to be highly expressed in the lung ACs. The aim of this study was to determine if immunohistochemical detection of napsin A and TTF-1 can be powerful in discriminating primary lung AC from metastasis.

Design: Twenty-nine resected metastatic carcinomas of the lung metastatic from 7 colonic ACs, 10 conventional renal cell carcinomas (RCCs), 3 papillary or Hürthle cell carcinomas of thyroid, 1 endocervical AC, 1 ovarian endometrioid carcinoma, 1 prostatic ACA, 2 hepatocellular carcinomas, and 2 adrenocortical carcinomas and 2 breast carcinomas along with tissue microarrays (TMA) of 121 the lung ACs, and 92 clear cell, 15 papillary and 4 chromophobe RCCs and 4 oncocytomas were immunohistochemically studied using antibodies against TTF- and napsin A. Nuclear and cytoplasmic staining for TTF-1 and napsin A were considered positive, respectively, and the percentage of positively stained cells was recorded along with intensity (graded as weak, moderate, or strong). A p value of <0.05, as determined by Fisher's exact test, was considered statistically significant.

Results: Three of 7 metastatic colonic AC showed weak to moderate and patchy nuclear staining for TTF-1 in 5% to 20% of the tumor cells; one of 10 clear RCC, 1 ovarian carcinoma and 1 prostatic AC also exhibited 5% to 30% of tumor cells weakly to moderately positive for TTF-1. Reactive type II pneumocytes were strongly positive for TTF-1. All cases were negative for napsin A. In the lung AC, napsin A and TTF-1 were detected in 85.9% (104/121) and 81.0% (98/121), respectively and the sensitivity between the two was not statically different. Papillary RCCs were positive for napsin A (>80% tumor cells, moderate to strong) in 12 of 15 cases (80%) and all other renal epithelial neoplasms were negative for napsin A. TTF-1 was not detected in all cases in the RCC TMA, including oncocytomas.

Conclusions: This is the first time to report that TTF-1 is detected in both clear cell RCC and prostatic AC metastatic to the lung. Combined TTF-1 and napsin A immunostains are more powerful in separating the primary lung AC from metastasis.

1858 EGFR Mutation and p53 Overexpression in the AAH-BAC-Small Adenocarcinoma Sequence of the Lung

SB Yoo, HJ Lee, CT Lee, SH Jheon, JH Chung. Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Republic of Korea.

Background: A progression model of atypical adenomatous hyperplasia (AAH) to bronchioloalveolar carcinoma (BAC) to invasive adenocarcinoma(ADC) has been proposed. However, the genetic alterations of the AAH-BAC-ADC sequence are not clearly established. We examined the mutation of the epidermal growth factor receptor (EGFR) gene and p53 protein overexpression in the AAH, BAC and small ADC to understand their role in the pulmonary adenocarcinoma pathogenesis.

Design: Twenty AAH, 39 BAC (19 Noguchi type A and 20 type B) and 32 ADC (Noguchi type C) were enrolled in this study. EGFR mutations at exons 18-21 and p53 protein expression were examined by PCR-direct sequencing and immunohistochemistry, respectively.

Results: Mutations of the EGFR gene were noted in 32 (35.2%) lesions, which included 7 (35.0%) of AAH, 13 (33.3%) of BAC and 12 (37.5%) of small ADC. Eighteen (19.8%) of the mutations were detected as exon 19 deletion, 13 (14.3%) as exon 21 point mutation and 1 (1.1%) as exon 18 point mutation. Overexpression of p53 protein was found in 16 (17.6%) lesions, none of AAH, 4 (10.3%) of BAC and 12 (37.5%) of ADC.

Table 1. Comparison of EGFR gene mutation and expression of p53 protein

Histology (no.)	EGFR gene mutation negative	EGFR gene mutation positive	p value	p53 protein expression negative	p53 protein expression positive	p value
AAH (20)	13 (65.0%)	7 (35.0%)		20 (100.0%)	0 (0.0%)	
BAC (39)	26 (66.7%)	13 (33.3%)		35 (89.7%)	4 (10.3%)	
ADC (32)	20 (62.5%)	12 (37.5%)		20 (62.5%)	12 (37.5%)	
Total (91)	59 (64.8%)	32 (35.2%)	0.935	75 (82.4%)	16 (17.6%)	0.001

Conclusions: High frequency and similar incidence of EGFR mutation in AAH, BAC, and ADC supports that EGFR gene mutation seemed to be associated with early stages of pulmonary ADC, and BAC with EGFR mutation might progress into invasive adenocarcinoma easier than those without mutation. On the contrary, p53 overexpression was identified in the late step of the AAH-BAC-ADC sequence model. The genetic alterations of the EGFR and p53 might play a role in the different stages of the peripheral pulmonary adenocarcinoma development.

1859 Prognostic Significance of the Proposed IASLC/ATS/ERS Revised Classification of Lung Adenocarcinoma in 514 Stage 1 Lung Adenocarcinomas (ADC)

A Yoshizawa, N Motoi, GJ Riely, M Kris, BJ Park, VW Rusch, WD Travis. Kyoto University Hospital, Kyoto, Japan; Cancer Institute Hospital JFCR, Tokyo, Japan; Memorial Sloan Kettering Cancer Center, New York, NY.

Background: The International Association for the Study of Lung Cancer (IASLC), the American Thoracic Society (ATS) and European Respiratory Society (ERS), have proposed a revised classification of lung adenocarcinoma. There are no studies investigating the prognostic significance using the proposed criteria. We sought to investigate the usefulness of this classification to identify prognostically significant ADC subtypes.

Design: A total of 514 patients were classified as Adenocarcinoma in situ (AIS), minimally invasive adenocarcinoma (MIA), lepidic predominant non-mucinous (LPNM), acinar predominant (AP), papillary predominant (PP), micropapillary predominant (MPP), solid predominant (SP), colloid predominant (CP) and mucinous adenocarcinoma (MA). Statistical analysis was performed using SPSS version 17 with crosstable using Chi-square statistics. Survival analysis was performed using Kaplan Meier analysis for disease free survival (DFS) and Cox regression.

Results: We found 323F (63%) and 191M (37%) with 376 1A (73%) and 138 1B (27%); mean age 68 yrs (33-89 yrs). 5-yr DFS for males was significantly worse (77%) than that for females (88%, p=0.011); it was also worse for IB (75%) than for 1A (86%, p=0.001). Three overall prognostic groups for 5 yr DFS were identified: 1) 100% for AIS: n=1, MIA: n=7 and LPNM: n=28; 2) 85% for PP: n=143, 86% for AP: n=232 and 86% for MA: n=15 and 3) 69% for SP: n=66, 62% for MP: n=12 and 69% for CP: n=9 (p<0.001). In addition, survival was significantly worse for MA (76%) compared to LPNM (100%, p=0.014). In multivariate analysis stratified for stage, proposed IASLC classification, lymphatic invasion and sex were independent prognostic predictors of survival.

Conclusions: The proposed IASLC/ATS/ERS classification identifies prognostically significant categories of Stage I lung ADC. AIS and MIA are rare tumors at MSKCC, comprising less than 2% of all cases and LPNM accounted for only 5.4% of all tumors. These data support the proposal to use the predominant subtype for classifying the remaining 93% of our lung adenocarcinomas which were invasive.

1860 Mucinous Carcinoma (Colloid Carcinoma) of the Lung, an Immunohistochemical and Molecular Analysis

M Zenali, N Kalhor, LMS Soto, G Roso, II Wistuba, CA Moran. The University of Texas, Houston, TX; The University of Texas MD-Anderson Cancer Center, Houston, TX.

Background: Mucinous (Colloid) Carcinoma of lung is an uncommon subtype of pulmonary adenocarcinomas. Differentiating between primary pulmonary and metastatic mucinous adenocarcinoma of extrapulmonary origin, namely lower GI tract origin, can be challenging; as there is a considerable histological and immunophenotypic overlap between the two. Current study was performed to evaluate immunohistochemical profile and EGFR and KRAS gene mutation status in 12 cases of mucinous carcinoma of the lung.

Design: H&E stained sections from surgical resection of 17 cases of pulmonary mucinous carcinoma were obtained from MD-Anderson. Selection was subsequent to exclusion of five patients, found to have mucinous adenocarcinoma of extrapulmonary origin. Immunohistochemical probes were utilized for detection of: CK7, CK20, TTF-1, SP-A, and CDX2; extent of expression was assessed by light microscopy in scale of 0-4+, 0: none and 4+: more than 75% staining. Molecular analysis for EGFR, exons 18-21, was carried using dye terminator PCR sequencing method. KRAS codons 12, 13, and 61 were analyzed by pyrosequencing. All EGFR and KRAS sequence variants were confirmed by independent PCR from at least two micro-dissections, sequenced in both directions.

Results: The immunohistochemical results are listed in the table 1. Molecular analysis detected wild type EGFR sequence in all cases studied. 3 cases had KRAS mutation of codons 12 or 13.

Table 1

Case #	CK7	CK20	TTF-1	SP-A	CDX2
1	4+	2+	0	0	2+
2	4+	4+	0	0	3+
3	4+	4+	1+	0	4+
4	4+	2+	0	0	2+
5	4+	4+	1+	0	4+
6	4+	4+	0	0	4+
7	4+	3+	0	0	4+
8	4+	0	0	0	3+
9	2+	4+	N/A	0	N/A
10	4+	3+	1+	0	2+
11	4+	2+	1+	0	2+
12	3+	1+	0	1+	4+

N/A: not available

Conclusions: Our results indicate that the use of immunohistochemistry and clinical/radiological correlation remains the gold standard for the site of origin of mucinous carcinomas occurring in lung. Strong and diffuse expression of CK7 in colloid carcinoma of the lung can help in differentiation from metastatic mucinous adenocarcinoma of lower GI tract origin. Occurrence of mutation in EGFR tyrosine kinase domain (exon 18-21) is less frequent in Colloid Carcinoma than other lung adenocarcinoma subtypes. However, the frequency of KRAS mutation is similar to that of other lung adenocarcinoma subtypes.

Quality Assurance

1861 Quality of Reporting Gallbladder Carcinoma – An Audit of a Consultation Practice at a Tertiary Care Hepatopancreaticobiliary (HPB) Centre

Z Afshar-Ghotli, MA Khalifa, C Rowsell. Sunnybrook Health Sciences Centre, Toronto, Canada.

Background: Over the past decade, much attention has been given to improving the quality of surgical pathology reports for cancer cases. In our jurisdiction, a successful pathology reporting project has focused on completeness through a Province-wide adoption of the College of American Pathologists (CAP) checklists. In five common disease sites, colorectal, breast, lung, prostate, and endometrial carcinoma specimens, the CAP synoptic reporting was mandated. Less common cancers, however, received less attention. The purpose of our study was to assess the completeness of reporting of gallbladder resection specimens in our referred-in cases as an example of reporting on a less common site.

Design: Consultation reports on gallbladder carcinomas were searched from the surgical pathology database at Sunnybrook Health Sciences Centre. Surgical pathology reports from the original hospitals were obtained, and evaluated for the presence of the following parameters as per the CAP Gallbladder Cancer protocol: Specimen type, Histologic type, Tumor site, Tumour Grade, Cystic duct margin, Liver bed margin, lymphovascular invasion, perineural invasion, pTNM staging. Our referral pool was community hospital-based laboratories who subscribed to the Province-wide pathology reporting project.

Results: Thirty-two cases of gallbladder carcinoma were received for consultation/review during the study period. Out of these cases, only one fulfilled CAP requirements for completeness. Missing required elements included: Tumor site (28/32, 87%); Tumor size (25/32, 77%); Histologic grade (6/32, 20%); Liver bed margin (23/32, 73%); Cystic

duct margin (11/32, 33%). pTNM staging was not stated in 22/32 (70%) of reports. The non-mandatory elements of lymphovascular invasion and perineural invasion were missing in 22/32 (70%) and 23/32 (73%) of reports, respectively.
Conclusions: This audit provides a snapshot of completeness of gallbladder carcinoma reporting in our region. Some of the commonly missing elements (margins, stage) are critical to the multidisciplinary HPB team for treatment decisions. The results highlight the need for further educational initiatives on cancer reporting outside of the common organ sites which have already been targeted.

1862 A Novel Daily Quality Assurance/Quality Control (QA/QC) Program Based on the National Society for Histotechnology/College of American Pathologists (NSH/CAP) HistoQIP Program

P Aoun, K Zeitner, JM Gerriets, DE Muirhead. University of Nebraska Medical Center, Omaha, NE; The Nebraska Medical Center, Omaha, NE.
Background: Criteria for measuring the quality of histological preparations on a routine basis are typically developed internally and lack standardization. The NSH/CAP HistoQIP Program is designed to evaluate slides according to standardized criteria, providing peer comparison and benchmarking data, but is available only twice yearly. The goal of this study was to evaluate the feasibility and impact of implementing a daily slide QA/QC program based on the HistoQIP standardized criteria.
Design: Criteria for grading the quality of the fixation, processing, embedding, microtomy, and staining were developed based on published reports from the HistoQIP Program. During a 3 month pilot program, H&E slides were reviewed daily by randomly selecting 1 slide from each rack of 20 slides (5%), and graded by a senior histotechnologist using the HistoQIP Program scoring system. Subsequently, the histology laboratory staff were educated about the new program, and the number of selected slides was increased to 2 slides from each rack of 20 (10%). For the 10% review period, data were recorded daily for 17 months, and presented to the technical staff monthly and to the pathologists quarterly.
Results: A total of 19,690 of 209,380 slides were reviewed. Deficiencies were present in 10.8% of all reviewed slides and were primarily in microtomy (84.8%), followed by embedding (6.4%), fixation (4%), processing (2.8%), and staining (2%). Microtomy deficiencies included folds/wrinkles (49.1%), chatter (8.7%), extraneous epithelial cells (8.6%), knife lines (6.8%), incomplete sections (6%), loose tissue (3%), floaters (1.5%), and inproper section thickness (1.3%). As a result of monitoring, targeted interventions were implemented during the study period, resulting in a decrease in the number of deficiencies from an average of 21% (range 20.4-22.1%) during the pilot program to an average of 10.1% (range 6-15.6%) during the study period. Improvements in quality of non-reviewed slides, staff attention to detail, and documentation of problems encountered during embedding and cutting were also noted by laboratory management.
Conclusions: The NSH/CAP HistoQIP Program criteria for evaluation of the quality of histological preparations can provide a basis for a standardized daily QA/QC program that is easily implemented and that can be used to develop performance indicators for monitoring and improving quality.

1863 Measures To Assure Tissue Identification during Intraoperative Consultation: A Patient Safety Measure That Prevents Tissue Mismatch

F Arif, J Melamed, D Warfield, BY Wang. New York University School of Medicine, New York, NY.
Background: During intraoperative consultation (IOC), procedures for identification of tissue throughout the process are needed to prevent tissue mismatch. In a high volume frozen section service, where many cases are handled simultaneously, procedures and practical methods for labeling of the frozen block are key to secure correct identification. We have devised a few simple and easily implemented procedures to assure frozen tissue identification, and describe our four years experience with its implementation.
Design: We utilize several steps as part of our procedure to maintain identification of tissue throughout the IOC process. These include to 1) Embed and freeze a specimen with identification label directly into the block. 2) Limit wherever possible a single chuck per cryostat. 3) Require the cryostat operator to maintain custody of tissue and be responsible for transfer of tissue into a labeled cassette. We have monitored these procedures for ease of use and compliance by IOC personnel, and provide an estimate of the reduction of mismatch through implementation of this policy.
Results: In our institution these procedure have been readily accepted and implemented with 96% compliance rate (n= 8967 frozen section cases) over a 4 year period. On the few occasions, where the procedure was not followed, 3 "near miss" events were documented at a rate of 3 per 360 cases (0.8%) compared to 0 events in 8607 cases where the procedure was followed.
Conclusions: Adherence to simple practical procedures for tissue labeling during frozen section can be easily adapted to enhance patient safety, and can significantly reduce the possibility of mismatch.

1864 Implementation of a Digital Slide System for Quality Assurance

B Dangott, R Silowash, L Anthony, R Wilson, J Duboy, L Drogowski, AV Parwani, J Ho, D Jukic. University of Pittsburgh Medical Center, Pittsburgh, PA.
Background: In many pathology departments, a subset of cases is routinely reviewed by a second pathologist as a method of quality assurance (QA). Studies have shown that disagreement rates range from 0.26% to 1.2% for global in-house prospective review and 4.0% for retrospective blinded review. The disagreements may be classified as major, minor or clerical. Traditionally, QA evaluation has been done by physically transferring the case to another pathologist within the department. This approach is somewhat limited in geographic reach, and there may be an element of bias because of the working relationship between the pathologists. By implementing a digital slide (DS) approach to QA, the geographic limitations can be eliminated, and the QA evaluation can be done anonymously in a more effective manner. This study was performed to evaluate DS as a method of performing QA, and to compare DS QA results with the original glass slide QA results.
Design: A CoPath (Cerner Corporation, Kansas City, MO) tool electronically queried the surgical pathology database for cases that had been previously viewed for quality assurance. For simplicity purposes, investigators decided to exclude cases that had over five blocks. Thirty accessions containing a total of sixty-six cases were then randomly selected from this subset, and the 202 glass slides from these cases were scanned using an Aperio T2 scanner (Aperio Technologies, Vista, CA).
Results: Pathologists viewed the digital slides through network connections on remote workstations via a downloadable database. A quality assurance survey recorded the level of agreement of each of the participating pathologists at case completion. Two-hundred and forty responses were received from 6 participating pathologists. There were 11 moderate disagreements and 3 major disagreements recorded in a total of 12 case parts (2 cases had 2 pathologists disagree with the original diagnosis). This represents an average of 5.0% disagreement which is comparable to the 4.0% average reported in blinded retrospective reviews.
Conclusions: Using DS for quality assurance requires pathologists to make a diagnosis on the digital slide, and this is a significant move toward implementing the technology in a clinical setting. In addition, the results from the QA study demonstrate comparable levels of agreement with traditional QA models. DS has the added advantages of overcoming geographic boundaries, eliminating potential biases, and improving quality assurance practices.

1865 Anatomic Pathologists' Attitudes and Experiences Regarding Error Disclosure

SM Dintzis, TH Gallagher. University of Washington, Seattle, WA.
Background: The patient safety movement emphasizes not only error reduction but also the importance of greater transparency in the discussion of medical errors with affected patients. Pathologists face unique challenges related to error disclosure since they traditionally have limited direct patient contact. This study describes attitudes and experiences of anatomic pathologists in the Pacific Northwest toward error disclosure.
Design: 260 practicing anatomic pathologists belonging to the Pacific Northwest Society of Pathologists and/or the Washington State Society for Pathologists were invited to participate in a self-administered mailed survey in April of 2009. The survey included questions regarding estimated error rates, barriers to and experience with error disclosure. Additional questions measuring participant demographics, practice experience and environment were also included.
Results: The survey was returned by 114 of 260 pathologists (44%). Ninety three percent of anatomic pathologists have been personally involved with pathology errors: 88% with a near miss, 79% with a minor error and 53% with a serious error. Only 17% of respondents reported disclosing a serious error and 4% a minor error directly to a patient. Of the pathologists having disclosed serious pathology error directly to a patient, 94% reported satisfaction with the results of the disclosure conversation. All pathologists who reportedly disclosed minor pathology error to a patient reported satisfaction with the disclosure conversation. Anatomic pathologists generally supported disclosure; 96% of respondents agreed that serious errors should be disclosed to patients. However, their beliefs varied as to which less harmful errors should be disclosed. Only 75% believed that minor errors should be disclosed and 21% agreed that near misses should be revealed. Respondents were split in their beliefs regarding the cause of medical errors: 59% believed that they are due to failures of care delivery systems, not individuals, while 41% disagreed.
Conclusions: The vast majority of anatomic pathologists have experience with error; however, only a small percentage has experience disclosing error. Pathologists generally support error disclosure to patients, but a significant gap exists between pathologists' expressed interest in disclosure and current practice.

1866 Tracking Pathology Report Addenda as Part of a Quality Assurance Process

A Finkelstein, G Levy, N Buza, P Cohen, V Parkash. Yale University, New Haven, CT.
Background: Most institutions track amended reports as a part of quality improvement programs. Amendments are defined as changes to information that occur after release of pathology reports. Amendments often possess a certain stigma of an error that has occurred during the diagnostic process. This prompts a trend among many pathologists to issue addenda to final pathology reports if the information added to the report doesn't seem to be changing the nature of the diagnosis. This study aims to investigate the type and impact of information reported in addenda.
Design: We obtained all reports with addenda in the Department of Pathology database for a one month period in 2008. The addenda were reviewed by a panel of three pathologists to estimate the impact of the information contained within the addenda on the final diagnosis and whether this information should be tracked by quality improvement programs.
Results: Of 2,435 retrieved cases, 209 cases had one or more addenda, totaling 338 addenda. Of these 338 addenda, 16 reported information from additional H&E sections and 5 reported missing parts or missing data (organ weights, laterality errors, additional parts, and additional clinical information). Overall, 21 cases (10% of cases with addenda and 0.9% of all reviewed cases) had information within the addenda that had significant diagnostic impact, such as additional sections revealing invasion, critical immunohistochemical stains, and lymph node status.
Conclusions: Analysis of pathology reports with addenda for one month in 2008 revealed the use of addenda to report information that significantly affected either the final diagnosis or potential treatment decisions. The use of an addendum rather than an amended report does not place this information in the optimal formate for retrieval by clinicinas or the electronic medical records. These cases comprised 0.9% of the total

number of cases reviewed. This number is comparable with the commonly reported rate of amendments. Therefore: 1) reports with addenda should be periodically reviewed by institutions and tracked along with amendments as one of the quality assurance/quality control (QA/QC) indicators, and 2) the threshold for issuing amended reports may need to be lowered.

1867 An Analysis of Addenda to Pathology Reports

A Finkelstein, G Levy, N Buza, P Cohen, V Parkash. Yale University, New Haven, CT.

Background: Surgical pathology reports have to be signed out in a certain number of days from receipt of the specimen. With the advent of new technologies such as immunohistochemistry and molecular techniques, pathologists are able to better characterize lesions and provide valuable information to clinicians; however, these procedures often take several days and can delay reporting. One way to avoid this is to report a diagnosis and then write an addendum upon receipt of additional information from auxiliary studies. We investigate the rate of addenda creation and its dynamics from 1993 to 2008.

Design: We queried the Department of Pathology database for reports with addenda issued in the same month in the years 1993, 1998, 2003, and 2008. The number and types of cases and the number of addenda per case were recorded. The addenda were assigned a category based on their diagnostic and therapeutic significance.

Results: The percentages of cases with addenda in one month in 1993, 1998, 2003 and 2008 were 0.9%, 1.7%, 5% and 8.6%. The percentage of cases with 2, 3, 4 and 5 addenda per case changed from 0% in 1993 to 20%, 9%, 4%, and 1% in 2008. The most common type of case changed from GI in 1993 to breast in 2008. The most common type of addenda in 1993 was electron microscopy, in 1998 was flow for ploidy, and in 2003 and 2008 was prognostic immunohistochemistry. The number of addenda that lead to changes in the diagnosis has increased from 0 in 1993 to 21 in 2008. Summary in tables 1 and 2.

1 month in	# cases	# cases with addenda	% cases with addenda	Most common type
1993	1635	14	0.9	GI (6)
1998	2278	39	1.7	Breast (19)
2003	2974	150	5	Neuro (32)
2008	2435	209	8.6	Breast (58)

1 month in	IHC diagnostic/ prognostic	Molecular	EM	Cytogenetics	Ploidy	Other	Diagnostic changes
1993	5/0	1	7	0	0	1	0
1998	5/21	5	8	0	26	1	4
2003	40/44	14	25	2	11	83	12
2008	60/69	53	24	10	0	122	21

Conclusions: The number of addenda has increased more than 8 fold since 1993 and the information within addenda has changed from purely diagnostic to prognostic and therapeutic, therefore, signing out an incomplete report and conveying this important data later may be inadequate. We propose that the guidelines for turnaround time be reconsidered or initial results be reported as a preliminary diagnosis, which is made available to clinicians. When auxiliary studies are finished, a completed report incorporating the findings should replace this "preliminary report" as a Final report, in the manner used for reporting autopsies.

1868 Maintaining Clinical Tissue Archives and Supporting Human Research: Challenges and Solutions

C Giannini, MM Oelkers, WD Edwards, MC Aubry, MM Muncil, KH Mohamud, SG Sandleback, JM Nowak, AJ Bridgeman, P Heelis, ME Brown, JC Cheville. Mayo Clinic, Rochester, MN; Item Tracker, London, United Kingdom.

Background: As requests to use clinically archived tissue in translational research continue to increase, it is apparent that research use of tissues originally collected for diagnosis and therapeutic purposes poses unique challenges. Conflicts may arise between pathologists who are responsible for overseeing and preserving these tissues and investigators who depend upon this material in their research endeavors.

Design: We evaluated the status of the institutional Mayo Clinic Tissue Registry Archive and found the existing process for managing tissue loans, including slides and paraffin blocks, insufficient for the complexity and volume of this task, resulting in a number of significant deficiencies. We therefore developed updated written policies and procedures in order to support a new modern and robust tracking system with some features of a library loan system. The new database tracking system, Item Tracker, required extensive work and customization and was ready for implementation in January 2008. We present the data from our first year of implementation (2008) compared to an index year with the old system (2005).

Results: While in 2005, return rates for glass slides and paraffin blocks were respectively 46% and 60%, in 2008, with a total number of 206,330 slides and 51,416 blocks on loan, return rates for glass slides and paraffin blocks were highly improved, reaching 97% by the final due date. 71% of blocks and 68% of slides were requested in support of IRB-approved research protocols, while 25% and 22% respectively for clinical purposes. The smaller remaining numbers for education and quality activities. Slides and blocks yet to be returned are tracked and followed. Material which was found to be permanently "lost" represented respectively 0.021% of slides and 0.04% of blocks, none fortunately representing the only diagnostic material for the case.

Conclusions: We were able to develop and implement policies, processes, and procedures which allowed enhanced oversight of diagnostic pathologic tissue, slides, and blocks. With expanding needs for tissue slides and blocks for clinical care and growing demands for translational research, it is essential that all departments of pathology especially at institutions with large tissue-based research endeavors have a pathology tracking and management system in place to meet all clinical, education and research needs as well as legal requirements.

1869 Pathologic Evaluation of the Morcellated Uterus: A Quality Assurance Study

IS Hagemann, AR Hagemann, VA LiVolsi, KT Montone. University of Pennsylvania, Philadelphia, PA.

Background: Uterine morcellation is performed to allow extraction of the uterus through a small incision. The laparoscopic morcellator processes the tissue into unoriented cores, making it impossible for the pathologist to thoroughly evaluate the specimen. It is generally accepted that morcellation should be performed only in cases where significant histopathology is not anticipated. The standard of care includes a preoperative workup to exclude malignancy in the organs being removed. Careful quality assurance practices are important in ensuring that morcellation is performed only under appropriate circumstances and after appropriate workup.

Design: We performed a retrospective clinicopathologic study of morcellated hysterectomies at our institution between 2006 and 2009.

Results: Of 70 cases meeting inclusion criteria, the majority were performed for meno/metrorrhagia (57%) or pelvic organ prolapse (27%). Preoperative sampling of the endometrium was documented in 41% of all cases and in 57% of cases performed for bleeding. Preoperative Pap smear was documented in 54% of all cases and in 65% of cases performed for bleeding. Only 35% of patients with bleeding had both endometrial sampling and Pap smear in the year prior to hysterectomy, although this is the workup recommended by OB/GYN departmental policy for most morcellations. No workup revealed significant concern for hyperplasia, dysplasia or malignancy in the organs to be morcellated, although one endometrial biopsy showed atypical trophoblastic tissue favored to represent a placental site nodule and another showed simple hyperplasia without atypia. Endometrium was detected histologically in 69/70=99% of all morcellated hysterectomies, as was cervix in 8/15=53% of cases that included cervical resection. No significant endometrial or cervical pathology was identified on resection, but the case with atypical trophoblastic tissue could not be adequately classified. Institution of a departmental policy on morcellation did not improve the completeness of the preoperative workup.

Conclusions: Morcellated specimens are not amenable to full pathologic evaluation, yet a minority of patients in our series underwent the recommended anticipatory workup. In this series, there was no evidence that neoplasia was underdiagnosed in the resulting hysterectomies.

1870 Joint Commission Standards for Ongoing and Focused Performance Evaluation in Anatomic Pathology: Current Trends in Practice

JL Hunt, MT Smith, WS Black-Schaffer. Massachusetts General Hospital, Boston, MA; Medical University of South Carolina, Charlestown, SC.

Background: In 2008, the Joint Commission (JC) began to require on-going and focused physician competency assessment. Ongoing professional practice evaluation (OPPE) must occur more than once a year, and focused professional practice evaluation (FPPE) must be used for new privileges or if performance issues arise. OPPE and FPPE must be clearly defined (metrics, duration/frequency of data collection, thresholds, and how data is used to affect privileging). In anatomic pathology (AP), very little information exists about applying such standards, or the metrics that are useful to assess physician competency.

Design: An on-line survey was designed to assess understanding of OPPE and FPPE, and to investigate metrics AP practices use to assess pathologist competency. The survey was sent to members of the Association of Directors of Anatomic and Surgical Pathology (ADASP).

Results: Of 44 respondents, 98% hold administrative positions in AP. When asked to rate their understanding of credentialing on a scale of 1 (worst) to 10 (best), the mean level was 8.4 for departmental/institutional policies, compared to 6.1 for these Joint Commission policies. 84% report a formal process for new physician credentialing. 98% report formal peer review, most commonly random (20%) and/or on focused subsets of cases (36%). Only 44% proctor signout and 38% proctor frozens for new hires. Frozen-final correlation, turnaround times, and conference case discrepancies are the most frequently collected physician performance metrics. Approximately 20% use group level data, and do not measure individual physician performance. 64% report tracking error rates for physicians, but fewer than half have established a threshold or formal process for acting on performance issues. Only 45% assess physician competency more than once a year; 10% never assess. The reported level of understanding of OPPE and FPPE is approximately the same in groups that meet JC standards as those that don't.

Conclusions: AP leaders report incomplete understanding of the standards set by the Joint Commission for OPPE and FPPE, and many identify policies that do not meet the JC standards for hospital physician competency and credentialing. Education around JC standards and sharing of best-practice policies among institutions would be of benefit to improve consistency, standardization, and implementation OPPE and FPPE in anatomic pathology.

1871 Specimen Labeling Errors in an Anatomic Pathology Laboratory: An Eighteen Month Experience

LJ Layfield, GM Anderson. University of Utah School of Medicine, Salt Lake City, UT; ARUP Laboratories, Salt Lake City, UT.

Background: The recognition and elimination of medical errors is an important issue for both clinicians and pathologists. Errors occurring in the Anatomic Pathology laboratory can involve a variety of processes including specimen labeling, specimen processing and staining as well as diagnostic interpretation. Little has been published on the frequency of specimen labeling errors. Such mislabeling can occur at pre-analytic, analytic, and post-analytic points.

Design: We reviewed our experience with mislabeled specimens for a 12 month period. During that period, 29,479 cases were accessioned and associated with 109,354 blocks and 248,013 slides. Percentage error was calculated on a block and slide basis.

Errors were characterized as mislabeled specimen containers/request forms (clinic), mislabeled blocks (gross room), mislabeled slides (histology laboratory) and mislabeled immunohistochemistry slides (immunohistochemistry laboratory). Labeling errors were characterized as major (wrong patient) or minor (same patient but different specimen site).

Results: Fifty-nine major labeling errors were detected (0.05% of blocks and 0.024% of total slides) and 31 minor labeling errors were found representing 0.03% of total blocks and 0.012 % if total slides. The majority (63%) of mislabeled specimens occurred within the gross room due to incorrect labeling of the cassettes submitted to the histology laboratory. These errors were detected in the histology laboratory or by the sign-out pathologist.

Conclusions: While infrequent, labeling errors occur and do involve specimen misidentification as to patient and specimen source. Two-thirds (59 of 90) of labeling errors resulted in assigning the slides to the incorrect patient. The majority of errors in our series occurred within the gross room where cassettes were assigned an incorrect number. This frequently led to the slide being mislabeled and associated with the incorrect patient. Increasing attention to the gross room phase of specimen labeling appears warranted to reduce the frequency of specimen mislabeling. Newer technologies such as bar coding and chip techniques may aid in reducing the frequency of labeling errors.

1872 Improving Quality and Efficiency of Pap Test Processing: A Lean Approach

CW Michael, K Naik. University of Michigan Hospital, Ann Arbor, MI.

Background: In this era of enormous economic pressures, maintaining cost effectiveness while improving quality and patient safety is a challenge. We utilized lean methods to examine our Pap test processing procedure with the goal of improving processing time (PT) and reducing accessioning and/or labeling errors.

Design: A team composed of 2 cytopreparatory staff, 1 cytotechnologist, medical director, supervisor and a lean coach was charged to evaluate our ThinPrep Pap test processing procedure. A value stream map (VSM) from in-lab specimen receipt to production of labeled slides was created and reviewed with the following objectives: 1) identify opportunities to reduce waste and errors 2) design a new VSM based on identified opportunities 3) implement the new VSM and 4) measure the impact. Implemented changes included: 1) single piece flow (SPF) during accessioning 2) minimizing processing batch size in the T3000 instrument and 3) elimination of redundant steps. Impact of changes was evaluated by measuring the following monitors pre- and post-implementation: 1) total PT 2) number of accessioning errors (discrepancies between information on the requisition and that entered into the LIS) encountered during the normal workflow as well as via random audits for a period of four weeks and 3) number of labeling errors at the clinical site that were missed at the accessioning step, but identified downstream.

Results: Pre-implementation data review revealed: 1) PT for 1140 samples ranged from 1-3 days with an average of 2 days, 2) 29 accessioning errors were detected by review of 384 (7.6%) requisitions, 3) 5 of the 23,600 Pap tests processed in 6 months had labeling errors (mismatch of patient identification between the requisition and vial or no/inadequate identifier on vial) that had gone undetected in the processing stage. Four were detected later during specimen processing but one reached the reporting stage. Post-implementation data revealed no undetected labeling errors to date and PT remained consistently at 1 day. Random audits for accessioning errors are in progress.

Conclusions: Implementation of SPF and minimizing batch size allows for higher quality and greater patient safety by maximizing up-front detection of labeling errors. Single piece flow improves efficiency by reduction of the number of times each sample is handled during the process and elimination of re-work due to errors detected down stream. When implemented with engaged, actively participating staff, lean can be successfully implemented in the Cytopathology laboratory to improve efficiency and quality.

1873 An Investigation into False Negative Transthoracic Fine Needle Aspiration/Biopsy Specimens

DM Minot, EA Jaben, MC Aubry, JS Voss, SG Van Epps, DJ Tuve, MR Henry, DR Salomao, PUY Lee, SK Carlson, AC Clayton. Mayo Clinic, Rochester, MN.

Background: Transthoracic fine needle aspiration under CT-guidance (FNA) has proven to be a useful technique in the assessment of pulmonary nodules. We sought to determine the false negative (FN) rate at our institution and identify potential causes of our FN diagnoses.

Design: Medical records were reviewed from 1,043 consecutive patients who underwent CT-guided FNA/biopsy of lung nodules for a five-year time period (2002-2007). False negative cases, "negative" FNA/biopsy with malignant outcome, were identified. All cases were coded by the worst diagnosis from FNA or corresponding biopsy. Outcome was based on clinical and/or histopathologic evidence of disease. All cases were reviewed independently (blinded to original diagnosis) by three pathologists with 15 age and gender matched positive controls (PC) and negative controls (NC). Diagnosis (nondiagnostic, negative or positive for malignancy, atypical or suspicious) and qualitative assessments were recorded.

Results: There were 37 patients with a FN diagnosis (3.5%). Of the 36 cases available for review, 35 had core biopsy. Consensus diagnosis was suspicious or positive in 31% (11/36) of FNA cases (Table 1) and suspicious in 3% (1/35) of biopsy cases (Table 2), indicating potential diagnostic errors. Of the 12 diagnostic error cases, 9 were adenocarcinomas (5 primary, 4 metastatic), 1 squamous cell carcinoma, 1 metastatic renal cell carcinoma and one lymphoma. FN cases were smaller in size radiographically and tended to abut the pleura, while pathologically, they tend to be markedly necrotic and air-dried specimens.

FNA Consensus Diagnosis of FN, PC and NC cases

	FN FNA	PC FNA	NC FNA
Nondiagnostic	1	0	4
Negative for Malignancy	19	0	9
Atypical	5	0	1
Suspicious for Malignancy	8	2	1
Positive for Malignancy	3	13	0
Total	36	15	15

Core Biopsy Consensus Diagnosis of FN, PC and NC cases

	FN Biopsy	PC Biopsy	NC Biopsy
Nondiagnostic	0	0	0
Negative for Malignancy	33	2	14
Atypical	1	1	0
Suspicious for Malignancy	1	2	0
Positive for Malignancy	0	9	0
Total	35	14	14

Conclusions: Our FN rate is low (3.5%). Sampling error appears to be the most common cause for pulmonary FN diagnoses in 69% (25/36) of FNA and 97% (34/35) of biopsy specimens. Diagnostic errors account for 31% and 3% of our FN FNA's and biopsies respectively and were mostly adenocarcinomas (9/12).

1874 Flow Cytometry Underestimates the Bone Marrow CD34-Positive Blast Population Compared to Immunohistochemical and Morphologic Assessments

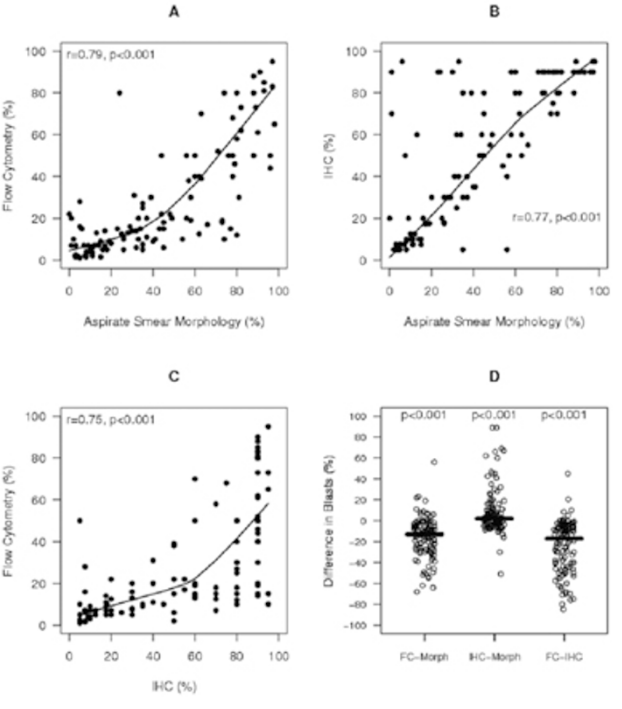
EA Morgan, KY Oh, CG Waghorne, D Neuberg, K Stevenson, JL Kutok. Brigham and Women's Hospital, Boston, MA; Dana-Farber Cancer Institute, Boston, MA.

Background: Accurate quantification of bone marrow (BM) blast percentages is critical for the diagnosis and classification of hematological malignancies. We evaluated the validity of using flow cytometry (FC) or immunohistochemistry (IHC) as a method of quantifying CD34+ blasts compared to BM aspirate morphologic (morph) blast counts.

Design: We identified 112 samples from 90 patients having concurrent BM aspirate counts, BM biopsies with CD34 IHC, and FC analysis with CD34+ blasts performed at our institution between 1/1/2006 and 1/1/2007. IHC estimates of CD34+ blasts were made by dividing positively staining blasts by the total nucleated marrow cells. FC detection and quantification of the blast percentages was performed by defining a blast gate using low to intermediate forward and low side scatter, and dividing the CD34+ cells in that gate by the total number of cells analyzed. Cases of subset expression of CD34 by the blast population were excluded from this study. Paired comparison of the difference (Δ) in blast % between the three methods was assessed by the Wilcoxon signed-rank test and correlation analysis was assessed by Spearman's rank correlation test. A locally weighted scatter plot smoother fit was used to investigate trends between these methods.

Results: While there was a positive correlation between all three counting methods (correlation coefficients ranging from 0.75-0.79; p<0.001) (Fig 1A-C), further analysis revealed FC consistently showed lower values compared to IHC and morphology counts (median Δ=FC-Morph=-13.0, range (-68, 56); median Δ=FC-IHC=-17.0, range (-85, 45); both p<0.001) (Fig 1D).

Conclusions: Simultaneous comparison of 3 methods for blast determination (morphology, IHC, FC) in a large series revealed that FC underestimates the BM blast population compared to the other methodologies. Given the importance of blast determination in the diagnosis of hematological malignancies, use of the blast count as determined by FC may lead to the misclassification of these entities and, therefore, alter clinical decision making.



1875 Initial Experience with a Novel Pre-Signout Quality Assurance Tool (PQAT) for Review of Random Surgical Pathology Diagnoses in a Subspecialty-Based University Practice

SR Owens, LT Wiehagen, SM Kelly, AL Piccoli, SA Yousem, R Dhir, AV Parwani. University of Pittsburgh Medical Center, Pittsburgh, PA.

Background: Quality assurance and quality improvement are important parts of surgical pathology (SP) practice, particularly given current attention to patient safety and healthcare cost containment. Our subspecialty-based practice recently instituted a novel laboratory information system (LIS)-based PQAT that randomly selects SP reports for mandatory prospective review by a second pathologist in the same center of excellence. We now have data from the first 8 months of its use.

Design: The PQAT selects an adjustable percentage of cases for review, allowing real-time documentation of diagnostic agreement or one of three levels of disagreement: minor, moderate or major. The review must be completed prior to case verification. Originating pathologists are blinded to the selection activity by the LIS. The review level was 5% from January-May 2009, and 8% from June-August 2009. The number and level of diagnostic disagreements found using the PQAT were analyzed and compared to those in a similar timeframe prior to its implementation. SP case turnaround time (TAT) was also analyzed.

Results: 1523/23968 (6.4%) SP cases were reviewed between January and August 2009. 1489 (97.8%) resulted in diagnostic agreement. There were 33 (2.17%) minor and 1 (0.07%) moderate, but no major disagreements. Over the corresponding 8 months in 2008 (using a random post-signout review level of 5% with a 2-month lag between diagnosis and review), 1140/23698 (4.9%) of cases were reviewed, with 1109 (97.3%) in agreement. There were 25 (2.19%) minor, 5 (0.44%) moderate and 1 (0.09%) major disagreements. Average TAT for cases reviewed using the PQAT was 2.47 days while average TAT for non-reviewed cases in the same time period was 2.13 days (p=0.84).

Conclusions: Similar discrepancy levels were identified using pre- and post-signout review methods, and use of the PQAT caused no significant change in TAT. The PQAT has the advantages of saving time and effort in slide retrieval for retrospective review, identifying errors in real time, and stimulating discussion of diagnostic approach as cases are being encountered. Additionally, while no major diagnostic disagreements were identified using the PQAT during the time period studied, the prospective nature of the novel tool should allow for prevention of some major diagnostic errors in addition to the identification of process errors and difficult case subsets.

1876 Inter-Institutional Differences in Frozen Section Protocols for Endometrial Carcinoma

V Parkash, N Rassaei, O Fadare, CN Otis, GL Keeney, JL Hecht. Yale University, New Haven, CT; Beth Israel Deaconess Hospital, Boston, MA; Baystate Health Systems, Springfield, MA; Vanderbilt University, Nashville, TN; Mayo Clinic, Rochester, MN.

Background: The NCCN guidelines call for pelvic and periaortic lymphadenopathy in staging of all cases of endometrial carcinoma, citing a likelihood of 15-20% for preoperative undergrading and understaging, Data from the Mayo Clinic suggests that pre and intraoperative evaluation can accurately identify carcinoma that is at low risk for metastasis and save 20% of patients from lymphadenectomy. The difference in data may be due to a lack of pathologist standardization.

Design: A questionnaire was sent to pathologists with interest in gynecologic pathology at institutions that perform FS for endometrial carcinoma. Specifically the questionnaire focused on number of blocks frozen, and reporting of high risk parameters at FS namely – confirmation of grade of tumor, size of tumor, depth of myoinvasion, presence of lymphovascular space invasion (LVSI) and cervical involvement.

Results: The Mayo Clinic FS evaluation consisted of a detailed gross evaluation, with reporting on the size of tumor, a significantly larger number of blocks frozen (range 4-10 blocks), and evaluation of said high risk parameters in all cases. The other institutions were more variable, with number of blocks frozen ranging between 1 (3 institutions) and 4 (1 institution). While depth of invasion and grade were reported at all institutions, volume/size of tumor was reported by none. LVSI was uniformly searched for and reported (albeit on 1 section) at only one institution. Only one institution routinely evaluated cervical involvement.

Conclusions: We have documented the reasons for differences in FS results for endometrial carcinoma at different institutions, which may explain the reasons for the inability to accurately identify high risk endometrial carcinoma pre-operatively. A modification of the FS protocols to include the Mayo clinic parameters may allow for more accurate preoperative staging of endometrial carcinoma, and save women with low risk endometrial carcinoma from an extensive lymph node staging operation.

1877 Factors That Impact Turn around Time of Surgical Pathology Specimens in an Academic Institution

S Patel, JB Smith, J Guarner. Emory University, Atlanta, GA.

Background: Turnaround time (TAT) of laboratory results is an important factor in customer satisfaction. Monitoring of TAT for routine specimens is mandatory. However, there is no standard definition of routine specimen; thus each institution creates its own definition. The objective of this study was to analyze which factors impact TAT of surgical pathology specimens.

Design: We calculated the TAT for all surgical specimens (excluding biopsies) from receipt to verification of results adjusting for weekends and holidays. Twenty days were studied, ten in June and 10 in July 2009. Factors recorded for each specimen included tissue type, number of slides per case, decalcification, immunohistochemistry (IHC), consultations with other pathologists, and diagnosis. Fisher exact test was used for statistical comparisons and $p<0.05$ were considered statistically significant.

Results: A total of 713 specimens were analyzed, of which 551 (77%) were verified within 2 days and 162 (23%) in 3 days or more (97 in 3 days, 37 in 4, 15 in 5, and 13 in 6 to 14). The overall average TAT was of 2.07 days (SD 1.18); however, the mean TAT was >2.07 days for genitourinary (GU), lung, breast, skin, head and neck, and gastrointestinal (GI) samples. A diagnosis of cancer was made in 47% of cases verified in 3 days or more and in 14% of those verified within 2 days (p=0.0001). TAT was also significantly impacted if the case had more than 10 slides, IHC studies, or consultations with other pathologists. Decalcification did not impact significantly the TAT. Study of the variables per tissue type showed that a diagnosis of cancer impacted TAT significantly for GI tissues, head and neck, soft tissues, skin, breast, gynecologic (GYN), as well as various other specimens but did not impact TAT of lymph nodes, lung and GU tissues. IHC studies impacted significantly the TAT of GI, skin, GYN, GU, and various tissues. Having more than 10 slides impacted significantly the TAT of head and neck, skin, breast, and various tissues. Consultations with other pathologists impacted significantly the TAT of soft tissue, skin, breast, and various tissues.

Conclusions: TAT for surgical specimens is impacted by all variables studied except decalcification. Central to significantly prolonging the TAT for surgical pathology specimens is the diagnosis of cancer (7 out of the 11 tissue types) suggesting that institutions serving cancer centers will tend to have longer TAT than those that do not serve cancer centers. The interrelationship between the variables and TAT should be studied further.

1878 Do Surgical Pathology Reports Contain Too Much Information?

N Rassaei, P Cohen, LM Hao, M Pinto, V Parkash. Yale University, New Haven, CT.

Background: Surgical pathology reports (SPR) communicate the results of a pathologic evaluation to a clinician. They include fields in addition to the final diagnosis. With an ever increasing array of additional studies and information reported, the SPR has become very long, raising the question as to whether the clinician can expeditiously glean the essential information required for management given the time constraints of practice.

Design: Our SPR contains the following segments: patient demographics, clinical history (as submitted), list of specimen parts, final diagnosis with comments, gross description, frozen section diagnosis, tabulated list of stains, tabulated list of microscopic sections submitted and addenda listing results of additional studies. Previous pathology reports are not included in the final report, but are referenced when pertinent. Clinicians were asked to rank order the parts of the SPR as follows; 1: absolutely essential 2: not as important as 1, but looked at >50% of the time, 3: usually this not reviewed, however, may be important on occasion, 4: Never review, consider removing from standard report, and 5: information not part of the current report but would be useful to have.

Results: 22 clinicians returned our survey. All ranked patient demographics and final diagnosis as the most important segments of the SPR. The summary of sections and list of stains, considered of importance by pathologists, were ranked low (score of 4) by virtually all. Results of additional testing, which at our institution is appended to the tail of the report was felt to be of high importance by oncologists and was rated just below final diagnosis and demographics. The rank order of gross description varied by specimen type and clinician subspecialty. Oncologists in particular considered the inclusion of the previous pathology as important, the others rated this variably.

Conclusions: Pathologists and clinicians rank order differently the various fields of the SPR. Since the purpose of the SPR is to communicate essential and relevant clinical information for management to the clinicians, consideration should be given to recording certain information in the pathology information systems but not reporting generally e.g. summary of sections, list of stains, or details of the IHC procedure (clones, fixation times etc.). These should form part of the intradepartmental chart of the patient to be accessed by clinicians if and when pertinent. Formal surveys of clinicians may help to create SPRs with greater usefulness in clinical practice.

1879 Evaluation of Resident Education and Quality Practice in Gross Examination Services

MS Ryan, SS Raab. University of Colorado, Denver, CO.

Background: At our institution, residents perform the gross examination of all large specimens and learn gross examination techniques through apprenticeship with senior residents and faculty and reading a protocol manual. The effect of this practice on resident education and patient care quality is unknown.

Design: We performed a two-year retrospective review of all gross examination reports of uteri removed for non-malignant causes (n=78). For each case, we recorded the number and anatomic regions of histologic sections, case turn around time (TAT) from accession to sign-out, the number of sections submitted and the number of bucket dives (BD) or returns to obtain more sections after initially sectioned tissues were processed. These metrics were correlated with resident PGY year (PGY1-4), specific attending pathologist (n=12), and month (e.g., first or second) of resident rotation.

Results: The mean case TAT of specimens grossed by first and fourth year residents was 3.1 and 2.5 days, retrospectively. If a resident performed a BD (n=7), the mean case TAT was 5 days (versus 2.5 days average TAT if no BD performed) and 71% of BDs were performed by PGY1 residents, while the other 29% were performed by PGY3 residents. Individual pathologists had an average TAT from 1.25 to 4.8 days (mean=2.6 days), and only 5 pathologists requested a BD. A resident on the first and second month of his/her surgical pathology rotation had a mean TAT of 3.2 days and 2.3 days, respectively. The number of sections per case varied from an average of 9.5 for PGY1 residents to 7.3 for PGY4 residents. The individual pathologists had an average number of sections per case ranging from 6.3-13.6 (mean= 8.8). When all basic sections (anterior and posterior cervix and anterior and posterior endomyometrium) were submitted initially, the TAT was 2.64 days, whereas those cases in which these sections were not included had an average TAT of 3.35 days.

Conclusions: Our current practice of gross specimen examination is non-standardized and has resulted in less than optimal resident education and patient care quality. Although our data demonstrate resident performance improvement over time, our data also shows a lack of safety focus for beginning residents. We currently are standardizing practice by creating a unified code and number of sections for basic gross techniques to improve TAT and grossing efficiency.

1880 Improvements in Training and Credentialing of Residents for Independent Frozen Section Sign-Out Responsibility

RJH Ryan, M Snuderl, WS Black-Schaffer, J Hunt. Massachusetts General Hospital, Boston, MA.

Background: At our institution, residents are eligible to become qualified for independent sign-out of weekend and nighttime (non-billed) frozen sections (FS, amounting to ~4% of FS cases), with staff backup available on an as-needed basis. We sought to formalize their training and assessment to comply with hospital standards for competency assessment/credentialing.

Design: Data were gathered on QA statistics, and opinions were sought in a survey of residency program graduates about their preparation for FS and experience with independent sign-out. We then initiated a new training and credentialing program for residents.

Results: Differences in night and daytime FS case composition complicate direct comparison, however, analysis of the small difference in FS-final correlations discordance rate between staff and resident failed to show statistical significance. On survey (n=32), past graduates reported that active FS training activities (rotating on FS service, taking call, and self-assessment with daily slides from the FS service) were most useful. Passive activities (observation of FS service or group study of FS slides) were less useful. Few graduates had experience with virtual or glass-slide based FS teaching sets. 72% agreed that they had been well prepared to sign out FS as a senior resident. 71% had called staff backup on a FS case (median 1-2 times in total). 75% reported that their senior FS experience prepared them better for staff FS sign-out than colleagues who had not had independent resident FS experience. Our new credentialing process for residents includes active learning opportunities and assessment. A mandatory weekly frozen section conference challenges residents to diagnose frozens from the prior week's cases in a hot-seat format. We have also assembled both a virtual slide teaching set (120 selected frozen section slides, viewable online as unknown cases for self-assessment) and multiple glass-slide teaching sets. A 2-step assessment process is required for final credentialing of residents for independent frozen section sign-out: successful completion of a period of staff-supervised semi-independent frozen section sign-out, and a slide-based examination.

Conclusions: Graduates felt independent FS sign-out responsibility was an invaluable part of residency training, and preferred active to passive learning activities for FS. We enhanced the range of active learning experiences and active assessments for credentialing residents to take independent FS call.

1881 The Effect of Process Variability on Frozen Section Latent and Active Error, Turn around Time, and Efficiency

SB Sams, ML Smith, TA Wilkerson, AE King, SS Raab. University of Colorado Denver, Aurora, CO.

Background: The quality metrics of an intraoperative consultation with frozen section examination include diagnostic accuracy and turn around time. The effect of process variability on these metrics, efficiency, and risk of error has not been studied.

Design: Using Lean methods, we performed process mapping of 35 intraoperative frozen section consultations in an academic institution where specimens are accessioned by technicians, examined grossly and sectioned by residents, and interpreted and reported by attending pathologists. We broke down the entire process into 10 main steps and by using observational techniques, we measured the frequency of latent and active errors and variability of turn around time of each step. Using time motion analysis, we measured the excess work, or inefficiency of each step. For each error, we performed root cause analysis using Lean and Eindhoven methods.

Results: In all cases, there was no major or minor diagnostic discrepancy, although the number of latent and active errors averaged more than 10 per case. Active errors included failure to page residents and pathologists, using inappropriate techniques of sectioning and staining, coverslipping wrong slides, failure to prepare cryostats, failure of pathologists to be present when cases were ready for sign-out, and lack of diagnostic or technical back-up. Using Eindhoven methods, latent errors included the lack of paging and response protocols, the lack of training in gross examination and sectioning techniques, and the lack of focus on safety practices. In no case did the residents perform the individual specimen sectioning steps in the same manner. The mean turn around time between receipt and diagnostic call was 22:04 minutes, although individual steps ranged in completion time by more than 50%. The most variable steps in terms of turn around time were block preparation, sectioning, and pathologist sign-out. Overall, there was 35% excess waste in motions and unnecessary work for each case (range 15%-70%).

Conclusions: We conclude that our frozen section service showed marked lack of standardization of all process steps. This lack was not correlated with major diagnostic errors in our small sample size, but our processes were associated with a high frequency of latent and active errors that may contribute to major errors in rare cases. We also found that the lack of standardization contributed to delayed case turn around times and considerable inefficiency in work effort.

1882 Discrete Data Field (DDF) Synoptic Cancer Pathology Reporting Enables Timely Prognostic Factor Analysis and Quality Indicator Reporting: A Population-Based Study of 4296 Resection Reports

JR Srigley, D Divaris, T McGowan, M Yurcan, J Ross, K Milnes, J Mazuryk, R McCleod, J Irish, C Sawka. Cancer Care Ontario, Toronto, ON, Canada; McMaster University, Hamilton, ON, Canada; University of Toronto, Toronto, ON, Canada.

Background: Standardized cancer pathology reports (CPRs) facilitate clinical management and data collection by cancer registries, accrediting bodies and planning agencies. In Ontario (population 13 million) we have previously shown that single text field synoptic reporting improves completeness of CPRs based on College of American Pathologists (CAP) checklist standards (J Surg Oncol 99:517-24, 2009). Previous studies used resource-intensive manual auditing. Since 2008, Cancer Care Ontario (CCO) has implemented electronic tools (e-tools) for DDF synoptic CPRs thus enabling automated quality indicator reporting.

Design: CCO receives about 90% of all CPRs (about 137,000 per year) from Ontario hospitals through an electronic pathology system (e-Path). CPR content standards based on CAP checklists (2005) and common formatting and messaging standards were developed for breast, colorectal, lung, prostate, endometrium CPRs. CCO assisted hospitals to implement e-tools for DDF synoptic reporting through e-Path. Quality indicators were developed including % CPRs submitted in DDF format, % DDF CPRs complete against CAP standards, % DDF colorectal CPRs with 12 or more lymph nodes examined and % DDF radical prostatectomy CPRs with positive margins in setting of pT2 disease.

Results: Between May 2008 to August 2009, 15/46 primary e-Path reporting hospitals and 16 associated secondary hospitals implemented e-tools and reported against CCO standards. The % CPRs submitted in DDF synoptic format was 3965/4296 = 92%. 3723/3965 (94%) DDF reports were complete against CAP standards for applicable disease sites. In August 2009, 22% of CPRs (450/2033) for all resections were received in DDF format. CCO has operationalized the completeness indicator process with monthly reporting to hospitals. With respect to surgical pathology quality indicators, 583/643 (91%) colon and 239/269 (89%) rectal and rectosigmoid resections had 12 or more lymph nodes examined. The overall rates of margin positivity for pT2 prostate cancer based on radical prostatectomy reports was 117/450 (26%).

Conclusions: Standardization of CPRs in DDF format automates and facilitates data usage for multiple purposes including cancer registration, stage capture, population-based cancer research and reporting performance metrics related to quality indicators.

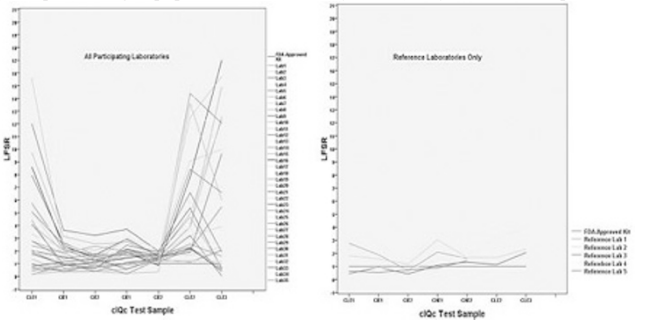
1883 Laboratory/FDA-Approved Kit Score Ratio (LFSR) Is a Useful Tool in Measuring Laboratory Performance in Immunohistochemistry Proficiency Testing; CIQc Experience

EE Torlakovic, LAG Lining, D Pilavdzic, L Quenneville, J Garratt, N Makretsov, B Gilks. Royal University Hospital, University of Saskatchewan, Saskatoon, SK, Canada; Sir Mortimer B. Davis Jewish General Hospital, Montreal, QC, Canada; Lions Gate Hospital, Vacouver, BC, Canada; Faculty of Medicine, Memorial University of Newfoundland, St. John's, NFL, Canada; Vancouver General Hospital, University of British Columbia, Vancouver, BC, Canada.

Background: Majority of participants in the Canadian Immunohistochemistry Quality Control (cIQc) proficiency testing (PT) produce concordance of ≥ 90% for ER and PR testing based on "positive" versus "negative" scoring. Image analysis may have greater discriminatory power and could potentially provide more accurate information on laboratory performance.

Design: Selected tissue cores with different expression of ER from TMAs of two different cIQc runs were scanned and analyzed by image analysis. H-scores were calculated from measured Percent 3+, Percent 2+, and Percent 1+ Positive Nuclei parameters. Each laboratories' H-scores were divided by H-scores obtained by FDA-approved kit to obtain Laboratory/FDA-Approved Kit Score Ratio (LFSR). Tissue cores with low expression (CLE) and high expression (CHE) were compared for their ability to discriminate between the sensitivity of staining of participants.

Results: LFSR varied between different cores of the same TMA and for the same cores between participants. CLE had largest variation of LFSR between laboratories. CHE LFSR had much lower variation (Figure 1). LFSRs of the five reference laboratories were consistently close to 1; their results were very similar to the FDA-approved kit although none used the kit for testing. Reference laboratories preformed better than other participants as a group ($p<0.05$, Mann-Whitney U Test) only with CLE samples.



Conclusions: Image analysis identifies subtle problems in sensitivity of ER testing, which are not detected when a simple "positive" versus "negative" assessment is used. CHE samples are not useful in PT since they poorly discriminate between laboratories with highly reproducible results and laboratories with lesser reproducibility. LFSR is a useful tool to measure laboratory performance in immunohistochemistry PT.

1884 Inappropriate Frozen Sections: An Analysis To Determine Utilization Validity, and the Need To Educate Physicians as Part of a QA Program

C Tornos, P Kane, M Singh. Stony Brook University Medeical Center, Stony Brook, NY.

Background: Part of our current QA process is to assess appropriateness of frozen section (FS) requests, and determine any patterns of use that need to be corrected. Valid indications for a frozen section include: establish a diagnosis that needs immediate additional surgery or other therapy, determine adequacy of surgical margins and establish whether the specimen obtained contains enough viable lesional tissue for diagnosis. Inappropriate requests for frozen section include: to satisfy clinical curiosity, desire solely to communicate results to the family, or locate anatomical landmarks that should

be recognizable by any surgeon. We report the results of reviewing FSs performed in the last 12 months at our hospital.
Design: A computer search of all FSs performed during the last 12 months (7/08 to 6/09) was conducted on a monthly bases for our QA review. We examined all pathology reports, and pertinent clinical history provided. The FSs were deemed appropriate according to the criteria mentioned above. FSs that seemed inappropriate were further investigated and were discussed with the requesting physician if needed. If there was no justifiable reason for the FS the request was categorized as inappropriate.
Results: A total of 1177 FSs were performed, of which 1165 (98.9%) were done for appropriate reasons including: 838 (71%) to establish a diagnosis for immediate treatment, 225 (19%) to assess surgical margins, and 102 (8.6%) to determine adequacy of tissue. The remaining 12 (1%) were requested for inappropriate reasons. In 5 of these when the FS diagnosis was called the surgery had already finished and the surgeon could not be located. In 7 cases the surgeons confirmed that nothing else would have been done based on the result of the FS. Five of these were done after hours or on weekends. Three surgeons accounted for 11/12 cases. They were personally contacted by the Director of the service and appropriateness of the FS request was discussed with them. Monitoring to assess whether the meetings were effective in correcting utilization of FSs is underway.
Conclusions: FS requests need to be monitored in each institution to identify inappropriate utilization and provide opportunities for education of surgeons with the aim of improving patient care, avoiding misuse of fresh tissue, and encouraging optimal expenditure of resources.

1885 "Pay for Performance" in Pathology – *Does It Perform?*

A Vora, B Feltmann, J Pfeifer. Washington University, St. Louis, MO.
Background: Pay for Performance (P4P) is a new measure instituted by the Centers for Medicaid and Medicare (CMS) in response to patient quality issues identified by the Institute of Medicine (IOM). The P4P system links compensation by CMS to measures of work quality, including improvements in patient care and pathology reporting. Per CMS, a financial incentive awarded to providers for the P4P program will result in improved patient care. However, no long-term studies have been performed in pathology to see if P4P benefits patients or their health care institutions. To address these issues, a retrospective audit was performed to determine the impact of P4P measures on patient care and financial reimbursement at our institution.
Design: A retrospective review of all breast carcinoma resections diagnosed by an academic pathology department at a tertiary care hospital was performed for fiscal year (FY) 2008 (June 2007-July 2008). Based on the pathology reports, resections were stratified to see if they met or exceeded defined P4P criteria, and the resulting professional and administrative costs of implementing the P4P algorithm were calculated.
Results: Of the breast carcinoma resections in FY 2008 (n=1,252), only 25% (n=319) were patients covered by the Medicare program; 100% of these cases met the inclusion criteria for P4P best medical practice and the performing pathologist's total Medicare allowable charge base was $290,239. The calculated P4P bonus on these charges was $4,354 (1.5% of the allowable charges). However, the retrospective analysis demonstrated that it had cost $5,870 to implement the changes in specimen processing and reporting to meet P4P criteria, and that there was a $330 administrative cost involved in submission of P4P claims. A similar analysis of colon adenocarcinoma resections showed that 100% of cases met inclusion criteria for P4P best medical practice, but that the costs of participation in the P4P program exceeded the reimbursement received (data not shown).
Conclusions: In a tertiary care academic pathology department, participation in the P4P program did not improve patient care (standard of care reporting criteria in the department met or exceeded P4P criteria in 100% of breast and colon resections prior to participating in the P4P program). Furthermore, the P4P algorithm did not provide a clear financial incentive (participation in the P4P program was associated with a net cost). We conclude that, in the setting of a tertiary care academic pathology department, patient care needs dictate reporting standards, not P4P initiatives.

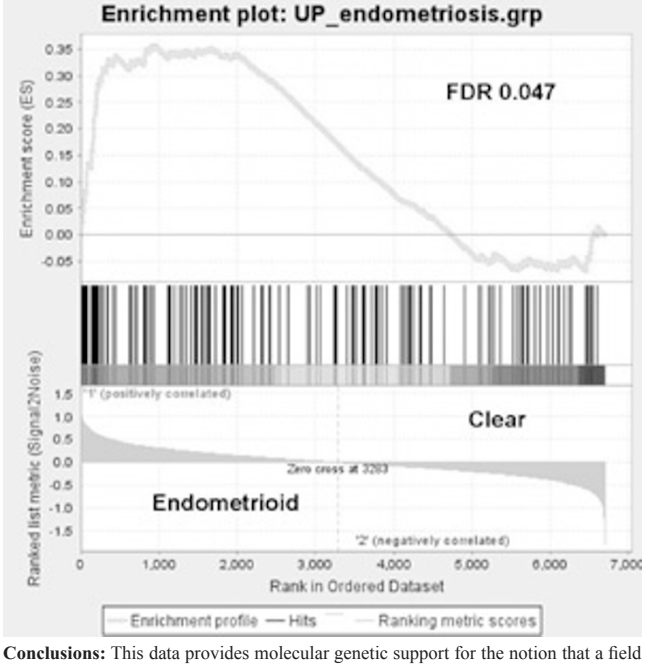
Pan-genomic/Pan-proteomic Approaches to Diseases

1886 Derivation and Independent Validation a Gene Expression-Based Predictor for Post-Cystectomy Recurrence in Nodal Negative Muscle Invasive Urothelial Carcinoma

AS Baras, SC Smith, CA Moskaluk, HF Frierson, D Theodorescu. UVA Health System, Charlottesville, VA.
Background: Despite radical surgery and lymphadenectomy, approximately half of muscle invasive urothelial carcinoma (MIUC) patients experience metastatic recurrence within two years of surgery. Within this population, patients with nodal negative disease are not commonly offered adjuvant chemotherapy, though treatment failures remain common. Predictive risk stratification in this population would be useful for decisions regarding adjuvant therapy.
Design: We used two published studies of gene expression profiling of tumor tissue to design a prediction metric for recurrence post-cystectomy among pathologically node negative MIUCs. First, we used one dataset based on the Affymetrix HG-U133A platform for training to compare gene expression between a subset of cases evincing disease free survival >2 years (N=17) to those with disease specific recurrence in < 2 years (N=14). A nearest neighbor classification system yielding a prediction score from 0 to 1 was employed to classify samples based on expression of recurrence related genes. This gene set was then applied to an independent test dataset of 47 tumors profiled on the Illumina Human WG6 V2 platform. Association between the gene expression-based prediction score and clinicopathologic parameters was tested through multivariate logistic regression and receiver operating characteristic (ROC) analysis.
Results: By a criterion of 2-fold differential expression, > 75 units average difference, and P<0.001, we found 33 candidate probes associated with disease recurrence in the training set. Prediction scores within the learning dataset were found to be independent of stage, grade, age, and sex (p=0.011). From these 33 probes, 27 Unigene IDs were able to be matched across microarray platforms. When the same prediction algorithm was applied to the independent test set of nodal negative MIUCs, we again found a significant independent association with disease recurrence (P=0.015), with a favorable area under the ROC curve (P=0.012).
Conclusions: Prediction models derived from gene expression analysis of tumor tissue samples can provide independent prognostic information about the course of patient disease in node negative stage MIUCs. This approach may show promise as an adjunct to routine histologic examination in determining patient therapy, pending validation in larger independent cohorts.

1887 Gene Set Enrichment Analysis Identifies Ovarian Tumor Field Defect

J Cuff, AH Beck, TA Longacre. Stanford University, Stanford, CA.
Background: Ovarian endometrioid and clear cell carcinoma are associated with endometriosis. A step-wise transformation of a specific precursor lesion has been proposed for clear cell carcinoma, while a possible field defect has been postulated for endometrioid carcinoma, whereby neoplastic progression is distributed throughout the extended mullerian system. We utilized gene set enrichment analysis to determine whether unique patterns of gene expression in ovarian clear cell and endometrioid carcinomas are distinct with regard to endometriois, an acknowledged common precursor lesion.
Design: We pursued a two step bioinformatic approach utilizing publicly available gene expression data. Significance analysis of Microarray's (SAM) was used to construct an endometriosis gene signature by comparing expression array data **(GSE7305)** from endometriosis (n=10) and cycling eutopic endometrium (n=10). SAM was implemented in R where ~1000 probes were deemed to be significantly different between the two groups (delta level =5; false discovery rate of zero expected at this level of significance). The second step utilized a data set of stage I ovarian cancers (GSE8841); analysis was restricted to the subset of clear cell and endometrioid carcinomas (n=35). Gene Set Enrichment Analysis (GSEA; Broad institute) was performed to determine if differences in gene expression between clear cell and endometrioid carcinomas differ in a coordinated fashion with respect to the previously defined background/stromal gene expression of endometriosis.
Results: A set of 36 genes was upregulated in endometriosis and significantly enriched in endometrioid but not clear cell carcinoma. Gene annotation revealed several known oncogenes, genes encoding tyrosine kinases, and genes associated with neoplasia inducing translocations. These genes are suspect candidates in the neoplastic transformation of a common precursor lesion into distinct tumor types.



Conclusions: This data provides molecular genetic support for the notion that a field defect with a unique set of genetic changes is operative in ovarian endometrioid but not clear cell tumors. Endometriosis may presage ovarian endometrioid and clear cell carcinoma, however different genetic changes likely participate in divergent morphologic and clinical phenotypes.