


# FROZEN SECTION QUALITY ASSURANCE



FACTORS AFFECTING ACCURACY AND TURNAROUND TIME

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Professor and Consultant  
Mayo Clinic Florida

ET Bell Symposium  
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## DISCLOSURES

- None

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## AGENDA

- Broad overview of FS QA
- Factors affecting accuracy
- Factors affecting TAT
- Conclusion

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## INTRAOPERATIVE CONSULTATION QUALITY ASSURANCE PLAN

- Purpose: This quality management plan is designed to assure that this laboratory meets regulatory and performance standard for quality and safety.
- Domain and Oversight: This plan is a part of the quality management plan for Anatomic pathology and is under the direction of (Lab director). This committee reports directly to (Dept of Lab Med and Pathology QA committee). Some data may be shared with other departments (e.g. surgery), hospital QA committee or risk management.
- Policies and procedures: These may be included here if they address specific issues relevant to quality and safety.
- Responsibility: A listing of individuals that are responsible for collection of data should be included with a timetable for the QA committee meeting and presentation of the data.

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### QUALITY MONITORS

Aspect of quality	Specific Monitors
Statistics	Number and location of interoperative consultations Number of frozen sections Number of cases by service and clinician
Pre-analytic	Specimen adequacy Remote site timely delivery Remote site scheduling
Analytic	FS-permanent section discordance FS-permanent section deferral
Post-analytic	Appropriate documentation of FS diagnosis Appropriate documentation of discordance Appropriate documentation of communication in instances of discordance
Turnaround time	TAT of single block cases TAT of multiple block cases
Customer satisfaction	Customer satisfaction survey may be part of more general surveys of the laboratory usually every 2-3 yrs

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## Interinstitutional Comparison of Frozen-Section Consultation

A College of American Pathologists Q-Probe Study of 79 647 Consultations in 297 North American Institutions

Richard J. Zarbo, MD, DMD; Gerald G. Hoffman, MD; Peter J. Howanitz, MD

(Arch Pathol Lab Med. 1991;116: 1167-1194)

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**Table 3.—Performance in Frozen-Section (FS) Consultation**

	No.	Overall %*	Adjusted %†
Total FS requests	79 647	...	...
Total FS diagnoses rendered	76 037	...	...
Deferred diagnoses	3340	4.2	
Concordant diagnoses	75 039	94.2	98.3
Discordant diagnoses	1268	1.6	1.7

\* Uses total FS requests (including deferred) as denominator.  
† Uses total FS diagnoses (minus deferred) as denominator.

**Table 4.—Reasons for Discordance\***

	Overall Rate, %	All Laboratories, Mean %
Tissue sampling	44.3	42.2
Misinterpretation	40.0	42.4
Sectioning	12.7	16.3
History	5.6	14.3
Staining	1.5	4.3
Labeling	0.8	0.9
Other	3.0	2.0

\* Total is greater than 100% because more than one reason may have been recorded as contributing to discordance in some cases.

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- ### CONCLUSIONS 1989 CAP Q-PROBES STUDY
- 297 institutions, 52,464 cases, 79,647 FS
  - FS rate 5.6% of cases with an average of 1.5 FS/case
  - FS rates increased with hospital size up to 15%
  - Of all FS, 4.2 % were deferred (92.6% appropriate, 1.2% inappropriate, 6.2% N/A)
  - 98.3% concordant adjusted for deferred diagnosis
  - Sampling 44.8%, misinterpretation 40%, sectioning 12.7%, inadequate history 5.6%, staining 1.5%
  - Assessment of discordant dx, 2.5% greatly affected, 20% minimally affected, 74% not affected.

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## The Accuracy of Frozen-Section Diagnoses in 34 Hospitals

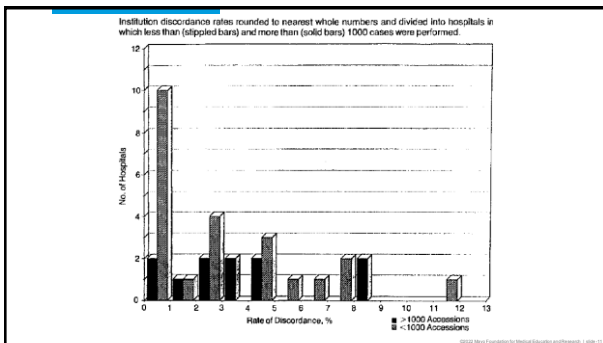
Peter J. Howanitz, MD; Gerald G. Hoffman, MD; Richard J. Zarbo, MD, DMD

Arch Pathol Lab Med 1971;4:469-1500

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No. of frozen sections	1952
Diagnosis deferred, %	3.9
Diagnostic concordance, %	96.5
Diagnostic discordance, %	3.5

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	%
Unaffected	79.1
Minimally affected	14.9
Greatly affected	6.0

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	%
Inability to identify lesion in specimen	44
Technical problems in sectioning	8
Technical problems in staining	0
Misinterpretation	44
Inadequate clinical information	8
Labeling errors	3

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- BASILINE STUDIES**
- Larger hospital do more frozen section
  - Smaller hospital have higher error rate
  - Reasons for discordance similar
    - Tissue sampling
    - misinterpretation

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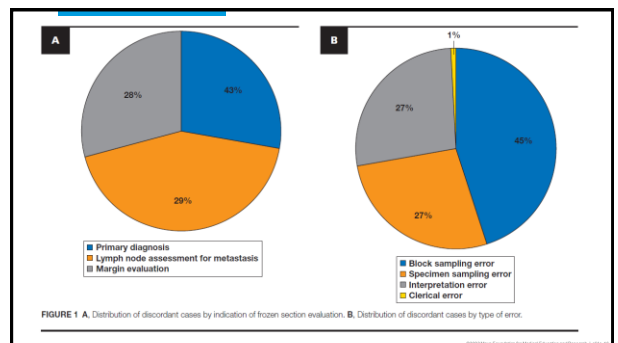
**A Quantitative and Qualitative Assessment of Frozen Section Diagnosis Accuracy and Deferral Rate Across Organ Systems**

Anas Mohamed, MD,<sup>1,\*</sup> Muhammad Masood Hassan, MD,<sup>2</sup> Wen Zhong, MD,<sup>3</sup> Aisha Kousar, MD,<sup>1</sup> Kotaro Takeda, MD,<sup>1</sup> Deepak Donthi, MD,<sup>4</sup> Areeba Rizvi, MD,<sup>5</sup> Manwan Majeed, MD,<sup>1</sup> Ahmed I. Younes, MD,<sup>1</sup> Ahlam Ali, MD,<sup>6</sup> Ann Sutton, MD,<sup>1</sup> Gina Murray, MD,<sup>1</sup> Abdullah Thayyil, MD,<sup>1</sup> John Fallon, MD,<sup>1</sup> and Kim Geisinger, MD<sup>6</sup>

From the <sup>1</sup>Department of Pathology and Laboratory Medicine, East Carolina University/Vidant Medical Center, Greenville, NC, USA; <sup>2</sup>Department of Pathology, University of Mississippi Medical Center, Jackson, MS, USA; <sup>3</sup>Department of Pathology, Division of Neuropathology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA; <sup>4</sup>Department of Pathology, University of Texas Southwestern Medical Center, Dallas, TX, USA; <sup>5</sup>Department of Pediatrics, Faculty of Medicine, Omar Al Mukhtar University, Al Bayda, Libya; and <sup>6</sup>The Joint Pathology Center, Silver Spring, MD, USA.

Am. J. Clin. Pathol. 2022;139:692-701

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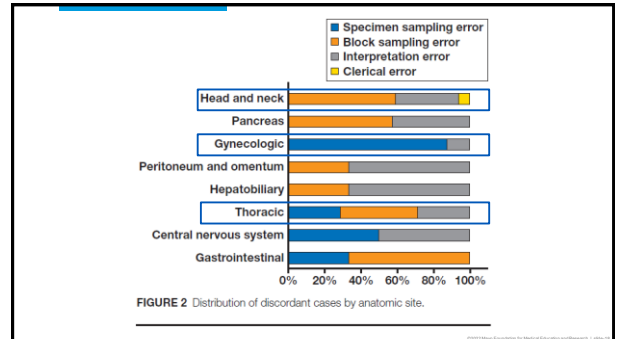


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Organ/Organ System	No. of Cases	Deferred Cases, No. (%)	Discordant Cases, No. (%)	Concordance Rate, %
Pancreas	150	3 (2)	7 (4.8)	95.2
LN	643	21 (3.26)	28 (4.5)	95.5
Gynecologic	573	25 (4.36)	24 (4.4)	95.6
Peritoneum and omentum	99	4 (4.04)	3 (3.2)	96.8
Hepatobiliary	113	8 (7.07)	3 (2.9)	97.1
Head and neck	854	5 (0.58)	17 (2)	98.0
Gastrointestinal	204	3 (1.41)	3 (1.5)	98.5
Thoracic	516	23 (4.45)	7 (1.4)	98.6
CNS	180	2 (1.11)	2 (1.1)	98.9
Thyroid and parathyroid	110	1 (0.9)	1 (0.9)	99.1
Musculoskeletal and skin	131	10 (7.63)	1 (0.8)	99.2
Breast	14	1 (7.14)	—	100.0
Genitourinary	88	2 (2.27)	—	100.0
Total	3,675	114 (3.1)	96 (2.7)	97.3

CNS, central nervous system; LN, lymph node.

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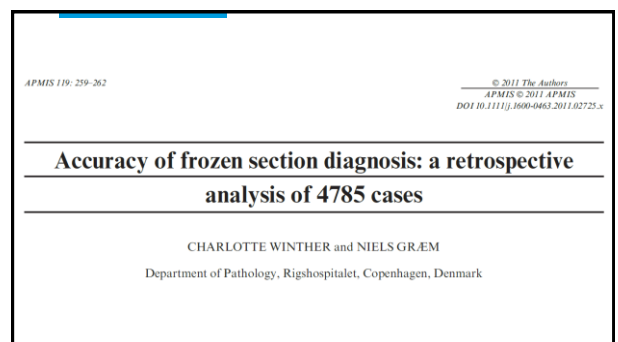


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## CONCLUSIONS

- Discordant rate (2.7%), Deferral rate (3.1%)
- Lowest discordant rates: breast and GU cases
- Highest discordant rates: Pancreas, LN and GYN
- Deferral rates lowest: thyroid, parathyroid and neuro
- Deferral rates highest: Soft tissue, breast and Hepatobiliary
- Discordance associated with block/sampling error (45%) specimen sampling (27%) and interpretive error (27%)

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**Table 1.** Distribution of diagnostic agreements, disagreements and deferred cases according to tissue type

Tissue type, n = 4785	Concordance (%)	Discordance (%)	Deferral (%)	Total no. specimens in category (%)
Skin	1448 (99.2)	10 (0.7)	2 (0.1)	1460 (30.5)
Axillary sentinel node	1038 (90.6)	107 (9.3)	1 (0.1)	1146 (23.9)
Lung, pleura, mediastinum	490 (98.8)	4 (0.8)	2 (0.4)	496 (10.4)
Lymph node	363 (92.8)	25 (6.4)	3 (0.8)	391 (8.2)
Female genital	270 (93.8)	14 (4.9)	4 (1.4)	288 (6.0)
Oral cavity, nasopharynx, pharynx, larynx	184 (93.4)	6 (3.0)	7 (3.6)	197 (4.1)
Abdomen, pelvis	151 (95.6)	2 (1.3)	5 (3.2)	158 (3.3)
Liver, biliary system, pancreas	144 (99.3)	1 (0.7)	-	145 (3.0)
Soft tissue, bone, joint	122 (87.8)	2 (1.4)	15 (10.8)	139 (2.9)
Gastrointestinal tract	97 (93.3)	5 (4.8)	2 (1.9)	104 (2.2)
Thyroid, parathyroid	86 (95.6)	-	4 (4.4)	90 (1.9)
Urinary tract	66 (94.3)	3 (4.3)	1 (1.4)	70 (1.5)
Masculine genital	43 (93.5)	2 (4.3)	1 (2.2)	46 (1.0)
Breast	12 (75.0)	2 (12.5)	2 (12.5)	16 (0.3)
Cardiovascular system	13 (93.0)	-	1 (7.1)	14 (0.3)
Other	22 (88.0)	2 (8.0)	1 (4.0)	25 (0.5)
Total	4549	185	51	4785 (100)

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- CONCLUSIONS**
- Skin Margins and LN mets most frequent FS
  - LN discordance most frequent
  - 182 discordant (178 false negative, 4 false positive)
  - Accuracy and concordance rates varied for different tissue types
  - Overall concordance was 95.1%

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**The Value of Monitoring Frozen Section-Permanent Section Correlation Data Over Time**

Stephen S. Raab, MD; Joseph A. Tivrek, MD; Rhona Souers, BS; Richard J. Zarbo, MD, DMD

(Arch Pathol Lab Med. 2006;130:337-342)

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**Table 2. Distribution of Yearly Concordant Diagnostic Frequencies**

Year	No. of Institutions	All Institutional Percentiles				
		10th	25th	50th	75th	90th
1999	83	96.77	97.87	98.67	99.38	100.00
2000	94	95.60	97.88	98.95	99.59	100.00
2001	81	96.85	98.36	99.07	99.72	100.00
2002	69	96.88	98.28	99.20	99.88	100.00
2003	55	97.28	98.26	98.97	100.00	100.00

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**Table 3. Distribution of Yearly Discordant Diagnostic Frequencies**

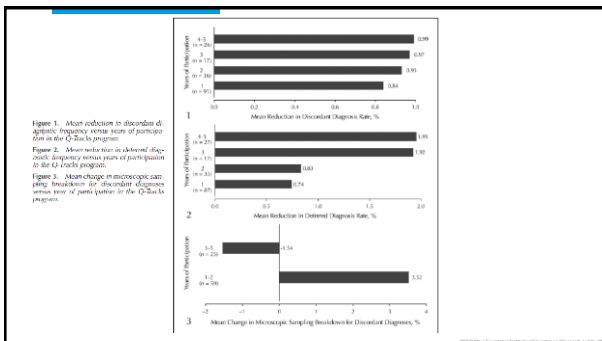
Year	No. of Institutions	All Institutions Percentiles				
		10th	25th	50th	75th	90th
1999	83	0.00	0.62	1.33	2.13	3.23
2000	94	0.00	0.41	1.06	2.12	4.40
2001	81	0.00	0.28	0.93	1.64	3.15
2002	69	0.00	0.12	0.80	1.72	3.13
2003	55	0.00	0.00	1.03	1.74	2.72

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**Table 4. Distribution of Yearly Deferred Diagnostic Frequencies**

Year	No. of Institutions	All Institutional Percentiles				
		10th	25th	50th	75th	90th
1999	81	0.00	0.52	1.52	2.89	4.54
2000	94	0.00	0.46	1.42	3.28	6.30
2001	81	0.00	0.33	1.74	3.84	6.28
2002	69	0.00	0.18	1.16	3.20	5.97
2003	55	0.00	0.47	1.63	3.34	4.83

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**CONCLUSIONS**

- Long-term monitoring of FS-PS correlation is associated with sustained improvement in performance.
- Longer participation in Q-Tracks program associated with lower discordant rate
- 4 and 5-year participants showed a decrease of discordant cases by 0.99%
- Longer participation resulted in decrease of microscopic sampling discordant diagnoses

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## Evaluation of the accuracy of frozen section in different anatomical sites

*Avaliação da acurácia diagnóstica do exame intraoperatório  
por congelação em diferentes sítios anatômicos*

Rafael P. Santana<sup>1</sup>; Nivaldo S. Moraes<sup>1</sup>; Yves Brenan S. Samary<sup>2</sup>; Artur Lício R. Bezerra<sup>2</sup>; Daniela M. Takano<sup>2</sup>

<sup>1</sup> Faculdade Pernambucana de Saúde (FPS), Pernambuco, Brazil; <sup>2</sup> Instituto de Medicina Integral Professor Fernando Figueira (Imip), Pernambuco, Brazil.

J Bras Patol Med Lab. 2018 Oct; 54(5): 319-321.

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TABLE 1 – Accuracy in each of the evaluated anatomical sites (n = 1,226)

Anatomical site	n cases (n)	Concordant (n%)	Discordant (n%)
Ovary	335 (27.32%)	317 (94.6%)	18 (5.4%)
Sentinel lymph node	243 (19.82%)	235 (96.7%)	8 (3.3%)
Breast	101 (8.23%)	100 (99%)	1 (1%)
Peritoneum	87 (7.09%)	79 (90.8%)	8 (9.2%)
Uterus	82 (6.68%)	82 (100%)	0 (0%)
Lymph node	78 (6.36%)	75 (96.1%)	3 (3.9%)
Liver, gallbladder, pancreas	64 (5.22%)	63 (98.4%)	1 (1.6%)
Esophagus, stomach, colon, rectum	61 (4.97%)	59 (96.7%)	2 (3.3%)
Urologic	52 (4.24%)	50 (96.2%)	2 (3.8%)
Lung	34 (2.77%)	34 (100%)	0 (0%)
Skin	25 (2.03%)	25 (100%)	0 (0%)
Others	19 (1.54%)	19 (100%)	0 (0%)
Omentum	17 (1.38%)	17 (100%)	0 (0%)
Central nervous system	13 (1.06%)	13 (100%)	0 (0%)
Retroperitoneum	9 (0.73%)	7 (77.7%)	2 (22.3%)
Vulva, vagina, cervix	6 (0.48%)	6 (100%)	0 (0%)

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## FINDINGS

- 1226 cases, 96.33% concordant, 3.67% discordant
- Discordant cases: 15.4% false positive, 84.6 false negative
- Most false positive cases 3(1.2%) sentinel LN
- Most false negative cases 17(51.51%) ovary

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## Accuracy of frozen-section analysis in the diagnosis of ovarian tumors: a systematic quantitative review

L.R. MEDEIROS<sup>a</sup>, D.D. ROSA<sup>†</sup>, M.I. EDELWEISS<sup>††</sup>, A.T. STEIN<sup>§§</sup>, M.C. BOZZETTI<sup>†††</sup>,  
A. ZELMANOWICZ<sup>††</sup>, P.R. POHLMANN<sup>¶</sup>, L. MEURER<sup>‡</sup> & M.T. CARBALLO<sup>\*</sup>

<sup>a</sup>Epidemiology and <sup>†</sup>Medical Sciences, Federal University of Rio Grande do Sul, Porto Alegre, Brazil; <sup>††</sup>Pathology Unit, Hospital de Clínicas de Porto Alegre, Porto Alegre, Brazil; <sup>†††</sup>Public Health, Universidade Luterana do Brasil, Luterana, Brazil; <sup>§</sup>Medical Science, Porto Alegre Federal Faculty of Medical Science, Porto Alegre, Brazil; <sup>¶</sup>Department of Social Medicine, Faculty of Medicine, Federal University of Rio Grande do Sul, Porto Alegre Brazil; and <sup>‡</sup>Cancer Prevention Center, Complexo Hospitalar Santa Casa, Porto Alegre, Brazil

Int J Gynecol Cancer 2005, 15, 192–202

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**FINDINGS**

- Meta analysis of 14 studies, 3659 cases
- Benign vs borderline/malignant, for benign (95% probability)
- Malignant vs benign, for malignant (98% probability)
- Borderline vs benign, for borderline (79% probability)
- Borderline vs malignancy, for borderline (51% probability)

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**Interinstitutional Comparison of Frozen Section Turnaround Time**

**A College of American Pathologists Q-Probes Study of 32 868 Frozen Sections in 700 Hospitals**

David A. Novis, MD, Richard J. Zarbo, MD, DMD

(Arch Pathol Lab Med. 1997;121:559-567)

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**Table 3.—Aggregate Frozen Section (FS) Block Completion Times (min) and Number of Blocks Prepared Per Specimen, by Tissue Type**

Tissue Type	Percentage of Total Blocks (N = 32 659)	No. of Blocks per Specimen, % (N = 24 801)			FS Block Completion Time, min	
		0-1	2-4	>5	50th Percentile	90th Percentile
		Skin	20.7	60.7	33.2	6.1
Breast	16.7	89.6	9.2	1.2	11	19
Lymph nodes	13.3	82.5	15.9	1.6	11	20
Female genital	9.8	79.6	18.9	1.5	10	19
Thyroid, parathyroid	6.6	85.6	13.4	1.0	11	20
Oral, nasopharyngeal	6.4	86.8	10.4	2.8	11	26
Lung, pleura, mediastinum	5.1	88.4	11.0	0.6	12	20
Gastrointestinal	5.0	82.3	16.4	1.3	11	20
Soft tissue, bone, joint	3.4	89.2	8.9	1.9	12	20
Central nervous system	2.7	92.2	7.3	0.5	12	23
Urinary system	2.4	89.8	9.2	1.0	12	21
Male genital	2.3	80.5	16.8	2.7	10	20
Peritoneum, omentum	1.8	90.8	8.8	0.4	10	20
Hepatobiliary	1.8	91.7	7.7	0.6	12	20
Pancreas	0.9	84.3	14.3	1.4	12	22
Cardiovascular	0.2	87.7	12.3	0.0	10	18
Adrenal, paraganglion	0.1	87.5	12.5	0.0	13	21
Other	2.4	88.9	10.7	0.4	11	20
All tissue types	100.0	87.6	15.4	2.0	10	20

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**Table 4.—Aggregate Frozen Section (FS) Block Completion Times (min) and Number of Blocks Prepared Per Specimen, by Reason for FS Request**

Reason for FS Request	Total Specimens	Percentage of Specimens (N = 24 354)			FS Block Completion Time, min	
		No. of Blocks per Specimen			50th Percentile	90th Percentile
		0-1	2-4	≥5		
Confirm presence of primary malignancy	52.1	84.8	13.6	1.6	10	20
Determine adequacy of resected margins	17.8	67.1	28.1	4.8	9	20
Confirm presence of metastatic malignancy	13.0	83.9	14.7	1.4	11	20
Confirm sufficient tissue taken	4.8	88.5	9.8	1.7	11	20
Confirm appropriate tissue taken for studies	2.7	92.2	7.5	0.3	12	20
Microscopic identification	2.5	91.2	7.5	0.3	12	20
Interest of patient, patient's family	2.5	91.8	7.3	0.8	10	20
Facilitate management	2.2	92.1	7.2	0.7	11	19
Multiple reasons stated	1.3	89.3	9.7	1.0	11	19
Reason unknown	0.5	65.5	27.2	5.3	8	15
Requested by mistake	0.3	90.8	9.2	0.0	12	20
Liability concerns	<0.1	77.8	22.2	0.0	12	22
Academic interest	<0.1	100.0	0.0	0.0	10	27
Other	<0.1	50.0	50.0	0.0	20	23
All Reasons	100.0	82.5	15.5	2.0	10	20

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### Q-PROBES

- FS TAT Arch Pathol Lab Med 1997;121:559
- 700 Hospital 32,868 FS
- 90% were completed within 20 minutes
- Prolonged TAT was associated with:
  - More than one pathologist involved
  - Pathology resident or student participated
  - Need to retrieve prior material
  - Multiple cases occurring at the same time
  - Technical problems occurred

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### Frozen Section Quality Assurance

#### Using Separate Frozen Section Slide Preparation Times and Interpretative Time Measurements to Improve Process

Joseph M. Laakman, MD, Stephanie J. Chen, MD, Kim S. Lake, John L. Blau, MD, D. Anand Rajan KD, MBBS, Megan I. Samuelson, MD, and Robert A. Robinson MD, PhD

From the Department of Pathology, Carver College of Medicine, University of Iowa, Iowa City, IA, USA.

**Key Words:** Frozen section; Turnaround time; Quality improvement

*Am J Clin Pathol* September 2021;156:461-470

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### METHODS

- Technical and interpretive times for 1992 specimen
- Sorted by surgical specialty
- Technical time: grossing through stained slide sections
- Interpretation time: Pathologist receives slides to just before the diagnosis is call to OR
- % of third quartile indicator of longer TAT
- Small volume specialties were eliminated

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**Table 1B**  
Times Required for Rendering a Diagnosis by Specialty\*

Specimen by Surgical Service	Technical Time, min		Interpretation Time, min		Total Time, min	
	Mean	Third Quartile	Mean	Third Quartile	Mean	Third Quartile
Gynecologic	19.0	22	5.1	8	24.1	28
Pulmonary	16.5	19	6.3	7.75	22.8	26
Breast	14.4	17	8.2	10	22.6	27
Gastrointestinal	14.4	17	6.6	8.5	21.0	26
Head/neck	13.7	15	6.0	8	19.7	23
Genitourinary	14.1	16	5.3	5.5	19.4	22
Mean of all specialties	15.4		6.3		21.7	

\*Third quartile times were empirically set as a metric for "prolonged" times.

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## RESULTS AND CONCLUSIONS

- Technical times were significantly longer than interpretation time
- Technical issues identified for certain specimens
- GYN and pulmonary dissections were prolonged

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## Accuracy of frozen section remote subspecialty consultation using real-time telepathology and whole-slide imaging in gynecologic cases

Charisse Liz B. Treece, MD<sup>a</sup>, Jennifer Filipek, PA, Jitin Makker, MD, Neda A. Moatamed, MD, Erika F. Rodriguez, MD, PhD

Department of Pathology and Laboratory Medicine, UCLA David Geffen School of Medicine, Los Angeles, CA, US

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- Am J Clin Pathol 2023;XX:1-7
- Comparison of In-person consultation vs. WSI vs. videoconference
- 100% concordance of videoconference and WSI, 98.5 concordance rate for in-person consultation
- TAT mean was 45 min for videoconference, in-person consultation TAT 33 min (image)

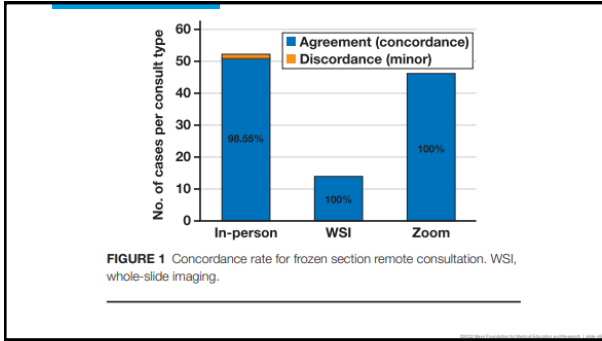
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**TABLE 1** Descriptive Statistics: Turnaround Time (in Minutes) per Type of Consultation

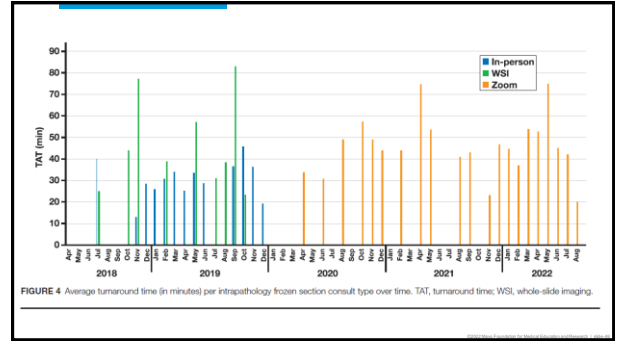
Statistic	Turnaround time for IPC, min	Turnaround time for WSI, min	Turnaround time for Zoom, min
No. of observations	52.00	14.00	46.00
Minimum	13.00	19.00	17.00
Maximum	85.00	122.00	87.00
Median	30.50	38.50	46.50
Mean	33.37	46.79	45.59
SD	13.31	26.74	15.02
SEM	1.86	7.42	2.24

IPC, in-person consultation; WSI, whole-slide imaging.

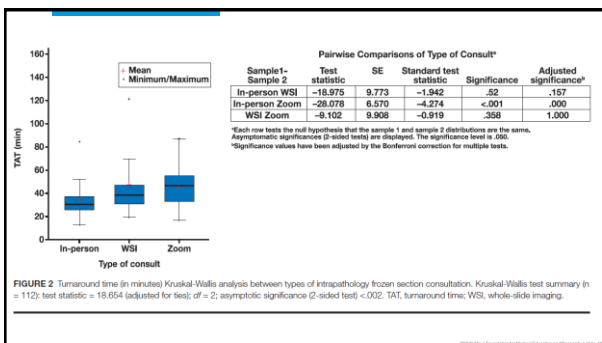
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## Real-time Telepathology Is Substantially Equivalent to In-Person Intraoperative Frozen Section Diagnosis

Joseph M. Rubin, MD, PhD; Kevin Cinnearough, MD; Mark Tuthill, MD; Jason Pimental, MD; Rodney Markin, MD, PhD

(Arch Pathol Lab Med doi: 10.5858/arpa.2022-0261-0A)

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**Table 1. Tissue Site and Turnaround Time (TAT) for Telemicroscopic Cases by Hospital/Surgical Center\***

Anatomic Site	Institution 1												Institution 2			Overall		
	Hospital 1				Hospital 2				Combined				Hospital 1			Overall		
	No.	n With TAT	TAT		No.	n With TAT	TAT		No.	n With TAT	TAT		No.	n With TAT	TAT	No.	n With TAT	TAT
Parathyroid	243	234	18:01	18	18	15:07	261	252	17:49	2	2	30:00	263	254	17:55			
Skin	213	182	13:08	1	0	N/A	214	182	13:08	1	1	32:30	215	183	13:14			
Lymph node	66	59	23:14	31	30	19:15	67	89	21:53	3	3	33:00	100	92	22:35			
Brain	0	0	N/A	1	0	N/A	1	0	N/A	51	50	30:40	52	50	30:40			
ENT	15	14	20:04	2	2	24:30	17	16	20:37	34	34	24:55	51	50	23:32			
Prostate	0	0	N/A	0	0	N/A	0	0	N/A	15	15	22:10	15	15	22:10			
Ovary	0	0	N/A	1	1	23:00	1	1	23:00	7	7	21:20	8	8	21:33			
Thyroid	1	1	18:00	6	5	22:00	7	6	21:20	1	1	25:00	8	7	21:51			
Soft tissue	0	0	N/A	4	3	27:20	4	3	27:20	4	4	23:45	8	7	25:17			
Neuro	0	0	N/A	0	0	N/A	0	0	N/A	7	7	24:25	7	7	24:25			
Joint	0	0	N/A	6	6	13:02	6	6	13:02	0	0	N/A	6	6	13:02			
GI	0	0	N/A	0	0	N/A	0	0	N/A	4	4	20:35	4	4	20:35			
GU	0	0	N/A	0	0	N/A	0	0	N/A	3	3	21:25	3	3	21:25			
GYN	0	0	N/A	0	0	N/A	0	0	N/A	3	3	25:50	3	3	25:50			
Breast	0	0	N/A	0	0	N/A	0	0	N/A	2	2	20:30	2	2	20:30			
Liver	0	0	N/A	1	1	13:00	1	1	13:00	1	1	31:00	2	2	22:40			
Bone	0	0	N/A	0	0	N/A	0	0	N/A	1	1	30:00	1	1	30:00			
<b>Total/average</b>	<b>538</b>	<b>490</b>	<b>16:53</b>	<b>71</b>	<b>66</b>	<b>18:15</b>	<b>609</b>	<b>556</b>	<b>17:03</b>	<b>139</b>	<b>138</b>	<b>26:32</b>	<b>748</b>	<b>694</b>	<b>18:56</b>			

Abbreviations: ENT, otolaryngologic (ear, nose, and throat); GI, gastrointestinal; GU, genitourinary; GYN, gynecologic; specimens separate from ovary; N/A, not applicable; Neuro, extracranial neurological specimens ("Brain" indicates intracranial).

\* The distribution by organ undergoing frozen section diagnosis with the respective TAT (in minutes:seconds) as available is included. Institution 1 serves 2 satellite hospitals.

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**Table 2. Telemicroscopy Versus Glass Turnaround Time (TAT) by Institution\***

	Institution 1		Institution 2		Overall	
	Telemicroscopy	Glass	Telemicroscopy	Glass	Telemicroscopy	Glass
Mean TAT, mins	17:03	14:17	25:30	15:24	18:14	14:25
SD	08:03	07:07	07:16	07:08	07:28	07:08
P	<.001		<.001		<.001	
No. of blocks <20 min, n (%)	427/556 (76.80)	4812/5432 (88.59)	62/91 (68.13)	595/695 (85.61)	489/647 (75.58)	5407/6127 (88.25)
P	<.001		<.001		<.001	

\* The means and SDs for each institution and the combined are indicated. For both institutions and overall, the glass diagnoses were faster ( $P < .001$ ). Glass diagnoses also had a greater proportion returned in less than 20 minutes than telemicroscopy ( $P < .001$ ). These data include only the TAT by telemicroscopy at institution 2 that parallels the time frame during which the data for glass diagnoses were available. Comparisons were performed within each institution and overall/in combination as indicated.

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**CONCLUSIONS**

- In-person FS statistically faster than telemicroscopy
- Telemicroscopy in most cases <20 min
- Rare technologic issues disrupted the process

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**Review of the use of telepathology for intraoperative consultation**

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<https://doi.org/10.1080/17443440.2018.1549887>

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## METHODS OF TELEPATHOLOGY

- Static (still image)
- Dynamic (live stream)
- Robotic (live stream with control)
- Whole slide image (still image)
- Hybrid (still image and live stream)

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## CONCLUSIONS

- Allow remote FS
- Static microscopy first used
- Early dynamic telepathology systems have lower cost than RM and WSI
- RM has been shown to take longer than WSI but allows focusing
- WSI requires more complex image management and bandwidth
- latest telepathology systems offer hybrid solutions: incorporate WSI with RM or dynamic capability, as well a lower cost option that uses image stitching to form a WSI at higher magnifications.

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## Systematic Review of the Use of Telepathology During Intraoperative Consultation

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**Key Words:** Telepathology; Intraoperative consultation; Frozen section; Systematic review

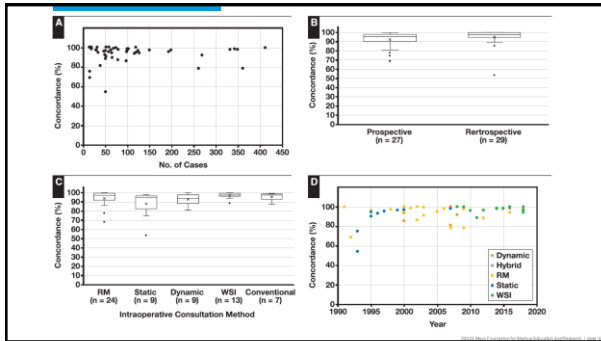
Am J Clin Pathol February 2020;151:198-209

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- 56 Telepathology studies with 13,996 cases
- 96.9% concordance

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### Intraoperative frozen section consultation by remote whole-slide imaging analysis –validation and comparison to robotic remote microscopy

Thomas Menter , Stefan Nicolet, Daniel Baumhoer, Markus Tolnay, Alexandar Tzankov

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**Table 1** Details of the cases investigated as well as the technical procedures

	Median	Mean	Range
Slides per case	2	2.5	1–5
Time for scanning* (min)	4	3	1–9
Time for transmission to uPath* (min)	3	3	2–7
Handling time of the pathologist* (min)	2	2	1–7
Total handling time of the technician* (min)	9	9	5–18
Total time for WSI approach* (min)	11	11	6–22
Total handling time of the pathologist using robotic telemicroscopy (min)	16	21	6–61
Total handling time of the pathologists using WSI and Ventana Image Viewer	6	11	4–46

\*These are times per case and not per slide as the cases were scanned batchwise simulating the procedures during real-time frozen section analysis. As transferring of the files to uPath started already while the later slides were still in the scanning process, scanning and data transfer of single slides cannot be given for all cases. WSI, whole slide imaging.

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### CONCLUSIONS

- TAT for onsite FS is easily achievable for most cases
- Prolonged TAT associated with:
  - Need for consultation with a colleague
  - Technical issues in some specimens
  - Need to review prior material or get additional history
  - Multiple cases at the same time
  - Remote read of cases with any technology

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