected turn-around time

2: Specimen recollected within 3 days and/or on the same encounter

3: Specimen recollected after 3 days and/or on a different encounter

4: Specimen never recollected

Data was collected through review of lost specimen checklists and order notes in our laboratory information system. Lost specimens with incomplete checklists were excluded from analysis.

Results: 126 specimens were reported lost during the study period (0.003% of total received), 71 of which had completed checklists. Of these 71, 40 (56%) were found in the laboratory and analyzed within stability, thus all scoring 0-1 for impact. Most lost specimens had impact scores of 1 (N=35) or 4 (15) (Table & Figure 1). A total of 16,658 mins (278 hrs) were spent looking for specimens, averaging 235 mins/specimen (range: 15-960), with the most time spent on those with impact scores of 1 and 4 (Table 1, Figure 2). Using an average staff wage, we spent $5,254.20 searching for specimens. Sixteen lost specimens (22.5%) resulted in recollections and 15 (21%) were never recollected. The cost of these recollections (phlebotomy charge and staff time) was $187.60 total.

Impact Score	Number of Specimens	Total Time Spent Looking (mins)
Category 0	5	165
Category 1	35	3526
Category 2	9	1080
Category 3	7	990
Category 4	15	25 68

Figure 1 - 1997

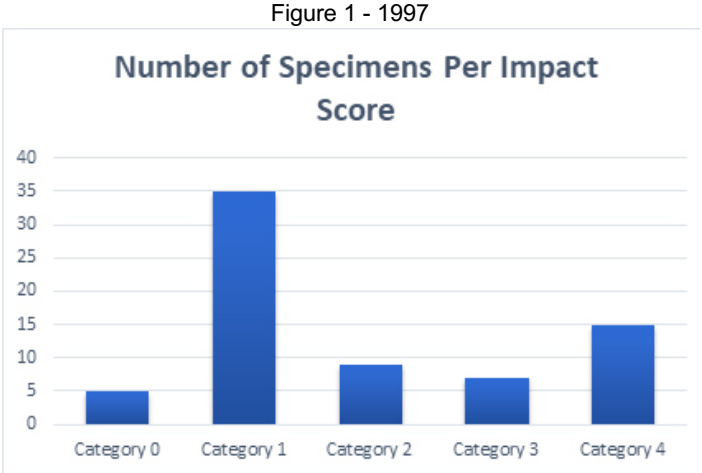
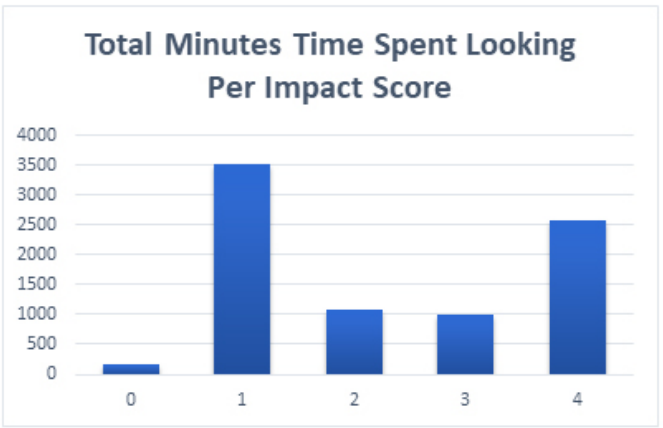


Figure 2 - 1997



Conclusions: Over half of our lost specimens were found in the laboratory and tested and resulted without apparent patient impact, though we spent valuable staff time (approximately 4hrs/specimen) recovering them. Costs of searching and/or recollection were almost $5500 during these 1.5 yrs. and are likely underestimated by our analysis. Our data supports a root cause analysis into lost specimens in our laboratory to reduce costs.

1998 Diagnostic Discrepancy of Second Opinion Surgical Pathology Review: One-Year Experience at an Academic Center

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Disclosures: Ayesha Farooq: None; Gustavo Moreno: None; Marisa Boskey: None; Nino Javakhishivili: None; Amrou Abdelkader: None; Tamar Giorgadze: None; Julie Jorns: None

Background: Diagnostic errors in pathology can have grave consequences. Second opinion frequently offers patient reassurance but is also an opportunity for identification of diagnostic error. The objective of our study was to compare diagnoses rendered on contributing and second opinion pathology review and determine discrepancy rates.

Design: Outside and in-house reports from second opinion cases at our institute (1/18-12/18) were reviewed. 3738 consecutive cases from 2656 patients from 230 institutions were included. 501 non-gynecologic cytology cases from the same time period were also reviewed (data to be presented at the American Society of Cytopathology Annual Meeting). Clinical information was collected via chart review. All cases with apparent major discrepancy underwent detailed chart review and select slides were re-reviewed for classification as major discrepancy with or without management change (e.g. surgery, chemotherapy).

Results: Male: Female ratio was 1.1:1 and mean age 60.7 yrs (range 11.7-98.0 yrs). Cases were divided amongst 11 subspecialty services (Figure 1). Among 2656 patients, 2497 (94%) had no major discordance, 135 (5.1%) had major discordance with no change in management and 24 (0.9%) had major discordance with change in management. Highest rates of discordance were observed for patients with endocrine (11.5%), bone/soft tissue (10.8%), genitourinary (8.1%), gynecologic (7.6%) heme (6.6%), gastrointestinal/liver (4.8%) and thoracic (4.7%) pathology, with distribution by case shown in (Figure 2). Discordance was associated with multiple pathologist review, with 40 (28%) and 11 (45.8%) undergoing review by at least one additional pathologist when there was significant discordance without and with management change, respectively (as compared to 397 (11.1%) of cases without significant discordance). Amongst discordant cases, management change was most frequent in head/neck (1.4%) and dermatologic, breast and gynecologic (each 1%) cases.

Figure 1 - 1998

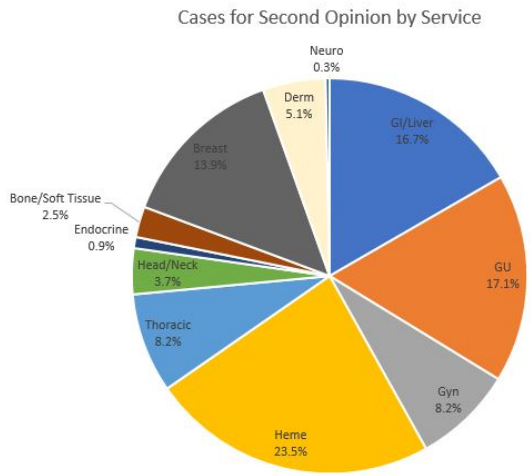
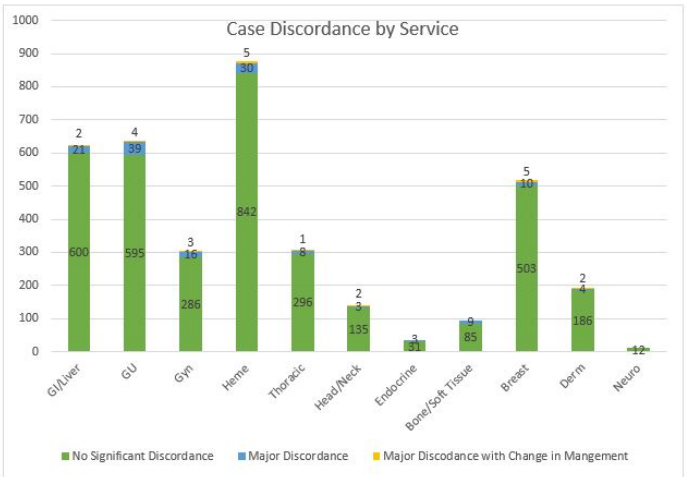


Figure 2 - 1998



Conclusions: The majority of second opinion diagnoses are concordant with outside diagnoses. However, there was a fraction of cases with discordant results that led to drastic change in management, with distribution over multiple subspecialties, highlighting the importance of pathology re-review.

1999 Color Blindness Survey in Anatomic Pathology

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Disclosures: Thomas Flotte: None; Charlene Brown: None; Lynn Cornell: None

Background: Pathologists use stains to enhance contrast in microscopic sections. The contrast enhancement is generally a function of color and intensity. However, approximately 8% of men and 1% of women are color blind. The National Eye Institute categorizes color

blindness into 3 broad categories, red-green, yellow-blue, and complete color blindness. There is very limited data regarding the adaptations of practicing pathologists to color blindness. The purpose of this project was to better understand the circumstances in which color blindness requires a different approach and the adaptations utilized.

Design: An anonymous online survey was developed in REDCap (Vanderbilt University) of practicing pathologists who are color blind regarding their experiences with stains. Four societies agreed to send invitations that include a link to an online survey to their members, ASDP, American Society of Dermatopathology, Renal Pathology Society, Arthur Purdy Stout Society, and ASCP.

Results: There were 339 respondents with 54% of those who identified as women. 23 people identified themselves as color blind with 21 as red-green color blind and two as uncertain type. There were no examples of blue-yellow or complete color blindness. All of the color blind respondents were male. 8 of the pathologists indicated that they thought their color blindness conferred advantages to them. The most common advantage was a greater appreciation of morphology with less confusion by variations in stain quality or intensity. 19 pathologists thought that their color blindness conferred disadvantages. The most common were the identification of eosinophils and acid fast bacilli. Other structural elements that caused difficulties included red blood cells and nucleoli. The other stains that caused occasional difficulties were alcian blue, Brown and Brenn, congo red, crystal violet, Fite, Giemsa, mucicarmine, PAS, and FISH. Only 2 of the pathologists found digital slides more difficult than glass slides. One of those pathologists alters the substage condenser to increase contrast.

Conclusions: Although this survey was not designed to determine prevalence, the frequency of color blindness approximated that of the general population, suggesting that color blindness does not affect career choice. There is no evidence to suggest that color blindness has any effect on the interpretation of slides. Digital pathology may provide several approaches for aiding color blind pathologists with the interpretation of certain stains.

2000 Rates and Causes of Frozen Section Discordance in Radical Cystectomy/Cystoprostatectomy at a Tertiary Care Center

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Disclosures: Andrew Fong: None; Manju Aron: None; Shivani Kandukuri: None

Background: Intraoperative frozen section (Fs) consultations drive clinical decision making during surgery. Radical cystectomy/cystoprostatectomy (CC) for urothelial carcinoma utilizes Fs to evaluate ureter and urethral margins. In this study, we examine the incidence and causes of discordance between frozen section and final diagnosis in CC cases.

Design: Fs and final diagnosis discordance records which are maintained as a part of our departmental quality management were retrospectively reviewed. The CC cases on which Fs were performed over an 11 month period were identified and examined for discordance. Discordance was identified when Fs diagnosis did not match the final diagnosis. The discordant cases were recorded for ureter and urethral Fs and reviewed to identify the type of error which resulted in the discordance. Errors were classified as interpretational or histologic sampling. It was also determined if the pathologist reviewing the Fs had genitourinary (GU) expertise or not.

Results: Over the study period Fs done on CC cases (n=128) were reviewed. There were 276 Fs of ureter and 110 were Fs of urethra. The concordance for ureters and urethra Fs were 96% (n=269) and 97% (n=106), respectively. The discordance rate for all Fs is 3% (n=11). Of these cases 3% (n=7) ureter Fs and 4% (n=4) urethral Fs were discordant (see Figure 1).Of the discordant ureter Fs 5 were classified as interpretation errors and 2 were classified as sampling errors. Of the discordant urethral Fs 3 were classified as interpretation errors and 1 was classified as sampling errors (see Figure 2). Interpretation errors represented 73% (n=8) of discordant cases while sampling errors only represented 27% (n=3). All of the discordant cases were signed out by a general pathologist.

Table 1: Detailed list of frozen section errors.

SPECIMEN	FROZEN SECTION DIAGNOSIS	FINAL DIAGNOSIS	ERROR
Ureter	Atypia present, favor reactive/inflammation	Focal invasive urothelial carcinoma; not present on frozen section, **identified only on permanent sections**	Sampling
Ureter	Atypia present, favor reactive	Focal invasive urothelial carcinoma	Interpretation
Ureter	No carcinoma seen	Focal high grade urothelial dysplasia/urothelial carcinoma in situ; not present on frozen section, **identified only on permanent sections**	Sampling
Ureter	Atypia, favor reactive	Urothelial carcinoma in situ	Interpretation
Ureter	Carcinoma in situ	Segment of benign ureter	Interpretation
Ureter	Carcinoma in situ	Segment of benign ureter	Interpretation
Ureter	Favor Carcinoma in situ	Benign ureter	Interpretation
Urethra	Atypical cells present, mild suspicion, not definitive carcinoma in situ	Urothelial carcinoma in situ	Interpretation
Urethra	Focally suspicious atypia	Focal invasive carcinoma	Interpretation
Urethra	No carcinoma or urothelium seen	Minute focus of carcinoma; not present on frozen section, **identified only on permanent sections**	Sampling
Urethra	Carcinoma in situ	Negative for carcinoma	Interpretation

Figure 1 – 2000

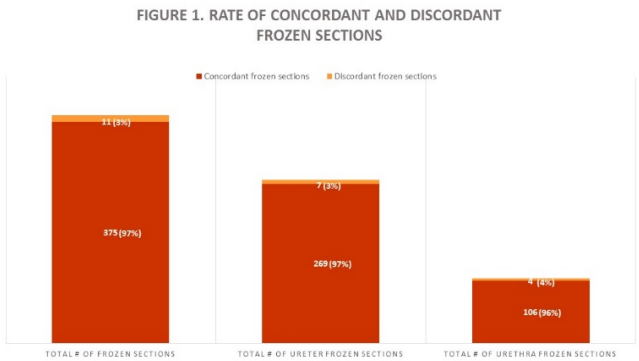
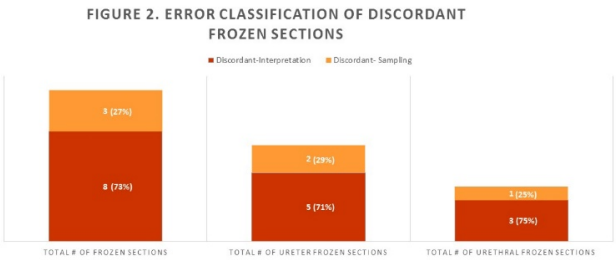


Figure 2 - 2000



Conclusions: In conclusion: 1. Invasive carcinoma (n=4) and carcinoma in-situ (CIS) (n=2) were most associated with discordant Fs. 2. Denuded ureter Fs was also associated with subsequent upgrading to CIS (9%, n=1). 3. Equal number of cases (n=4) were over-called and under-called. 4. Having a GU pathologist sign out or encouraging intraoperative consultation with one may considerably lower the rate of interpretation errors; for those who have no access to GU expertise maybe access to online or hands-on training is an option that can be offered. 5. Sampling errors were mainly due to inadequate sectioning into the tissue. Taking additional/ deeper sections may increase concordance rate. Evaluating more cases will provide more events and reveal targetable trends.

2001 Lessons Learned from Amendments in Implementation of New Laboratory Information System in Cytopathology

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Disclosures: Matthew Gabrielson: None; Jessica Kahler: None; Erika Rodriguez: None

Background: Epic Beaker is a new and evolving laboratory information system offered by Epic Systems Corporation and distributed with its electronic medical record system, EpicCare. This retrospective study evaluates the implementation of Epic Beaker at a large academic medical center, with a focus on the frequency of and reason for case amendments as a quality assurance measurement for cytopathology cases.

Design: We analyzed cytopathology cases for which an amendment was added between our go-live date in February 2019 until June 2019. Post go-live adjustments and optimizations were identified following cases for which an amendment was added due to an issue related to the implementation of Epic Beaker.

Results: A total of 6,571 cases were signed out during the study period, with thirty-one (31) amendments made to cases. The majority of amended cases during this period were in February (17 amended cases), with 3-7 amendments per month between the months of March-May, and 0 amendments in June. The majority of issues that were encountered during the early phase of implementation resulting in an amendment were due to difficulties in adjusting to a new laboratory information system. However, one of the first and most critical errors was a functionality issue which prevented final verification by staff pathologists, and required final verification by the cytopathology supervisor. Among the most common errors resulting in an amendment include case release without an interpretation, diagnoses added to an incorrect field, and amendments initiated in error. The measurements for improvement included education and the addition of a system hold if the pathologist attempted to release the case without a diagnosis on the proper field. Those measurements resulted in 0 amendments for the month of June. Despite these difficulties, the implementation has been successful based on the downtrend of amendments issued from the start of go-live until the end of our study period. The optimization of Epic Beaker workflow at our institution continues to be an ongoing process.

Conclusions: The EPIC Beaker laboratory information system was successfully implemented at our institution. Post-implementation measures put in place contributed to a decrease in the number of amendments issued. Implementation and continued quality improvement required adjustment, adaptation, and education of all laboratory and pathology staff.

2002 The Hunt for Lymph Nodes: Is Total Submission of Standard and Extended-Template Pelvic Lymph Node Dissections Necessary for Detecting Metastatic Prostate Cancer?

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Disclosures: Mohamad Gafeer: None; Martina Risech: None; Ioannis Ioannidis: None; Aileen Grace Arriola: None

Background: Both CAP and ISUP do not have any guidelines on submission of pelvic lymph node dissection (PLND) specimens. According to an ISUP consensus paper, <1/3 of participants entirely sample PLND. Our institution follows this practice for both standard (ST) and extended (EXT)-template PLND. In this study, we aim to analyze the utility of this practice and whether lymph node (LN) yields vary between ST and EXT-template PLND.

Design: Cases of RP with PLND during the period of 1/1/12-6/28/19 were reviewed. Pathology reports and slides (when available) were reviewed and information on LN status, number of cassettes submitted for palpable LN and remaining fat, number of grossly identifiable LN, and RP features such as Gleason score (GS), extraprostatic extension (EPE), margin status, tumor volume (TV), and seminal vesicle invasion (SVI) were recorded. Differences between categorical values were assessed by Fisher exact test and continuous values by student T-test.

Results: There were 734 cases in the study (227/732, 31% EXT PLND and 505/732, 69% ST PLND). EXT PLND yielded significantly higher mean number of total and +LN, compared to ST PLND. However, EXT PLND specimens required significantly more tissue blocks for palpable LN and remaining fat as compared to ST PLND, even as high as 44 additional blocks (Table 1). The added value of submitting the remaining fat after dissection of all palpable LN meant identifying an average of 5.7 more LN (5.5 SD, range 0-34). There were 77 +PLND specimens (22 ST, 54 EXT, and 1 unknown) and slides were reviewed for 57 of these cases. Most of the +LN were palpable (83%, 74/89). Of the nonpalpable +LN, 3 of 15 (20%) would have been missed if all of the remaining fat was not entirely submitted. These 3 LNs were present in the 1st, 2nd, and 8th blocks of the remaining fat and measured 1.6 cm, 0.2 cm, and 0.2 cm, respectively. Finally, the mean size of palpable +LN vs. nonpalpable +LN was significantly higher (0.99 cm vs. 0.33 cm, p-value=0.000092).

Table 1. Lymph node yield and cassettes submitted for extended vs. standard pelvic lymph node dissection (PLND) specimens.

Parameter	Extended PLND (N=227) Mean, SD, and range	Standard PLND (N=505) Mean, SD, and range	p-value
Total # of LN	19 (9.5 SD) (range 1-55)	12 (7.5 SD) (range 2-68)	<0.00001
# of +LN	0.6 (1.8 SD) (range 0-17)	0.06 (0.3 SD) (range 0-3)	<0.00001
Total # cassettes submitted	20 (10 SD)	12 (7 SD)	<0.00001

	(range 2-58)	(range 2-34)	
# of cassettes submitted for "remaining fat"	8 (6 SD) (range 0-44)	5 (4 SD) (range 0-25)	<0.00001
Total # palpable lymph nodes	12 (7 SD) (range 1-38)	7 (7 SD) (range 1-30)	<0.00001
Additional LN due to submission of "remaining fat"	6.9 (6.1 SD) (range 0-33)	5.2 (5.1 SD) (range 0-34)	0.00026

Conclusions: Even though entire sampling of EXT PLND increases the yield of lymph nodes, it requires more tissue sections and increases the financial implications for the laboratory per case. Since according to our experience in most cases the identification of additional number of lymph nodes had minimal or no effect on patient management or outcome, we question the use of excessive resources in attempting to reach this relatively arbitrary target. Further studies to assess relationship of EXT PLND to outcomes are needed.

2003 Blood Center Platelet Utilization After Initiation of Verax Pan Genera Detection Testing: An Evaluation of Platelet Availability, Patient Safety, and Economic Considerations

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Disclosures: Sarah Glogowski: None

Background: Functional platelets are integral for coagulation and therefore platelet administration may be required during patient management. Platelet product regulations mandate that single donor apheresis platelets (SDP) must be transfused within 5 days after donor acquisition due to the increased risk of bacterial growth and subsequent possibility of transfusion reaction. This short time frame frequently results in unused products being discarded. Even after pre-storage culture testing was initiated, platelet products continue to be a significant source of transfusion reactions. Pre-administration testing of platelet products with Verax Pan Genera Detection (PGD) has been utilized to provide a greater patient safety margin and can extend the expiration from 5 to 7 days.

Design: 1771 SDP units nearing day 5 expiration were screened by PGD. A negative result allowed the SDP to be used within an additional 24 hours from the time the result was read. A positive result was tested in duplicate. Two additional negatives were read as a false positive (FP), one positive and one negative as indeterminate, and two positive as a true positive (TP).

Results: Six of 1771 SDPs tested positive on initial PGD screen (0.3%). Five SDPs indicated the presence of gram positive organisms while 1 indicated gram negative organisms. After repeat testing, 5 of the SDPs were determined to be FP while 1 was a TP. The TP SDP was then cultured and grew Staphylococcus epidermidis. 96 units expired before there was a need for transfusion. No transfusion reactions were reported after administration of the 1675 SDPs.

Conclusions: SDP acquisition difficulties often occur secondary to low donor turnout from weekends, holidays, and inclement weather. 1675 of the 1771 platelet samples that would have otherwise been discarded due to outdating, tested negative for bacterial organisms and were successfully transfused into patients without any adverse reaction. Previous studies have reported day 6-7 platelets are not inferior to day 2-5 platelets when evaluating patient response to treatment. Initial costs for implementing PGD is estimated at $4500. Individual PGD testing costs approximately $20 per unit. A SDP unit sells for approximately $550. Over the 8-month period, utilization of extended life platelets allowed the blood center to net just under $900,000 after the costs of testing were deducted. This suggests extended life PGD confirmed SDPs are safe and effective for patient use as well as an economical means for blood banks.

2004 Optimizing Test Order Practices for Cytomegalovirus Immunohistochemistry in Gastrointestinal Biopsy Specimens

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Disclosures: Geetika Goyal: None; Tatyana Zinger: None; Dana Warfield: None; Wenqing Cao: None

Background: Cytomegalovirus (CMV) infection of gastrointestinal organs (GI) is the most common manifestation of tissue-invasive disease, especially in immunocompromised individuals. It is often seen in patients with IBD, post transplantation, HIV and cancer. The histopathologic diagnosis of CMV infection relies on histologic evaluation of viral inclusions and immunohistochemistry (IHC) confirmation. To avoid missing CMV infection in patients, numerous CMV IHC test requests are submitted by physicians or pathologists each year.

However, more than 90% percent of cases are reported negative. The high volume of test requests not only negatively impact the efficiency of CMV test resource, but also increase the cost burden for hospital and patients. We analyzed the CMV IHC test data and related clinical information in order to improve the practices by eliminating the unnecessary use of resources.

Design: CMV IHC test orders from 2017 to 2018 were retrieved from surgical pathology computerized database to find CMV IHC results, physician or pathologist requests, tissue inflammatory status, blocks tested, and other related clinical information. After excluding the cases from non-gastrointestinal sources, cytology, autopsy and resection specimens, 1025 individual orders of CMV IHC on GI biopsy specimens were included. Analysis was performed to find out the significant factors contributory to positive test results.

Results: The overall CMV IHC positive rate is 4.1% (43/1025) in our institution. The positive rate from physician request and pathologist order was not significantly different (5.5% vs 3.7%).Cases with multiple tissue blocks generated a higher positive rate as compared to single block (6.8% vs 2.6%, p=0.0019).Cases with severe inflammation showed significant higher positive CMV staining than that with moderate or less inflammation (5.3% vs 2%).CMV positivity in biopsies from post-transplant patients, IBD, cancer or others was 13.6%, 3.5%, 4.4% or 3.9%, respectively. Positive rate in post-transplantation patients was higher than other populations.

Conclusions: Significant number of negative CMV stains could be cut down through optimizing the test orders. While ordering CMV IHC on GI biopsy specimens, clinical history and severity of tissue inflammation should be considered. For high risk cases such as post transplantation, multiple blocks may need to be submitted. IBD patients did not have higher CMV positive rate than other patient population, perhaps due to recently improving therapeutic approach.

2005 Intraoperative Frozen Section Diagnosis of Schwannoma can be Challenging, Particularly in Visceral Sites

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Disclosures: Cynthia Harris: None; Ivan Chebib: None; Vikram Deshpande: *Grant or Research Support*, Advanced Cell Diagnostics; *Advisory Board Member*, Viela; *Grant or Research Support*, Agios Pharmaceuticals; Mari Mino-Kenudson: None; G. Pétur Nielsen: None; Yin Hung: None

Background: While histologic diagnosis of schwannomas is typically straightforward, their intraoperative diagnosis can be challenging. The presence of degenerative changes, coupled with unusual locations, may lead to frozen section misdiagnoses and alter management. This study aimed to assess the intraoperative diagnostic accuracy of schwannomas across multiple sites, with considerations of pitfalls and differential diagnoses.

Design: In our institutional archive from 1/2011 to 8/2019, we identified all specimens diagnosed as schwannomas on frozen sections (FS) and/or permanents. We examined cases with discordant frozen section diagnosis (FSD) and permanent diagnosis (PD), recorded clinicopathologic features, and determined rates of deferral or error. Comparisons across sites were performed using chi-squared tests, with statistical significance defined as $p<0.05$.

Results: Of 1009 schwannomas from 917 patients (51% women; age: 8-90 [median 52] years), 775 (77%) were submitted for frozen section. 720 (93%) were strongly favored/diagnosed as schwannomas, 37 (5%) were deferred, and 18 (2%) were strongly favored/diagnosed as other tumors, including sarcoma/metastatic carcinoma ($n=5$), meningioma ($n=4$), ependymoma ($n=3$), leiomyoma/angioleiomyoma ($n=3$), and solitary fibrous tumor ($n=3$). While the overall rates of deferral and error were 5% and 2%, respectively, both varied by locations: Schwannomas in central/peripheral nervous system and somatic soft tissue collectively comprised 93% of cases, with deferral and error rates of 3.9% and 1.1%, respectively. However, schwannomas in visceral sites (mediastinum, abdominopelvic cavity, and retroperitoneum) and head/neck showed higher rates of deferral (17%; $p<0.0001$) and error (19%; $p<0.0001$). In these cases, classical features of schwannomas such as hyalinized vessels, verocay bodies, and lymphoid aggregates were subtle-to-absent. While severe cytologic atypia could occasionally be seen, no definitive mitoses or necrosis were identified. Furthermore, during the study period, 13 soft tissue tumors (6 solitary fibrous tumors; 3 malignant peripheral nerve sheath tumors; 1 each low-grade fibromyxoid sarcoma, unclassified spindle-cell sarcoma, inflammatory myofibroblastic tumor, and synovial sarcoma) were strongly favored/misdiagnosed in frozen sections as schwannomas.

Conclusions: Intraoperative frozen section diagnosis of schwannoma can be challenging, particularly those in visceral sites, with higher rates of deferral and error.

2006 Comparison of Intraoperative Consultation Performance between Surgical Pathology and Cytopathology Fellows and First-Year Attendings

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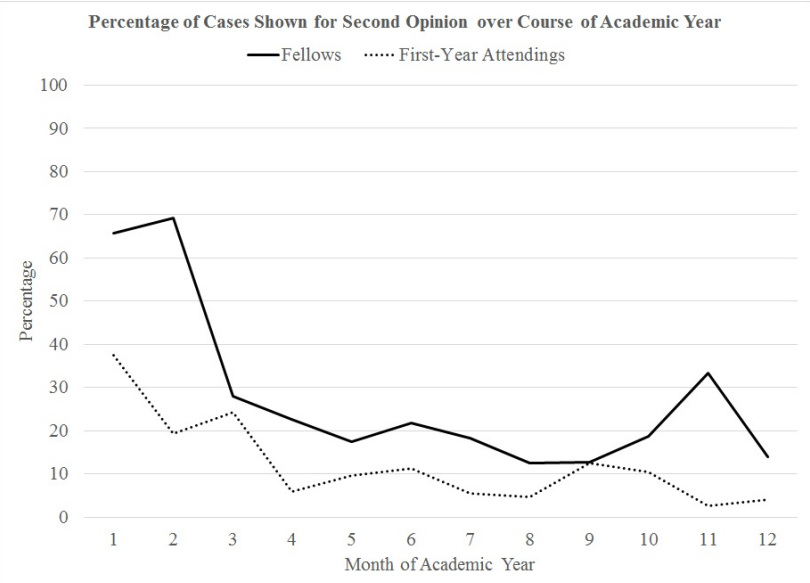
Disclosures: Bryce Hatfield: None; Valentina Robila: None; Sadia Sayeed: None; Raghavendra Pillappa: None; Woon Chow: None

Background: Intraoperative consultation (IOC) aids in guiding immediate surgical management. At our institution, surgical pathology and cytopathology fellows, following a certification period of up to two months, are in the rotation along with attendings for daily IOC coverage and are expected to render IOC interpretations independently. In this study, we retrospectively analyzed and compared the IOC performance of our recent fellows and first-year attendings so as to establish a benchmark for fellow competency and provide a reference for internal quality assurance.

Design: Data from IOC cases at our institution spanning four academic years from 2015 to 2019 were reviewed. We tallied one-year figures for each fellow (n = 12) and first-year attending (n = 4), including the number of IOC cases performed per month, number of cases shown for second opinion, turnaround time (TAT) from accession to callback, and percentage corroboration of IOC diagnosis with final diagnosis. Student's t-tests are performed on each set of data.

Results: There is no statistically significant difference between the fellow and attending groups for the number of IOC cases performed per month (fellows mean = 14.5 cases, attendings mean = 12.1 cases, p = .58) and overall percent corroboration of IOC diagnosis (fellows mean = 97.2% corroborated, attendings mean = 98.3% corroborated, p = .26). Neither of these two sets of data varied appreciably from month to month. Overall TAT is lower for the attending group (fellows mean = 14.7 min, attendings mean = 12.6 min, p < .05). For both groups, the number of cases shown for second opinion exhibits a downward trend over the course of the academic year (see Figure). Moreover, first-year attendings consistently show fewer cases than fellows (fellows mean = 22.1% shown, attendings mean = 11.8% shown, p < .05).

Figure 1 - 2006



Conclusions: Our findings demonstrate that with graduated responsibility during fellowship training at our institution, trainees gain confidence with IOC interpretation with time, similar to new attendings. More importantly, IOC diagnostic accuracy of fellows is comparable to that of the first-year attendings.

2007 Histopathologic Processing and Examination of Extranodal Extension in Head and Neck Squamous Cell Carcinoma

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Disclosures: Keenan Hogan: None; Kayla Hoskins: None; Ahmed Noorsaeed: None; Stephanie Wood: None

Background: Extranodal extension (ENE) in metastatic head and neck squamous cell carcinoma (HNSCC) has prognostic significance and helps guide adjuvant chemoradiation. While all grossly negative lymph nodes (LNs) are submitted entirely, there is no consensus on how many sections to submit of large grossly positive lymph nodes (GPLNs). Most practices submit representative sections of GPLNs and rely on gross evaluation or random sampling to identify ENE. Some literature recommends submitting one section per centimeter of GPLNs, but supportive evidence has been lacking. To date, no studies have assessed the diagnostic accuracy of macroscopic examination

to identify ENE in GPLNs, and there is concern that representative sections may be insufficient to identify ENE in these GPLNs, thus missing an important factor that could change adjuvant treatment decisions.

Design: The grossing protocol for GPLNs was changed at our institution in October 2018 to include gross evaluation of possible ENE and submission of the entire capsule of all GPLNs. A retrospective review was completed of available GPLNs from cases of metastatic HNSCC between October 2018 and July 2019. Independent slide reviews were performed by KH and SW with subsequent consensus discussion on all GPLNs with notation of the presence of microscopic ENE.

Results: An institutional database search returned 39 GPLNs which had submission of the entire capsule. Possible ENE was grossly identified in 21 GPLNs with microscopic confirmation in 14. Among the 18 GPLNs without grossly-identified ENE, microscopic examination identified ENE in 10. The specificity and sensitivity for gross identification of ENE is 53% (95% CI: 27-79%) and 58% (95% CI: 37-78%), respectively. There was no significant difference in gross detection rate for ENE based on metastasis size or distance of ENE ($p = 0.39$ and 0.78, respectively). Interestingly, ENE was present in 85% of blocks submitted when ENE was grossly absent, and 51% when ENE was grossly present. Preoperative neck imaging was performed in all cases and identified suspicion for ENE in 2 of 21 cases with GPLNs, both of which were microscopically confirmed as ENE.

Conclusions: The results of this study demonstrate low sensitivity and specificity of macroscopic examination for ENE in GPLNs, and low sensitivity of radiographic evaluation for ENE. Given the clinical importance of ENE identification, complete capsule submission of GPLNs is a reasonable practice.

2008 Improvement of Critical Action Value Delivery at a Tertiary Care Center

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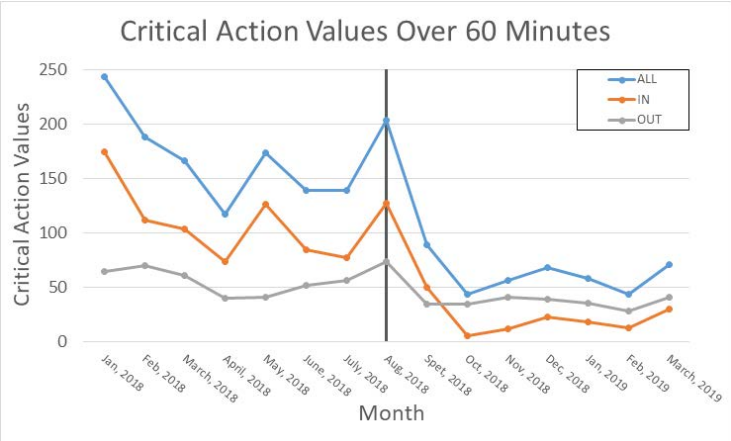
Disclosures: Mark Hopkins: None; Monica Hill: None; Kevin Martin: None; Lona Small: None; Lori Sokoll: None

Background: Prompt notification of abnormal laboratory values to providers is critical to effective care. At our institution, all values meeting predetermined criteria are delivered to providers via telephone by a team of customer service representatives (CSR). All attempts to contact providers are logged in the laboratory information software (LIS). If no provider is reached after 60 minutes, a clinical pathology resident is notified to assist in identifying an appropriate provider. Approximately 5200 such calls are processed per month in our Core Laboratory. To improve the delivery of these critical action values (CAVs), a quality improvement project was initiated to determine the obstacles to prompt notification and to identify possible interventions to improve this process.

Design: Pre-intervention and post-intervention CAV call logs were downloaded from the SoftLab LIS and analyzed using Microsoft Excel. Data were subsequently abstracted, including delivery time, patient location, test name, and call time. All CAVs with delivery times greater than 60 minutes were reviewed by two authors (MRH and MRH) for one representative month in both the pre-intervention (July 2018) and post-intervention (March 2019) period. Significance of average pre- and post-intervention rates of delayed CAV delivery was calculated using the t-test. Interventions included modifying the color-coded time-dependent triggers in the LIS interface call list to help CSRs better triage values, introduction of techniques to more easily identify the provider responsible for each patient, and reorientation of CSRs to hospital policies related to CAV callback.

Results: The number of CAVs with delivery times over 60 minutes over a fifteen month period is shown in the figure. The vertical bar denotes the initiation of our interventions. The average number of values not delivered within 60 minutes decreased by 64% across all locations following the interventions ($p<0.0001$). The decrease was most dramatic for values originating from inpatient locations at 81% ($p<0.0001$), though outpatient values also saw a marked decrease at 37% ($p<0.0001$). Time to delivery was also decreased by 18% for inpatient locations (15.8 minutes to 13.0 minutes, $p<0.0001$), but was not significantly decreased for outpatient locations (24.8 minutes to 24.7 minutes, $p=0.90$).

Figure 1 - 2008



Conclusions: Low complexity interventions to CAV callback protocol can significantly increase the efficacy communication between the lab and providers.

2009 Are Serial Sections on a Slide of Significant Use in Pathologic Evaluation of Biopsies?

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Disclosures: Niloufar Hosseini: None; Kiran Jakate: None; Shaheed Hakim: None; Adriana Krizova: None; Shawn Winer: None; Hala Faragalla: None; Rola Saleeb: None; Lananh Nguyen: None; Eleanor Latta: None; Corwyn Rowsell: None; Janice Lage: None; Catherine Streutker: None

Background: Despite variations in handling small biopsies in different pathology laboratories, many institutions cut 2-3 slides at deeper levels(50µm intervals) on each block with a ribbon of 2-3 serial sections(5µm intervals) of each level placed on one slide. Although the rate of new diagnostic findings identified on deeper levels in small biopsied was reported as 10-36.9%, there is no literature available about this rate when multiple serial sections of one level are examined. Yet the presence of multiple tissue sections has legal implications with respect to whether the whole slide has been examined. Thus, we aimed to identify the utility of evaluating serial sections of one level in small biopsies.

Design: A total of 357 small biopsies were assessed prospectively by six pathologists. The biopsies were from the following sites: gastrointestinal (50 esophageal, 28 gastroesophageal junction, 54 gastric, 39 small intestinal, 87 colorectal, 2 anal, 2 liver, 2 bile duct); gynecological (15 cervix,17 endometrium, 6 vulva,1 fallopian tube); genitourinary (20 prostate,1 bladder); breast (16); head and neck (6 nasal,6 larynx,1 maxillary sinus,1 lip), and 3 lymph nodes. The Pathologists were asked to determine if examining the next sequential section was useful in each case. In case of positive answer, they were asked to provide the reason for usefulness.

Results: Examining the next sequential section was not useful in 353/357(98.8%) of the cases. Among the 4 cases where evaluation of the next serial section was reported as useful, all were from gastrointestinal tract (1 esophageal, 2 gastric and 1 bile duct). Only in one of the biopsies (esophageal) there was a new diagnostic finding (subsequent section showed intestinal metaplasia which was not found in the previous section). In the remaining three cases, the next serial section was preferred due to the absence of the artifacts.

Conclusions: Assessment of the next serial section led to change in diagnosis in only 1/357(0.3%) of our cases. Therefore, diagnostic information was identical in serial sections on one slide in 99.7% of the cases. This study provides a quantitative measure for utility of the serial sections of one level in assessment of the small biopsies for the first time. While these serial sections can be useful for technical issues with the slide, considering the time spent on preparation and examination of the serial sections, surgical pathology laboratories could minimize the number of serial sections put on one slide in small biopsies.

2010 Uncertainty Reporting in Pathology Reports – Is There a Need for Standardization?

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Disclosures: Martin Hyrcza: None; Paige Demofsky: None; Jerusha Selvanayagam: None

Background: Communication of uncertainty of pathological diagnosis can significantly impact the interpretation of pathology reports and therefore affect patient care. Despite this, the topic has not been studied extensively to-date. We have undertaken a survey of pathologists' attitudes to reporting uncertainty in their reports.

Design: Pathologists at two academic Canadian tertiary cancer treatment centers were asked to complete an anonymous, web-based, nine question survey. The questions asked if diagnostic uncertainty should be reported and how, the reasons for reporting uncertainty, how it was conveyed, which phrases were used, if the pathologists were confident the physicians understood the implied uncertainty, and if there should be a standardized system of reporting diagnostic uncertainty.

Results: Fifty-three responses were received from the 178 pathologists contacted (response rate of 30%). All respondents think diagnostic uncertainty should be reported and all personally report it (53/53). Most responders (46/53, 87%) think this should be accomplished using specific phrases within the diagnostic lines of the report, but minority would also use a free text comment or a separate line in the main diagnostic report. The most common phrases used to convey uncertainty are "cannot exclude" (used by 49/53 (92%) of responders), "suspicious for" (48/53, 91%), "suggestive of" (47/53, 89%), and "favour(s)" (47/53, 89%); however, at least 15 different phrases are used in the surveyed group. Most responders report the degree of uncertainty in order to guide patient care (50/53, 94%) and / or to recommend a repeat sampling (47/53, 89%), with a minority (22/53, 41%) also trying to minimize any potential legal liability. Almost all of pathologists in our survey (51/53, 96%) also use comments to explain the reasons for the uncertainty of the diagnosis and to suggest the appropriate clinical action (42/53, 79%). The majority of pathologists (38/53, 72%) are generally confident the clinicians understand the uncertainty implied in their reports. Nevertheless, 47% of respondents (25/53) believe there should be a standardized system of reporting diagnostic uncertainty.

Conclusions: While the pathologists agree there is a need to report the level of diagnostic uncertainty, they vary in the methods employed to do so. Most pathologists believe their methods are effective in conveying the level of uncertainty of their report but nearly half agree a standardized system of reporting uncertainty should be instituted.

2011 Barrett Esophagus: A Ten Year Experience at a Single Institution

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Disclosures: Sarah Jamshed: None; Jacob Bledsoe: None; Michelle Yang: None; Xiaofei Wang: None

Background: The intra- and interobserver variability in the diagnosis of dysplasia arising from Barrett Esophagus (BE) is well documented, as is the challenge of interpreting atypical from regenerative epithelium, invasion beyond lamina propria, basal crypt dysplasia, unconventional forms of dysplasia e.g. serrated/foveolar types, and the lack of a supportive biomarker. Our department shifted from a general sign-out workflow to a subspecialized model in October 2017. This study aimed to retrospectively review the diagnostic prevalence of dysplasia and adenocarcinoma arising from BE and assess the impact of subspecialization. This was intended as a tool to improve the GI pathology service, and as a measure of departmental quality assurance (QA). To our knowledge, it is the first such study to be reported in the literature.

Design: The diagnostic lines "Barrett('s) esophagus" and "intestinal metaplasia" were searched within our institution's electronic medical records between June 2009 - September 2019, yielding 6007 cases. Phrases including "low(-)grade dysplasia" (LGD), "high(-)grade dysplasia" (HGD), "indefinite for dysplasia" (IND), "adenocarcinoma" and "carcinoma" (EAC) were searched within this cohort. Outside hospital consults were included. Specimens other than gastroesophageal junction biopsies i.e. oncologic resections and endoscopic mucosal resections were excluded. Post-2017 cases were signed out by subspecialty GI-trained pathologists, so data pre- (Pre) and post-subspecialization in 2017 (Post) were compared using the two-tailed Fischer's exact test, with a p-value of <0.05 considered statistically significant.

Results: Among the 6007 cases, 66.1% were male, 33.9% were female and median age was 62 years (range: 22-95 years). LGD was called on 3.35% (n=146) of all BE biopsies Pre, and on 1.94% (n=32) Post (p=0.0036). HGD was reported 1.87% Pre, and 4.62% Post (p<0.0001). IND and EAC prevalence Pre and Post were 1.37% and 0.9% (p=0.1541), and 1.52% and 2.18% (p=0.0925). The overall diagnosis of dysplasia arising in BE Pre and Post was 7.02% and 7.83% (p=0.0765), respectively, and was not considered quite as statistically significant.

Conclusions: Our study validates the department's subspecialized sign-out structure. It is likely LGD was overdiagnosed and HGD undercalled before this. This highlights the value of specialty training and experience, and underscores the importance of a consensus diagnosis of dysplasia by 2 pathologists, one with expertise in GI/BE dysplasia.

2012 Inter-Rater Reliability (IRR) in a Consensus PD-L1 Immunohistochemistry (IHC) Service in an Academic Multi-Hospital Health System

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Disclosures: Pouya Jamshidi: None; Amandeep Kaur: None; Lin Liu: None; Megan Sullivan: None; William Watkin: None; Ajit Paintal: None

Background: While checkpoint inhibitors have revolutionized the practice of oncology, their use in many tumor types is predicated on the use of PD-L1 IHC as a predictive biomarker.

We have developed a central consensus-based PD-L1 IHC service at our hospital system consisting of 4 dedicated pathologists. All PD-L1 IHC studies are reviewed by between 2 and 4 pathologists in a blinded fashion. As such we have collected scoring data from multiple observers for all PD-L1 IHC performed at our institution.

Our goal was to review the IRR of PD-L1 IHC in regards to different scoring systems, cutpoints, tumor types, and specimen types.

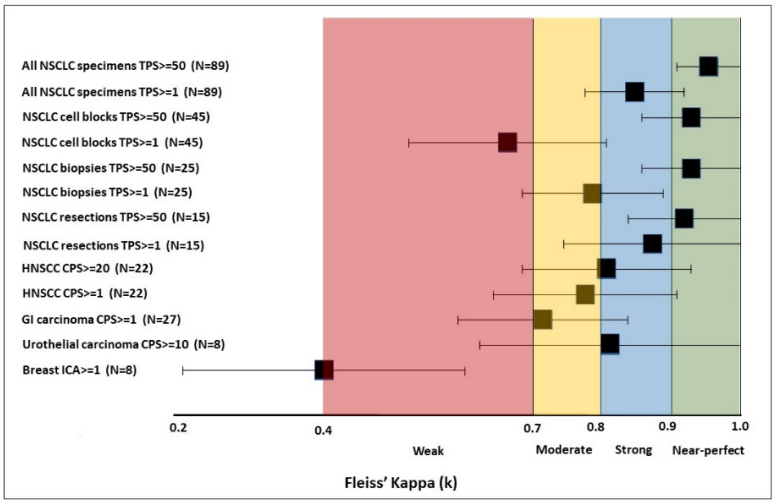
Design: We compiled scoring for all PD-L1 IHC performed at our institution in 2019. All PD-L1 IHC employed the SP263 antibody clone. Unanimous agreement (UA) was calculated based on the percentage of cases in which all observers' scores agreed in regards to the clinically relevant cutpoints (Non small cell lung carcinoma (NSCLC): TPS>=1,50; GI carcinoma: CPS>=1; Head/neck squamous cell carcinoma (HNSCC): CPS>=1,20; Urothelial CA: CPS>=10; Breast: ICA>1). IRR was calculated using Fleiss' kappa (k).

Results: 162 cases were identified with 2-4 raters (mode=3). All data is summarized in Table 1 and Figure 1. Excellent UA (99%) and strong to almost perfect IRR (k=.98 (.91-1)) was seen in NSCLC overall and in all specimen types (cell blocks (CB), core biopsies, and resections) at the TPS>=50 cutpoint. At the TPS>=1 cutpoint, UA for NSCLC cases was 89% and IRR was moderate to almost perfect overall (k=.85 (.78-.92)) and for biopsies and resections. IRR was found to be weak to moderate (k=.67 (.53-.80)) in CBs. For cases of HNSCC, UA was 86% at the CPS>=20 cutpoint and 95% at the CPS>=1 cutpoint. IRR was moderate to almost perfect at both cutpoints (k=.81 (.69-.93) and k=.78 (.65-.91) respectively). For GI carcinoma cases, UA was 89% at the CPS>=1 cutpoint and IRR was moderate to strong (k=.72(.6-.84)). UA at all cutpoints was similar for cases where CPS was scored (86%) and cases where TPS was scored (89%) (p=.59).

Tumor/specimen type		Cutpoint	Number of cases (n)	Cases with unanimous agreement	Fleiss' Kappa (k) (95% Confidence interval)
All NSCLC specimens		TPS>=50	89	99%	0.98 (.91-1)
All NSCLC specimens		TPS>=1	89	89%	0.85 (.78-.92)
NSCLC cell blocks		TPS>=50	45	100%	1 (.86-1)
NSCLC cell blocks		TPS>=1	45	80%	0.67 (.53-.80)
NSCLC biopsies		TPS>=50	25	98%	0.96 (.86-1)
NSCLC biopsies		TPS>=1	25	89%	0.79 (.69-.89)
NSCLC resections		TPS>=50	15	100%	1 (.84-1)
NSCLC resections		TPS>=1	15	93%	0.9 (.75-1)
HNSCC		CPS>=20	22	86%	0.81 (.69-.93)
HNSCC		CPS>=1	22	95%	0.78 (.65-.91)
GI Carcinoma		CPS>=1	27	89%	0.72 (.6-.84)
Urothelial Carcinoma		CPS>=10	8	87%	0.85 (.63-1)

Breast		ICA>=1	8	75%	0.4 (.21-.61)
All TPS		Variable	89	89%	
All CPS		Variable	57	86%	

Figure 1 - 2012



Conclusions: Scoring of PD-L1 IHC among a team of 4 pathologists demonstrated at least moderate agreement for most tumor types and amongst different specimen types in NSCLC cases. Scoring of all specimen types at the TPS>=50 cutpoint in NSCLC cases showed particularly strong IRR while IRR in CBs in NSCLC cases at the TPS>=1 cutpoint was particularly weak. UA amongst all cases where TPS and CPS were scored was similar.

2013 Team Approach to Frozen Section Diagnosis to Achieve Optimal Turn-Around-Times

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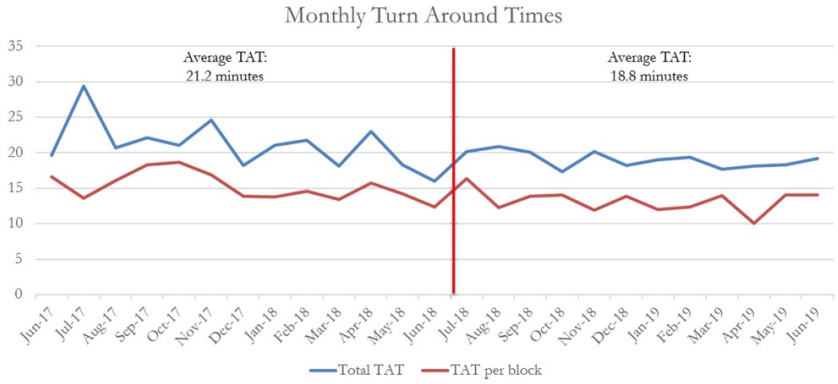
Disclosures: Clay Jarrell: None; Seunghyug Kwon: None; Nicholas Dietz: None

Background: Frozen section diagnosis can be a difficult procedure, both technically and diagnostically. A generally accepted turn-around-time is 20 minutes. However, the original investigation to determine optimal turn-around-time noted that when residents are involved, turn-around-times often increase, due to lack of familiarity with the procedure or with the specific specimen. Despite this, it is necessary to meet turn-around-times while residents train. We wanted to determine if a team approach of at least two residents per frozen section diagnosis could decrease turn-around-times.

Design: Turn-around-times for all frozen section procedures performed at the main teaching hospital were examined from July 2017 to June 2018 as baseline data. Additional data points collected included the number of people involved, the number of blocks cut, and the PGY level of those preparing the block(s). A team of at least two residents on the surgical pathology service were present for all frozen sections, if possible, from July 2018 to June 2019. Frozen sections with incomplete data, performed outside of normal business hours (0700 to 1800), or on weekends were excluded. Turn-around-times were analyzed as an average per month and by the number of blocks produced. The averages between the baseline and implementation period were compared.

Results: The average pre-implementation turn-around-time was 21.2 minutes. The average of single block specimens was 18.4 minutes and the average of multi-block specimens was 26.4 minutes. The average post-implementation turn-around-time was 18.8 minutes with an average for single block specimens of 15.7 minutes and for multi-block specimens of 24.0 minutes. The p-value for the change in overall average turn-around-times was <0.001. Additionally, the standard deviation also decreased from 8.2 minutes to 7.7 minutes. Figure 1 shows the average turn-around-times on a month by month basis.

Figure 1 - 2013



Conclusions: Having at least two residents present for the majority of frozen sections during the post-implementation period led to a statistically significant decrease in the average turn-around-time for frozen section diagnosis. Additionally, we believe that the over two-minute drop in turn-around-time can be clinically significant and have an impact on patient care. The change in standard deviation also indicates a smoother, more controlled procedure.

2014 Changes in Practice Paradigms Before and After Introduction of the Diagnosis "Non-Invasive Follicular Thyroid Neoplasm with Papillary-Like Nuclear Features" (NIFTP): An Institutional Experience

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Disclosures: Levon Katsakhyan: None; Sharon Song: None; Marcos Lepe: None; Hadi Shojaei: None; Kathleen Montone: None; Virginia LiVolsi: *Consultant*, VERACYTE, INC.; Zubair Baloch: None

Background: The recently adopted terminology of "Noninvasive follicular thyroid neoplasm with papillary-like nuclear features" reflects the indolent behavior of these tumors. In contrast to conventional papillary thyroid carcinomas, NIFTPs can be managed conservatively. The purpose of this study was to investigate changes in surgical and pathologic practice patterns at our institution since introduction of the NIFTP diagnosis in 2016.

Design: A retrospective computerized search was performed of the pathology database for all thyroid specimens received in our laboratory between 01/2015-4/2017. This study was approved by the institutional review board. The following data points were collected: demographics, type of surgery, specimen weight, the extent of gross submission of the index nodule and specimen (partial vs. entirely), and histologic diagnoses.

Results: The final cohort consisted of 1586 thyroidectomy specimens from 1531 patients (1164 women (76%; age range: 18-92 years) and 367 men (24%; age range: 17-92 years)). Cases were divided into "Pre-NIFTP" (n=852) vs. "Post-NIFTP" (n=734) depending on whether they were received before or after the first diagnosis of NIFTP was made at our institution. The size of the nodules ranged from 0.3-9.2cm for benign, 0.1-12.8cm for malignant and 0.8-7cm for cases that ended up being diagnosed as NIFTP. Following the use of the NIFTP diagnosis at our institution, the number of total thyroidectomies decreased (-4%), partial thyroidectomies increased (+3.9%) and completion lobectomies remained unchanged. A NIFTP diagnosis was made in 67 cases (9.1%, 67/734 cases). The number of cases diagnosed as follicular variant of papillary thyroid carcinoma (PTC-FV) in the pre and post-NIFTP era were 177 (20.8%) and 59 (8%), respectively. Smaller shifts in the number of follicular adenomas (FA) and classic variant of papillary thyroid cancer (PTC-CV) were noted. The frequencies of other diagnoses remained largely unchanged, as did the overall trends in specimen submission at the grossing bench for histopathology evaluation (see Results Table).

Surgical Procedure	Pre-NIFTP (n=852)	Post-NIFTP (n=734)
Total thyroidectomy	**65.7% (560)**	**61.7% (453)**
Specimen submission	72% entirely submitted	65% entirely submitted
	28% partially submitted	35% partially submitted
Partial thyroidectomy	**30.3% (258)**	**34.2% (251)**
Specimen submission	82% entirely submitted	79% entirely submitted

	18% partially submitted	21% partially submitted
Completion lobectomy	**4.0% (34)**	**4.1% (30)**
Specimen submission	94% entirely submitted	90% entirely submitted
	6% partially submitted	10% partially submitted
NIFTP	-	**9.1% (67)**
Malignant	**53.9% (459)**	**44.8% (329)**
PTC-FV	20.8% (177)	8.0% (59)
PTC-CV	14.2% (121)	18.7% (137)
PTC-TCV	5.3% (45)	3.7% (27)
PTC-Other	7.6% (65)	7.5% (55)
Follicular Carcinoma	1.9% (16)	2.7% (20)
Hürthle Cell Carcinoma	1.5% (13)	2.5% (18)
Other	2.6% (22)	1.8% (13)
Benign	**46.1% (393)**	**46.0% (338)**
FA	16.7% (142)	14.4% (106)
Hürthle Cell Adenoma	5.0% (43)	5.7% (42)
Reactive/Benign	24.4% (208)	25.9% (190)

PTC-FV: follicular variant of papillary thyroid carcinoma; PTC-CV: classic variant of papillary thyroid carcinoma, PTC-TCV: tall cell variant of papillary thyroid carcinoma; PTC-Other: other variants of papillary thyroid carcinoma; FA: follicular adenoma

Conclusions: The results of our study suggest that NIFTPs are encountered in almost a tenth of the thyroid specimens received at our institution. Compared to the pre-NIFTP era, there appear to be subtle trends towards less aggressive surgical management with fewer total and more partial thyroidectomies overall, as well as expected shifts in pathologic diagnoses accounting for the change in nomenclature.

2015 A Patient's Best Chance: Statistical Modelling Regarding Precision Medicine in Lung Cancer

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Disclosures: Marilyn Kinloch: None; Cassidy Bell: None

Background: An estimated 790 patients are diagnosed with lung cancer each year in Saskatchewan. Advanced stage lung adenocarcinoma (LAC) patients are eligible for personalized molecular treatments, if their tumour shows an EGFR sensitizing mutation. Long delays in receiving mutation results contribute to delayed treatment. Our previous process mapping shows the longest, most variable delay is after histologic diagnosis but before the molecular request reaches the lab. Our project focuses on three objectives: evaluating the time delay in receiving molecular results in Saskatchewan, the time difference between oncologist-initiated molecular ordering versus pathologist reflexive ordering, the cost investment of reflexive ordering.

Design: Patients in Saskatchewan diagnosed with LAC between 2016 and 2017 were selected for chart review. Stage at presentation and turn-around-times were calculated for late stage (stage IIIB to stage IV) patients between Saskatoon and Regina using oncologist-initiated ordering. This was modeled against pathologist-reflexive ordering with Wilcoxon signed-rank non-parametric test to determine statistical significance. Reflexive testing investment was calculated by patient per year diagnosed with LAC, not eligible for molecular testing, multiplied by the local cost of performing PDL-1, ROS-1, ALK-1 IHC and EGFR, BRAF, KRAS sequencing ($820 CDN).

Results: 649 patients were reviewed with 360 (55%) showing advanced stage. 281/360 (78%) received an EGFR test [132 in Saskatoon and 135 in Regina]. 32/281 (11%) of patients had an EGFR sensitizing mutation and 19/32 (55%) patients received EGFR targeted therapy.

92 patients diagnosed with early stage disease had EGFR testing over the course of 4 years, representing a total of 70% patients eventually meeting the requirements for testing.

The mean turn-around-time for oncologist-initiated test results was 42 days in Regina and 68 days in Saskatoon (p=0.22). The reflexive time is 21 and 23 days. This represents a shorter turn-around-time of 32 days and median time of 12 days (p=<0.0001).

Implementing reflexive testing, on all stage tumours, would be an investment of $53,625 CDN/year.

Conclusions: Given the mortality of LAC, any delay to appropriate testing is detrimental to their care and outcome. An investment to reflexive ordering would allow 100% of patients to receive testing with a 50% reduction in wait time for results and potentially capture missed patients eligible for testing or receive therapy.

2016 The Pathologist Will See You Now: Qualitative and Quantitative Analysis of Pathologist's Attitudes Towards Seeing Patients

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Disclosures: Lauren Kroll-Wheeler: None; Dustin Johnston: None; Brian Tolle: None; Scott Owens: None; Cathryn Lapedis: None

Background: Cancer patients have expressed a high level of interest in meeting with a pathologist to discuss their report and see their tissue under the microscope. Tissue visualization may be a useful tool to improve treatment decisions and treatment adherence, and to aid in behavior change. It is unclear if pathologists would be interested in directly interacting with patients.

Design: Pathologists were surveyed via Michigan Medicine's Pathology Twitter platform. Pathologists rated their level of interest in meeting with a patient to discuss their pathology report and show them their tissue pathology. Pathologists were also asked to explain in a free text box the reason for their level of interest. Pathologists were asked to rank their interest on a six-point scale from "Definitely Interested" to "Definitely Not interested". Pathologists were asked to assume that their time would be adequately compensated and that the patient had already been told their diagnosis by the treating clinician. Age, gender, rank, and type of practice were collected.

Results: 193 pathologists completed the survey via twitter. 85% of respondents were either definitely interested or interested in meeting with patients. Interest level did not differ by age, gender, or rank. Interest was significantly higher in pathologists in academic practices as compared to pathologists in community practice (p= 0.02). Qualitative themes from interested pathologists included a desire to provide a service to patients, a thought that meeting with patients could improve continuity of care, an interest in improving the visibility of pathology, and a desire to highlight the value of the pathologist. Many pathologists also expressed a strong interest in connecting with patients. Qualitative themes in the disinterested pathologists included a disinclination to interact directly with patients, a hesitancy to assume a new role in the patient-clinician relationship, concerns regarding general logistics of the interaction, and the thought that the interaction may not be valuable for patients or pathologists.

Conclusions: There is a high level of pathologist interest in meeting with patients. In general, pathologists feel that a patient-pathologist consultation program could provide value to the patient, the pathologist, and the field of pathology. Concerns regarding communicating with patients, interacting in a new role with treating clinicians, and logistics should be addressed when testing the value of patient-pathologist interactions.

2017 A Retrospective Analysis of Discordant Results between Gastric Biopsy Diagnosis and Other Clinical Diagnostic Tests on Helicobacter Pylori Infection

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Disclosures: Kevin Kuan: None; Tony El Jabbour: None; Xi Zhang: None; Qiang Liu: None; Yanan Fang: None

Background: Helicobacter pylori (HP) infection is a common infection in the United States. Several clinical tests, including the rapid urease test (CLOtest), HP stool antigen test (SA), and HP culture, have been used as adjuncts to gastric biopsy specimen for HP detection. This study aims to investigate the discordance between gastric biopsies and clinical tests with focus on cases with negative biopsy but positive clinical test, identify underlying cause, and assess the impact on clinical management.

Design: Following IRB-approved protocol, reports from August, 2013 to August, 2018 were retrieved using the institutional database using the following criteria: 1) status of HP infection was commented, and 2) only one other clinical test (CLOtest, SA, or HP bacterial culture) was performed within 7 days of the biopsy procedure. Special stain or immunohistochemical (IHC) stain was not required on the biopsies in diagnosing HP infection. Results of the clinical tests were compared to the pathology diagnosis. Cases with negative HP biopsy but positive clinical test were reassessed and the patients' clinical history was reviewed.

Results: Total of 1210 pathology reports were identified, and 950 biopsies (79%) had clinical tests performed within 1 day of biopsy. We found that 108 ancillary tests (8.9 %) were discordant to their respective histologic diagnoses (See table). Seventeen cases had negative pathology diagnosis (4 with IHC and 13 with Warthin-Starry stain) but positive clinical test (6 with CLOtest and 11 with SA). Fourteen of the 17 cases were retrieved for re-examination, IHC was performed if not done before and all 17 patients' medical history were obtained. We found that 3 patients were on chronic proton pump inhibitors before the test and biopsy, 4 patients were treated after the positive clinical test but before the biopsy, 7 patients received treatment after the biopsy, and 3 patients were lost to follow-up. Furthermore, 2 cases with Warthin-Starry (WS) stain performed initially were confirmed the presence of HP with subsequent IHC stain.

	Number of cases	CLOtest	Stool antigen test	HP Bacterial culture	Average number of sample/biopsy
Total number of tests	1210	342	306	562	1.79
Concordant test	1102	328	282	492	1.80
Discordant test	108	14	24	70	1.76
Discordant rate (%)	N/A	4.09	7.84	12.46	N/A
Positive biopsy with negative clinical test	91	8	13	70	N/A
Negative biopsy with Positive clinical test	17	6	11	0	N/A

Conclusions: The study showed rare HP negative biopsy cases with positive clinical tests. The discordance could be due to sampling, or patients under HP treatment at time. IHC stain is more sensitive than WS stain in detecting HP organism. Majority of the patients received treatment.

2018 Frozen Section Quality Assurance: Using Separate Frozen Section Slide Preparation Times and Interpretative Time Measurements to Improve Process

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Disclosures: Joseph Laakman: None; Stephanie Chen: None; Kim Lake: None; John Blau: None; Anand Rajan KD: *Advisory Board Member*, Roche Diagnostics Corporation; Megan Samuelson: None; Robert Robinson: None

Background: Frozen section turn-around time (FS TAT) has been used as a metric for measuring a laboratory's operation, but utilizing a single TAT value does not allow for specific workflow process assessment. We wished to determine if we could utilize novel FS TAT measurements tied to specimen types as a means to assess processes, with the hypothesis that longer times were related to 1) inefficient technical processes and/or 2) diagnostic difficulties depending on the specimen.

Design: We analyzed 1992 specimens submitted for frozen section analysis in 2017. Specimen accessioning-to-'slide finished' (technical) time and pathologist review-to-call back (interpretive) time for each case were linked to a prosector and a pathologist, respectively. The data were categorized into one of six groups based on surgical specialty (gynecologic, breast, pulmonary, gastrointestinal, urologic, and head/neck). Mean and quartile times were determined for each major specimen type, with >3rd quartile times established empirically as a metric for "prolonged" times (Table 1). Given the goal of comprehensive process evaluation, all specimens were assessed equally, including those which utilized more than one FS block.

Results: Across all specimen types, the technical times were significantly longer than interpretation times (Table 1, p<.0001 for all types). Grouping by specialty greatly facilitated seeing trends across specimen type and also assessing where grossing and interpretation run into difficulties. We identified unexpected problem areas in the technical component with both hysterectomy and pulmonary lobectomy specimens which were over processed by being dissected beyond necessity for FS. Among cases with TAT>25 min, gynecologic specimens were significantly over-represented ($\chi 2$ test; p<0.001). As to interpretative times, not surprisingly we found that pathologists were challenged most with certain ovarian neoplasms and bile duct margin assessments for dysplasia.

Specimen by Surgical Service					
	Technical (mean time, min)	Interpretation (mean time, min)	p Value of differences of means	Technical and interpretation (mean time, min)	Technical and interpretation (3rd quartile time, min)
Gyn	19.0	5.1	< .0001	24.1	28
Pulm	16.5	6.3	< .0001	22.8	26
Breast	14.4	8.2	< .0001	22.6	27
GI	14.4	6.6	< .0001	21.0	26
Head/Neck	13.7	6.0	< .0001	19.7	23
GU	14.1	5.3	< .0001	19.4	22

Conclusions: These data demonstrate that a single FS TAT for a laboratory lacks intrinsic usefulness. Longer technical times could be reduced by re-structuring and improving the process of FS grossing protocols. Longer interpretative times could point to implementation of targeted pathologist educational efforts in topics of diagnostic difficulty. Using technical and interpretative FS TAT measurements, with subsequent sorting by specimen types, can be a tool to identify types of cases where improvements to both process and TAT can be made.

2019 Educational Interventions to Improve Quality in the Gross Laboratory

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Disclosures: Anthea Lafreniere: None; Joanne Swift: None; Sergey Pyatibrat: None; Iris Teo: None

Background: Gross assessment of surgical specimens influences pathologists' ability to provide high-quality reports. In 2018, we implemented a prospective data-driven system which permitted analysis of gross specimen re-examination (GRE) at our institution. We obtained a baseline GRE rate of 11.1% (140/1258) for large specimens, and determined the causes to include pre-analytic issues (3%), analytic issues (31%), and nature of the lesion (e.g. unexpected findings), accounted for 60%. Using this data, we developed targeted educational interventions for pathology assistants (PAs) and assessed their effect on GRE.

Design: Interventions included in-service education on grossing for selected specimens; increased 1-to-1 interactions between PAs and pathologists; and personalized feedback highlighting areas for improvement. Between January 1 and March 31, 2019, a list of all GRE cases grossed by PAs was retrieved and compared to the pre-intervention analysis for same period in 2018. We reviewed the final report and the GRE instructions. Clinical/pathologic impact (CPI) and root cause analysis codes (RCAC) were assigned to each case, as assessed independently by a pathologist, pathology resident, and a charge PA.

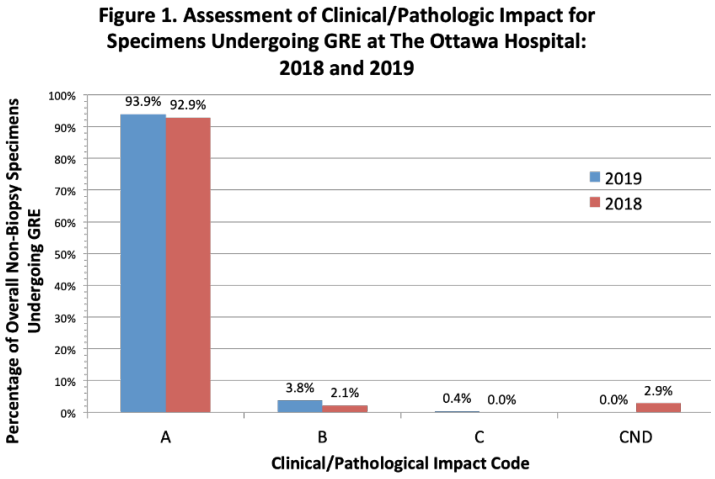
Results: For this time period, out of 2808 large specimens, 264 underwent GRE (9.4%). The majority of GRE specimens were breast (N=60; 22.7%), gynecologic (N=99; 37.5%), and gastrointestinal (N=50; 18.9%). A decrease in the proportion of breast and GI specimens was seen, relative to 2018. The proportion of GRE for skin, musculoskeletal, and ENT specimens increased more than two-fold (see Table 1). In terms of CPI, 93.9% of GRE resulted in minimal to minor CPI, 3.8% moderate, and 0.4% severe (see Figure 1). This contrasts 2.1% moderate and 0% severe clinical impact in 2018. In terms of RCAC, analytic issues increased by 3.2% (35.2%; N=93); and GRE due nature of the lesion decreased by 3.8% (56.8%; N=150) (see Figure 2).

Table 1. Proportion of Specimens Undergoing GRE by Organ Site at The Ottawa Hospital: 2018 and 2019.

	2019 (Jan 1-Mar 31)		**2018** (Jan 31-Mar 31)	
Organ Site	**Total GRE Cases (N=264)**	**Proportion of GRE Cases (%)**	**Total GRE Cases (N=140)**	**Proportion of GRE Cases (%)**
Breast	60	22.7%	47	33.6%
GI	50	18.9%	29	20.7%
Gyne	99	37.5%	46	32.9%
Derm	11	4.2%	3	2.1%
MSK	21	8.0%	5	3.6%
GU	10	3.8%	5	3.6%
ENT	5	1.9%	0	0.0%
Thoracic	8	3.0%	5	3.6%

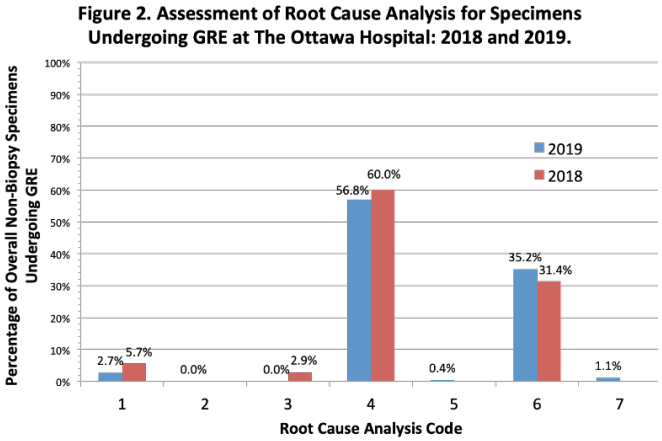
Caption: Gyne, gynecologic; GI, gastrointestinal; GU, genitourinary; Derm, dermatologic; MSK, musculoskeletal; ENT, ear, nose, and throat.

Figure 1 - 2019



Clinical Impact Codes: A: Minimal/minor clinical/pathologic impact; B: Moderate clinical/pathologic impact; C: Severe clinical/pathologic impact; CND: Cannot be determined.

Figure 2 - 2019



Root Cause Analysis Codes: 1: Unclassifiable; 2: Extradivisional operational issues; 3: Pre-analytic issues; 4: Nature of the lesion (unpreventable); 5: Analytical divisional medical issues; 6: Analytic divisional technical tissues; 7: Recurrent.

Conclusions: Following our interventions, the overall rate of GRE decreased by 1.7%. This represents a substantial reduction in a large-volume tertiary care institution, indicating the benefit of focused in-service and personalized feedback. While the proportion of cases undergoing GRE due to analytic issues and cases with moderate to severe clinical impact have increased, there were fewer cases where cause and impact could not be determined relative to the prior year's assessment. Analysis of these cases provides a method for ongoing quality improvement.

2020 A 5 Year Retrospective Review of HPV and Cytology ‘‘Cotesting’’ in Young Women: Do Our Clinical Colleagues Follow Practice Guidelines?

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Disclosures: Razvan Lapadat: None; Tatjana Antic: None

Background: The American Society for Colposcopy and Cervical Pathology (ASCCP) screening guidelines recommend HPV and Cytology ‘‘Cotesting’’ every 5 years as preferable for women 30-65 years old. In women less than 30 years of age cytology based screening is preferred while high-risk HPV (hrHPV) testing is not recommended for this age group. The aim of this study was to analyze the usage of co-testing in patients younger than 30 years at a large academic institution.

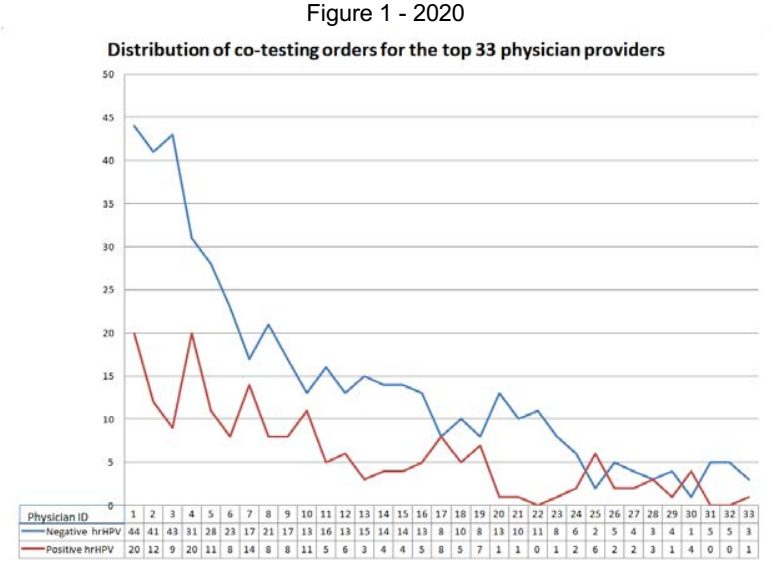
Design: A retrospective review was performed by querying the departmental LIS system (Copath, Sunquest Information Systems, Tucson, AZ). A natural language search was performed for Papanicolaou test reports spanning July 2014 to September 2019 (N=42650 cases). Cytology diagnosis was defined using the Bethesda System for Reporting Cervical Cytology. High-risk HPV (hrHPV) results on the Aptima HPV platform were recorded as HPV+ (N=2997) or HPV- (N= 19940). The 5-year cumulative physician orders were analyzed using Access and Excel software (Microsoft, Redmond, WA).

Results: Our search identified 863/42650 (2%) women with HPV-Pap cotesting results which were <30 years old ordered by 94 individual physician providers. There were 241 HPV+ (28%) and 622 HPV- (72%) cases. The cytology diagnosis for the HPV-Pap co-tested patients are listed in Table. The hrHPV-positive rates were lower in women with benign or low-grade lesions (26.7%), but they were higher in women with high grade lesions (89.4%, p<0.0001 Chi square test). For physicians ordering co-testing in more than 5 patients (N=33, Figure 1) there was a significant difference between hrHPV- results (average=16.6) compared to hrHPV+ results (average=6.36; p=0.000497, one tailed *t*-test).

	Negative hrHPV	Positive hrHPV
NILM	544	124
ASC-US	44	49
LSIL	13	46
ASC-H	2	7

HSIL	0	10
AGC	1	0
UNSAT	16	3

Figure 1 - 2020



Conclusions: hrHPV-cytology co-testing is a common practice in patients over 30 years old and provides an effective tool for risk stratification. The current study shows that the guidelines for patients <30 years of age are not followed in 863 cases (2%) over the 5 year period. Implementing additional quality assurance measures and providing feedback to the clinical care team is necessary in order to avoid:

- non-contributory HPV+ information in cytology-negative patients
- harm such as psychosocial impact of a positive test
- additional clinical visits, procedures and increased costs
- treatment of lesions which will probably resolve.

2021 Model for Assessing Cytopathology Workload, Efficiency, and Wellness

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Disclosures: Yunjie (Angel) Li: None; Kathleen Cederlof: None; Tim Cowan: None; Francis De Leon: None; Kristi Mendoza: None; Angela de Jesus: None; Christina Kong: None; Brittany Holmes: None

Background: A comprehensive model is needed to benchmark staffing, assess efficiency, and track wellness in today's work environment. Traditional proxies for workload, such as case volume, days on service, or relative value units (RVU) are less applicable as pathology departments shift to subspecialized service models. These traditional proxies also do not capture efficiency or wellness. A new model could inform scheduling and long-term planning, and provide real-time feedback on wellness.

Design: Optimal cytopathologist staffing was determined by retrospectively quantifying cytopathology work from 2014-18. The Royal College of Pathologists (RCP) system was applied to interpretation of fine needle aspiration (FNA) biopsies, fluids, and Paps. 1 additional RCP point was added for rapid on-site evaluation of image-guided FNAs. FNA performance by palpation was assigned 8 points and by ultrasound, 12 points. Review of outside pathology for confirmation of diagnosis was assigned 3 points; consult cases, 8 points. By converting all work to time units and assuming a 40-hour week based on the Federal Fair Labor Standards Act, the requisite number of full-time equivalents (FTEs) was determined. As a proxy for adequate staffing and efficiency of practice, the percentage of cases finalized outside of normal business hours (work-after-work) was calculated for a 3-month period (11/2018-2/2019). To qualitatively assess wellness, a simple daily text survey was sent to faculty and trainees for 2 months (3/2019-5/2019). After a one-week revised schedule pilot, which included optimal staffing, clearly delineated responsibilities, and decreased interruptions, efficiency and wellness were re-assessed.

Results: The RCP calculation showed that 2.2 FTEs are required to staff the service, which highlighted a gap from the existing 1.8 FTEs. The 18% staffing gap tracked with the 33% of cytology cases finalized after hours. Perceived wellness increased after the revised schedule

pilot, with 92% of survey respondents reporting that their workload felt manageable vs. 64% pre-pilot. Specific measures of work-after-work are ongoing.

Conclusions: The ideal pathology work environment requires a balance between optimal staffing and efficient workflow. A workload model that quantifies efficiency and wellness can function as a decision-making tool for justifying staffing needs, identifying existing inefficiencies, and tracking progress over time. Simple text surveys can serve as a qualitative gauge of overall wellness.

2022 Improvement of Pediatric Liver Core Biopsy Adequacy by Reducing Laboratory-Related Tissue Fragmentation and Increasing Portal Tract Yield

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Disclosures: Jiancong Liang: None; Mary Abbuhl: None; Huiying Wang: None; Vinay Prasad: None; Alice Coogan: None

Background: Liver biopsy is arguably the most valuable tool to evaluate pediatric liver diseases for guiding clinical management. In laboratory practice, however, the quality of biopsy may be compromised by processing-related factors, negatively affecting specimen adequacy rate and pathologic diagnostic efficacy. We aimed to identify potential laboratory causes encountered in our institution leading to suboptimal biopsy quality, and sought to implement corresponding measures to enhance our diagnostic performance.

Design: A quality improvement project was designed to prospectively monitor tissue core size and number of tissue fragments at the time of specimen receiving, grossing and glass slide reading in consecutive 200 cases of medical liver biopsies over 10 months (September 2018 to June 2019). Specimen tissue loss, degree of laboratory-related fragmentation, and number of portal triads were recorded. Multiple quality improvement measures were initiated from January to April 2019 and maintained thereafter.

Results: We found that laboratory-related tissue fragmentation, rather than tissue loss, appeared to be the major negative factor associated with low biopsy adequacy rate. The principle solution was the establishment of multistep monitoring of tissue integrity and adjustment of specimen processing conditions accompanied by staff training and raising awareness. Step-wise implementation of laboratory adjustment measures resulted in reduction in overall tissue fragmentation from 59% to 24% ($p<0.01$). Such improvement in specimen integrity was associated with increase in the number of evaluable portal tracts, resulting in higher rate of biopsy adequacy (using criteria from American Association for the Study of Liver Diseases Practice Guidelines) from 32% to 56% ($p<0.01$). We also calculated the number of evaluable portal tracts per tissue length and found an increase in portal tract yield from 4.4 to 5.7 portal tracts per centimeter of tissue ($p<0.01$), further validating the improvement in biopsy quality.

Figure 1 - 2022

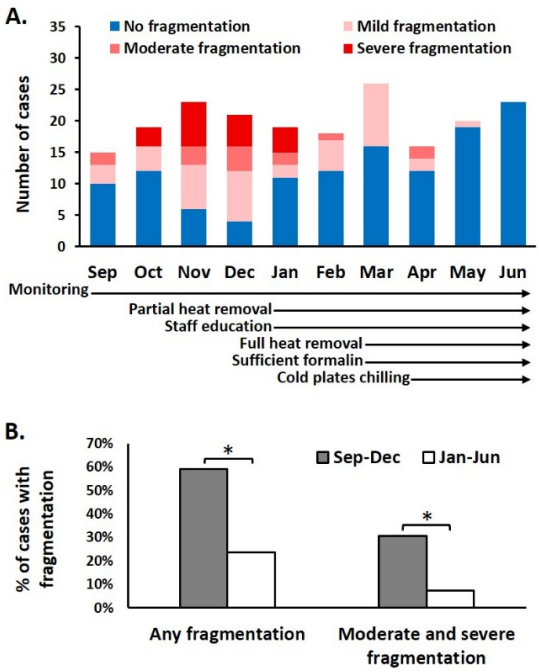

Figure 1. The degree of laboratory-related liver biopsy fragmentation correlated with the implementation timeline of tissue processing condition adjustment. (**A**) Structured monitoring of tissue fragment size and number was initiated at the beginning of the prospective study. Multiple tissue processing condition adjustments were initiated in January, March and April, 2019. The number of cases suffering from various degrees of tissue fragmentation gradually decreased after January. (**B**) The percentage of cases with laboratory-related tissue fragmentation significantly reduced after the implementation of laboratory measures initiated in January (* p value < 0.01 by Fisher exact test).

Figure 2 - 2022

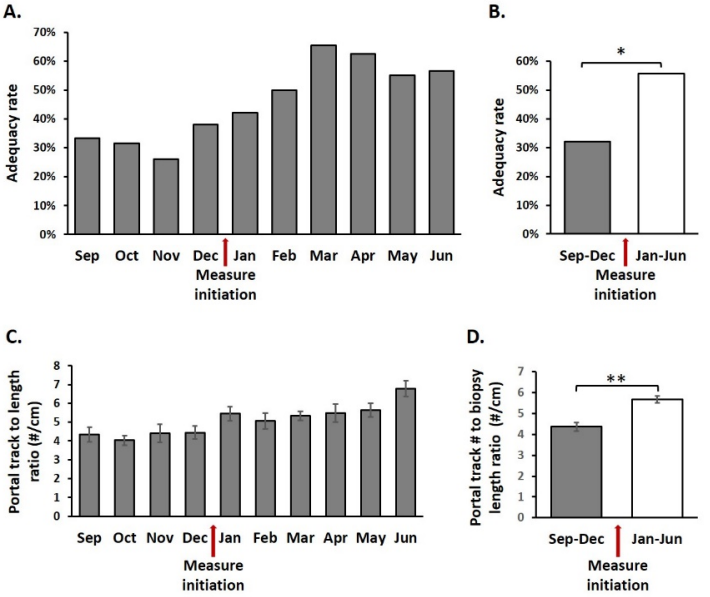

Figure 2. The liver biopsy adequacy rate and portal tract yield correlated with the implementation timeline of tissue processing condition adjustment. (**A**) Liver biopsy adequacy rate (by month) over a 10-month period from September 2018 to June 2019. (**B**) The overall liver biopsy adequacy rate significantly increased following the implementation of laboratory measures initiated in January (* p value < 0.01 by Fisher exact test). (**C**) The portal tract yield (by month) gradually increased after the initiation of laboratory measures in January. (**D**) The overall portal tract yield significantly increased following the implementation of laboratory measures initiated in January. (Error bars represent standard errors; ** p value < 0.01 by Student's t-test).

Conclusions: We demonstrate a marked improvement in the overall quality of pediatric needle core liver biopsies. A reduction in tissue fragmentation was established by structured tissue monitoring, fine-tuning specimen processing, staff retraining and raising awareness. Improved biopsy integrity and increased evaluable portal tracts allowing optimal diagnosis were accomplished by systematic process improvement.

2023 Burnout in Pathology and Laboratory Medicine

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Disclosures: Daniel Liauw: None; David Dupee: None; Andrea Barbieri: None; Stephen Smith: None; Vinita Parkash: None

Background: Disengagement is a state of vital exhaustion from a negative relationship to work. It has reached epidemic proportions in US Healthcare workers. It is associated with poor physician health, poor quality and safety outcomes for patients and high organizational costs. The drivers of disengagement differ amongst professions and specialties and are also influenced by an individual's intrinsic mindset towards work. Job oriented people view work as a means to support their true interests which lie outside their job; calling oriented individuals value work itself as integral to their identity; and, career-minded individuals view work as an "upward mobility" ladder.

Design: A cross-sectional survey study using a validated burnout (MiniZ) and meaningfulness of work survey (courtesy Amy Wrzesniewski, Yale School of Management) examined burnout and meaningfulness of work in Pathology. The survey was circulated through the ASCP, ADASP, Pathologists Assistant (PA) Facebook page, and list-serves and social media platforms.

Results: 2363 Pathology professionals (438 Pathologists;111 PA's; 911 Pathology Professionals; 993 undeclared) responded to the survey. 32% were in their 30's, 20% each in their 40's and 50's and 28% in their 60's or older; 84% were white; 74% female. The Pathology workforce demonstrated high levels of burnout (60 %). Lab professionals demonstrated a statistically significant higher level of burnout than pathologists and PA's. Gender non-binary individuals had 2.3 times the odds of burnout relative to males, and white respondents had 1.7 times the odds of burnout relative to non-white counterparts. Lack of control over workload, inadequate time for documentation, and

poor work atmosphere were the primary drivers for burnout (OR 4.9 - 6.0), although the ranking of primary drivers differed amongst professional categories. Job Stress and Job Dissatisfaction were highest for physicians. A calling orientation was associated with a protective effect against burnout in all three categories. The high percentage of calling orientation for Pathologists and PA's relative to a high primary job orientation among Pathology professionals may explain some of the difference in levels of burnout amongst these professions.

Conclusions: Burnout is high in the Pathology workforce and is highest amongst those at the lowest levels of the organizational ladder (non-physician, non-PA staff). Efforts to reduce burnout in Pathology must to be two-pronged and address both pathologists and their staff.

2024 Retrospective Review of Utilization, Medical Decision Making, and Cost Analysis of PDL1 Testing in a Large Academic Medical Center

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Disclosures: Kara Lombardo: None; Binny Khandakar: None; Alexander Marwaha: None; Vamsi Parimi (Parini): None; Peter Illei: *Advisory Board Member*, AstraZeneca; *Speaker*, Roche Diagnostics; Andres Matoso: None

Background: Immunohistochemistry for PDL1 is FDA approved in non-small cell lung cancer (NSCLC), gastric or gastroesophageal junction adenocarcinoma (GEJ), cervical cancer, urothelial carcinoma (UC), head and neck squamous cell carcinoma (HNSCC), and esophageal squamous cell carcinoma (ESCC). PDL1 testing has been limited to these sites but oncologists are requesting it in other malignancies. In this study we assessed utilization and cost of PDL1 testing at a large academic medical center.

Design: The study included all cases tested for PDL1 from 1/2016 to 1/2019. Results were reported by combined positive score (CPS) for UC, GEJ, and cervical carcinomas, or tumor percentage score (TPS) for all others. Scoring was positive for CPS (> or = 1% for cervical and GEJ, > or = 10% for UC) or as high (> or =50%) or low (1-49%) for TPS. Criteria for response included reduced tumor volume and/or clinicians notes stating favorable response. The cost/test was estimated using the 2019 Medicare Fee Schedule based on the number of responders per patients tested.

Results: There was a total of 1,162 cases including 704 NSCLC, 58 gastric/GEJ, 21 cervical, 17 colorectal/small bowel, 12 ESCC, 19 UC, 8 uterus, 8 HNSCC, 6 pancreas, 6 vulva/vagina, and 4 breasts, 23 sarcomas; 210 metastatic carcinomas; and 66 others. Overall, 89.1% of cases were scored with TPS and 10.9% with CPS with positivity in 577 (49.7%) cases. Highest rate of positive results was in cervical carcinomas (90%), ESCC (66.7%), gastric/GEJ (53%) and NSCLC (50%). Highest rate of positive cases treated with immunotherapy was in LN metastases (50%), ESCC (43%), UC (40%) and primary NSCLC (30%). Highest rate of response was in UC (50%), NSCLC (46%), brain metastases (28%) and LN metastases (25%). No patients with sarcomas, bone metastases, gastric/GEJ, ESCC, colorectal/small bowel, pancreatic, or breast carcinomas that received immunotherapy responded to treatment. The overall cost was approximately $2K per responding patient in FDA-approved sites and $9.6K in cases from non-FDA-approved sites.

Conclusions: Testing of PDL1 expression assists oncologists in management of patients with a wide range of clinical situations beyond those currently FDA-approved. The highest rates of response are in patients with FDA-approved sites and the lowest in patients with metastatic carcinomas and malignancies from not yet FDA-approved sites. While expensive, the cost of testing is relatively small compared to the cost of treatment.

2025 Increasing Incidence of Acute Invasive Fungal Rhinosinusitis: 30-Year-Review of Pathology Practice

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Disclosures: Manuel Lora Gonzalez: None; Rebecca Chernock: None

Background: Acute invasive fungal rhinosinusitis (AIFRS) is a fulminant disease with a high mortality rate. The most important risk factor is the immune status of the host. Other factors, including environmental, may play a role. This retrospective study evaluates changes in the incidence and diagnostic practice for AIFRS over 30 years at a tertiary-care academic center.

Design: 203 cases from 105 patients with AIFRS were identified from 1989 to 2019 in the pathology department files. AIFRS was defined pathologically as the presence of fungal hyphae in tissue and/or necrosis with positive culture results/clinical picture consistent with AIFRS.

Results: Mean age was 48 years with a male to female ratio of 1.5. 92.3% of the patients were immunosuppressed and 42.9% had received induction chemotherapy within 2 months from presentation. Nine patients (8.5%) had poorly-controlled diabetes mellitus. The

average cases per year was 6.8 in the past decade versus 1.9 before 2009. There was no correlation between incidence and average annual rainfall or temperature. Anatomic pathology services were requested as: 1) a diagnostic biopsy alone at operating room or bedside, 2) combined diagnostic biopsy and debridement, 3) additional debridement in patients with confirmed diagnosis. On average, each patient was biopsied or taken to the operative room 2.1 times (maximum of 7). Intraoperative consultation (IOC) was performed in 55.2%. The mean IOC per case was 1.5 (range 0-37) with an increase in the number of IOCs per case in the past 10 years (average 2.4 IOC per case). Disagreement between final diagnosis and IOC was seen in 8.3% of cases. Interpretive error (missed fungus or necrosis) occurred in 2.5% and sampling error occurred in 2.5% cases (error type not documented in 3.4%). An attempt to categorize the fungal organism based on histopathology was performed in 78.1% of patients. Cultures were ordered in 38.3% of patients, and a fungal species was identified by culture in 24.3% of patients. A specific organism (*Fusarium or Alternaria* species) was identified by PCR in 7 patients.

Conclusions: The incidence of AIFRS has increased over the past decade compared to historical rates with greater use of IOCs to aid in patient management. Understanding the cause may be useful for developing prevention strategies. Development of a diagnostic protocol for AIFRS that includes standardized IOC reporting is needed.

2026 Utilization of Frozen Section Pathology Services for Dermatology Specimens by Surgical Pathologists, Final Pathology Concordance Rates and Clinical Outcomes

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Disclosures: Andres Madrigal: None; David Elder: None; Ketan Patel: None

Background: Frozen section pathology services (frozens) for dermatology specimens are challenging specimens due to their infrequency and extremely high impact in clinical decision making. The purpose of our study is to evaluate the clinical utility of frozens for dermatology specimens and the discordance rate between the frozen section diagnosis by non-dermatopathology subspecialty pathologists and final permanent section diagnosis by dermatopathology subspecialty pathologists.

Design: The study involved cases spanning a 1-year period with review of pathology reports, glass slides and pertinent electronic medical records.

Results: We identified 26 (19 inpatient, 7 outpatient) cases of dermatology specimens submitted for frozens (<1 percent of total frozen section cases) to evaluate for infection (46%), cancer (46%), Stevens-Johnson Syndrome/toxic epidermal necrolysis, or graft-versus-host disease (8%). Our study revealed a 4% discordance rate between the diagnosis obtained at frozen section and on permanent section, with no major clinical impact. The discordant case revealed the presence of tumor on the permanent section that was subtly missed on frozen sections. For cases specifically submitted to evaluate for infection, an 8% discordance rate was found between pathology findings and microbiology culture results in one case with no clinical impact. This finding illustrates the lesser sensitivity of tissue compared to culture diagnosis for infectious agents. Over one-third of inpatients expired during their hospital stay. Adult inpatients who were discharged had a shorter time from admission to frozens diagnosis (average (ave): 1.5 days (d), range: 0-8 d), shorter time from frozen section diagnosis to discharge (ave: 6.2 d, range: 1-22 d), and a statistically significant overall shorter hospital stay (ave: 5.9 d, range: 1-11 d), as compared to patients who expired in the hospital (ave: 15.6 d, range: 1-63 d; 12.3 d, range 4-35 d; and ave: 43.1 d, range: 8-100 d), respectively).

Conclusions: Our findings demonstrate an overall low discordance rate between frozen section diagnosis and permanent diagnosis of dermatology cases and identify the types of cases that require improvement in frozens to reduce the discordance. Importantly, the findings of this study emphasize the value of frozens for dermatology specimens in patient care to obtain better outcomes in earlier potential diagnoses, shorter hospital stays and chance of discharge.

2027 Increasing Lymph Node Recovery Through Automated Compressive Filtration Leads to Improved Confidence in Nodal Staging Score

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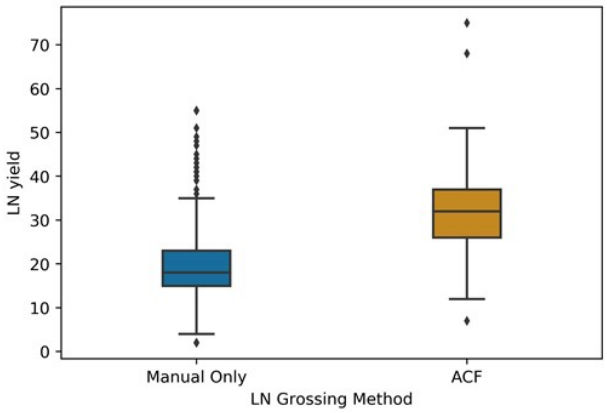
Disclosures: Elias Makhoul: None; Ryan Casao: None; Elena Chang: None; Maha Guindi: None; Stacey Kim: None; Brent Larson: None; Richard Mertens: None; Kevin Waters: None; Bonnie Balzer: None

Background: Lymph node (LN) recovery from gross examination and the correct analysis of LN status are necessary for accurate pathologic staging after colorectal cancer resection. Nodal Staging Score (NSS [Gonen et al. Journal of clinical Oncology 2009]) was developed to predict the probability that a patient is correctly staged as node negative. We evaluated whether Automated Compressive Filtration (ACF) of pericolic adipose tissue yields more LNs and increases the percent of cases achieving a high NSS.

Design: ACF was implemented as a supplementary LN grossing technique. After standard manual LN dissection, remnant adipose tissue was placed in acetone overnight (~15 hours). Fat was subsequently removed via ACF, which was performed with a Parker Isaac CY600 Adipose Tissue Separator (Ithaca, NY). The remnant tissue was entirely submitted for microscopic examination. Historical data and records were reviewed to establish historic LN yield. NSS was calculated as described by Gonen et al. (from 0 to 100 percent, with 100 representing 100% confidence in node negativity).

Results: Between 2016 and 2019, mean LN yield was 20 per case (n=302), resulting in only 40% of cases achieving an NSS of >95% and 84% of cases achieving an NSS of >90%. Thirty consecutive colorectal cancer resection specimens employed ACF. Initial grossing and manual dissection of those 30 cases yielded an average of 13 LN per case (range 6-40). Subsequent ACF of those 30 cases yielded an average of 18 additional LN per case (range 4-46). Average LN yield per case increased to 33 per case, resulting in 84% of cases achieving 95% NSS, and 96% of cases achieving 90% NSS (Figure 1). The average weight of the pericolic adipose tissue prior to ACF was 170 grams (range 37-417) and after ACF was 37 grams (range 6-112) representing an average 78% weight reduction. The average number of slides submitted from ACF was 17 (range 5-48). There were 2 instances of additional positive nodes recovered via ACF, one resulting in upstaging for the patient from a pN1a to pN1b.

Figure 1 - 2027



Conclusions: This study demonstrates that ACF can significantly increase LN yields in colorectal cancer specimens and allow for a higher rate of adequate LN sampling. Consequently, use of ACF results in an increase in nodal staging confidence. Additionally, we demonstrate that this novel technique has the potential to result in upstaging compared to standard LN evaluation.

2028 The Utility of Acetone and Automated Compressive Filtration (ACF) in Lymph Node (LN) Procurement: Interobserver Variability

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Disclosures: Elias Makhoul: None; Brian Cox: None; Bonnie Balzer: None; Elena Chang: None; David Frishberg: None; Maha Guindi: None; Richard Mertens: None; Mary Wong: None; Kevin Waters: None

Background: Lymph node (LN) recovery from gross examination and the correct analysis of LN status are necessary for accurate staging after colorectal cancer resection. The use of acetone and Automated Compressive Filtration (ACF) of pericolic adipose tissue (PAT) has been identified as a novel technique to yield more LNs. We aim to investigate the effect on interobserver variability in identifying lymph nodes with this novel technique.

Design: We utilized a case-control study design consisting of 40 total PAT slides from archival colon resection cases for colorectal carcinoma. The control cohort (N=20) was comprised of representative sections of manually compressed PAT that were submitted after the initial LN search yielded fewer than 12 LNs. The comparison cohort consisted of representative sections of PAT (N=20) that underwent ACF. All 40 slides were blinded to preparation technique and randomized. Eight pathologists counted the number of LNs on each slide. LNs were defined as lymphoid tissue with at least one of the following structures: a capsule, LN sinus, or hilar vessels. To investigate whether morphology of large grossly positive-appearing LN would alter due to ACF, a large LN from PAT underwent ACF and morphology was assessed. Fleiss' kappa was run to determine agreement.

Results: There was moderate overall interobserver agreement in the assessment of LN in the control cohort, κ = 0.694 (95% CI=0.652, 0.735). PAT that underwent ACF also showed moderate overall agreement, κ = 0.639 (95% CI=0.599, 0.678). Kappas for the control cohort were consistently moderate while the ACF cohort showed greater agreement when lymph node counts were 0-1. Both the case and control cohorts showed less agreement with an increasing number of lymph nodes. No alteration of morphology or increased fragmentation was noted in the ACF slides. Also, a grossly positive large LN (1.6 x 1.0 x 0.8 cm) that underwent ACF did not fragment and maintained normal histology when compared to FFPE H&E stained LN.

Conclusions: There was essentially no significant difference in interobserver agreement between lymph node counts in manually versus automated compressed PAT with each group displaying moderate agreement. The enlarged LN that underwent ACF did not fragment or have altered morphology. We found no evidence that ACF negatively impacts LN count in colon resections specimens.

2029 Development and Utility of a Consolidated Flow Cytometry Panel for Evaluation of Small or Limited Specimens

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Disclosures: Minh Yen Mays: None; Joseph Casano: None; Genevieve Crane: None

Background: There is increasing reliance on small biopsies for diagnosis due to both workflow and the ability of the patient to tolerate more invasive procedures. Other low cellularity specimens (e.g. cerebrospinal fluid (CSF) and bronchioalveolar lavage (BAL)) are also often received. We developed a combined flow cytometry panel to better detect atypical cell populations in the initial evaluation of these specimens (which often contain fewer than optimal cell counts even for a single panel) and assessed whether relevant populations may be missed by focusing on analysis on either B or T cell subsets.

Design: We developed and optimized a modified 8-color combined B and T cell flow panel (“BTS”) by overlapping markers rarely co-expressed on these cell types (kappa/CD2-FITC; lambda/CD7-PE; CD20/CD8-PACB) and single markers CD5-PerCP-Cy5.5, CD19-PE-CY7, CD10-APC, CD3-APC-H7, CD45-V500C, CD4-BV605). We retrospectively reviewed 402 cases analyzed with this method on a BD FACSCanto (12/19/2018-9/6/2019). Cost and workflow evaluation compared to prior standard practice were performed.

Results: Diverse sample types were evaluated: 121 fine needle aspirates (FNA), 120 small biopsies, 96 CSF, 41 BAL, 6 peripheral bloods, 13 bone marrows and 27 body fluids. Overall, 83 atypical B cell, 5 atypical T cell, and 2 atypical blast populations were identified (Table 1, Figures 1 and 2). Two cases had monotypic B cell populations that co-expressed the T cell markers selected for overlap (Figure 1), but only minimally limited evaluation on this panel. In addition, two abnormal blast populations were detected with CD7 (Figure 2). Analysis of the BTS tube required less technologist time compared to separate B and T cell tubes and reduced patient billing (Medicare: $476.23 compared to $534.91). In samples where only one tube was possible, BTS usage increased billing (from $328.62 for a single 8-color panel) but was potentially more informative.

Specimen Type	Cell Count	Clinical History	Flow Panel	Result	Utility of BTS panel
Lymph node core	2.0×10^4	67 yo F with history of T cell lymphoma (T follicular helper phenotype); elevated light chains	BTS	Atypical CD4+, bright CD5+ and CD7+; no abnormal B cell	Exclude concurrent B cell neoplasm with history of T cell lymphoma
BAL	1.5×10^5	4 yo F with history of CARMIL2 deficiency (primary immune deficiency syndrome)	BTS	Reduced CD4:CD8 ratio, no monoclonal B cell population	Abnormal T cell distribution, concern for B cell lymphoma
FNA of lymph node (12R)	1.0×10^6	67 yo M with history of lymphadenopathy, chronic cough, weight loss, malaise, weakness	BTS	Atypical CD10+ T cell population	Detected an atypical T cell population with unique flow cytometry panel
Bone marrow aspirate	4.07×10^6	57 yo F with history of acute myeloid leukemia	BTS, ALOT (AML panel)	Atypical CD7+ blast population	Detected an atypical blast population (known phenotype) with limited cells
FNA Lung (RUL)	3.0×10^4	28 yo M with history of refractory acute myeloid leukemia with lung consolidation	BTS	Atypical CD7+ blast population	Detected an atypical blast population (known phenotype) with limited cells
BMA	5.0×10^7	84 yo M with history of CLL not responding to treatment with Ibrutinib	BTS	Atypical CD2+ CD5+ Kappa restricted B cell population	Challenge in detection of a rare atypical B cell population
PB	8.0×10^7	77 yo M Vietnam veteran with likely Agent Orange exposure with history of mantle cell lymphoma	BTS	Atypical CD7+ CD5+ Lambda restricted B cell population	Challenge in detection of a rare atypical B cell population

Figure 1 - 2029

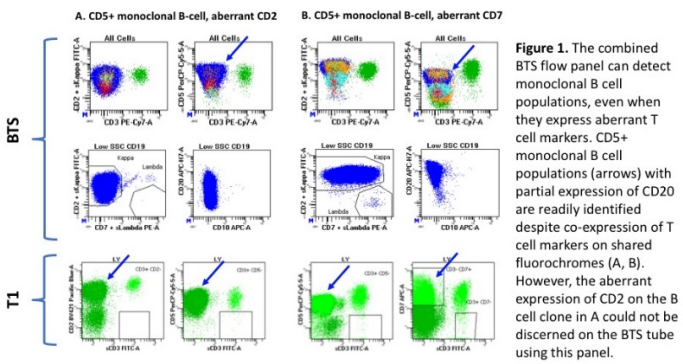

Figure 1. The combined BTS flow panel can detect monoclonal B cell populations, even when they express aberrant T cell markers. CD5+ monoclonal B cell populations (arrows) with partial expression of CD20 are readily identified despite co-expression of T cell markers on shared fluorochromes (A, B). However, the aberrant expression of CD2 on the B cell clone in A could not be discerned on the BTS tube using this panel.

Figure 2 - 2029

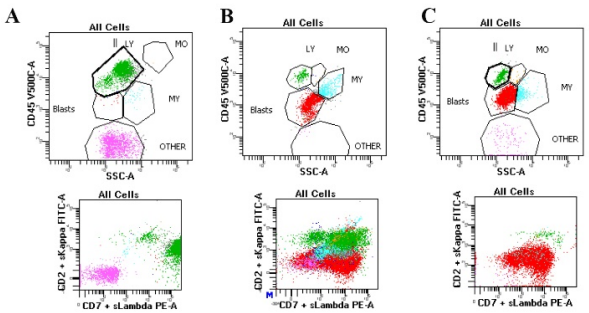

Figure 2. Abnormal findings included atypical T cell populations (CD7 bright, CD2 dim, A), and atypical myeloid blast populations (B, C) with aberrant expression of CD7.

Conclusions: Using overlapping markers to create a combined BTS panel did not greatly affect ability to detect B cell clones and increased sensitivity for detection of abnormal cell populations compared to individual panels previously used in this setting. This assay was particularly useful for paucicellular specimens in patients with unknown malignancy, T follicular helper neoplasms (which may have associated B cell clones) or concurrent myeloid neoplasms. Technologist time was similar or reduced using the combined analysis, and patient billing was only modestly affected.

2030 Using Text Mining for Quality Assurance following Publication of Consensus Guidelines

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Disclosures: Chelsea Mehr: None; Amrom Obstfeld: None

Background: Consensus guidelines provide expert recommendations that are used by practicing pathologists. Guidelines are written based on the best evidence available in the peer reviewed literature as well as expert opinion. However, little is known about the implementation of these guidelines into daily practice which is an essential step in ensuring high quality patient care. Typically manual review of pathology reports is required when performing quality assurance as related to the degree of adherence to guidelines. We used text mining techniques to evaluate how the Lower Anogenital Squamous Terminology Standardization Project (LAST) guidelines published in 2012 were implemented to ensure the quality of cervical biopsy diagnosis reporting.

Design: Pathology reports for cervical biopsies cases between 2006 and 2017 were extracted from our surgical pathology report repository. The R statistical programming language was used to mine the free text reports and to analyze the findings. In order to evaluate changes in the diagnoses related to the LAST criteria, the use of human papilloma virus related terms (e.g. “HPV”, “human papilloma virus”, etc.) and the presence or absence of the term p16 were determined for each year. These rates for years before 2012 and after 2012 (2012 removed as a washout period) were compared using chi-squared testing.

Results: During the inclusion period, 20,646 individual specimen diagnoses were analyzed before 2012 and 15,491 individual specimen diagnoses were analyzed after 2012. For the years prior to 2012, 11,088 (53.7%) of diagnoses used HPV related terms while after 2012, 1118 diagnoses used an HPV term (7.2%, p-value <0.001), representing an 86% drop from the baseline period prior to 2012, (Figure 1). For the years prior to 2012, 123 (0.6%) diagnoses had p16 while after 2012 789 diagnoses had p16 in the report (5.1%, p-value <0.001). This represents a more than 8-fold increase in the use of p16 immunohistochemical staining (Figure 2).

Figure 1 - 2030

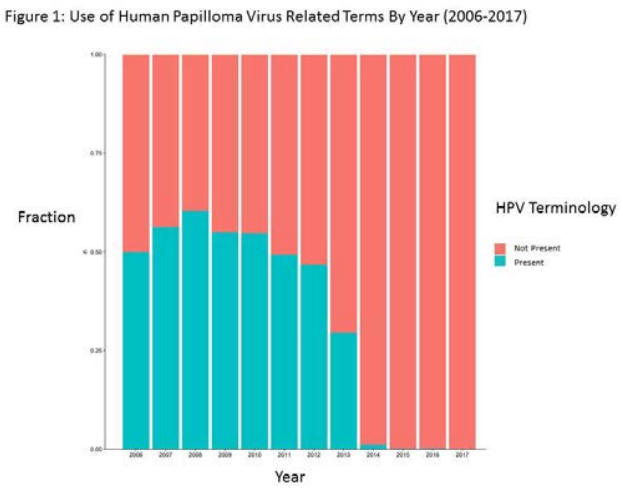
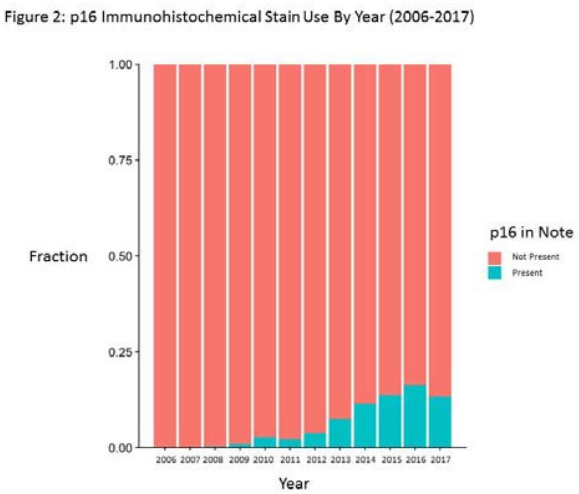


Figure 2 - 2030



Conclusions: Given the LAST criteria recommendations, changes in the diagnoses and habits of pathologists are expected. Our data suggest a significant decrease in the use of HPV related terms and an increase in the use of p16 immunohistochemical staining following the publication of the LAST criteria which is consistent with guideline recommendations. Continued monitoring of these metrics on a periodic basis can provide a continuous quality assurance program in a gynecologic pathology service.

2031 Resolution of a Modified CDC Definition for Carbapenem Resistant Enterobacteriaceae (CRE) Using a Rapid Multiplex, Cartridge-Based Molecular Assay for the Confirmation of Carbapenemase Genes

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Disclosures: Harshita Mehrotra: None; Laura Favazza: None; Brie Kezlarian: None; Randal Fowler: None; Nancy Hanson: *Advisory Board Member*, Streck; Robert Tibbetts: None

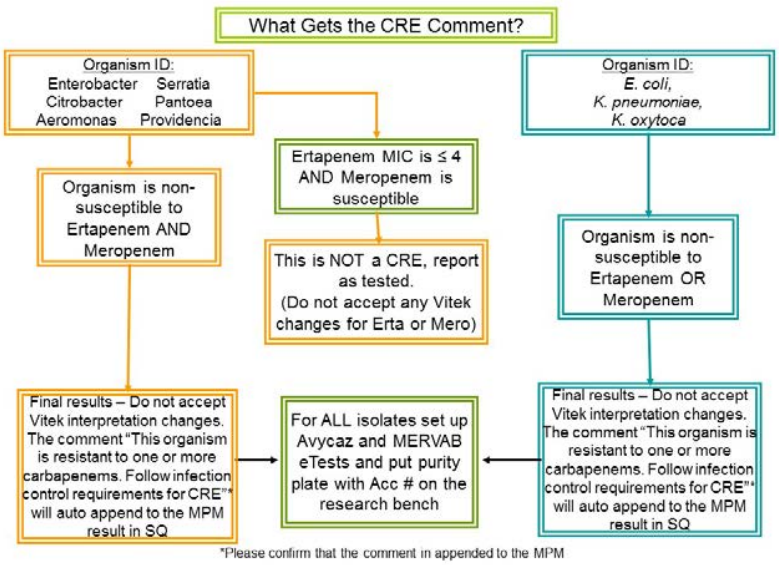
Background: CRE have emerged as a global threat due to their potential to cause invasive infections, often with high mortality rates and are primarily healthcare, associated, with a potential for spread to community settings. The CDC updated its definition of CRE as resistant to a carbapenem: MIC of ≥4 ug/ml for doripenem, meropenem, or imipenem, ≥2 ug/ml for ertapenem, OR documented to produce a carbapenemase. CRE are resistant to carbapenems primarily through the expression of carbapenemase genes (CP-CRE) carried on plasmids, which are easily transferrable hence the CDC recommendation to isolate patients with CP-CRE. However, production of AmpC/ESBL β-lactamases with a decrease of outer membrane proteins (OMP) (non-CP-CRE) can also lead to a higher ertapenem MIC, of which OMPs are not transferable but meet the CDC definition for CRE. The purpose of this study was to develop an algorithm to differentiate CP-CRE from non-CP-CRE using carbapenem MIC and confirmation by a rapid molecular assay.

Design: Genetic and phenotypic testing was performed on 61 isolates of Enterobacteriaceae with MICs to ertapenem ranging from <0.25 ug/ml to >64 ug/ml using PCR to detect *bla*$_{KPC}$, *bla*$_{AmpC}$ and *bla*$_{ESBL}$, and SDS-PAGE to determine OMP production. These data were used to create an algorithm to define CRE in our lab using MIC, the presence of resistance genes and/or OMP production. 40 isolates, including positive and negative controls, with known antibiotic susceptibilities were defined by this algorithm and confirmed by commercially available FDA approved rapid multiplex PCR for carbapenemase genes.

Results: Using this algorithm, we observed 5 discordant PCR results giving us 85% concordance. However, we believe that 3 of these were due to loss of plasmids by repeated freeze-thaw cycles and intend to reanalyze MICs to confirm this. On eliminating these 3 isolates, we have 93% concordance.

	Commercial Mulitplex Molecular Assay	
CRE defined by algorithm	**Carbapenemase detected**	**Carbapenemase not detected**
CP-CREs	20	3
non-CP-CREs	2	15

Figure 1 - 2031



Conclusions: A combination of the CDC definition for CRE and lowered breakpoints to ertapenem led to overcalling non-CP-CRE as CP-CRE may have resulted in inappropriate patient isolation, which is known to have negative patient outcomes and increase costs. Implementation of a multiplex PCR to rule out carbapenemases in isolates with elevated ertapenem but susceptible meropenem MICs resulted in a more sensitive and specific identification of CP-CRE.

2032 STAS Tumor Status is a Reproducible Prognosticator Among Practicing Pathologists

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Disclosures: Veronica Merelo Alcocer: None; Negar Rassaei: None; Christopher Febres-Aldana: None; Monica Recine: None; Robert Poppiti: None; John Varlotto: None

Background: "Spread through airspace" (STAS) is defined as the spread of tumor cells into airspaces in the lung parenchyma adjacent to and beyond the edge of the main tumor. It is a newly recognized pattern of invasion reported in adenocarcinoma and squamous cell lung carcinoma . Higher STAS has been reported to be more commonly seen in patients with solid and micropapillary predominant invasive adenocarcinoma, pleural and lymphovascular invasion, and tumor size of 10 mm or larger. Also, STAS has been considered to be an important risk factor for locoregional and distant recurrence in small adenocarcinomas treated by limited resection. In this study, we aim to evaluate if the observer (pathologists) is a determinant of the STAS tumor status.

Design: All primary lung cancer reports from January 1, 2018 to August 1, 2019 were reviewed. A total of 247 CAP Tumor Summaries were completed by our group of 8 general surgical pathologists, two of whom with interest in pulmonary pathology (pathologists 2 and 4). In addition to reporting variability among pathologists, we evaluated the relation between STAS and histologic type, tumor size and grade, and type of resection (lobectomy and wedge resection). This analysis was performed using a multivariate regression analysis conducted in SPSS® (version 22.0; Chicago, Illinois, USA).

Results: STAS, was reported in 128 CAP summaries (52%). Only 2 of the pathologists reported STAS in all cases (pathologists 2 and 4). The rate of positivity for rare reporters, pathologists 3, 6 and 8 was higher (66.66%) than the frequent reporters, pathologists 2 and 4 (26%), suggesting that rare reporters evaluated STAS when it was present in selected cases. Overall, when comparing frequent reporters (pathologists 2 and 4) with all the other pathologists (1, 3, 5, 6, 7, 8), the positivity rate is not significantly different (27.27% vs. 24.13%, respectively). Growth pattern was the only variable showing a significant association with the presence or absence of STAS in multivariate analysis (Figure 1 and Table 1).

Figure 1 - 2032

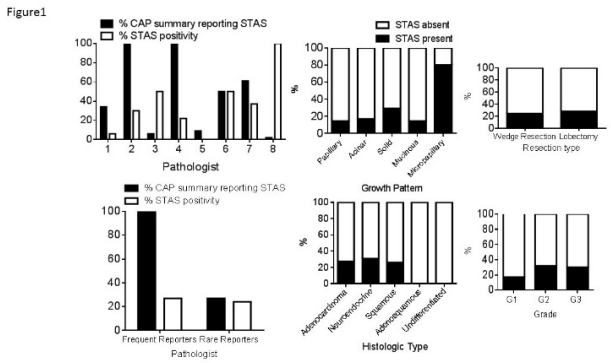

Figure 2 - 2032

Table 1. Multivariate linear regression analysis for STAS as the dependent variable

Variable	Standarized coefficient (β)	P-value	Partial Correlation
Pathologist	0.033	0.708	0.034
Growth Pattern	**0.307**	**0.001**	**0.300**
Histologic type	-1.539	0.126	-0.138
Tumor Grade	0.136	0.131	0.136
Resection type	0.045	0.535	0.048

Conclusions: This fit regression multivariate model demonstrates that the presence or absence of STAS is more likely to be determined by the variable growth pattern with no significant contribution of other variables. As expected for a parameter with high reproducibility, this result affirms that the observer (pathologist) is not significantly influencing the likelihood of STAS to be positive or negative.

2033 Diff-Quik Staining: An Alternative Technique for Rapid Evaluation of Acute Inflammation in Synovial Frozen Sections

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Disclosures: Virginia Miller: None; Ivy John: None; Karen Schoedel: None; Stell Patadji: None

Background: Synovial tissues are routinely sent for intra-operative assessment and characterization of inflammation, both quantitative and qualitative. Convention dictates the use of a rapid H&E or rapid pap staining method for this valuation, relying on a sequence of dehydration and rehydration elements in between the staining steps. Diff-Quik (DQ) is another rapid staining technique, often encountered in rapid assessment of air-dried cytologic specimens. This method is quicker than H&E, having fewer overall steps, and shorter staining periods. DQ is a modification of the Romanowsky stain, and like eosin in H&E, has differential staining properties capable of accentuating composition, size and morphologic differences between nuclei, cytoplasm, background stroma and granules. We propose to determine whether DQ staining could be applied to frozen section evaluation of synovial tissues as a more expeditious process, without compromising assessment of number and composition of inflammatory infiltrates.

Design: We collected 20 cases of synovial tissue routinely submitted for intra-operative consult, with varying degrees and types of inflammation. At frozen section, two additional OTC embedded cuts were obtained and each was stained with either DQ or wet-fixed in ETOH (95%) and stained per institutional protocol. H&E slides were cover-slipped and the two preparations were compared for quality and interpretability by two anatomical pathologists at the time of frozen section.

Results: Each staining preparation produced well-stained slides that were readily interpretable (Fig A and B). The most notable difference was in the preparation time. Rapid H&E with hematoxylin immersion for 120 seconds, averaged 150 seconds in total, while DQ averaged 40-45 seconds. Comparatively, DQ staining reduced the time to evaluation by 70%. Additionally, DQ distinguished histiocytes and lymphocytes from neutrophils, delineating the cytoplasm of the former as a contrasting light blue beside the metachromatic stroma. Air-drying did not appear to effect interpretation, and possibly enhanced the appreciation of neutrophils, making them larger and more conspicuous.

Figure 1 - 2033

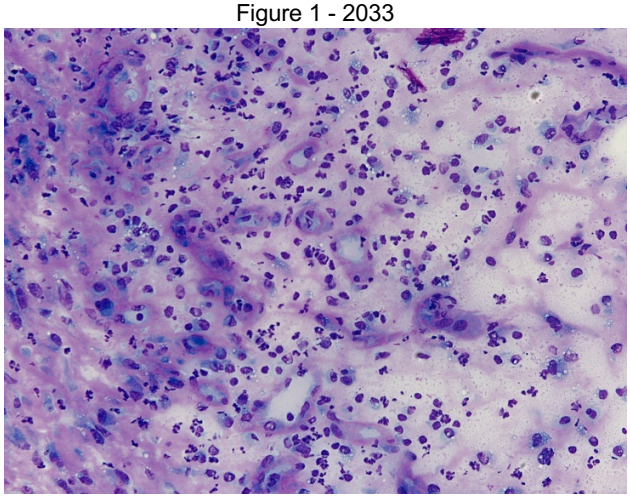
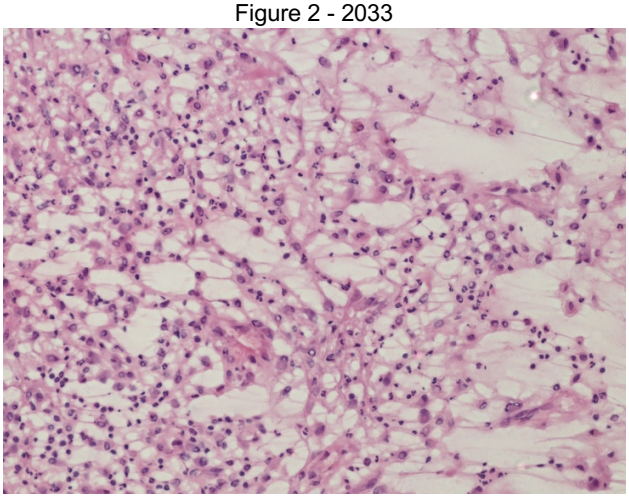


Figure 2 - 2033



Conclusions: Diff-quik staining may be regarded as a viable and expedient alternative to the common rapid H&E technique. Additional cases should be examined, and differing preparation techniques (wet vs dry, alcohol vs acetone etc.) may be explored in combination with Diff-quik staining to fully optimize outcome.

2034 Breast Tissue Obtained on Core Needle Biopsy: What is the Loss Observed with Testing for Prognostic Markers?

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Disclosures: Dereen Mohammed Saeed: None; Osama Elfituri: None; Nasma Majeed: None; Manmeet Singh: None; Elizabeth Wiley: None

Background: Breast masses are common and obtaining prompt and accurate pretreatment diagnosis of breast masses is a key step for appropriate patient management. Ultrasound guided core needle biopsy (USGCNB) has become a well-established tool used to obtain tissue for diagnosis of breast cancer. Molecular testing of breast carcinoma requires procurement of adequate neoplastic tissue to identify driver mutations and select proper treatment. Pathology laboratories and pathologists are expected to effectively manage and process tissue biopsies that are diminishing in size, to make sure enough tissue is available for ancillary studies.

Design: Whole slide images from 90 breast carcinomas (82 patients) diagnosed by USGCNB in 2017-2019 were retrospectively reviewed. The number of cores per biopsy, number of blocks, length of shortest (SC) and longest cores (LC) on initial H & E sections, longest tumor core (TC) length and lengths of these cores after 8 sections were cut for prognostic markers (PM). The change in core and tumor lengths were compared to total number of blocks, cores, and TCs, for volume of tissue loss.

Results: A median of 2 blocks and a median of 4 cores (range 2-7 cores) were submitted per biopsy. Average change in TC length was 0.91 mm (median 0.6 mm, range 0-5.2 mm), LC length was 1.3 mm (median 0.8 mm, range 0-6.1 mm) and SC length was 0.77 mm (median 0.5 mm, range 0-5 mm) with the sections taken for PM testing. Biopsies with >4 cores had the smallest change in core lengths overall (TC 0.6 mm, SC 0.7 mm, LC 1.1 mm). Changes in LC were greatest with 24 cores losing >2 mm, including 4 cores initially less than 10 mm length. Biopsies with >3 TC had smaller changes in core length than ones with 3 or less TC (0.8 vs 1 mm).

Table 1. Table shows changes of core length by block count, total core number and number of tumor cores

Case type	Average H&E tumor length (mm)	Average PM tumor length (mm)	Average change tumor (mm)	Average H&E shortest core (mm)	Average PM shortest core (mm)	Average Change shortest core (mm)	Average H&E longest core (mm)	Average PM longest core (mm)	Average Change longest core (mm)
1 block	10.3	9.4	1	8.8	8.2	0.7	14.1	13	1.4
2 or more blocks	8.9	8.2	0.9	9.3	8.6	0.8	13.6	12.5	1.3
2 to 4 cores	10.5	9.6	1	9.6	8.8	0.8	14.2	13	1.4
5 or greater cores	7.6	7.1	0.6	8.1	7.6	0.7	13.1	12.1	1.1
1 to 3 tumor cores	9.2	8.3	1	8.9	8.1	0.8	13.9	12.7	1.3
4/+ tumor cores	9.9	9.2	0.8	9.2	8.8	0.7	13.7	12.6	1.2

Conclusions: The lack of uniformity of core needle biopsies hampers development of standardized procedures for tissue preservation. This study selected a relatively standard set of USGCNB breast cancer cases in which a single needle gauge was employed. Changes in TC length depended on tumor volume as well as the total number of cores obtained. Results show that there is greater loss (average1 mm) of tumor tissue for cases with <5 total cores and <4 TC when additional sections are taken for PM. Reduction of this loss of neoplastic tissue will be key in preserving adequate tissue for future testing. We plan to study core needle biopsies of other organ sites using this data as a baseline, to monitor tissue loss and change procedures to improve tissue preservation.

2035 Do We Understand Each Other? – Comparison of Intraoperative Diagnoses Recorded in Pathology Reports and Operative Notes

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Disclosures: Amanda Moodie: None; Gabor Fischer: None

Background: Clear and efficient communication between pathologists and surgeons is critical in the setting of intraoperative consultations. Any miscommunication may have an irreversible impact on patient care.

Design: We examined the concordance of intraoperative diagnoses recorded in pathology reports to surgeon-dictated operative notes as a result of verbal communications. Discrepancies were categorized as minor with minimal to no clinical impact, and major with potentially significant impact on patient management.

Results: 221 surgical cases with 578 frozen sections were examined. In 23% of the cases the intraoperative diagnosis was not recorded in the operative reports at all. Minor discrepancies were noted in 35% (59) of the remaining cases, and major discrepancies were recorded in 2% of the cases (3). Deferrals accounted for 24% of minor and 33% of major discrepancies overall. 54% of the minor and all of the major discrepancies were multipart cases. Two of the major discrepancies involved margin assessments, and one represented misinterpretation of the pathology diagnoses on some specimens of a multipart case. One of the major discrepancies led to major negative impact on patient management where a margin was diagnosed and recorded as positive, but interpreted as negative by the surgeon.

Conclusions: Miscommunications do occur and account for postanalytical errors in the intraoperative settings. The study highlights the importance of auditing the intraoperative communication in local settings. Potential improvements may be achieved by educational sessions in multidisciplinary setting to address the communication gaps, and developing professional guidelines for giving and receiving critical diagnostic information in intraoperative settings.

2036 Bronchial Brushing with Modified Cellblock Cytology in the Diagnosis of Pulmonary Lesions

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Disclosures: Bryan Morales: None; Samuel Bidot: None; Dana Thomas: None; James Niles: None; Tabathar Allen: None; Eric Flenaugh: None; Gabriela Oprea-Ilies: None

Background: Lung carcinoma remains the leading cause of cancer deaths in both men and women, and early diagnosis is critical to improve survival. Flexible fibro-optic endoscopy using conventional or tip-tracking localization techniques for cytology and/or histology evaluation has substantially improved its diagnosis.

Bronchial brushing (BB) allows for a wider sampling of lesion area and the cytology material obtained offers better-preserved cells for evaluation. However, cytology preparation from BB is not standardized. Our goal was to evaluate the diagnostic value of a modified method for cytological sampling obtained by BB.

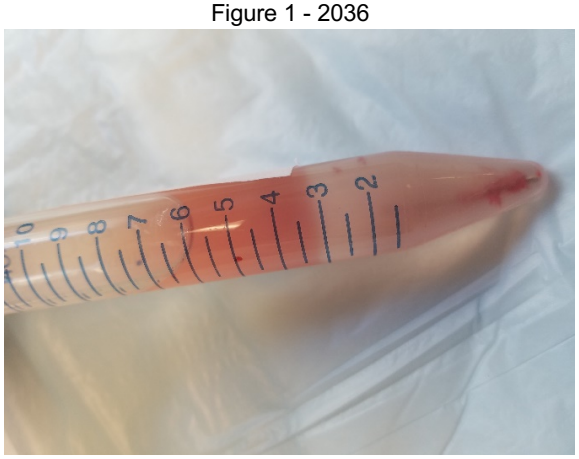
Design: This retrospective study included all patients seen in our lung nodule clinic during 12/2018-07/2019 who had BB in combination with ≥ 1 other diagnostic procedure, such as FNA, biopsy, or bronchial washing. Our modified method of cytological sampling consists of adding rapid on site evaluation for adequacy and submitting the brush for cellblock preparation (modified bronchial brushing, M-BB, Fig.1) in addition to smears only BB (SO-BB), as previously performed in our department. The diagnosis of malignancy was established when any of the specimens obtained through the multiple possible methods types was malignant. We compared the accuracy of our M-BB versus SO-BB for the diagnosis of lung malignancy.

Results: Thirty patients were diagnosed with lung carcinoma (median [interquartile range] age: 62 [58-67] years; 17 men). M-BB and SO-BB were performed for 17 and 13 patients, respectively.

Our M-BB technique was positive for malignancy in 16/17 malignant cases (94%, 95% confidence interval [95%CI]: 71-100)) versus 5/13 (38%, 95%CI:14-68) for SO-BB (p=0.001). For one patient (6%), M-BB was the only technique positive for malignancy, while FNA and biopsy were negative.

In addition, M-BB allowed better cancer subtyping in 6 patients (35%), by revealing the squamous component of a lung adenosquamous carcinoma for one patient, and by diagnosing lepidic features in 5 cases.

Figure 1 - 2036



Conclusions: These results suggest that our M-BB improves the diagnostic value of cytopathology for suspected pulmonary malignancies. Submitting the brush for cellblock following rapid on site evaluation is a quick and inexpensive additional step to SO-BB allowing larger sampling of tissue, and therefore better diagnostic accuracy for malignancy. In addition, our M-BB might allow better subtyping of malignancies in some patients.

2037 Impact of Intradepartmental Consensus Conference on Number of Send-Out Consultations: A 13-Year, Single Institution Review

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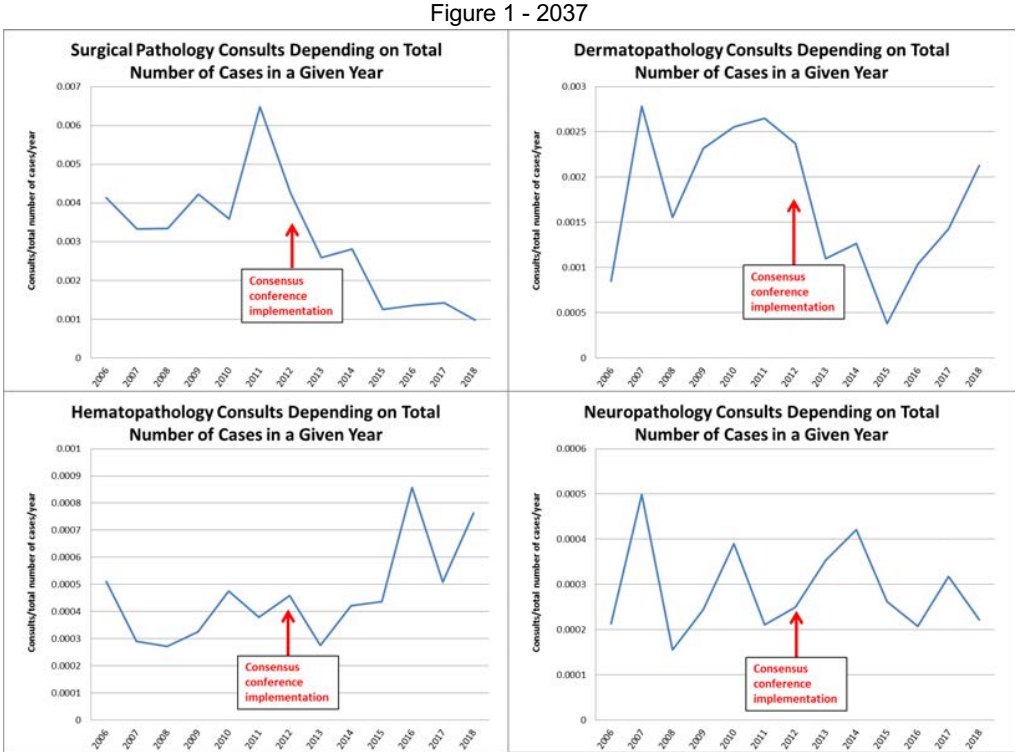
Disclosures: Michael Moravek: None; Aaron Muhlbauer: None; Eva Wojcik: None; Stefan Pambuccian: None

Background: An essential component in the oversight of anatomic pathology practices is quality assurance, which aims to reduce diagnostic error in an effort to positivity impact patient care. The implementation of a regular intradepartmental consensus conference is one such method widely used by both academic and private practices. Several studies have shown that consensus conference is a useful method to reduce intradepartmental diagnostic discrepancies; however, there is little data on the influence of consensus conference on the number of send-outs for expert consultation. Thus, the purpose of our study was to compare the number of send-out consultations before and after the implementation of a daily intradepartmental surgical pathology consensus conference in order to assess potential cost savings and improved diagnostic efficiency.

Design: A 13-year retrospective review of surgical pathology-related send-out tests was conducted using an electronic pathology information system. A total of 1940 surgical pathology send-out consultations were identified and stratified based on whether they were submitted by the dermatopathology, hematopathology, neuropathology, or surgical pathology service. The number of send-out consultations requested was compared before and after the implementation of consensus conference, which began in July 2012.

Results: Because dermatopathology, neuropathology, and hematopathology cases are rarely brought to this conference, they were separated in the data analysis. The results show that average number of surgical pathology cases submitted for consultation per year in the 6 years prior to the implementation was 101/year while the average number after implementation was 64/year. When compared to the number of total cases signed out in a given year, there was a statistically significant difference ($p<0.005$). There was also a statistically significant decrease in the number of dermatopathology cases ($p<0.05$) but no difference in the number of hematopathology ($p=0.13$) or neuropathology cases ($p=0.85$). The findings are depicted in figure 1.

Figure 1 - 2037



Conclusions: As supported by our study, implementing an intradepartmental consensus conference is associated with a decreased number of external consultations. Consequently, diagnostic turnaround times are likely to be reduced as well as patient medical bills. The overall effect is improved patient satisfaction and cost-effective care.

2038 Comparison of Mutated Gene Frequencies in Acute Myeloid Leukemia

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Disclosures: Charles Myers: None; Conrad Shebelut: None; Linsheng Zhang: None

Background: Identification of specific gene mutations in patients diagnosed with Acute Myeloid Leukemia (AML) has diagnostic, prognostic, and therapeutic implications. Next generation sequencing (NGS) of targeted gene panels are often used to detect such mutations. Assessing the frequency at which mutations are identified in all patients tested is a metric that can be used to ensure internal testing accurately reflects the population. Here, we compare the mutation frequencies in different genes, defined as the rate of a ene having any pathogenic mutation within a dataset, identified by our 75 gene panel NGS for myeloid neoplasms (MMP75) with the population mutational frequencies for AML reported elsewhere.<

Design: This study looked at all unique cases of AML with NGS testing since November 2018. Genes with mutations of a rate greater than 5% were selected for comparison. The frequency of mutations in individual genes in our patient population was compared to four public datasets (mycancergenome.org, datasets from OSHU and TCGA found on cBioPortal, and Papaemmanuil E et al. 2016, PMID 27276561), as well as a recent review article (DiNardo and Cortes 2016, PMID 27913501). Furthermore, the prevalence of specific subtypes of AML from our data was compared to the OHSU dataset.

Results: Dispersion rates varied greatly amongst the individual genes (coefficient of variation (CoV) 0.1 to 1.62, see table). Genes with higher dispersions (CoV>0.5) with robust average frequencies (>5%) included SRSF2 and ASXL1. Comparison of CoVs with and without our internal data showed a negative effect on the dispersion of several genes, including IDH1/2, RAS, and RUNX1. The rate of AML subtypes in our dataset is similar to the OHSU dataset.

Mutational Frequencies and Variability of Selected Genes within Datasets								
Gene	AML Database %	AML Internal %	Database STD	Database CoV	Db+Internal Average	Db+Internal STD	Db+Internal CoV	Change CoV
ASXL1	8.70	11.39	6.93	0.80	9.24	6.12	0.66	0.13
BCOR	4.79	7.59	3.65	0.76	5.35	3.40	0.63	0.13
CEBPA	6.82	8.86	4.08	0.60	7.23	3.65	0.50	0.09
DNMT3A	21.66	24.05	2.34	0.11	22.14	2.29	0.10	0.00
ETV6	5.07	0.00	8.21	1.62	4.05	7.47	1.84	-0.22
FLT3	26.78	32.91	11.04	0.41	28.00	9.95	0.36	0.06
IDH1	8.26	15.19	1.29	0.16	9.65	3.29	0.34	-0.19
IDH2	10.99	15.19	1.11	0.10	11.83	2.11	0.18	-0.08
JAK2	1.78	5.06	1.36	0.77	2.43	1.88	0.77	-0.01
KIT	2.95	2.53	1.19	0.40	2.87	1.04	0.36	0.04
KRAS	4.74	7.59	0.65	0.14	5.31	1.40	0.26	-0.12
NF1	3.28	5.06	2.73	0.83	3.64	2.50	0.69	0.15
NPM1	23.82	30.38	5.29	0.22	25.13	5.44	0.22	0.01
NRAS	12.69	22.78	4.88	0.38	14.71	6.18	0.42	-0.04
PHF6	2.63	6.33	0.54	0.21	3.55	1.90	0.54	-0.33
PTPN11	5.61	7.59	1.94	0.35	6.01	1.90	0.32	0.03
RUNX1	11.93	18.99	2.68	0.22	13.34	3.92	0.29	-0.07
SRSF2	7.29	20.25	4.96	0.68	9.88	7.22	0.73	-0.05
STAG2	4.99	8.86	1.67	0.33	5.76	2.25	0.39	-0.06
TET2	12.58	13.92	3.80	0.30	12.85	3.34	0.26	0.04
TP53	9.31	15.19	2.70	0.29	10.49	3.52	0.34	-0.05
U2AF1	4.05	10.13	1.13	0.28	5.26	2.89	0.55	-0.27
WT1	5.75	10.13	1.61	0.28	6.63	2.40	0.36	-0.08

Conclusions: The high dispersion of several genes, especially ASXL1 and SRSF2, suggests a lack of homogeneity between the datasets. The increase in CoV with the addition of our internal data also suggests some population mutational difference. These and other datasets are being cited in multiple papers and used as de facto prevalences; however, individual data points and averages of the datasets routinely fell outside of the cited ranges for mutational frequency. While these variations may be due to region or AML subtype, there is currently insufficient data to investigate further at a single institution. Current data should be used cautiously on a population level, and additional data collection and research needs to be performed for adequate AML mutational prevalence databases.

2039 Variability in Synoptic Reporting of Colorectal Cancer T4a Stage and Large Vessel Lymphovascular Invasion

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Disclosures: Julia Naso: None; David Schaeffer: None; Hui-Min Yang: None

Background: Features of prognostic significance in colorectal cancer (CRC) include pT4a stage and the presence of extramural large vessel invasion. We explored how synoptic reporting data and an image-based survey could be used to assess variability in the reporting of these features. We then investigated whether the presentation of information from the College of American Pathologists guidelines could reduce variability in interpretation.

Design: Synoptic reports from 93 pathologists at 14 hospitals on 1555 consecutive cases of CRC were collected over an 18 month period. Statistical analysis used multivariate logistic regression adjusting for features including grade, lymph node involvement and size. An online survey with test questions delivered before and after an information component was completed by 49 pathologists.

Results: Hospital sites differed in the odds of reporting T3 vs. pT4a stage (P = 0.004), but did not significantly differ in the odds of reporting other pT stage designations. The odds of lymphovascular invasion (LVI) being identified differed between sites and between pathologists within the same site (P ≤ 0.002). Large vs. small vessel invasion was specified in only 81% of cases with LVI. The odds of large vessel invasion being identified differed between sites and between pathologists (P ≤ 0.03), whereas the odds of small vessel invasion being identified did not significantly differ. In survey data, interobserver agreement for pT3 vs. pT4a classification was only moderate (κ = 0.47 [95% CI 0.43-0.51]; 83% agreement with the standard diagnosis). Following guideline presentation, pT stage agreement was not significantly altered, whereas responses in favor of using an elastic stain for LVI assessment increased from 32% to 66%. The interpretation of elastic stained images showed only moderate agreement (κ = 0.55 [95% CI 0.52-0.58]; 75% agreement with the standard diagnosis) with only mild improvement after the information component (κ = 0.65 [95% CI 0.62-0.68]). Most respondents (63%) reported using an elastic stain in less than 20% of their own CRC cases.

Conclusions: Considerable variability is present in pT4a staging and the reporting of large vessel invasion both in a test setting and in daily practice. Our online module encouraged the use of elastic stains but had limited impact on image interpretation. Our study exemplifies a use of synoptic data for quality assessment and identifies clinically relevant features to target in future standardization efforts.

2040 Tissue Thickness and Size Monitoring at Grossing as a Measure of Paraffin Block Quality Control in Anatomic Pathology

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Disclosures: Nicole Peyton: None; Kim Lake: None; Megan Samuelson: None; Robert Robinson: None; Anand Rajan KD: *Advisory Board Member*, Roche Diagnostics Corporation

Background: Tissue thickness in paraffin blocks has multiple downstream effects on the preparation and interpretation of histologic slides. Increased size and thickness in blocks lead to poor tissue fixation and dehydration which impairs the ability to create high quality slides. This results in increased special handling requests including slide recuts, additional grossing and tissue submission, and difficulties in immunohistochemistry interpretation. Ultimately, this worsens turnaround time and negatively impacts process quality.

Design: An interventional protocol monitoring tissue thickness in cassettes was instituted over a total of 15 weeks in 2019 (10 weeks: Feb-Apr; 5 weeks: July). Optimal tissue thickness was set at ~0.3 cm and all tissue above cutoff were subject to re-sectioning prior to submission. Overall and per-prosector rates of suboptimal block submissions were calculated for pre- and post-test periods.

Results: The per-day suboptimal block number at grossing showed a significant drop at the onset of intervention (Week 1 vs Week 2, 15-94 vs 0-31, p = 0.02, t-test). Total blocks needing trimming remained low thereafter through the 10-week observation period. Monthly suboptimal paraffin block counts in histology showed a significant reduction in the trial period compared to prior year's counts (mean: 76.8 vs 15.75, p = 0.005, Wilcoxon test). The range of blocks needing to be trimmed in the follow up period (July) was 2-24 blocks.

Conclusions: We found that implementation of a tissue quality monitoring step at grossing produced a rapid improvement in block quality. Global block monitoring is costly and labor-intensive and intermittent checking showed comparable quality results. Block thickness monitoring allows for proper education of residents in gross room techniques, acts as a reminder to pathology assistants to self-monitor block thickness appropriately, and potentially decreases special handling of specimens.

2041 Characterization of Extraneous Tissue on Slides and Assessment of Response to Changes in Embedding and Grossing Processes

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Disclosures: Nicole Peyton: None; Meredith Parsons: None; Allen Choi: None; Kim Lake: None; Anand Rajan KD: *Advisory Board Member*, Roche Diagnostics Corporation; Stephanie Chen: None

Background: Extraneous tissue on slides can lead to diagnostic dilemmas and is made more challenging as minimally invasive biopsies are performed more often, limiting architectural context in small biopsies. In the era of personalized medicine and increased molecular testing, it is crucial to ensure the tissue in a given block belongs to the intended patient. Our objectives were to systematically characterize extraneous tissue and evaluate the effect of processes intended to decrease rates of extraneous tissue.

Design: We evaluated 1087 representative slides from our tertiary care institution; 502 slides from October 2018 and 585 slides from March 2019. Between the two time points, a protocol to monitor section thickness was implemented in the gross room and embedding forceps were changed from serrated- to smooth-tipped. All extraneous tissue was characterized by on-slide proximity to main tissue (close, far), tissue type relative to main (same, similar, different) and persistence on levels (on only one level, at least one level, multiple levels). Specific tissue types were also recorded for extraneous and main tissue.

Results: Extraneous tissue rates were not significantly different (p=0.14, X^2) between 2018 (361/502 slides, 72%) and 2019 (445/585 slides, 76%). Stray tissue most closely resembling the main tissue (same or similar + close) was noted on 208/1087 slides (19%). Possible block contaminants (different + on multiple levels or at least one level) were seen on 27/1087 slides (2.5%). Most frequent extraneous tissue types were fibrous tissue (17%), blood (15%), skin (13%), colon (10%), lymphoid tissue (8%) and brain (6%). Main tissue types with the highest rates of stray tissue included placenta (100%), brain (93%), liver (91%), bone (87%) and amputations (80%).

Conclusions: Monitoring section thickness and changing embedding forceps showed no significant impact on extraneous tissue rates. Our overall rates are higher than those reported in the literature, but the majority are stray tissue routinely visually filtered out and ignored, although still requiring pathologist time and attention. Stray tissue most closely resembling the main tissue (19% of slides) can lead to the most difficulty in accepting tissue as extraneous and may result in the need for molecular identity testing. Potential block contaminants that could theoretically result in erroneous molecular testing results occurred much less frequently (2.5% of slides).

2042 Proposed Triaging Criteria of Pleural Effusion Cytology Specimens for Ancillary Flow Cytometric Analysis

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Disclosures: Regina Plummer: None; Sarah Kelting: None; Rashna Madan: None; Maura O'Neil: None; Katie Dennis: None; Fang Fan: None

Background: There are no established criteria in selecting pleural effusion (PE) specimens for flow cytometric analysis (FCA), especially on patients without known hematologic malignancies. In an effort to improve lab test utilization, this retrospective study aims to identify the uniting characteristics of PE cytology specimens on which the addition of FCA has high diagnostic yield.

Design: Cases with FCA performed on PE cytology specimens collected between July 2014 and June 2019 were identified. Pertinent patient demographic data and history, FCA diagnosis, cytologic diagnosis, cytologic cellular composition and quantities on cytology slides, and peripheral blood counts were collected on each case. Using Chi squared and Mann-Whitney U tests with a significance level of $p < 0.05$, we determined which of these characteristics were statistically significant and at what thresholds significance was obtained.

Results: We identified 164 FCA cases corresponding to 142 patients. Patients' ages ranged from 19-90 with a male to female ratio of 2.2:1. Forty-five of 164 (27%) FCA cases were positive for a monoclonal myeloid or lymphoid population. Clinicopathologic features associated with FCA results are shown in Table 1

	History of hematologic malignancy	Average number of lymphocytes (per high power field)	Cases with predominant monomorphous lymphocytes	Cases with isolated large atypical cells present	Cases with Mitoses present	Peripheral blood lymphocytes ≥20%
FCA positive (n=45)	41 (91%)	128	11 (24%)	15 (33%)	3 (7%)	20 (55%)*
FCA negative (n=119)	61 (51%)	92	11 (9%)	5 (4%)	1 (1%)	23 (24%)*
p value	<0.05	>0.05	<0.05	<0.05	<0.05	<0.05
	*Peripheral blood counts were available in 36 of 45 FCA positive cases and 97 of 119 FCA negative cases					

Conclusions: Our study shows that history of hematologic malignancy, ≥20% peripheral blood lymphocytes, and cytology specimens with large atypical cells, predominantly monomorphous lymphocytes, or mitoses are associated with a positive flow cytometric analysis result in pleural effusion specimens. Further studies are ongoing using the combination of these identified features to support an algorithmic approach to guide ancillary flow cytometric analysis and avoid unnecessary testing.

2043 Pancreatic Ductal Adenocarcinoma: Diagnostic Concordance between SharkCore Fine-Needle Biopsy and Cytology Specimens

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Disclosures: Liza Quintana: None; Raul Gonzalez: None

Background: Pancreatic lesions are primarily biopsied under endoscopic ultrasound guidance, and fine-needle aspiration (FNA) has traditionally been used as the sampling technique in this setting. In recent years, fine-needle biopsy (FNB) devices that can sample the pancreas, such as SharkCore, have increased in use, including at our institution. In this study, we sought to evaluate the differences in diagnostic yields and categorization of potentially malignant specimens diagnosed on FNA and FNB.

Design: We searched our departmental archive for SharkCore biopsies taken from patients with a high clinical concern for adenocarcinoma versus pancreatitis. After excluding cases of serous cystadenoma, neuroendocrine tumor, and metastasis, a cohort of 100 consecutive cases was formed. We then determined which of these cases had concurrent cytology sampling. For each cytology case, we recorded modality, cell block cellularity, cytologic diagnosis, FNB diagnosis, and final patient diagnosis. FNA and FNB diagnoses were stringently compared.

Results: Among the 100 SharkCore biopsies, 75 had concurrent cytology samples, including 60 FNAs, 14 bile duct brushings, and one stent sample. Cell block was available for 39 FNAs and 3 brushings, though cellularity was typically scant or low (24, 57%). Concordance between FNB and FNA diagnosis was 67% (40 of 60 cases). For the discordant cases, a more definitive interpretation was rendered on the FNB sample in 15 (75%) and on the FNA in 5 (25%). The combination of cytologic sampling and FNB sampling led to a correct patient diagnosis in 46 of 60 cases (77%) of the cases. Cytology samples with moderate or high cellularity on cell block did not lead to definitive diagnosis more often than those with low or scant cellularity (68% vs. 79%, P=0.71).

Conclusions: In our series, FNA and FNB typically showed good concordance in diagnosing pancreatic lesions. In discordant cases, FNB more often yielded a more definitive diagnosis, but FNA was more diagnostic in several. Both modalities therefore have value. Given the difficulty of interpreting both FNA and FNB samples, both types should be taken concordantly whenever possible in order to improve diagnostic yield.

2044 Tissue Detection Failure Rates for Selected Gynecologic and Breast Specimens using an FDA Approved Digital Pathology Imaging System: Practical Implications for Pathology Workflow and Patient Safety

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Disclosures: Joseph Rabban: *Employee*, Spouse is employee of Merck & Co.; Nicholas Ladwig: None; Yunn-Yi Chen: None; Gregor Krings: None

Background: A requirement for using a digital pathology imaging system (DPIS) for primary diagnosis of surgical pathology specimens is that each whole slide image (WSI) must contain all content in the glass slide. However, the only FDA-approved DPIS uses artificial intelligence to selectively identify content within a target area of the glass slide (the maximal scan zone (MSZ)). The FDA warns that this may result in incomplete scanning in 4 high risk scenarios: 1.) small tissue fragments, 2.) tissue with low contrast staining, 3.) adipose, and 4.) tissue outside the MSZ. The scope of this risk has not been studied. Many gyn and breast specimens fall into these risk categories. This study defines DPIS tissue detection failure rates for selected specimen types in a women's cancer pathology service.

Design: 1,042 slides from specimens representing each high risk scenario were evaluated: endocervical curettage; endometrial biopsy; cervical biopsy; benign breast core biopsy; benign breast margins, excisions and nodes. Slides were scanned and examined using the FDA-approved Philips Intellisite Pathology Solution system. Tissue detection failure was defined as: a.) tissue/suspected tissue on the macro image view but not in the scanned region of interest (sROI) of the WSI; b.) tissue/suspected tissue outside the sROI of the WSI; or c.) tissue directly transected at the borders of the sROI of the WSI.

Results: Tissue detection failure occurred in 24% to 75% of WSI (Table 1). Unscanned tissue/suspected tissue beyond the sROI (Fig 1) accounted for slightly more failures than tissue directly transected at sROI borders (Fig 2). Most curettages, including consults from other institutions, had tissue on the glass slide beyond the Philips MSZ. The WSI consisted of 2 to 8 separate scattered sROI of varying size and shape in up to half of cases. WSI failed to detect 1 case of cervical HSIL consisting of a single tumor fragment in a curettage.

Specimen Type	Overall Detection Failure Rate (% of cases)	Transected tissue at borders of sROI (% of cases)	Tissue/suspected tissue outside sROI (% of cases)	WSI consists of multiple scattered sROI (% of cases)
Endocervical curettage	75%	43%	69%	52%
Endometrial curettage/biopsy	24%	6%	23%	4%
Cervical biopsy	58%	4%	57%	1%
Omentectomy for gyn cancer staging (benign diagnosis)	60%	52%	43%	24%
Breast core biopsy (benign diagnosis)	41%	30%	33%	20%
Breast margins/excision/nodes (benign diagnosis)	30%	52%	33%	18%

Figure 1 - 2044

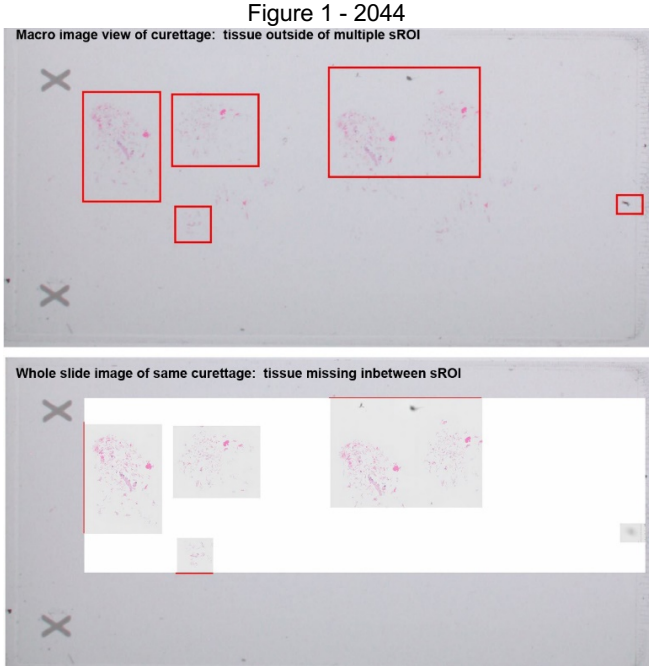
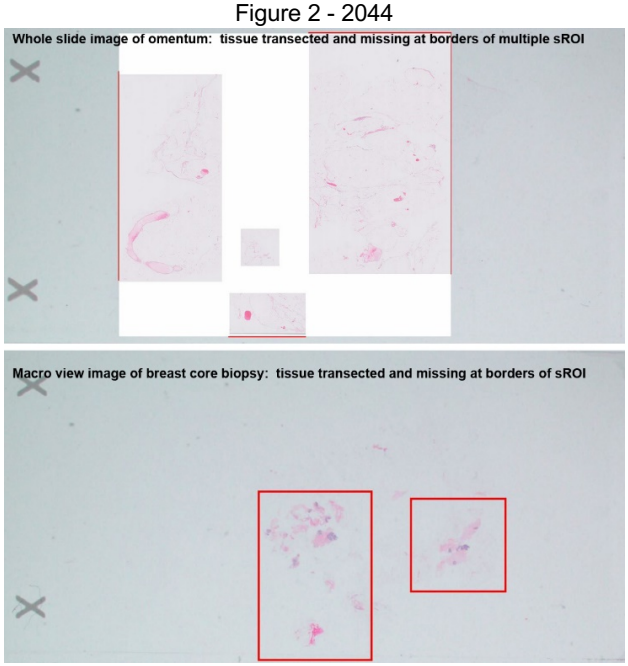


Figure 2 - 2044



Conclusions: The selective scanning algorithm of Philips DPIS has a high failure rate for tissue detection in predictable specimen types of a women's cancer pathology service. WSI of breast and endocervical specimens are often fragmented into multiple scattered fields (sROI) rather than a single WSI field for review. Furthermore, the Philips MSZ is not large enough for many specimen types. Conversion to glass slide review would be required for a high percentage of these breast and gyn cases to ensure that a small focus of cancer is not missed by WSI.

2045 Factors Affecting the Success of Clinically Relevant RNA Fusion Assays Using Next-Generation Sequencing

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Disclosures: Nisha Ramani: None; Mark Routbort: None; Keyur Patel: None; Hui Yao: None; Russell Broaddus: None; Hui Chen: None; Asif Rashid: None; Alexander Lazar: None; Jawad Manekia: None; Hyvan Dang: None; Geeta Mantha: None; L. Jeffrey Medeiros: None; L. Jeffrey Medeiros: None; Rajyalakshmi Luthra: None; Sinchita Roy-Chowdhuri: None

Background: RNA-based assays are being used with increasing frequency for the comprehensive molecular profiling of solid tumors. Drugs targeting fusion genes (e.g. *NTRK, ALK, ROS1* etc) have generated interest due to the therapeutic responses against these targets.

To optimize fusion detection in a next-generation sequencing (NGS)-based assay, we evaluated the factors impacting clinical assay performance.

Design: A retrospective review was performed to identify cases from January 1 through April 30, 2018 that were evaluated by targeted RNA-based NGS. RNA was extracted from formalin-fixed paraffin embedded (FFPE) sections and/or cytology smears containing at least 20% tumor using the AllPrep kit on a QIAcube liquid handling platform (Qiagen). cDNA prepared from extracted RNA was combined with targeted amplicon-based NGS to amplify a set of targeted fusion sequences corresponding to clinically relevant known inter- and intragenic fusions in 51 genes. Sequences were aligned against a synthetic fusion genome and fusions were identified by coverage analysis.

Results: The study included 773 patients with a median age of 65 (range 7-92) years and an equal male to female ratio. The samples included 496 in-house and 277 outside consultation/referral specimens, including 425 (55%) core biopsy specimens, 268 (35%) resection specimens, and 80 (10%) cytology samples. The median RNA yield was 0.06 (range, 0.002-0.53) µg/µL. The overall failure rate of RNA fusion testing was 9.1% (70 cases). Cytology cases had the lowest fraction of failures (6.2%). Failure rates in biopsy and resection specimens were 7.2% and 12.7%, respectively, and frequently in cases submitted from an outside institution (32% and 38%, respectively) (Table 1). In the cases that were successfully sequenced, 647/703 (92%) had no detectable fusions and 50/703 (7.1%) had fusions detected, 13 of which were confirmed by orthogonal studies (Table 1). RNA fusion testing success positively correlated with RNA yield ($p<0.00001$) and negatively correlated with the presence of necrosis and decalcification ($p<0.0001$).

Table 1. Next-Generation Sequencing-based RNA Fusion Assays in Solid Tumors

	Total **(n = 773)**	**Core biopsy (n=425)**	**Cytology** **(n=80)**	**Resection (n=268)**
RNA yield • Mean • Median (Range)	0.09 µg/µL 0.06 (0.002-0.5) µg/µL	0.07 µg/µL 0.04 (0.002-0.5) µg/µL	0.07 µg/µL 0.04 (0.002-0.4) µg/µL	0.15 µg/µL 0.15 (0.003-0.5) µg/µL
Canceled cases, n	6	3	3	0
Failed cases, n (%) • Outside cases • Decalcified • Necrosis	70 (9.1%) 23 (32.9%) 11 (15.7%) 7 (10%)	31 (7.2%) 10 (32.2%) 8 (25.8%) 1 (3.2%)	5 (6.2%) 0 0 1 (20%)	34 (12.7%) 13 (38.2%) 3 (8.8%) 5 (14.7%)
No fusion detected cases, n (%)	647 (92%)	367 (86.4%)	68 (85%)	212 (79.1%)
Fusion detected cases, n (%) • Confirmed by FISH IHC • Negative/indeterminate by FISH	50 (7.1%)	24 (5.6%) 6 *ALK* 2 *ROS1,* 1 *RET*	4 (5%) 0 1 RET	22 (8.2%) 1 *ALK,* 1 *ROS1* 1 *ALK*

Abbreviations: FISH, fluorescence in situ hybridization; IHC, immunohistochemistry

Conclusions: The success of RNA-based NGS testing is multifactorial and depends on the quality and quantity of RNA extracted. Identification of pre-analytical factors affecting nucleic acid quality and yield can improve testing success rates.

2046 Impact of a Cellular Concentration Method on Endocervical Curettage Specimen Adequacy

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Disclosures: Maximiliano Ramia de Cap: None; David Jou: None; Yigu Chen: None; Jonathan Hecht: None; Paul VanderLaan: None; Athena Chen: None

Background: The diagnostic sensitivity of endocervical curettage (ECC) is frequently limited by scant tissue and abundant mucus. We evaluated the performance of a cellular concentration processing method to improve diagnostic yield.

Design: A total of 1,319 patients underwent colposcopy with ECC at our institution between October 2018 and June 2019, inclusive, some with concurrent cervical biopsies. ECC specimens were assigned chronologically to one of two groups: Non-Concentrated ECC (NECC) or

Concentrated ECC (CECC). NECC specimens underwent routine histological processing after filtration through a mesh specimen bag. CECC specimens were centrifuged at 2000 rpm for 10 minutes; the sediment was transferred to a plastic mold (Tissue Path Disposable Mold, Thermo Fisher Scientific, Waltham, MA), embedded in HistoGel (Thermo Fisher Scientific), and then underwent routine histological processing. A diagnosis for each ECC +/- concurrent cervical biopsies was made by one of six gynecologic pathologists at our institution. A standard criterion for an adequate sample was not applied. Multivariate logistic regression analyses were performed to evaluate the impact of ECC processing methods on rate of discordance from prior Papanicolaou smears and non-diagnostic specimens (adequacy), respectively. Concurrent biopsy (yes/no) and patient age group (<45/>=45) were included in the regression models as control variables.

Results: ECC processing methods did not significantly impact either diagnostic discordance rate or specimen adequacy rate when controlled for other contributing factors (Table 1). Overall, the rates of ECC adequacy for NECC and CECC were 88.2% and 84.7%, respectively (p=0.06). In cases without concurrent biopsies, ECC adequacy for NECC and CECC were 83.1% and 80.1%, respectively. In patients who had a concurrent biopsy diagnosed as positive for a lesion, adequacy was 92.5% and 92.0% (p=0.87). In patients with a negative concurrent biopsy, adequacy was 90.4% and 85.3% (p=0.09).

Table 1. Multivariate logistic regression analyses comparing ECC processing methods.

Discordance from prior Papanicolaou smears: multivariate logistic regression model

Factors	OR (95% CI)	P value
ECC methods (Concentrated or Non-concentrated) ref= “Concentrated”	0.74 (0.51, 1.10)	0.11
ECC adequacy (“Yes” or “No”) ref = “No”	0.46 (0.29,0.73)	<0.01
Concurrent biopsy status (“Yes” or “No”) ref= “No”	0.65 (0.44, 0.94)	0.02
Age (“<45” or “>=45”) ref= “<45”	0.77 (0.52, 1.15)	0.20

Specimen adequacy: multivariate logistic regression model

Factors	OR (95% CI)	P value
ECC methods (Concentrated or Non-concentrated) ref= “Concentrated”	1.36 (0.98, 1.88)	0.06
Concurrent biopsy status (“Yes” or “No”) ref= “No”	1.76 (1.27, 2.44)	<0.01
Age (“<45” or “>=45”) ref= “<45”	0.39 (0.28, 0.55)	<0.01

Conclusions: The use of cellular concentration in processing ECC specimens decreased the rate of adequate specimens; however, this decrease was small and did not reach statistical significance. Limitations of this study include lack of adequacy criteria and use of sequential rather than split samples processed by the two methods.

2047 Pathologist-Verified Billing: Suboptimal Necessary Correction Rates Using Frozen Sections as a Proxy

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Disclosures: Cara Randall: None; Christine Bookhout: None

Background: With the adoption of EPIC / Beaker at our institution, specimens are assigned a charge code at the time of accessioning, and pathologists are responsible for verifying the accuracy of the code prior to case sign out. This study seeks to identify the frequency with which necessary changes were correctly made by the attending pathologist, using frozen section cases as a proxy (all of which are assigned a charge code of 88305 at the time of accessioning), as well as to estimate the financial impact of missed changes.

Design: All surgical pathology cases (with the exception of neuropathology and dermatopatology) sent for frozen section between June 2018 and December 2018 were identified. The cases were reviewed to determine whether the automatically assigned 88305 was the correct code for the specimen, in which case they were excluded from analysis. For cases where the final charge should not have been 88305, we assessed whether the sign out pathologist had made the correct changes. Data analysis was performed in aggregate as well as by individual pathologist (with 5 or more cases).

Results: A total of 2191 frozen section specimens were accessioned during the 7 month period. Of these specimens, 84% were correctly coded as 88305 at accessioning, and 16% (352) should not have been 88305 by final diagnosis. Of these 352 specimens, 348 should have been upgraded to 88307 or 88309, and 4 should have been downgraded to 88304. 195 (55%) had billing codes correctly changed by the attending pathologist, and 157 (45%) were not changed (149) or changed incorrectly (8). Individual pathologist change rates ranged from 0% to 100%, with a mean rate of 43%. Using average code reimbursements at UNC, the loss in revenue from the 157 missed and incorrect frozen section changes was $14,585 ($2083 per month).

By pathologist (≥ 5 cases):	Correct change	Not changed or incorrect	Total	Correct change rate (%)
1	52	0	52	100.0
2	3	26	29	10.3
3	21	1	22	95.5
4	57	9	66	86.4
5	0	24	24	0.0
6	1	11	12	8.3
7	0	17	17	0.0
8	25	4	29	86.2
9	4	6	10	40.0
10	1	7	8	12.5
11	12	9	21	57.1
12	1	8	9	11.1
13	7	22	29	24.0
14	6	0	6	100.0
15	1	7	8	12.5
				Overall: 42.9 (mean)
Low volume:				
LV1	0	3	3	0.0
LV2	0	1	1	0.0
LV3	0	1	1	0.0
LV4	2	2	4	50.0
LV5	0	1	1	0.0

Conclusions: Overall, attending pathologists had a suboptimal rate (55%) of correct billing code changes for frozen sections prior to sign out in our pathologist-verified billing system. Individual pathologist rates, however, showed that some pathologists did have a high rate of successful changes (up to 100%), indicating that with sufficient training, attention, and motivation, accurate pathologist-verified billing is possible. We used frozen section cases as a proxy for overall pathologist-verified billing; however, assigning codes by specimen type for other specimens is imperfect and the lost revenue from missed changes for our full case volume is almost certainly much higher than $2000 per month.

2048 To Flow or not to Flow: An Institutional Review of the Relevance of Flow Cytometry for the Diagnosis of Cutaneous T-Cell Lymphoma

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Disclosures: Daniel Reiter: None; Cassie Xu: None; Linh Ho: None; Joshua Wisell: None; Julie Rosser: None

Background: The histologic diagnosis of cutaneous T-cell lymphoma (CTCL) may be aided by the use of flow cytometry and/or with T-cell receptor gene rearrangement analysis by polymerase-chain reaction (PCR) studies. Although no specific guidelines are in place, at our institution if CTCL is clinically suspected, the sample is sent for all three diagnostic modalities (histology, flow cytometry, T-cell receptor gene clonality studies). Anecdotally, a significant proportion of flow results seemed diagnostically futile, likely due to low sample cellularity. We aimed to study the relevance of sending all clinically suspected CTCL skin biopsy specimens for flow cytometric evaluation.

Design: We reviewed the clinical data for all patients with clinically suspected CTCL from 2016 to 2018. We then compared the histologic diagnosis to the flow cytometry results to determine the utility of flow cytometry. We considered all confirmatory flow cytometry results (positive or negative histology with respective positive or negative flow cytometry), and all positive flow results with negative histologic diagnoses as valuable information for diagnosing CTCL. We considered flow cytometry results of indeterminate, hypocellular, and negative but with positive histologic diagnoses, as not valuable.

Results: A total of 76 cases of clinically suspected CTCL with flow cytometry results were reviewed. Twenty-two of these had flow results that were considered valuable (12 confirming a positive histologic diagnosis, and 10 confirming a negative histologic diagnosis). None of the flow cytometry results gave a positive result where histology was negative. Non-valuable flow cytometry results were found as follows: hypocellular (n=12), indeterminate (n=8), likely peripheral blood (n=11), and negative flow results but the histology was diagnostic of CTCL (n=23).

Conclusions: The majority of samples of clinically suspected CTCL resulted in a non-valuable flow cytometry result (a majority of which were due to sampling errors or indeterminate results). The diagnostic utility of sending all clinically suspected CTCL specimens for flow cytometry should be called into question.

2049 The Hunt for Lymph Nodes: Is Entire Submission of Periprostatic Fat Necessary?

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Disclosures: Martina Risech: None; Mohamad Gafeer: None; Ioannis Ioannidis: None; Aileen Grace Arriola: None

Background: The periprostatic fat (PF) can uncommonly contain lymph nodes (LN). At our institution, PF is routinely submitted as a separate specimen in radical prostatectomy (RP) cases and entirely submitted for histopathologic review. We reviewed our experience with this practice to see how frequently PF harbors LN, including LN with metastasis (+LN), and whether entire submission impacts patient management.

Design: Cases of RP with PF during the period of 1/1/12-6/28/19 were included. Pathology reports and slides (when available) were reviewed and information on LN status (both PF and pelvic LN dissection [PLND]), number of cassettes submitted for PF and PLND, number of palpable LN, and RP features such as Grade group (GG), extraprostatic extension (EPE), margin status, tumor volume (TV), bladder neck involvement, and seminal vesicle invasion (SVI) were recorded. Differences between categorical values were assessed by Fisher exact test and continuous values by student T-test.

Results: 770 cases were identified. PF LN were present in 21% (162/770), with LN ranging from 1-13, and were the only source of LN in 16(2%) cases (PLND not submitted). Less than half of PF LN were palpable (75/162, 46%). Number of blocks submitted for entire PF ranged from 1-40, showing a weak association between block total and LN yield (linear regression coefficient=0.009; R^2=0.0012). Only 12/162 (7%) cases contained +LN and most (8/12, 67%) were the only source of +LN for staging. Palpable PF +LN were typically larger than nonpalpable +LN (0.36cm vs. 0.22cm, p-value=0.3) in cases where slides were reviewed (n=8 of the 12 cases). LNs were not palable in 2 out of 3 cases with PF +LN. Finally, PF +LN cases were significantly associated with adverse pathology on RP such as EPE and SVI compared to those without +LN in PF, although, positive margin status was not (Table 1).

Table 1. Pathologic features based on lymph node (LN) status in periprostatic fat specimens.

	Positive LN in periprostatic fat (N=12)	**Negative LN in periprostatic fat (N=150)**	**p-value**
RP Margin status			0.2438
Negative	5 (42%)	89 (59%)	
Positive	7 (58%)	61 (41%)	
Extraprostatic extension			**0.0003**
Present	2 (17%)	106 (71%)	
Absent	10 (83%)	44 (29%)	
Seminal vesicle invasion			**0.0004**
Present	4 (33%)	125 (83%)	
Absent	8 (67%)	25 (17%)	
Bladder neck involvement			**0.0032**
Present	8 (67%)	140 (93%)	
Absent	4 (33%)	6 (4%)	
Unknown	0 (0%)	4 (3%)	
Grade group (mean)	3.2	2.3	**0.00659**
Tumor volume (mean)	42	25.8	**0.02060**

Conclusions: The periprostatic fat specimen submitted by our surgeons contain LN in up to 21% of cases. Although metastasis to these LN are an uncommon events seen in only 1.5% of our cases (12/770), the majority of +LN identified (67%, 8/12) only had +LN in the PF and not PLND, and 67% (2/3) of these PF +LN would have been missed if the specimen wasn't entirely submitted as they were not palpable. Despite this evidence the entire submission of PF impacts patient management in just a minority of cases (0.3%, 2/770). The cost of this practice and impact on pathologists' workload should be examined further.

2050 Discordance in Diagnosis of Melanocytic Lesions and its Impact on Management: A Melanoma Referral Center Experience with 1718 Cases

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Disclosures: Shira Ronen: None; Elizabeth Keiser: None; Rami Al-Rohil: None; George Jour: None; Priyadharsini Nagarajan: None; Michael Tetzlaff: *Speaker*, Nanostring; *Advisory Board Member*, Novartis LLC; *Advisory Board Member*, Myriad Genetics; *Advisory Board Member*, Seattle Genetics; Jonathan Curry: None; Doina Ivan: None; Carlos Torres-Cabala: None; Victor Prieto: None; Phyu Aung: None

Background: Melanoma is the most common among the fatal forms of skin cancer. Our institution routinely performs a second-opinion review of pertinent previous pathologic material on patients referred for further care. In this current study, we evaluated the extent of discordance between primary histopathologic diagnosis and secondary review of benign and malignant melanocytic lesions; parameters of melanoma, and the subsequent impact on clinical management and follow-up were reviewed.

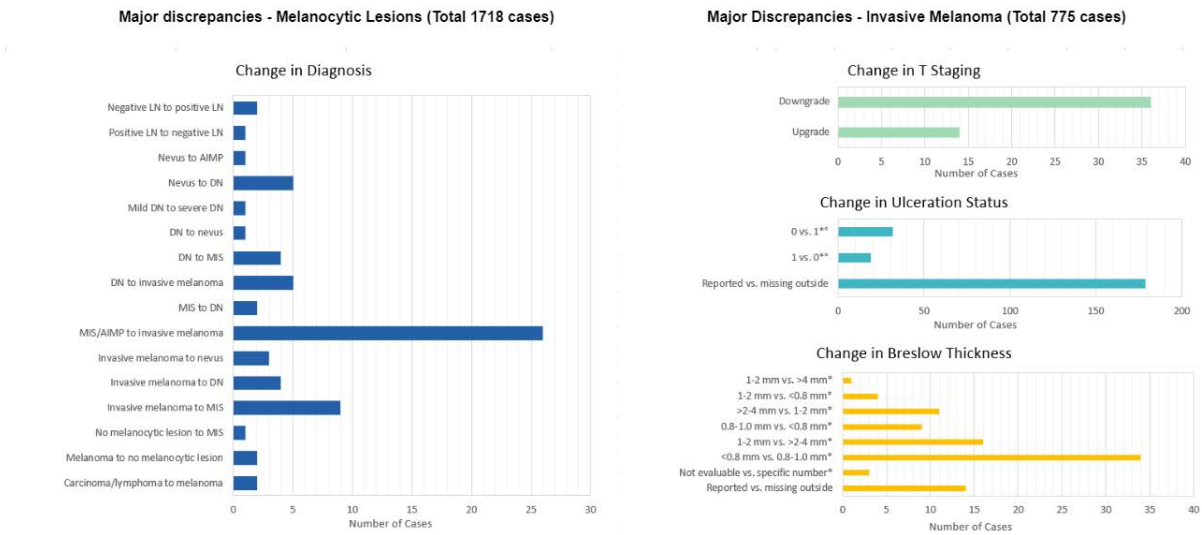
Design: In a retrospective review of 1718 referral cases of melanocytic lesions from 1/2010 to 1/2011, initial diagnoses from the outside institution were compared to second opinion reports. Consultation cases were excluded from the study. If the diagnosis was that of "invasive melanoma", the following parameters were collected: histologic type, Clark level, Breslow thickness, mitotic count, ulceration status, regression, lymphovascular invasion, perineural invasion, microsatellitosis, tumor infiltrating lymphocytes, associated nevus, and outcome. Discordance categories were classified as major or minor. Major discordance was defined as a change in the stage or diagnosis that would directly change the management. Minor discordance category included discrepancies that would not alter the stage or management.

Results: The final diagnoses were metastatic melanoma - 517 cases (30%), invasive melanoma - 808 cases (47%), melanoma in-situ (MIS) - 298 cases (17.3%), dysplastic nevus (DN) - 73 cases (4.2%), nevus - 19 cases (1.1%), and no melanocytic lesion seen – 3 cases (0.2%).

The concordance rates were as follows: for metastatic melanoma – 514 cases (99.4%), invasive melanoma – 775 cases (95.9%), MIS – 284 cases (95.3%), DN – 51 cases (69.8%), and nevus – 15 cases (78.9%).

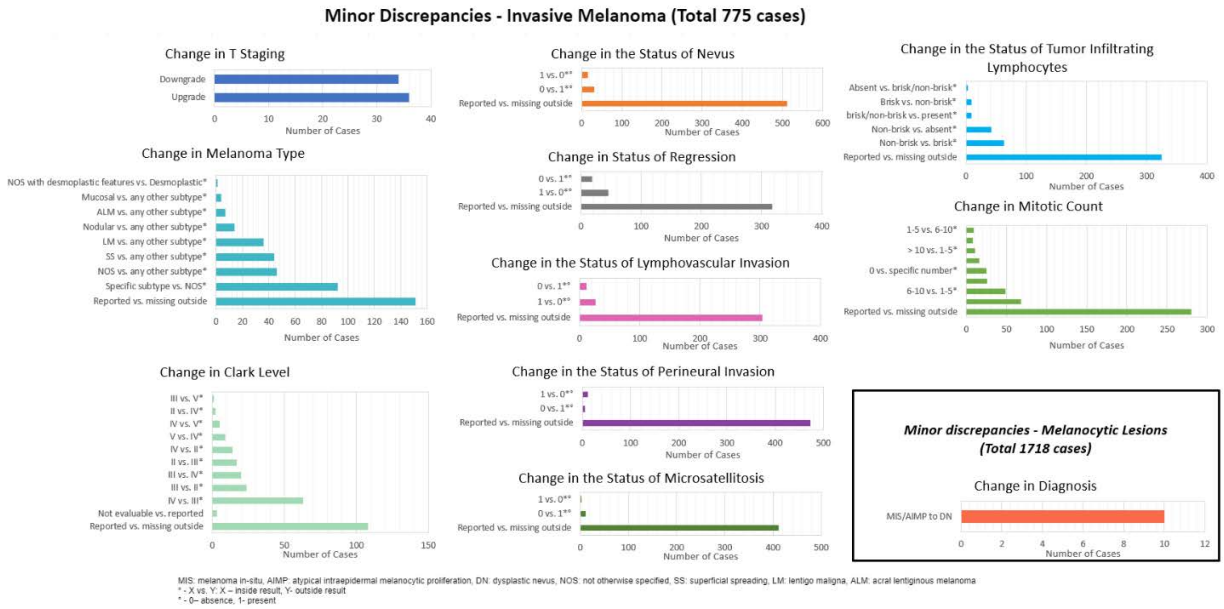
Major and minor discordances were found in 19.3% (n=332) and 42.7% (n=734), respectively (*Figures 1 and 2*). For major discordances, follow-up ranged between 0 to 114 months (mean 57.1 months). 140 (53.8%) patients showed no evidence of residual/recurrent or metastatic disease, 91 (35%) patients received other treatments besides surgery, and 86 (33%) patients died.

Figure 1 - 2050



MIS: melanoma in-situ, DN: dysplastic nevus, AIMP: atypical intraepidermal melanocytic proliferation, LN: lymph node
* - X vs. Y: X – inside result, Y- outside result
° - 0 – absence, 1- present

Figure 2 – 2050



Conclusions: Our study underscores the importance of secondary referral of melanocytic lesions for review by Dermatopathologists, since critical review of melanocytic lesions may lead to significant changes in the diagnosis of melanoma, tumor classification as well as staging, thus resulting in critical changes in clinical management and impacting patient survival.

2051 Dual Staining for Low Molecular Weight Keratin and D2-40 for Identification of Lymphatic Space Invasion

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Disclosures: Corwyn Rowsell: None; Hala Faragalla: None; Kiran Jakate: None; Shawn Winer: None; Shaheed Hakim: None; Janice Lage: None; Lananh Nguyen: None; Rola Saleeb: None; Catherine Streutker: None

Background: The presence or absence of lymphatic space invasion (LVI) is an important prognostic factor for most malignancies. Identification of lymphatic vessels and tiny clusters of malignant cells within them can be difficult in the background of elements such as inflammation, desmoplasia, retraction artifact and the presence of lymphoid cells or macrophages in the lymphatic spaces. The use of the D2-40 antibody allows more confident identification of lymphatic spaces, however there is still sometimes uncertainty as to whether the cells within are epithelial or not. We hypothesized that the use of a dual D2-40/low molecular weight keratin (LMWK) immunohistochemical stain would increase both the ease of identification of lymphatics as well as confidence in the presence or absence of LVI.

Design: Cases of malignancy with previous diagnosis of positive LVI were identified from the laboratory information system. Both the single D2-40 and dual D2-40/LMWK stain were performed on one block (Roche Podoplanin pre-dilute, Roche CAM 5.2, pre-dilute). 35 cases where LVI was present were used for the study (4 esophagus, 2 stomach, 14 colon, 4 uterus, 11 breast). Cases were semi-quantitatively scored by pathologists by ease of assessment for LVI (1=difficult, 2=moderate, 3=easy) and confidence in the diagnosis (1=not confident, 2=moderately confident, 3=confident). Pathologists were also asked which stain they preferred.

Results: For ease of interpretation, the average score was 2.46 for the single D2-40 stain compared to 2.64 for the dual stain (p value 0.05). For degree of confidence, the average score for the single stain was 2.64 compared to 2.76 for the dual stain (p value 0.11). With respect to which stain was preferred, the dual stain was favoured in 42.8% of reads, while the single stain was preferred in 14% of cases. In 34.2% of cases, the stains were felt to be equivalent. Reason for preference of the single stain over the dual stain was most often due to weaker staining of D2-40 in the dual stained slide.

Conclusions: The dual D2-40 keratin stain was found to have a greater ease of interpretation and was preferred in most cases, although it was not found to give a greater confidence in the diagnosis of LVI. The utility of the dual stain with greater ease and possibly shorter assessment time may balance out the greater cost of the dual stain, however the single D2-40 stain is clearly still effective.

2052 Implementation of a Daily Checklist to Monitor and Evaluate Sources of Errors During Intraoperative Consultations to Improve Patient Safety; Experience from a Large Tertiary Care Center

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Disclosures: Madhuchhanda Roy: None; Tieying Hou: None; Kaleigh Lindholm: None; Robin Norra: None; Arnold Dahay: None; Jo Ellen Atkins: None; Alejandro Contreras: None

Background: Intraoperative consultation (IOC) is a crucial component of surgical pathology practice as it helps to guide intraoperative clinical decision making. While much emphasis has been placed on identification of analytical components that result in errors, the contribution of the pre-analytical factors is often under-recognized in practice. We implemented a daily checklist in the frozen section (FS) laboratory specifically to identify and monitor the various pre-analytical components that contribute to errors. The aim was to educate the staff and modify the work flow in order to minimize errors and improve diagnostic performance.

Design: A daily FS checklist was developed and implemented to monitor metrics central to quality and safety during IOC. Data were collected between August 2018 and February 2019 including completion of checklist items and types of errors (technical, OR, grossing, pathology). These were reviewed daily by both the FS attending and the fellow. Data were shared with the staff who was then educated to be mindful of these errors and document as such. Follow-up data was then collected between March 2019 and August 2019 to compare and analyze any changes in error rate.

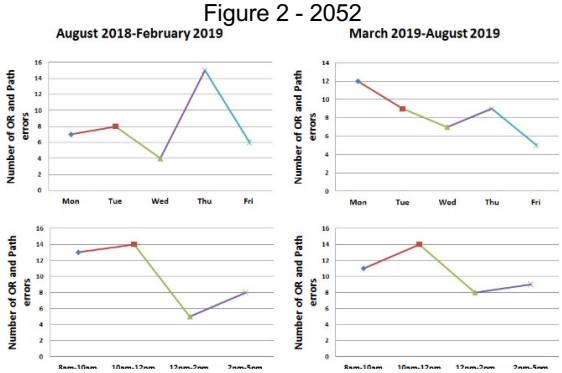
Results: FS laboratory evaluated a total of 12,203 slides between August 2018 and February 2019, and a total of 52 (0.43%) OR and pathology errors were identified (Figure 1). Analysis of the factors contributing to the errors indicated that these occur during the busiest OR days and busiest times of the day where multiple cases arrived at the FS laboratory simultaneously (Figure 2). Follow up data from March 2019 and August 2019 shows a similar trend: error rates continue to be higher on the busiest OR days and times of the day (Figure 2). Interestingly there was a slight increase in error rates, (0.57%), 59 errors were documented of 10,426 frozen section slides, likely due to the awareness amongst staff in documenting them. All of these errors were identified and corrected either before or during the time of slide review and no harm reached the patient.

Figure 1 - 2052

Errors	August	September	October	November	December	January	February	March	April	May	June	July	August
Technical	3	2	2	4	1	2	4	3	2	1	0	4	5
OR	4	0	4	3	0	1	4	4	2	6	6	1	5
Path	2	2	5	2	1	0	4	5	1	4	2	3	3
Grossing	0	2	0	0	0	0	0	0	0	1	1	0	0
	2018					2019							

Technical: Folds, shatter artifact in tissue
OR: Laterality, specimen label, orientation
Path: Accession, slide or block label
Grossing: Incorrect margins (en face margin instead of perpendicular)

Figure 2 - 2052



Conclusions: Implementation of a daily checklist in the FS laboratory helped identify the sources of error and develop awareness amongst the staff in the FS to minimize error and harm from reaching the patient. In addition, based on the observation that the highest error rates occurred during peak OR days as well as during the busiest times of the day, these data can help our laboratory to initiate staff scheduling changes in order to minimize errors.

2053 An Audit of Consult Practice in Gynecologic Pathology

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Background: Identification and classification of error in anatomical pathology is an essential part of quality assurance. Extradepartmental consultation requested by pathologists or confirmation of diagnosis before treatment decisions requested by clinicians is part of routine

practice of subspecialized pathologists. Study of pathologic characteristics, disease site and evaluation of concordance rate between original and final diagnosis in these cases is not only a quality assurance tool but also identifies challenging areas in pathology practice.

Design: All cases received during a six-month period for expert gyne-pathologist review either as “personal consultation” or “pretreatment review” were studied. Tissue characteristics were recorded. Expert pathologist diagnosis compared to the original diagnosis was categorized as “complete agreement” (same diagnosis), “minor disagreement” (same diagnostic entity with clinically inconsequential changes in details), and “disagreement” (different diagnostic entity or clinically important changes in details).

Results: Of 336 cases, 136 (40%) and 200 (60%) were personal consultations and pretreatment reviews, respectively, comprising of 62% biopsies and 38% resections. The most common disease site was endometrium (47%) followed by cervix (15%), ovary (11%), vulva (4%), myometrium (3%), etc. In general there was 22% disagreement rate between expert and original diagnosis. In the "personal consultation" category disagreement rate was 32% (44/136). Most frequent discordant final diagnoses were endometrial endometrioid carcinoma grade 1 (n=7) (mostly classified as atypical hyperplasia), non-hyperplastic endometrium (n=6) (classified as atypical hyperplasia), and atypical hyperplasia (n=4) (missed). Disagreement rate in the "pretreatment review" category was 15% (30/200). Discordant tumor type diagnosis accounted for 47% (14/30), mostly in cases of endometrial high grade carcinomas (8/14). Other disagreements involved determination of grade in endometrial carcinoma (4/30), depth of myometrial/cervical stromal tumor invasion (4/30), and vascular invasion (3/30).

Conclusions: We identified areas of diagnostic difficulty in gynecologic pathology the most common of which, interestingly in both "personal consult" and "'pretreatment review" categories, seems to be endometrial pathology. Addressing these challenges by extra training of pathologists and developing diagnostic guidelines are recommended to improve quality assurance and reduce error.

2054 Optimization and Cost Savings with Reduction of Negative Immunohistochemical Reagent Controls

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Background: Current tissue pathology diagnoses rely heavily on ancillary studies including immunohistochemistry. Like much of lab testing, immunohistochemistry requires both positive and negative controls on each tissue for every run when using the biotin-based methodology. However, with the advent of modern polymer-based detection, the College of American Pathologists (CAP) has acknowledged that this method is sufficiently free of background reactivity. Thus, negative reagent controls (NRC) may be omitted at the discretion of each lab following appropriate validation. After performing our own validation, we examined the cost and quality outcomes of optimizing our immunohistochemistry NRC.

Design: We recently transitioned to exclusively using polymer-based detection in our large academic care center that processes 100,000 immunohistochemistry orders per year. We developed a validation plan to discontinue the majority of NRC as permitted by the CAP Checklist. Based on faculty input, we eliminated automatic NRC orders for most antibodies except for *H. pylori*, Her2/neu, BRAF V600E, HHV8, spirochetes, toxoplasmosis, and herpes simplex and varicella viruses. Pathologists could still order an NRC for any block as needed. Following validation, we retrospectively examined quality metrics including cost, volume, and labor in the first quarter after implementation (July 7, 2019 to September 21, 2019) as compared to the corresponding weeks in 2018.

Results: We completed validation of 50 cases reviewed by pathologists to evaluate the NRC slides for background staining. All 50 samples lacked background staining or had expected endogenous pigment that matched the hematoxylin and eosin section. Based on reagent, instrument, and labor costs, we estimated saving $14.50 per NRC slide. In the first quarter after implementation, we reduced the number of immunohistochemistry NRC from 3,648 in 2018 to 731 in 2019, corresponding to an 80% decrease in NRC for that quarter. We extrapolated that this would save $200,015 and 345 labor-hours for our immunohistochemistry lab each year.

Conclusions: Elimination of a large majority of negative controls is both feasible and cost-effective in labs employing polymer-based detection. We found no difference in quality or accuracy of our diagnostic interpretation after selectively omitting NRCs in our practice. Applying this protocol can save substantial healthcare dollars and lab resources including diagnostic tissue, reagents, and both technologist and pathologist time and effort.

2055 Variation in Helicobacter Immunohistochemistry Utilization among Pathologists in Independent Pathology Practices

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Disclosures: Pooja Srivastava: None; Douglas Hartman: None; Jon Davison: None

Background: Experts recommend that immunohistochemistry (IHC), or other ancillary tests, be used to diagnose Helicobacter gastritis in select situations where recognizable patterns of inflammation and organisms are not observed on H&E stained sections. Universal ancillary testing is unnecessary because histologically 'normal' biopsies are almost never infected [PMID 24141174]. Based on these recommendations, we hypothesize that in pathology practices that do not perform universal or 'up front' testing, there will be significant variation in rates of IHC use among individual pathologists.

Design: We identified all gastric biopsies diagnosed during 2017 and 2018 in a group of 5 pathology practices by searching a centralized pathology electronic record. The 5 groups, located in the same city, include one subspecialized academic practice and 4 general practices. We coded each diagnosis for the presence or absence of Helicobacter gastritis based on a review of the diagnosis text. We also determined whether Helicobacter IHC was utilized in each case. We calculated Helicobacter gastritis diagnosis rates as well as the following IHC usage statistics for each individual pathologist: (1) the fraction of all gastric biopsies for which IHC was performed; (2) the fraction of Helicobacter negative biopsies for which IHC was used; (3) and the fraction of Helicobacter positive biopsies for which IHC was used.

Results: There was a total of 22,551 gastric biopsy cases in the cohort, with per hospital case volume ranging from 2581 to 9639 cases. Overall, diagnoses of Helicobacter gastritis were made in 5.6% (1262/22551) of cases, ranging from 3.9% to 6.7% across hospitals. Limiting the analysis to pathologists who practiced in each institution for all of 2017-2018, we found evidence of significant variation with respect to all IHC usage measures (Figure 1). Significant variation in the rate of diagnosis of Helicobacter gastritis was seen only among subspecialists.

Figure 1 - 2055

Table 1: Helicobacter IHC Utilization Frequency in Gastric Biopsies of Five Independent Pathology Practices

	IHC Utililzation Rate* in Helicobacter Negative Cases		IHC Utililzation Rate* in Helicobacter Positive Cases		IHC Utililzation Rate* in All Cases		Helicobacter Gastritis Diagnosis Rate**	
Pathology Practice***	n/total (%)	P-value	n/total (%)	P-value	n/total (%)	P-value	n/total (%)	P-value
Subspecialist								
Pathologist_1	304/1290 (23.6)	10(-84)	16/68 (23.5)	10(-20)	320/1358 (23.6)	10(-70)	68/1358 (5)	0.001
Pathologist_2	324/1167 (27.8)		23/64 (35.9)		347/1231 (28.2)		64/1231 (5.2)	
Pathologist_3	247/1730 (14.3)		94/101 (93.1)		341/1831 (18.6)		101/1831 (5.5)	
Pathologist_4	480/1275 (37.6)		36/83 (43.4)		516/1358 (38)		83/1358 (6.1)	
Pathologist_5	439/1008 (43.6)		40/67 (59.7)		479/1075 (44.6)		67/1075 (6.2)	
Pathologist_6	494/1283 (38.5)		44/88 (50)		538/1371 (39.2)		88/1371 (6.4)	
Pathologist_7	200/668 (29.9)		45/71 (63.4)		245/739 (33.2)		71/739 (9.6)	
General SP 1								
Pathologist_8	117/775 (15.1)	10(-78)	27/27 (100)	10(-28)	144/802 (18)	10(-89)	27/802 (3.4)	0.818
Pathologist_9	81/874 (9.3)		3/35 (8.6)		84/909 (9.2)		35/909 (3.9)	
Pathologist_10	112/667 (16.8)		28/28 (100)		140/695 (20.1)		28/695 (4)	
Pathologist_11	300/838 (35.8)		38/38 (100)		338/876 (38.6)		38/876 (4.3)	
Pathologist_12	21/753 (2.8)		4/35 (11.4)		25/788 (3.2)		35/788 (4.4)	
General SP 2								
Pathologist_13	719/862 (83.4)	10(-20)	53/53 (100)	1	772/915 (84.4)	10(-21)	53/915 (5.8)	0.151
Pathologist_14	719/738 (97.4)		60/60 (100)		779/798 (97.6)		60/798 (7.5)	
General SP 3								
Pathologist_15	386/2002 (19.3)	0.006	35/110 (31.8)	0.93	421/2112 (19.9)	0.009	110/2112 (5.2)	0.877
Pathologist_16	204/1315 (15.5)		24/74 (32.4)		228/1389 (16.4)		74/1389 (5.3)	
General SP 4								
Pathologist_17	58/1135 (5.1)	10(-9)	39/78 (50)	0.001	97/1213 (8)	0.00005	78/1213 (6.4)	0.354
Pathologist_18	99/779 (12.7)		15/63 (23.8)		114/842 (13.5)		63/842 (7.5)	

** IHC utilization rate: fraction of cases that involved the use of IHC*
***Helicobacter gastritis diagnosis rate: fraction of cases diagnosed with Helicobacter gastritis, regardless of method (H&E only; H&E with IHC)*
****Pathology practice: one subspecialized GI group; 4 general surgical pathology groups*
P-values are calculated by chi-squared test for each subtable.

Conclusions: We observed highly significant variation in IHC utilization among individual pathologists within independent pathology groups. Variation in IHC utilization in a low risk patient population may not be reflected in variation in Helicobacter diagnosis frequency.

2056 Comparing Prostate Cancer Area Assessment in Radical Prostatectomy between Visual Assessment by Pathologists and Computer Assisted Tumor Mapping in Digital Slides

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Disclosures: Alexander Tang: None; Lo Wing Anthony: None; Johann Lok: None; Tiffany Lau: None; Raiden Wong: None; Kwok Wah Chan: None

Background: Prostate cancer reporting guideline of the CAP requires reporting of the percentage of tumor volume in radical prostatectomy. Visual inspection by pathologist has been reported to be the commonest method of assessment, despite its subjectivity and presence of inter-observer variation. Assessment of percentage of tumor area in individual slide is basic to subsequent tumor volume assessment. With recent advance in digital pathology and availability of high-speed slide scanners, this pilot study aims at comparing assessment results of tumor area percentage by visual assessment amongst pathologists versus computer assisted tumor mapping in scanned digital slides.

Design: 30 microscopic slides with prostatic acinar adenocarcinoma from 9 radical prostatectomy specimens were selected. Tumor involvement ranged from tiny tumor focus to diffuse tumor infiltration. 4 attending pathologists with a special interest in urologic pathology and 4 residents independently performed visual assessment of tumor area percentage. These slides were scanned by NanoZoomer S210 digital slide scanner (Hamamatsu). Tumor mapping and area assessment of the digital slides were independently performed by 2 attending pathologists using QuPath (Version: 0.1.2; Bankhead, P. et al. QuPath: Open source software for digital pathology image analysis. Scientific Reports (2017)) computer software (Figure 1). The results were statistically analyzed using SPSS 25.0 (IBM).

Results: The median tumor area assessment by visual assessment of pathologists was statistically significantly higher than that of tumor mapping of digital slides using computer software (Figure 2, Wilcoxon Signed-Ranks Test, $Z = 463.00$, $p<0.001$). The mean tumor area assessment of individual slide was higher by visual assessment amongst pathologists in 29 of the 30 slides (see Table), and was statistically significant in 21 slides (2-tailed t test, $p<0.05$). 10 slides show mean difference of area assessment of more than 10%. No statistically significant difference in mean visual assessment of tumor area was observed between attending pathologists and residents in all 30 slides (2-tailed t test, $p>0.05$).

Table – Prostate tumor area percentage assessment by pathologists' visual assessment and tumor mapping using QuPath computer software

	Pathologist visual assessment Mean +/- SD (%)	Tumor mapping using QuPath software Mean +/- SD (%)	Mean Difference	p value
Slide 1	80.51 +/- 7.17	65.95 +/- 2.71	14.47	**0.005**
Slide 2	43.49 +/- 7.93	29.32 +/- 0.35	14.17	**0.001**
Slide 3	4.73 +/- 2.46	5.05 +/- 3.39	-0.325	0.916
Slide 4	4.50 +/- 4.35	1.89 +/- 0.25	2.61	0.134
Slide 5	32.68 +/- 5.86	22.84 +/- 0.50	9.83	**0.002**
Slide 6	27.31 +/- 4.77	22.83 +/- 0.57	4.48	**0.034**
Slide 7	13.14 +/- 4.04	6.37 +/- 4.05	6.77	0.206
Slide 8	39.13 +/- 3.87	32.21 +/- 0.89	6.92	**0.002**
Slide 9	1.68 +/- 1.50	0.37 +/- 0.70	1.31	**0.043**
Slide 10	2.89 +/- 1.29	1.75 +/- 0.13	1.14	**0.042**
Slide 11	22.71 +/- 6.60	18.2 +/- 0.36	4.51	0.095
Slide 12	61.09 +/- 12.28	34.77+/- 0.12	26.32	**0.001**
Slide 13	22.41 +/- 5.40	16.36 +/- 0.47	6.05	**0.016**
Slide 14	1.41 +/- 0.78	0.32 +/- 0.04	1.09	**0.005**
Slide 15	6.73 +/- 4.97	1.18 +/- 0.45	5.55	**0.016**
Slide 16	44.90 +/- 7.88	24.41 +/- 0.80	20.50	**<0.001**
Slide 17	15.60 +/- 5.35	5.23 +/- 2.99	10.38	**0.036**
Slide 18	77.71 +/- 8.24	58.89 +/- 4.17	18.81	**0.015**
Slide 19	75.20 +/- 6.32	63.86 +/- 4.07	11.35	0.069
Slide 20	11.20 +/- 4.54	6.93 +/- 1.52	4.28	0.068
Slide 21	4.61 +/- 1.19	1.96 +/- 0.36	2.65	**0.001**
Slide 22	0.66 +/- 0.61	0.59 +/- 0.68	0.073	0.907
Slide 23	13.99 +/- 3.76	9.87 +/- 0.75	4.12	**0.021**
Slide 24	8.54 +/- 3.45	4.34 +/- 1.21	4.20	**0.032**
Slide 25	41.18 +/- 6.29	29.15 +/- 2.71	12.03	**0.012**
Slide 26	42.64 +/- 14.89	31.53 +/- 1.09	11.11	0.074
Slide 27	24.25 +/- 4.62	19.72 +/- 0.43	4.55	**0.027**
Slide 28	52.25 +/- 18.38	34.37 +/- 0.92	17.78	**0.029**
Slide 29	10.19 +/- 5.93	2.14 +/- 0.52	8.05	**0.006**
Slide 30	30.47 +/- 4.96	25.85 +/- 1.77	4.62	0.078

Figure 1 - 2056

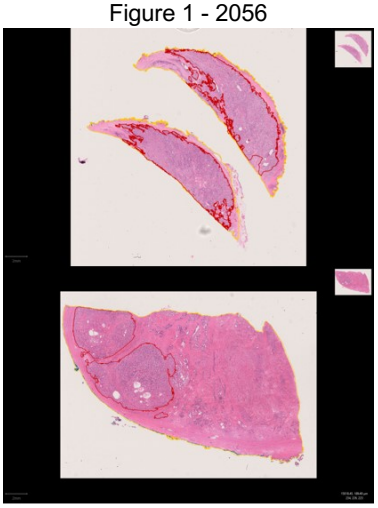
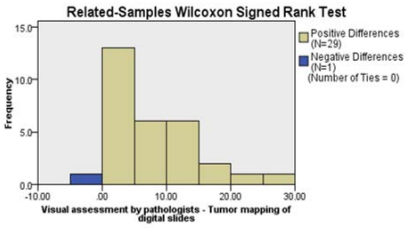


Figure 1: Prostate cancer tumor mapping by QuPath software (Red: Tumor; Yellow: Total area)

Figure 2 - 2056



Total N	30
Test Statistic	463.000
Standard Error	48.618
Standardized Test Statistic	4.741
Asymptotic Sig. (2-sided test)	.000

Figure 2: Median tumor area percentage between tumor mapping of digital slides and visual assessment by pathologists

Conclusions: In this pilot study, visual tumor area assessment by pathologists in radical prostatectomy results in significantly higher tumor area percentage estimation than tumor mapping of digital slides. This suggests the need for objective measurements including the use of image analysis in prostate cancer quantification in radical prostatectomy.

2057 Breast Lesions of Uncertain Malignant Potential (B3): A Study on Upgrade Rates and Utility of Vacuum-Assisted Biopsy in a Specialized Hospital over a 4 Year Period

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Background: The core needle biopsy (CNB) is an integral part of breast cancer screening. A proportion of these biopsies are classified as "lesions of uncertain malignant potential" (B3). This category comprises a heterogenous group of entities and the management of these lesions has been controversial. Vacuum-assisted biopsy (VAB) of the breast achieves a larger volume sampling, and hence a more representative sample. The utility of VAB and the comparison between different gauge sizes have been a topic of discussion. The aims of this retrospective study are to assess the upgrade rates of B3 lesions (excluding cellular fibroepithelial lesions, CFEL), and to compare the rates between the different biopsy methods and needle gauge sizes.

Design: We retrieved all breast biopsies performed at KK Women's and Children's Hospital (KKH), Singapore, from Jan 2015 to Dec 2018, with the diagnostic classification of B3. A total of 1151 cases were identified, of which cases with no surgical excision (n = 315) and cases diagnosed as CFEL (n = 396) were excluded. The remaining 440 biopsies and their respective surgical excisions were reviewed.

Results: A pathologic upgrade was defined as a diagnosis of ductal carcinoma in-situ, invasive ductal carcinoma or invasive lobular carcinoma in the surgical excision specimen. The total incidence of pathologic upgrade was 38 out of the 440 cases (8.64%). The diagnostic categories and the upgrade rates of the cases are shown in Figure 1.

98 out of the 440 cases were VAB and the remaining 342 were CNB. All VAB cases were done on lesions showing calcifications. The incidence of pathologic upgrade among the VAB cases was 12 out of 98 (12.24%) and that among CNB cases was 26 out of 342 (7.60%). The gauge needle sizes used in the VAB cases and the upgrade rates of the cases are shown in Figure 2.

Figure 1 - 2057

TABLE 1. *Number of cases in each diagnostic category, the incidence of upgrade and the upgrade rate for each category*

Diagnostic categories	Number of cases	Incidence of upgrade	Upgrade rate (%)
Papillary lesion	164	7	4.27
ADH	101	18	17.82
RS/CSL	84	3	3.57
FEA	47	3	6.38
LN	28	6	21.43
MLL	10	1	10
Spindle cell lesion	6	0	0
Total	440	38	8.64

ADH indicates atypical ductal hyperplasia; RS/CSL, radial scar or complex sclerosing lesion; FEA, columnar cell change with atypia or flat epithelial atypia; LN, lobular neoplasia; MLL, mucocele-like lesion.

Figure 2 - 2057

TABLE 2. *Gauge needle sizes used in the VAB cases, the incidence of upgrade and the upgrade rate for each size*

Gauge needle size	Number of cases	Incidence of upgrade	Upgrade rate (%)
8-gauge	23	3	13.04
11-gauge	71	8	11.27
Other sizes*	4	1	25
Total	98	12	12.24

*The other sizes used in the small proportion of cases were 10-gauge and 14-gauge.

Conclusions: Our overall upgrade rate was lower than that seen in most literature (a meta-analysis by Forester ND in April 2019 showed a rate of 17%), possibly due to differences in case mix as KKH is not a screening center and the patients present symptomatically. Higher upgrade rates were noted in cases classified as ADH and LN, thus suggesting that such cases should be surgically excised. The higher upgrade rate of VAB as compared to CNB might be due to the fact that VAB was preferentially used in cases with calcifications at our institution. Also, the higher upgrade rate of larger needle gauge sizes could be due to a larger number of cores taken when a smaller needle size was used.

2058 Elastic Staining in the Detection of Venous Invasion in Patients with Colorectal Cancer: A Single Center Quality Improvement Project

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Disclosures: Dalila Villalobos: None; David Hurlbut: None; Mark Schneider: None; Sonal Varma: None; Tao Wang: None; Andrea Grin: None

Background: Venous invasion (VI) in colorectal cancer (CRC) is an independent adverse prognostic factor and a risk factor for distant metastases. Studies have shown that VI is underreported and the use of elastic stains increases VI detection rate 2- to 3- fold in comparison to hematoxylin and eosin (H&E) alone. Proponents advocate for routine elastic stains in all CRC cases, however increased cost and technologist workload are cited as some of the limitations. In this quality improvement project we sought to improve the VI detection rate within our Department with the selective use of elastic stains.

Design: In March 2019, after attending an educational session reviewing the morphologic clues of VI, there was an agreement among gastrointestinal pathologists (GI) that elastic stains (elastic trichrome or Movat) would be performed on at least 2 tumor-containing blocks per case if VI was not detected on routine stains. Prior to this intervention, the practice amongst GI pathologists was varied. Pathology reports from April to December 2018 (n=130) and from April until August 2019 (n=67) were reviewed for the reporting of VI, as well as other synoptic reporting elements including small vessel lymphatic invasion (SVLI). Descriptive data and comparative analysis were performed using the SPSS statistical software program.

Results: There was an overall increase of VI detection rate from 22% to 46% (adjusted odds ratio [OR], 11.9; 95% confidence interval [CI], 10.1 to 37.3; p<0.001). Use of elastic stains was significantly higher, from 25% to 49% of cases (adjusted OR, 11.2; 95% CI, 9.7 to 37.3; p<0.001) and the number of tumor-containing blocks in which stains were performed also increased from a median of 2 to 3 blocks per case (p<0.001). However, the detection rate of VI was not significantly associated with the number of elastin-stained blocks (r=9.05; p=0.3). A reduction in the overall rate of SVLI was found, from 23% to 8% (adjusted OR, 16.2; 95% CI, 14.1 to 33.9; p<0.001).

Conclusions: The combination of increased awareness of the morphologic clues of VI and selective increased elastic staining was associated with a significant increase in the VI detection rate at our institution. Careful selection of blocks for elastic stains may be a feasible alternative to routine staining in resource limited settings. The reduced reporting of small vessel invasion may be explained as increased detection of VI over SVLI when elastic stains are used.

2059 Interpretation According to the Cut-Offs by PD-L1 Clones Reveals Better Concordance in Muscle-Invasive Urothelial Carcinoma

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Disclosures: Yeh-Han Wang: None

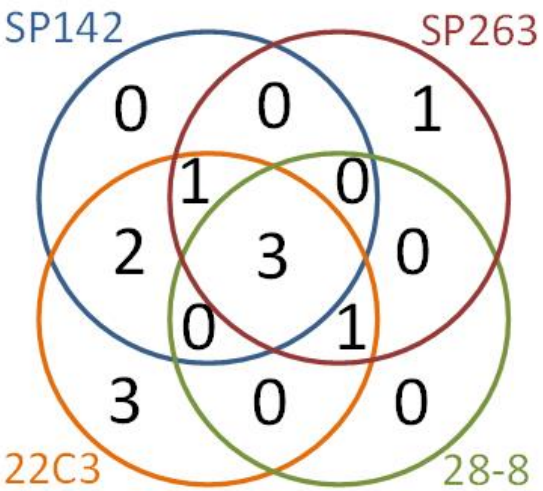
Background: Given different criteria of the measurement of PD-L1 immunohistochemical (IHC) staining in urothelial carcinoma (UC), it is difficult to harmonize this testing across clones (SP142, SP263, Dako 22C3 and 28-8). Since PD-L1 IHC is currently a companion test for the use of the 1st-line immune checkpoint inhibitor, this study aims to investigate the expression and concordance between PD-L1 in UC, providing a possible strategy for harmonization in clinical settings.

Design: A total of 43 cases of muscle-invasive UC was retrieved from the in-house archive, including specimens of either cystectomy or transurethral resection of bladder tumor (TURBT). IHC staining of PD-L1 with four clinical-use clones was applied on tissue microarrays (TMA), which contain two tissue cores of 2 mm diameter for each case. The PD-L1 expression on tumor cells (TCs) and immune cells (ICs) were both recorded according to the measuring protocols of each clone. The variation of expression is analyzed using one-way ANOVA on both TCs and ICs. Given the different cut-off values for positivity by clones (SP142: ICs >=5%; SP263: TCs or ICs >=25%; 22C3: TCs+ICs (i.e. combined positive score, CPS) >10; 28-8: TCs >=5%), the overall and pairwise concordance in positivity was analyzed using Fleiss's kappa and Cohen's kappa coefficient, respectively.

Results: The positive rate of PD-L1 IHC in muscle-invasive UC ranges from 9.3% (4/43) (clone 28-8) to 23.3% (10/43) (22C3). Among the ten positive cases, three (30%) express PD-L1 by all the 4 clones. The distribution of positive cases by clones is demonstrated in Figure 1. The expression on TCs and ICs reveals a significant difference between PD-L1 (p=0.023 in TCs, p<0.05 in ICs). However, the pairwise comparison of positivity by clones reveals moderate concordance, ranging from 0.51 to 0.77, while the overall concordance is 0.61 (Table 1).

PD-L1 clones	SP142	SP263	22C3	28-8
SP142	1			
SP263	0.61 (0.27-0.96	1		
22C3	0.70 (0.43-0.97)	0.55 (0.23-0.86)	1	
28-8	0.55 (0.6-0.94)	0.77 (0.48-1)	0.51 (0.19-0.82)	1

Figure 1 - 2059



Conclusions: The interpretation according to different cut-offs of the four companion PD-L1 IHC stains reveals better concordance given more discrepant numeric results of the expression on TCs and ICs in UC cases. The finding suggests a new way of harmonization of these companion test in the future scheme for better and more cost-effective patient selection.

2060 Wrong Tissue in Block: Grossing Gone Wrong can be Made Right by Tailored Informatics Solutions

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Disclosures: Kaitlin Weaver: None; Melanie Zona: None; Robert Seifert: None; Ashwini Esnakula: None

Background: Maintaining specimen identity during surgical pathology tissue processing is crucial for quality patient care and safety. We recently implemented Epic Beaker Laboratory Information System (LIS) (Verona, WI, USA) which utilizes a 2D barcode to ensure specimen identity. A supplementary step of block confirmation that requires sequential scanning of the specimen label and grossed cassettes ensures correct pairing of patient tissues and blocks. We report our institution's experience with wrong tissue in block (WTIB) grossing before and after adapting a "hard stop" feature to block confirmation step based on our workflow.

Design: During the first 18 months of Beaker application, block confirmation was not required. Due to frequent WTIB errors, we mandated block confirmation usage for a three-month period. To further ensure compliance, we collaborated with our information technology department to build a "hard stop" feature into the block confirmation step that prevents a grosser from scanning any non-confirmed blocks on a packing list to the off-site histology lab and this has been in place for last 13 months. For added quality control, custom logic was built for the histology lab Beaker interface to prevent processing of un-packed blocks. The WTIB incidents from before and after implementation of these features were reviewed.

Results: Before mandating block confirmation, we had 14 WTIB incidents. During the three-months of mandated block confirmation use, we had one WTIB incident where the block confirmation step was not performed. After implementation of the hard stop feature, there were 2 WTIB incidents where grossers did not follow protocol. The first grosser simultaneously grossed two parts and neglected sequential scanning. The second grosser ignored pop-up warnings during block confirmation and packing list creation, and tissue was placed into a block from another case that had been already submitted to histology.

Conclusions: Beaker LIS is a highly customizable platform that can be tailored to a lab's workflow and needs. When executed properly, block scanning and confirmation is an invaluable tool that can markedly decrease WTIB errors. We further maximized the program's safeguarded capabilities with the design and implementation of the custom-built hard stop, and in conjunction with the reciprocal quality control features, there is potential to eliminate WTIB errors altogether when protocol is properly followed.

2061 Effusion Cytology Specimens: Cytopathologist Utilization of Indeterminate Categories

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Disclosures: Yubo Wu: None; Athena Chen: None; Athena Chen: None; Athena Chen: None; Athena Chen: None; Paul VanderLaan: None; Liza Quintana: None

Background: The forthcoming International Guidelines for Reporting Serous Fluid Cytology will set criteria for negative for malignancy (NFM), atypia of undetermined significance (AUS), suspicious for malignancy (SFM), and malignant diagnostic categories. These categories are similar to those currently used at our institution. As yet there are no guidelines regarding use of the indeterminate (IND) categories AUS and SFM, e.g., benchmark rates of use, we evaluated our recent experience with IND diagnoses. In particular, we were interested in evaluating individual cytopathologist (CP) practices – whether there were differences in frequency of IND diagnoses and whether these could be related to level of experience and/or frequency of immunohistochemistry (IHC) use.

Design: All effusion fluid cytology specimens (pleural, peritoneal/ascites, and pericardial) from 2017-2018 at our institution were identified. Specimen characteristics were noted. For each case, diagnosis, which CP made the diagnosis, and whether IHC was performed were recorded. We calculated IND to malignant ratios for each CP.

Results: 2665 effusion fluid specimens were identified (1663 pleural, 856 peritoneal, and 146 pericardial), of which 2663 had ThinPrep (TP) slides (the other 2, which were malignant, had cytospin slides made in Hematology) and 2340 had cell blocks. The median specimen volume was 120 mL (range 0.05-6700).

Distribution of diagnostic categories used by CPs and IHC usage by CPs are summarized in Table 1 and Figure 1. CPs 1-4 have 0-7 years of experience (first year of practice for CP 1) and CPs 5-8 have >20 years. Overall 6.7% of all cases were diagnosed as IND. Frequency of

IND diagnoses did not depend on experience (p=0.37; two-tailed t-test 0-7 years of experience vs. >20 years, excluding CP 1 due to limited number of cases diagnosed independently following on-boarding process). CP IND:malignant ratios varied from 0.17-0.70 for CPs 2-8 and did not appear to be related to experience. IHC use varied depending on experience for NFM diagnoses only (p=0.01; two-tailed t-test), with greater IHC use by CPs 2-4.

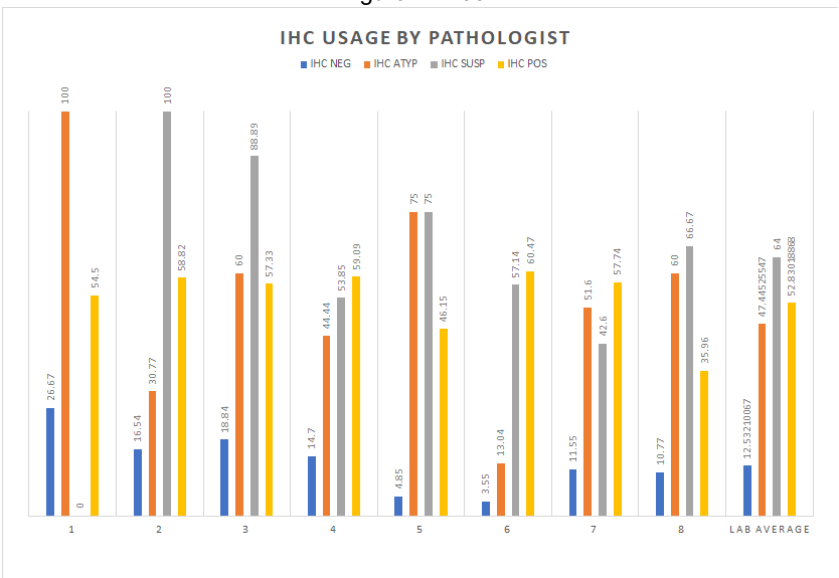
Table 1. Frequency of use of diagnostic categories and indeterminate (IND):malignant ratios for each cytopathologist, in order of experience.

	Cytopathologist								
	1*	2	3	4	5	6	7	8	Lab
NFM	15 (55.6%)	271 (73.2%)	345 (75.9%)	265 (70.7%)	206 (81.4%)	169 (69.8%)	249 (69.6%)	427 (72.9%)	1947 (73.1%)
AUS	1 (3.7%)	13 (3.5%)	25 (5.5%)	9 (2.4%)	4 (1.6%)	23 (9.5%)	31 (8.7%)	31 (5.3%)	137 (5.1%)
SFM	0 (0%)	1 (0.3%)	9 (1.9%)	13 (3.5%)	4 (1.6%)	7 (2.9%)	7 (1.9%)	9 (1.5%)	50 (1.9%)
Malignant	11 (40.7%)	85 (22.9%)	75 (16.5%)	88 (23.5%)	39 (15.4%)	43 (17.8%)	71 (19.8%)	118 (20.2%)	530 (19.9%)
Total cases	27	370	454	375	253	242	358	585	2664
IND:malignant ratio	0.09	0.17	0.45	0.25	0.21	0.70	0.54	0.34	0.35

Abbreviations: NFM – negative for malignancy, AUS – atypia of undetermined significance, SFM – suspicious for malignancy.

*Note: First year of practice for CP 1, with limited number of cases diagnosed independently following on-boarding process.

Figure 1 - 2061



Conclusions: Generally, we did not find an effect of experience or IHC use on rates of IND diagnosis. We wonder if use of IND categories could be related to other pathologist factors. Less-experienced CPs did use more IHC on NFM cases, suggesting a lower threshold for detecting cytologic atypia. IND:malignant ratios varied widely.

2062 Molecular Pathology Algorithm for Melanoma Reduces Time to BRAF Results by 68 Days

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Disclosures: Yaolin Zhou: None; Sepideh Asadbeigi: None

Background: Patients with metastatic melanoma need *BRAF* testing for treatment decision making. *BRAF* kinase inhibitors are highly effective for advanced melanoma; however, treatment decisions can be delayed if *BRAF* molecular results are not immediately available. Through collaborative efforts, we created a reflexive algorithm for testing *BRAF* on metastatic melanoma specimens.

Design: Previously, *BRAF* orders were only initiated by the melanoma oncologist, rather than reflexively ordered by the surgical pathologist (Figure 1). Our surgical pathologists were unclear when *BRAF* testing should be ordered and were hesitant to order *BRAF* unnecessarily. Starting in late 2016 and early 2017, we began a series of conversations with our ordering clinicians and the surgical pathologists who most frequently diagnosed metastatic melanoma. Through increased dialogue, we were able to agree upon an algorithm whereby surgical pathologists reflexively order *BRAF* on all patients with unresectable or metastatic melanoma (Figure 1), and the clinicians would notify surgical pathology if they became aware of a patient who does not need *BRAF* testing.

Results: Prior to 2017, it took an average of 79 days (n=150, median 14, mode 8) from time of specimen collection (or receipt by surgical pathology) to receipt by our affiliated academic molecular pathology laboratory. After our intervention, it took an average of 11 days (n=85, median 6, mode 6) (p=0.002), which likely represents the time for a pathologist to confirm metastatic melanoma. The 8 cases (8/85=9.4%) with TAT >20 days included 7 (87.5% of delayed cases, 8.2% of total) signed out by pathologists less familiar with the workflow. Four cases (50%; 4.7%) required further workup to confirm metastatic melanoma, likely contributing to delays. The 3 pathologists who had the highest number of cases also had greatest familiarity with the workflow and lower TAT (Figure 2).

Figure 1 - 2062

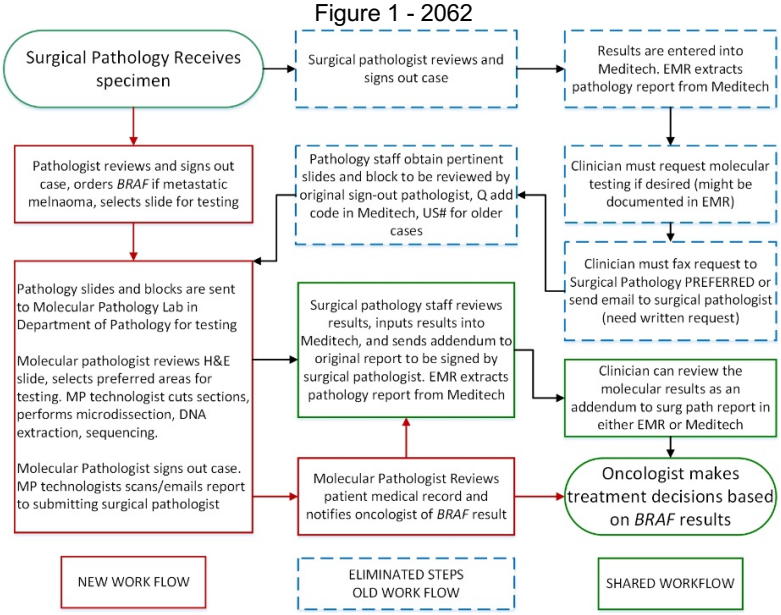
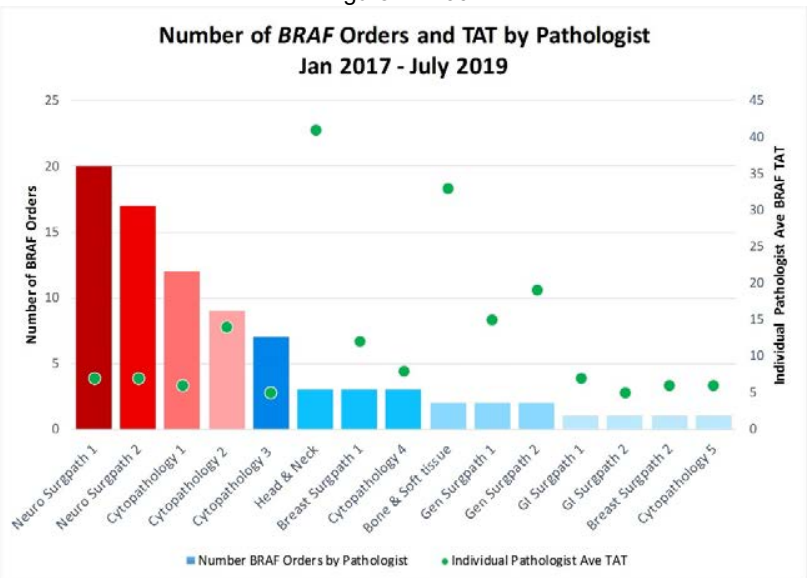


Figure 2 - 2062



Conclusions: Through incremental changes in communication and education, our new algorithm allowed us to reduce the time to *BRAF* results by 68 days (p=0.0026). This significant reduction has allowed our melanoma specialists to have *BRAF* results available when they meet their patients for the very first time. Quality improvement is context specific and depends on local institutional resources.

We show that a multidisciplinary approach involving surgical pathology, oncology, and molecular pathology was critical for the timely identification of targetable mutations at our cancer center.

2063 A Comprehensive Model to Optimize and Justify Staffing of a Surgical Pathology Gross Room

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Disclosures: Melanie Zona: None; Jesse Kresak: None; Ashwini Esnakula: None

Background: Determining adequate staff levels for a gross room laboratory can be challenging, given the unpredictability of workload, variability of work complexity, and underestimation of time necessary for daily operations and maintenance. At our institution, management of multiple laboratory sites has only added to the staffing quandary. Our original staffing model was simplistic and structured on specimen volume alone. We designed a more realistic, data-driven model that is easily reproducible.

Design: The staffing model was designed to include both revenue generating and non-revenue generating workloads, including paid time off. The revenue generating workload includes grossing specimens and performing intra operative consultations (IOC). Average grossing times for each specimen type based on Current Procedural Terminology (CPT) codes were determined by a grossing time study. Because of the discrepancy in grossing times within some CPT codes (ex. 88307 liver biopsy vs liver lobectomy), we subdivided certain codes as “small” and “large” for more accurate time estimations. We collaborated with our information technology team to build a tracking program with “gross start” and “gross stop” functions in our Epic Beaker laboratory information system (Beaker LIS). For 3 months, gross time tracking was performed on all specimens grossed by Pathologists’ Assistants to calculate average grossing times. Average time for an IOC was calculated by a time study conducted for one month. Specimen volumes and IOC numbers were extracted from Beaker LIS. Finally, Occupational Effectiveness was utilized to estimate the non-revenue generating workload by several weeks of direct observation and by structured time estimation of miscellaneous tasks. Similarly, we estimated resident grossing effort based on historic data.

Results: We were able to construct an equational model that incorporates revenue generating work depended upon IOC, CPT and specific specimen complexity, and non-revenue generating work. By using the model and 2-year retrospective data, we determined a gross room staffing shortage trending upward since September 2017. This data helped us to successfully justify three additional staff members.

Conclusions: Designing a comprehensive model that accounts for all work volume and time was essential in optimizing our staff level. We are currently using this model to prospectively monitor the estimated full-time equivalent (FTE) for our gross rooms based on the monthly revenue generating workload.