AI PATHOLOGY LAB

Harnessing Digital Cytopathology for Enhanced Quality Assurance

Yosep Chong

The Catholic University of Korea
Dept of Hospital Pathology

60th Anniversary

35th European Congress of Pathology

9–13 September 2023
CCD, Dublin
Ireland

35th European Congress of Pathology

Pathology – a bridge between Science and Medicine

9–13 September 2023, Convention Centre Dublin, Ireland

European Society of Pathology

Presenter: Yosep Chong

Disclosure Information

I declare no conflict of interests regarding this study.

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Yosep Chong

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채널 자세히 알아보기 >

채널 맞춤설정 동영상 관리

홈 | 동영상 | 재생목록 | 커뮤니티 | 채널 | 정보

최신순 인기순

Comparison of whole slide images for cytopathology practice @ 2022 Korean...

조회수 231회 • 1년 전

Korea experience on the clinical implementation of digital pathology

조회수 104회 • 1년 전

AI Approach in Digital Pathology 디지털병리에서의 인공지능의 적용

조회수 465회 • 1년 전

Histology for lymph node cytology 세포진단을 위한 림프절 질환의 조직병리

조회수 92회 • 1년 전

Recent application of AI in non-gynecologic cytology

조회수 55회 • 1년 전

디지털 병리 레드북 항목 소개 QA program for digital pathology by KSP

조회수 147회 • 2년 전

2020 Recommendations for pathologic practice using digital pathology: Consensu...

조회수 77회 • 2년 전

Considerations when implementing Digital toxicologic pathology 디지털 독성병리 도입...

조회수 76회 • 2년 전

Ki-67 labeling index patterns between DLBCL vs. Burkitt lymphoma

조회수 138회 • 2년 전

Overview of AI-based medical research 인공지능분석을 이용한 의학연구개론

조회수 99회 • 2년 전

Current Cytopathology Practices in Korea: A Nationwide Survey by the KSC 2019

조회수 28회 • 2년 전

디지털병리와AI Digital pathology and Artificial intelligence

조회수 882회 • 3년 전

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Yosep Chong

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Data (4)

Research items

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Digital pathology and artificial intelligence

Presentation March 2022

Yosep Chong

Add file Add to project Add supplementary resources

More things to read

Diagnostic Accuracy (Proficiency) Test in The Continuous Quality Improvement Program of The Korean Society for Cytopathology Using Digital Pathology

State-of-the-art application of artificial intelligence in urine cytology

The state-of-art of the pathologic AI models and patents

Recent Application of Artificial Intelligence in Non-Gynecological Cancer Cytopathology: A Systematic Review

Diagnostic proficiency test using cytopathology and comparative assessment of the whole slide images of cytologic samples for quality assurance program in Korea

5 practical tips to design AI research for pathology

Application of Artificial Intelligence in Cytopathology

Artificial Super Intelligence for Cytopathology Using a nationwide dataset

History of CNN and its application in Pathology

Today's talk includes…

An Overview of the Quality Assurance Program (QAP) in Korea and Digital Proficiency Tests

Comprehensive assessment on the image quality of whole slide images of cytology samples by scanners

The most recent advancements within the field of digital cytopathology
- National Cytopathology AI dataset projects
- Volumetric scanning / multilayer multifocus image fusion
- Clustering attention multiple instance learning
- Collaboration between platform and startup companies

Burgeoning role of AI in cytopathology

Summary

USCAP 112TH ANNUAL MEETING
FACING THE UNKNOWN
USCAP

USCAP
Creating a Better Pathologist
FACING THE UNKNOWN
USCAP 112TH ANNUAL MEETING
NEW ORLEANS, LOUISIANA
2023

H&E
Artificial Intelligence (AI)
AI learns to perform a particular task by first gaining exposure to large numbers of representative examples of that task (training sets). The composition of the training set is therefore a crucial determinant of how well AI will perform the task at hand.
Endoscopy - Training sets consisting of relatively simple gross endoscopic images have created AI algorithms that assist gastroenterologists in sampling lesions and avoiding blind spots.
Radiology - Training sets composed of predominantly black-and-white images - another success story.
Straightforward images with manageable variance across the same diagnostic entity and comparable image quality between different institutions do the trick for endoscopy and radiology.

GESTALT
DIAGNOSTICS
Digital Pathology
Artificial Intelligence
IT Services
EVIDENT
OLYMPUS
SAKURA
DeePathology.ai
AI AT YOUR
MODERN PATHOLOGY
techcyte
The Clinical Pathol
AI Platform
Yosep
Yosep Chong, MD, PhD
HOLOGIC
TUESDAY, MARCH 14 3:00–4:30 PM
TUESDAY, MARCH 14 9:30–11:00 AM
WEDNESDAY, MARCH 15 2:30–4:00 PM
USCAP
PathologyOutlines.com
300
MODERN PATHOLOGY

QAP for pathologic practice

QAP of KSC

- On-site laboratory assessment (along with KSP)
- Cytology practice survey including laboratory statistics
- Proficiency test (PT, diagnostic accuracy test)
- Sample adequacy test
  (random slide & diagnosis submission vs. digital PT)
- Donation of candidate slides for PT

Limitation of conventional QAP using glass slides

- Insufficient supply of test slides from the participating laboratories
- Time- and labor-intensive work of eligibility assessment
- Risk of damage or loss of glass slides during transportation
- Risk of patient personal information leakage
- Impaired credibility of a few cases
- Unequal distribution of QAP cases
- Storage-associated problems such as discoloration and contamination

Cytology practice survey including laboratory statistics

Cytoqa.cytopathol.or.kr

정도관리-관리자 | 게시판 | 슬라이드뱅크 | 기관관리 | 대한세포병리학회 홈페이지 | 로그아웃

정도관리 목록

구분	정도관리제목	시행년도	기관배정	1. 내부정도관리결과수집	2. 진단정확도평가	3. 진단정확도-부적절검체진단	4. 정도관리슬라이드제출	판정표 (학회진단)	최종제출현황
1	2022년 제 2차 정도관리 - 디지털 슬라이드 리스트	2022	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
2	2022 정도관리	2022	배 정	중지 현 황 통 계	진행중 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
3	2021년 4차 정도관리 - 대체평가기관(해당기관만)	2021	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
4	2021년 4차 정도관리 - 디지털 슬라이드 제출기관(해당기관만)	2021	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
5	2021년 제3차 정도관리 -재평가(해당기관만)	2021	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
6	2021년 제 3차 정도관리-디지털슬라이드 평가(해당기관만)	2021	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황 수발관리	중지 판 정 현 황 수발관리	관 리	관 리 설문
7	제 2차정도관리 재평가(일부기관 해당)	2021	배 정	중지 현 황 통 계	중지 배 정 현 황	중지 판 정 현 황	중지 판 정 현 황	관 리	관 리 설문

Cytology survey (Jan-Feb)

Cytology practice survey including laboratory statistics

정도관리 | 게시판 | 내기관정보 | 로그아웃 (테스트병원) | 관련사이트

2022.정도관리 | 2. 진단정확도평가 공문보기

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기관번호	00	기관명	테스트병원

각 기관과의 원활한 업무 소통을 위하여 주임교수님, 과장님 및 각 담당 선생님의 명단을 요청드립니다.

	성함	연락처	이메일
세포병리 정도관리 담당전문의	담당전문의	010 2805 - 4672	1111

해당하는 담당자가 따로 지정되어 있지 않을 경우에는 없음으로 표기해주시기 바랍니다.

[개인정보 수집 활용 동의서]
■ 수집하는 개인정보 항목 : 성명, 연락처, 팩스번호, 이메일
■ 개인정보의 수집 및 이용목적 : 공지사항, 관련자료 발송
■ 개인정보의 보유 및 이용기간 : 증빙서류 발급 시까지 활용, 담당자 변경 시까지 보관
■ 개인정보 제공 동의 거부 권리 및 동의 거부에 따른 불이익 내용 또는 제한사항 :
귀하는 개인정보제공 동의를 거부할 권리가 있으며, 동의 거부에 따른 개인의 불이익은 없습니다.
다만 위 제공사항은 대한세포병리학회 정도관리 진행에 반드시 필요한 사항으로 동의 거부를
하시게 되면 귀기관의 정도관리 참여가 불가능하게 됩니다.
따라서 귀기관에서 개인정보제공 동의를 하시는 분이 세포병리 정도관리 담당자를 해주시기 바랍니다.

☐ 개인정보 수집 활용 동의서에 동의 합니다. 세포병리 정도관리 담당자 성명 : 담당전문의

슬라이드 받은날짜 일괄적용 [ ] 적용 (적용후 저장 해주세요)

디지털 슬라이드는 슬라이드 파손여부 및 받은날짜는 기입하지 않으시면 됩니다 디지털 슬라이드는 Chrome 에 최적화 되어 있습니다.

No.	정도관리번호	부위(장기)선택	세포학적진단	슬라이드 파손여부	슬라이드상태	받은날짜	의견
배정받은 슬라이드가 존재 하지 않습니다							

home > 정도관리 이력 > 2022 정도관리 > 1. 내부정도관리결과수집

2022.정도관리 | 1. 내부정도관리결과수집 공문보기

세포검사통계 | 세포검사(외부위탁) | 진단별빈도 | 부인과세포조직검사진 | 진단불일치 | 1차검경현황

기관번호		기관명 단	

각 기관과의 원활한 업무 소통을 위하여 각 담당 선생님의 명단을 요청드립니다.

	성함	연락처	이메일
과 장		010 -	
세포병리 정도관리 담당전문의		010 -	
세포병리 정도관리 담당병리사		010 -	

해당하는 담당자가 따로 지정되어 있지 않을 경우에는 없음으로 표기해주시기 바랍니다.

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■ 개인정보의 수집 및 이용목적 : 공지사항, 관련자료 발송
■ 개인정보의 보유 및 이용기간 : 증빙서류 발급 시까지 활용, 담당자 변경 시까지 보관

☐ 개인정보 수집 활용 동의서에 동의 합니다. 세포병리 정도관리 담당전문의 :

		세포검사 통계			액상세포 검사					도말 검사					
분류	검체종류	검사총수 (A+B)	도말검사 건수(A)	액상세포 검사건수 (B)	액상세포 검사방법	Hematoxylin제 조사	Orange G 제 조사	Eosin Azure 제조사	염색자동 화기기 사용유무	검체고정 방법	검체고정액제 조사	Hematoxylin 제조사	Orange G 제 조사	Eosin Azure 제조사	염색자동 화기기 사용유무
산부인과	Cervical cytology	0	0	0					--						--
	기 타(ovarian cyst, Endometrium procedure등)	0	0	0					--						--
	합계	0	0	0											
비산부인과	호흡기(sputum, bronchial washing/brushing)	0	0	0					--						--
	체 액(pleural, ascites, pericardial)	0	0	0					--						--
	Urine	0	0	0					--						--
	CSF	0	0	0					--						--
	기 타(Joint fluid, Nipple discarge, Bile, ERCP등)	0	0	0					--						--
	합계	0	0	0											
세침흡인 (FNA)	Thyroid	0	0	0					--						--
	Lung	0	0	0					--						--
	기 타(EUS, EBUS포함)	0	0	0					--						--
	합계	0	0	0											

다운로드

Cytology survey (Jan-Feb)

Cytology practice survey including laboratory statistics

- Number of cytologic exams (GYN, non-GYN, FNA)
- Number of outsourcing test
- Diagnoses of GYN cytology samples (unsatisfactory, ASC-US, ASC-H, L-SIL, H-SIL, SqCC etc.)
- Cytology-histology correlation review (CHCR) and discordant cases information
- Screening cytotechnicians and their workloads

Cytology survey (Jan-Feb)

Cytology practice survey including laboratory statistics

2022.정도관리

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세포검사통계 | 세포검사(외부위탁) | 진단별빈도 | 부인과세포조직검사진 | 진단불일치 | 1차검경현황

기관번호	00	기관명	테스트병원	세포병리 정도관리 담당전문의	담당전문의

No.	진단명		건수	비율 % (*저장후 반영됨.)
1		Unsatisfactory		0.00
2		Negative (WNL, BCC)		0.00
3	Atypical Squamous Cells	ASC-US		0.00
4		ASC-H		0.00
5	Atypical Glandular Cells	AGC		0.00
6		AGC,favor neoplastic		0.00
7		LSIL		0.00
8		HSIL		0.00
9		AIS		0.00
10	Carcinoma	Squamous cell carcinoma		0.00
11		Adenocarcinoma		0.00
12		Others		0.00
		합계	**0**	**0**

다운로드

세포검사통계 | 세포검사(외부위탁) | 진단별빈도 | 부인과세포조직검사진 | 진단불일치 | 1차검경현황

기관번호	00	기관명	테스트병원	세포병리 정도관리 담당전문의	담당전문의
총비교건수		진단일치		진단불일치	
A		B		C	

다운로드

세포검사통계 | 세포검사(외부위탁) | 진단별빈도 | 부인과세포조직검사진 | 진단불일치 | 1차검경현황

단

기관번호	00	기관명	테스트병원	세포병리 정도관리 담당전문의	담당전문의

진단불일치안내_ 진단불일치 결과는 첨부된양식을 다운로드하여 작성후 업로드 해주시기바랍니다. 아래에 부인과에 해당하는 내용만 작성바랍니다

양식다운로드

파일첨부	파일 선택 선택된 파일 없음

세포검사통계 | 세포검사(외부위탁) | 진단별빈도 | 부인과세포조직검사진 | 진단불일치 | 1차검경현황

기관번호	00	기관명	테스트병원	세포병리 정도관리 담당전문의	담당전문의

세포병리 부문 세포병리사 1차검경 현황(이전년도 업무를 기준으로 입력하여 주십시오.)

기관에서 검사 항목을 시행하는 지 여부와 세포병리사가 1차검경 업무(세포병리사에 의해 이루어 지는 검체 적절성 평가 및 이상소견 판별을 뜻 합니다)를 하는 지 여부를 표시해 주십시오.

1) 세포병리검사의 1차검경을 하는 상근직과 파트타임으로 일하는 세포병리사의 수(명수)를 각각의 칸에 입력하여 주십시오.

1) 세포병리사	상근직	명	파트타임	명	총인원	명

2) 기관내 실시 여부 칸에는 기관에서 각 항목의 검사들을 시행하는 지 여부를 ○와 X로 표시하여 주십시오 (건수는 입력하지 않습니다)
3) 1차 검경 시행여부 칸에는 세포병리사의 1차검경 업무를 하는 지 표시해 주십시오.
모두 1차검경을 하면 [모두], 일부를 1차 검경하면 [일부], 1차 검경을 전혀 하지 않으면 [안함]을 선택해 주십시오.

구분	2) 기관내 실시여부	3) 1차검경 시행여부
자궁질도말 세포병리검사(C5920)		
액상자궁경부 세포검사(CX541)		
체액세포 병리검사(C5930+5931+5940)		
액상체액세포 병리검사(CZ521)		
흡인세포 병리검사(C5941+5942)		
액상흡인세포 병리검사(C5943+5944)		

4) 흡인세포병리검사 (C5941, C5942, C5943, CX541)를 세포병리사가 1차 검경한다면 하는 장기들을 모두 적어주십시오.

4) 1차 검경을시행하는 흡인세포병리검사의장기명(액상포함)	

다운로드

Cytology survey (Jan-Feb)

Participant institutions

Types of institutions	Number of responses	Proportion
University hospitals	84 (▲,+1)	39.1 (▼,-0.27%)
General hospitals	85 (▼,-1)	39.5 (▼,-1.23%)
Commercial laboratories	44 (▲,+4)	21.4 (▲,+1,49%)
Total	215 (▲,+4)	100.0

Cytology survey (Jan-Feb)

The number of total cytopathologic exams

Cytology survey (Jan-Feb)

The ratio of GYN / Non-GYN samples

Cytology survey (Jan-Feb)

Sample types according to the institutions (2022)

Total 9,358,043 case

Univ. Hos (84/215)

Gen. Hos (85/215)

Com. Lab (46/215)

Cytology survey (Jan-Feb)

Sample types according to the institutions (2022)

LBP ratio in GYN samples

Cytology survey (Jan-Feb)

LBP ratio according to sample types II (2019 ~ 2022)

Cytology survey (Jan-Feb)

Distribution of GYN Cytology Diagnoses

%	2018	2019	2020	2021	2022
Unsatisfactory	0.14	0.13	0.34	0.11	0.18
Negative (WNL, BCC)	95.29	95.43	95.05	95.56	95.72
ASC	3.64	3.53	3.64	3.42	3.26
ASC-US	3.45	3.34	3.46	3.23	3.05
ASH	0.19	0.19	0.18	0.19	0.19
AGC	0.05	0.05	0.04	0.04	0.04
AGC, favor neoplastic	0.01	0.01	0.01	0.001	0.01
LSIL	0.65	0.65	0.73	0.69	0.63
HSIL	0.19	0.17	0.16	0.15	0.14
Squamous cell carcinoma	0.02	0.02	0.02	0.01	0.02
Adenocarcinoma	0.01	0.01	0.01	0.01	0.01
ASC/SIL ratio	4.25	4.24	4.04	4.03	4.12

Cytology survey (Jan-Feb)

ASC/SIL ratio according to institutions

Cytology survey (Jan-Feb)

Internal QC (2007~2022)

Cytological-Histological Correlations for GYN Cytology

Year	Total	Concordancy		Minimal discrepancy		Minor discrepancy		Major discrepancy	
		No.	%	No.	%	No.	%	No.	%
2007	22640	19483	86.06	1306	5.77	1443	6.37	393	1.74
2008	24892	19497	78.33	2874	11.55	2128	8.55	350	1.41
2009	28396	22288	78.49	3725	13.12	1887	6.65	448	1.58
2010	38191	31351	82.09	4224	11.06	2201	5.76	413	1.08
2011	41084	32896	80.07	5949	14.48	2780	6.77	613	1.49
2012	64273	56150	87.36	5389	8.38	2462	3.83	508	0.79
2013	63263	54822	86.66	5621	8.89	2509	3.97	481	0.76
2014	49469	43930	88.80	4915	9.94	2351	4.75	341	0.69
2015	54910	46701	85.05	4975	9.06	2308	4.20	387	0.70
2016	33042	25105	75.98	5645	17.08	2056	6.22	253	0.77
2017	57846	48767	84.30	6379	11.03	2151	3.72	320	0.55
2018	69808	60823	87.12	6555	9.39	2301	3.30	361	0.52
2019	35059	26700	76.15	6255	17.8	2351	6.7	345	0.98
2020	39456	30451	77.18	5948	15.08	2088	5.3	378	0.96
2021	64909	56376	86.85	6672	10.28	2026	3.12	363	0.56
2022	**63349**	**55369**	**87.40**	**6102**	**9.63**	**1797**	**2.84**	**350**	**0.55**

Cytology survey (Jan-Feb)

Discrepancy in cytology-histology correlation for GYN cytology

Cytology survey (Jan-Feb)

Unsatisfactory rates in GYN samples

Cytology survey (Jan-Feb)

Unsatisfactory rates according to the institutions (2017~2022)

Cytology survey (Jan-Feb)

On-site laboratory assessment (Redbook)

대한병리학회/대한세포병리학회 병리과의 질관리 2022; 세포병리

세포병리 (C)

* 세포병리파트는 기관구분 병원/수탁 및 전문의 수에 따른 A~C 군에 따라 해당문항이 다릅니다. 그러나, 기관군에 해당하지 않더라도 질관리를 실시하고 있는 경우 '예'에 답할 수 있습니다.
* 여기에 언급한 "세포병리사"란 선별검사를 담당하는 세포병리사를 의미한다.

내부질관리

C.01.001 내부 질관리 지침이 있습니까? (32)

예 (__) 아니오 ( )

* 참고 : 대한병리학회 질관리 지침서.
* 질관리 지침서는 최소한 다음의 내용을 포함하고 있어야 한다. (2014. 9 수정)

질관리 지표 제목
목적
방법
빈도
역치 (필요한 경우)
평가방법
결과의 확인
관련서식 (필요한 경우)

* 내부 질관리 지침은 다음의 내부질관리에 관한 내용을 포함하고 있어야 하며, 최소한의 질관리 빈도를 표시하였다. 다만, 질관리의 범위는 학회가 정하는 규정에 따라 변경될 수 있다.
* 방법: 관련 서식을 사용하는 경우 구체적으로 누가 작성하는지와, 작성하는 방법을 기술해야 한다. 관련 서식이 없는 경우 어떤 방법으로 어떻게 자료의 입력이 이루어지는 지에 대한 구체적인 설명이 필요하다.
* 평가법법: 서술을 하는지 아니면 평가코드를 입력을 하는지 설명이 필요하며, 코드를 입력하는 경우는 평가코드가 준비되어 있어야 한다.
* 결과의 확인: 수작업에 의한 입력의 경우 어떠한 방법, 빈도는 어떻게 하여 누가 자료를 정리하며, 자료의 형태는 어떠해야 하는지 구체적인 설명이나 데이터가 있어야 한다. 필요한 경우 통계표의 형태를 표시한다. (2015.9 추가)

- 53 checklists, 386 points
- CHCR
- 10% random review,
- pathologists-cytotechnician screening correlation
- TBS reporting for GYN
- Sample adequacy check

On-site assessment (Apr-Jun)

On-site laboratory assessment (Redbook) (Apr-Jun)

Proficiency test (diagnostic accuracy test)

Proficiency test (May-Jun)

대한세포병리학회
The Korean Society for Cytopathology

Proficiency test (May-Jun)

home > 진행중정도관리>2022 정도관리 > 2. 진단정확도평가

2022.정도관리 | 2. 진단정확도평가 공문보기

기관번호	[redacted]	기관명	[redacted]

각 기관과의 원활한 업무 소통을 위하여 주임교수님, 과장님 및 각 담당 선생님의 명단을 요청드립니다.

	성함	연락처	이메일
세포병리 정도관리 담당전문의	[redacted]	[redacted]	[redacted]

해당하는 담당자가 따로 지정되어 있지 않을 경우에는 없음으로 표기해주시기 바랍니다.

[개인정보 수집 활용 동의서]
■ 수집하는 개인정보 항목 : 성명, 연락처, 팩스번호, 이메일
■ 개인정보의 수집 및 이용목적 : 공지사항, 관련자료 발송
■ 개인정보의 보유 및 이용기간 : 증빙서류 발급 시까지 활용, 담당자 변경 시까지 보관
■ 개인정보 제공 동의 거부 권리 및 동의 거부에 따른 불이익 내용 또는 제한사항 :
귀하는 개인정보제공 동의를 거부할 권리가 있으며, 동의 거부에 따른 개인의 불이익은 없습니다.
다만 위 제공사항은 대한세포병리학회 정도관리 진행에 반드시 필요한 사항으로 동의 거부를
하시게 되면 귀기관의 정도관리 참여가 불가능하게 됩니다.
따라서 귀기관에서 개인정보제공 동의를 하시는 분이 세포병리 정도관리 담당자를 해주시기 바랍니다.

☑ 개인정보 수집 활용 동의서에 동의 합니다. 세포병리 정도관리 담당자 성명 : 정요셉

슬라이드 받은날짜 일괄적용 [ ] 적용 (적용후 저장 해주세요)

디지털 슬라이드는 슬라이드 파손여부 및 받은날짜는 기입하지 않으시면 됩니다 디지털 슬라이드는 Chrome 에 최적화 되어 있습니다.

No.	정도관리번호	부위(장기)선택	세포학적진단	슬라이드 파손여부	슬라이드 상태	받은날짜	의견
1	http://221.163.35 보기	Cervical cytology	Adenocarcinoma				
2	http://221.163.35 보기	Cervical cytology	Squamous cell carcinoma				
3	http://221.163.35 보기	Thyroid	Papillary carcinoma				
4	http://221.163.35 보기	Peritoneal fluid (Asci	Malignant				
5	http://221.163.35 보기	Sputum	Malignant				
6	http://221.163.35 보기	Urine voided/cathete	Malignant				

최종제출됨

Proficiency test (May-Jun)

Results – Parallel DP & glass PT 2021

- **Total 215 institutes (Glass PT 108 & DP PT 107)** participated.
- **5 slides for glass PT, 6 WSI for DP PT; Total 540 glass PT, 642 DP PT**
  (2 GYN, 1 BF or urine, 2 Respiratory tract or thyroid or other FNA for glass PT,
  2 GYN, 2 BF or urine, 2 Respiratory tract or thyroid or other FNA for DP PT)

Proficiency test (May-Jun)

Category O concordant
Category A minimally discordant
Category B minor discordant
Category C major discordant

Digital proficiency test of KSC

- Category O concordant
- Category A minimally discordant
- Category B minor discordant
- Category C major discordant

Proficiency test (May-Jun)

Digital proficiency test of KSC

2020 9/ 48 institutes

2021 76/ 107 institutes

2022 19/ 82 institutes

Proficiency test (May-Jun)

Results – Pre-survey before DP PT 2021

Does/Will your institute implement DP ?

When will your institute plan to implement DP?

Will your insitute apply DP on cytology?

Will your institute participate DP PT?

How does you think about institute-tailored DP PT?

209/215 institutes

Sample adequacy test

Conventional sample adequacy test

5 glass slides of sequential cases
& sample adequacy report

Sample adequacy assessment

Review
by CQI KSC

Digital pathology sample adequacy test

Sample adequacy test (Sep-Oct)

5 DP GYN images

Pathology lab

Sample adequacy submission
Adequate
Inadequate

Donation of slides for PT

Donation of slides for PT (Nov-Dec)

National AI dataset projects – Open AI dataset project, or “Data dam project”

디지털뉴딜 한국판뉴딜

AI Hub

NIA 한국정보화진흥원 NATIONAL INFORMATION SOCIETY AGENCY

High-Quality AI training data, widely used in private sectors

Establish and open a total of 170 types in 8 major fields

Phonetic, Natural Language
[39 Types]

- Korea-English translation corpus
- Free conversation
- Phonetic by situation
- Korean text

Vision
[15 Types]

- Video comprehension
- Human behavior video
- Human action in sports
- Emotion recognition and summarized footage

Land and Environment
[12 Types]

- Land cover map and species of forest
- Aviation, Satellite
- Water and sewage
- Images of submerged marine litter

Agriculture, Livestock, Fishing
[14 Types]

- Agriculture
- Crop's pest and diseases
- Fish behavior and species
- Images of medical herbs

Safety
[19 Types]

- CCTV footage (surveillance camera recording)
- Public security
- Facility safety
- Energy-saving quality of electric power facilities

Healthcare
[32 Types]

- Images of breast cancer
- Oral and Maxillofacial 2D, 3D image (D as dimension)
- Diagnosis
- Diagnosis (cancerous tissue etc)

Autonomous Driving
[21 Types]

- Static object recognition in driving environment
- Harbor structure
- Road status and self-driving bus
- Drone footage

Miscellaneous
[18 Types]

- Synchronization of Indoor LiDAR (Light Detection and Ranging) and camera
- Mathematics learning competency measurement
- Landmark image
- Accuracy improvement of AR/VR screen

2021 STANDBAI PROJECT FUNDED BY NIA

AI Hub

214 pathology laboratories

5506 cytology WSI data for AI models (207037 patches)

대한세포병리학회 The Korean Society for Cytopathology

1194 WSIs

의정부성모병원

4312 WSIs

3 hospitals

세브란스 SEVERANCE

국립암센터 NATIONAL CANCER CENTER

9 consultant hospitals

삼광의료재단

서울아산병원 Asan Medical Center

SNUH 서울대학교병원

원자력병원

중앙대학교병원

강북삼성병원

용인세브란스병원

SNUH 분당서울대학교병원

대구가톨릭대학교병원

인제대학교 부산백병원

12 major hospitals

Quality Assurance Committee Secondary Review

Cytopathology Board Secondary Review

DEEP NOID 딥노이드 / MTS MOBILE TOTAL SERVICE 엠티에스컴퍼니

Data standardization, deidentification, color normalization

의정부성모병원 / 세브란스 / 국립암센터

Data labeling/annotation

DEEP NOID 딥노이드 / MTS MOBILE TOTAL SERVICE 엠티에스컴퍼니

Data quality control/ AI-model test

Cytopathology Board Review

Corresponding Histology review

Cytopathology Board Review

Corresponding Histology review

Dataset preparation process

Data acquisition

3 university hospitals in Korea

의정부성모병원

국립암센터 NATIONAL CANCER CENTER

세브란스 SEVERANCE

QAP KSC

대한세포병리학회 The Korean Society for Cytopathology

8 consultant hospitals

SNUH 서울대학교병원

SNUH 분당서울대학교병원

원자력병원

대구가톨릭대학교병원 DAEGU CATHOLIC UNIV. MEDICAL CENTER

SAMSUNG 강북삼성병원

용인세브란스병원 YONGIN SEVERANCE HOSPITAL

중앙대학교병원

인제대학교 부산백병원

Refinement

Refinement

의정부성모병원

Deidentification & preprocessing

딥노이드

엠티에스컴퍼니

삼광의료재단

Labeling

Labeling standard

의정부성모병원

Annotation

All hospitals

Filing

Quality aim setup

의정부성모병원

Data quality check

의정부성모병원

세브란스 SEVERANCE

Application

Quality assurance

의정부성모병원

서울아산병원 Asan Medical Center

Data validation by AI models

딥노이드

엠티에스컴퍼니

Today's talk includes…

An Overview of the Quality Assurance Program (QAP) in Korea and Digital Proficiency Tests

Comprehensive assessment on the image quality of whole slide images of cytology samples by scanners

The most recent advancements within the field of digital cytopathology
- National Cytopathology AI dataset projects
- Volumetric scanning / multilayer multifocus image fusion
- Clustering attention multiple instance learning
- Collaboration between platform and startup companies

Burgeoning role of AI in cytopathology

Summary

Specification comparison between WSSs

Manufacturer	3D Histech	Leica	Hamamatsu	Roche	Philips
Model	Pannoramic 250 Flash III	Aperio AT2	NanoZoomer S360	Ventana DP 200	Ultra Fast Scanner
Slide capacity	250	400	360	6	300
Scan speed 15x15 mm (40x)	1.5 min	2.5 min	0.5 min	1.5 min	1 min
GUI (User friendliness)	Excellent	Satisfactory	Good	Satisfactory	Excellent
File size 15x15 mm (40x) - 5 layers	4.5 GB	3.2 GB	1.0 GB	1.4 GB	0.9 GB
Magnification	20x, 40x	20x, 40x	20x, 40x	20x, 40x	20x, 40x
Weekly Capacity (Slides)	200	150	300	< 100	Not comparable
Imaging mode(s)	Bright field, fluorescent	Bright field	Bright field	Bright field	Bright field
Digital slide format	MRXS, JPG, and JPG2000	TIFF (SVS)	JPG, ndpi	BIF	iSyntax, fic
Multilayer support	Z-stack (30 layers) or extended focus	Z-stack (25 layers)	Z-stack (11 layers) or extended focus	Extended focus (15 layers)	Not support
Special features	Continuous loading Support fluorescent	Automated scanning	Quality scoring and intelligent rescans	Companion Dx image analysis	LCD touchscreen

Selected slides for image quality comparison

Label	Specimen type	Conventional vs. LBP	Diagnosis	Z-stacking	Layers
C16-092	Gynecologic smear	Conventional	Squamous cell carcinoma	Yes	5
C16-223	Gynecologic smear	Conventional	H-SIL	Yes	5
C-16-141	Gynecologic smear	LBP	L-SIL	No	1
C-16-005	Gynecologic smear	LBP	Adenocarcinoma	No	1
R-17-009	Bronchial Wash	Conventional	Squamous cell carcinoma	Yes	3
R-18-037	Sputum	LBP	Squamous cell carcinoma	Yes	3
BF-17-016	Pleural fluid	Conventional	Adenocarcinoma	Yes	3
BF-17-004	Ascites	LBP	Papillary serous carcinoma	No	1
U-17-030	Urine	Cytospin	High grade urothelial carcinoma	Yes	3
ABC18-006	Thyroid FNA	Conventional	Papillary carcinoma	Yes	3
ABC17-182	Salivary FNA	Conventional	Pleomorphic adenoma	Yes	3
ABC17-197	Lymph node FNA	Conventional	Metastatic invasive ductal carcinoma	Yes	3

Image quality assessment questionnaire

No.	Questions	1	2	3
1	All the area of the slide were scanned properly?	All	Partly No (<10%)	No (>10%)
2	The scanned image show even magnification in all the area?	Yes	Partly No	No
3	The white balance of the background image is appropriate?	Yes	Partly No	No
4	Is the focus of the image even enough throughout the image?	Yes	Partly No	No
5	Is it easy to differentiate cells and background artifacts such as inflammatory cells and mucinous materials?	Yes	Partly No	No
6	The color of the scanned image is even throughout the image?	Yes	Partly No	No
7	The color of the nuclei is even throughout the image?	Yes	Partly No	No
8	The image of overlapping cells or 3-dimensional clusters is clear enough to interpret?	Yes	Partly No	No
9	Is it easy to differentiate nuclei and cytoplasm of the cells (especially in the overlapping clusters)?	Yes	Partly No	No
10	The cytoplasmic membrane is clear enough to interpret?	Yes	Partly No	No
11	The nuclear membrane is clear enough to interpret?	Yes	Partly No	No
12	Is the image good enough to assess the cytoplasmic texture?	Yes	Partly No	No
13	Is the image good enough to assess the nuclear chromatin pattern?	Yes	Partly No	No
14	Is the image good enough to assess the nucleoli?	Yes	Partly No	No
15	Is the image good enough to assess the necrosis (only apply when the case includes necrosis)?	Yes	Partly No	No
16	Is the focus clear enough in the higher magnification?	Yes	Partly No	No
17	Is the focus clear enough in the lower magnification?	Yes	Partly No	No

Compared whole slide scanners (WSS)

3DHISTECH | Leica MICROSYSTEMS | HAMAMATSU | Roche | PHILIPS

Flash 250 III

Leica AT2

Nanozoomer S360

Ventana DP200

Ultra Fast Scanner

CaseViewer

ImageScope

NDP.view2

uPath software

IMS viewer

ImageQuant

Aperio image analysis

uPath Image analysis algorithm

3DHISTECH

Flash 250 III

Leica MICROSYSTEMS

Leica AT2

HAMAMATSU

Nanozoomer S360

Roche

Ventana DP200

PHILIPS

Ultra Fast Scanner

3DHISTECH

Flash 250 III

Leica MICROSYSTEMS

Leica AT2

HAMAMATSU

Nanozoomer S360

Roche

Ventana DP200

PHILIPS

Ultra Fast Scanner

C-16-092

SP: Pap smear (Conventional)
Dx: Squamous cell carcinoma
Z stack: 5 Layers

C-16-223

SP: Pap smear (Conventional)
Dx: H-SIL
Z-Stacking: 5 Layers

C-16-141

Pap smear (LBP)
Dx: L-SIL
No Z-Stacking

	3D Histech	Leica	Hamamatsu	Roche	Philips
10 x					
20 x					
40 x					

C-16-005

SP: Pap Smear (LBP)
Dx: Adenocarcinoma
No Z-Stacking

R-17-009

SP: Bronchial washing (Conventional)
Dx: SqCC
Z-Stacking: 3 Layers

	3D Histech	Leica	Hamamatsu	Roche	Philips
10 x					
20 x					
40 x					

R-18-037

SP: Sputum (LBP)
Dx: SqCC
Z-Stacking: 3 Layers

BF-17-016

SP: Pleural fluid
(Conventional)
Dx: Adenocarcinoma
No Z-Stacking

BF-17-004

SP: Ascites (LBP)
Dx: Papillary serous carcinoma
No Z-Stacking

U-17-030

SP: Urine (cytospin)
Dx: High grade urothelial carcinoma
Z-Stacking: 3 Layers

ABC-18-006

SP: Thyroid FNA
(Conventional)
Dx: Papillary carcinoma
Z-Stacking: 3 Layers

ABC-17-197

SP: Salivary FNA
(Conventional)
Dx: Pleomorphic adenoma
Z-Stacking: 3 Layers

ABC-17-182

SP: Lymph node FNA (Conventional)
Dx: Metastatic invasive ductal carcinoma (breast)
Z-Stacking: 3 Layers

	3D Histech	Leica	Hamamatsu	Roche	Philips
10 x					
20 x					
40 x					

Image quality assessment

	Questions	3DHistech Flash250III	Leica Aperio AT2	Hamamatsu NanoZommer 360	Roche DP200	Philips UltraFast Scanner
1	All the area of the slide were scanned properly?	1.2	1.4	1.5	1.5	1.5
2	The scanned image show even magnification in all the area?	1.3	1.6	1.7	1.7	1.6
3	The white balance of the backgroud image are appropriate?	1	1.3	1.2	1.4	1.4
4	Is the focus of the image even enough throughout the image?	1.4	1.7	1.8	1.9	2.2
5	Is it easy to differentiate cells and background artifacts such as inflammatory cells and mucinous materials?	1.1	1.4	1.4	1.6	1.7
6	The color of the scanned image is even throughout the image?	1.1	1.3	1.4	1.4	1.4
7	The color of the nuclei is even throughout the image?	1.1	1.4	1.4	1.4	1.4
8	The image of overlapping cells or 3-dimensional clusters is clear enough to interpret?	1.6	1.8	1.9	2.1	2.2
9	Is it easy to differentiate nuceli and cytoplasm of the cells (especially in the overlapping clusters)?	1.4	1.8	1.9	2	2.1
10	The cytoplasmic membrane is clear enough to interpret?	1.2	1.4	1.6	1.6	1.7
11	The nuclear membrane is clear enough to interpret?	1.2	1.4	1.6	1.7	1.8
12	Is the image good enough to assess the cytoplasmic texture?	1.2	1.4	1.7	1.7	1.9
13	Is the image good enough to assess the nuclear chromatin pattern?	1.2	1.4	1.6	1.9	2
14	Is the image good enough to assess the nucleoli?	1.3	1.5	1.8	1.9	2
15	Is the image good enough to assess the necrosis (only apply when the case include necrosis)?	1	1.7	1.7	1.7	1.7
16	Is the focus clear enough in the higher magnification?	1.6	1.8	1.9	2	2.2
17	Is the focus clear enough in the lower magnification?	1.2	1.3	1.3	1.5	1.6

ARTICLE OPEN

Modern Pathology; https://doi.org/10.1038/s41379-021-01000-8

Potential quality pitfalls of digitalized whole slide image of breast pathology in routine practice

Nehal M. Atallah[1,2], Michael S. Toss[1], Clare Verrill[3,4], Manuel Salto-Tellez[5], David Snead[6] and Emad A. Rakha[1,2]✉

Studied scanners	Scanning time	Average image file size	Missing tissue/ type	Out of focus images	Impact on the final clinical diagnosis
Scanner A	0.5–1.5 min	1.2 GB	Yes/Fat	No	No effect
Scanner B	7-9 min	1.5 GB	No	No	No effect
Scanner C					
• High Specimen threshold	1–2 min	800 MB	Yes/Fat	No	No effect
• Low Specimen threshold	3-4 min	1.7 GB	No	No	No Effect

Comparison of scanning metrics and the impact on the final diagnosis

Scanners	Scanning time (5x5mm)	Average file size	Missing tissue	Error rate per run	Out of focus	Impact on the final diagnosis
3DHistech	2 min	4.5 GB	Minimal	2	Minimal	None
Leica	3.5 min	3.2 GB	Moderate	4	Minimal	None
Hamamatsu	1.5 min	1.0 GB	Mild	3	Minimal	None
Roche	1.5 min	1.4 GB	Mild	3	Mild	None
Philips	1 min	0.9 GB	Severe	2*	Severe	Mild

*: ref) Modern pathology (2021) https://doi.org/10.1038/s41379-021-01000-8

Conclusion

3D Histech Pannoramic 250 Flash III - Generally satisfactory image quality with high capacity
- Big coverage, even focus, good z-stacking feature, low error rate, continuous loading
- Highest contrast, strongest saturation, longer scanning time, biggest file size

Leica AT2 – Generally satisfactory image quality with high capacity
- Middle coverage, sharp image with good focus, good z-stacking feature, high compatibility
- Little dark hue, slightly outdated user interface and usability, longer scanning time, slightly high error rate

Hamamatsu NanoZoomer S360 – Generally satisfactory image quality with high capacity
- Acceptable coverage, good scanning speed, even focus, good z-stacking feature, appropriate color and saturation,
- Smallest file size but still under the process of KFDA registration

Roche Ventana DP200 - Generally satisfactory image quality but limited capacity
- Good coverage, good focus with extended z-stacking, good color, specialized for companion Dx and image analysis
- Very limited capacity, good scanning speed.

Philips Intellisite UltraFast Scanner – Good image quality but poor focus for 3D-clusters-rich samples
- Good speed & capacity, most realistic hue, color, saturation, and contrast.
- Poor coverage, poor focus due to lack of z-stacking (Good image quality in GYN LBP), slightly high error rate. Very limited compatibility

Recommend at least 3 layers of z-stacking for LBP and 5 layers of z-stacking for conventional smear.
A careful selection considering the institutional characteristics of cytopathology practice is essential.
Thorough test running of candidate scanner models is recommended.

Today's talk includes…

An Overview of the Quality Assurance Program (QAP) in Korea and Digital Proficiency Tests

Comprehensive assessment on the image quality of whole slide images of cytology samples by scanners

The most recent advancements within the field of digital cytopathology

- **National Cytopathology AI dataset projects**
- Volumetric scanning / multilayer multifocus image fusion
- Clustering attention multiple instance learning
-
- Collaboration between platform and startup companies

Burgeoning role of AI in cytopathology

Summary

2021 STANDBAI PROJECT FUNDED BY NIA

AI Hub

214 pathology laboratories

5506 cytology WSI data for AI models (207037 patches)

대한세포병리학회 The Korean Society for Cytopathology

1194 WSIs

의정부성모병원

4312 WSIs

3 hospitals

세브란스 SEVERANCE

국립암센터 NATIONAL CANCER CENTER

9 consultant hospitals

삼광의료재단

서울아산병원 Asan Medical Center

SNUH 서울대학교병원

원자력병원

중앙대학교병원

강북삼성병원

용인세브란스병원

SNUH 분당서울대학교병원

대구가톨릭대학교병원

인제대학교 부산백병원

12 major hospitals

Quality Assurance Committee Secondary Review

Cytopathology Board Secondary Review

DEEP NOID 딥노이드 / MTS MOBILE TOTAL SERVICE 엠티에스컴퍼니

Data standardization, deidentification, color normalization

의정부성모병원 / 세브란스 / 국립암센터

Data labeling/annotation

DEEP NOID 딥노이드 / MTS MOBILE TOTAL SERVICE 엠티에스컴퍼니

Data quality control/ AI-model test

Cytopathology Board Review

Corresponding Histology review

Cytopathology Board Review

Corresponding Histology review

Dataset preparation process

Data acquisition

3 university hospitals in Korea

의정부성모병원

국립암센터 NATIONAL CANCER CENTER

세브란스 SEVERANCE

QAP KSC

대한세포병리학회 The Korean Society for Cytopathology

8 consultant hospitals

SNUH 서울대학교병원

SNUH 분당서울대학교병원

원자력병원

대구가톨릭대학교병원 DAEGU CATHOLIC UNIV. MEDICAL CENTER

SAMSUNG 강북삼성병원

용인세브란스병원 YONGIN SEVERANCE HOSPITAL

중앙대학교병원

인제대학교 부산백병원

Refinement

Refinement

의정부성모병원

Deidentification & preprocessing

딥노이드

엠티에스컴퍼니

삼광의료재단

Labeling

Labeling standard

의정부성모병원

Annotation

All hospitals

Filing

Quality aim setup

의정부성모병원

Data quality check

의정부성모병원

세브란스 SEVERANCE

Application

Quality assurance

의정부성모병원

서울아산병원 Asan Medical Center

Data validation by AI models

딥노이드

엠티에스컴퍼니

Z-stacking scan with extended z-stack image processing

- 40 x scanning with 3DHistech, Leica, Hamamatsu
- Conventional smear -> 5 layers, LBP -> 1-3 layers

Extended z-stacking image

Preprocessing of image data

AI Hub

AI 데이터찾기 | AI 개발지원 | 참여하기 | 정보공유 | 고객지원 | AI 허브소개 | 로그인 | 회원가입

데이터 분야

AI 데이터찾기 > 데이터 분야

소개 | 이용신청

본 데이터는 오프라인 안심존 데이터 입니다.

#세포병리 #체액세포 #디지털병리 #암 선별검사

체액 내 세포검사 이미지

분야 헬스케어 유형 이미지 구분 안심존(오프라인)

갱신년월 : 2022-07 구축년도 : 2021 조회수 : 172 다운로드 : 9

※ 내국인만 데이터 신청이 가능합니다.

데이터 개요

소개

세포병리검사 이미지를 이용한 암 진단시 병리의사 혹은 병리사의 진단업무를 보조할 수 있는 진
오류를 찾아내는 질관리 보조서비스

구축목적

암 진단의 선별검사로 사용되는 체액세포병리검사 이미지를 분석하여 암과 정 상을 분류할 수 있

Dataset composition

Sample type	Diagnosis	WSIs	Image patches
Respiratory tract	Lung ca	716	10069
	Benign	557	20521
Pleural fluid	Lung ca. Breast ca.	501	29952
	Benign	567	19909
Ascites	Ovary ca. Stomach ca. Colon ca. Pancreas ca.	524	24542
	Benign	507	21527
Urine	Bladder ca.	503	20105
	Benign	503	20382
FNA	Thyroid ca. Salivary gland ca. Lung ca. Pancreas ca. Lymphoma/meta	539	19925
	Benign	589	20105
Total		5506	207037

Dataset composition

Artificial Super Intelligence systems for cytopathology

Artificial Super Intelligence systems for cytopathology

Performance metrics for each AI model according to various sample types

Stain	Body fluid	Category (Cancer)	Test AUC	Test ACC
PAP	PF	Lung	0.992	0.939
		Breast	0.995	0.983
	ASC	Colorectal	0.889	0.933
		Stomach	0.978	0.895
		Ovarian	0.999	0.999
	FNA	Thyroid	0.999	0.999
	U	Bladder	0.973	0.932
H&E	PF	Lung	0.999	0.895
	ASC	Colorectal	0.999	0.999
		Stomach	0.999	0.947

Landing Med Intro

LANDING MED

FOUNDED | HQ:

2000 | Wuhan, China

ABOUT:

Digital Pathology Solutions

(AI Cervical Cytology)

INDEPENDENT LABS

5

Technology Components of Landing Med's AI-powered Cervical Cytology Screening Model

LANDING MED

1. SLIDE SCANNERS

Whole slide imaging scanners

2. LANDING MED AI CLOUD PLATFORM

AI model based on **10+ million** samples

For Dr. Yosep Chong

Landing Med's AI-powered Cervical Cancer Screening Workflow

1. Sample Collection and Slide Preparation

Slide Preparation
Centrifugal Sedimentation Method
(similar to ThinPrep Pap Test)

2. Slide Scanning and Upload to Cloud Platform

3. AI Cloud Platform Performs Initial Diagnosis

4. Cytopathologist Review, Report Issuance

Cytopathologist to review all positive cases and randomly select 10% of negative cases for review. Cytotech to support.

For Dr. Yosep Chong

Landing Med's Population-based Cervical Cancer Screening Case Studies in China

LANDING MED

Hannan District, Wuhan
20 Years, 0 Cervical Cancer Mortalities

2001-2021

Since Landing Med began the cervical cancer screening program in 2001 in Hannan District, more than **80,000** women have been screened and no cervical cancer mortalities have been reported.

National AI-Assisted Cervical Cancer Screening Program

2017-2021

Landing Med screened **4.3 million** women in rural regions across China using AI-assisted screening technologies.

Tibet's Shannan District Telepathology

2021

By using our slide scanner and AI cloud platform, Landing Med used telepathology to screen **50,000+ nomadic** women.

For Dr. Yosep Chong

Landing Med's Global Publications

Cervical Cancer [M]

Bojana Turic, Xiaorong Sun, Jian Wang, et al. The Role of AI in Cervical Cancer Screening. Cervical Cancer [M]. London: Intechopen, 2021: 21-28.

Cancer Medicine

Heling Bao, Xiaorong Sun, Yi Zhang, et al. The artificial intelligence-assisted cytology diagnostic system in large-scale cervical cancer screening: A population-based cohort study of 0.7 million women. Cancer Medicine. 2020; 9: 6896–6906.

Gynecologic Oncology

Heling Bao, Hui Bi, Xiaorong Sun, et al. Artificial intelligence-assisted cytology for detection of cervical intraepithelial neoplasia or invasive Cancer: a multicenter, clinical based, observational study. Gynecologic Oncology. 2020, 159(1): 171-178.

Landing Med's AI Cloud Platform

Internet Cloud Platform Login

Slide Preview

AI-assisted Cervical Cytology Screening
(flags suspicious cells for cytopathologists to review)

For Dr. Yosep Chong

Landing med

Home / Query management / Query management

Demo Hospital

Home | Information entry | Newly diagnosed | Referral | Audit | Query management

- Home
- Information entry
- Query management
- Explore diagnostics
  - Newly diagnosed
  - Referral
  - Audit
- Scan management
  - Data management
  - Device list

System queries

Project name: Please select a project n | Sample number: Please enter the sample number | state: Please select a sample s | date: Start date – End date | Search | reset

flushed

sequence	Project name	Sample number	name	age	gender	state	Diagnostician	Phone	Remote diagnostics	Refer to the examining doctor	Sending unit for inspection	Registration time	operate
1	Pathology (postoperative cryophilia)	FS002	131544225673		woman	Diagnostics	Demo Hospital		not		Demo Hospital 0413	2023-04-13 20:42:53	View edit Delete
2	Pathology (postoperative cryophilia)	FS003	131458373796		woman	Wait for your initial consultation			not		Demo Hospital 0413	2023-04-13 15:47:53	View edit Delete
3	Pathology (postoperative cryophilia)	FS001	FS001		woman	To be connected			not		Demo Hospital 0413	2023-04-13 15:43:14	View edit Delete
4	Pathology (general histology)	HE001	HE001		woman	Diagnostics	Demo Hospital		not		Demo Hospital 0413	2023-04-13 15:33:01	View edit Delete
5	Pathology (general histology)	HE002	HE002		woman	Diagnostics	Demo Hospital		not		Demo Hospital 0413	2023-04-13 15:30:13	View edit Delete
6	TBS	LDA007	Sample number 007	56	woman	Diagnostics	Demo Hospital	18888888888	not	Dr. Lau	Demo Hospital 0413	2023-04-13 13:52:01	View edit Delete
7	TBS	LYZ22076849	Sample number 002	66	woman	Wait for your initial consultation		18888888888	not	Dr. Wang	Demo Hospital 0413	2023-04-13 13:50:26	View edit Delete
8	TBS	LYZ22076787	Sample number 001	55	woman	Wait for your initial consultation		18888888888	not	Dr. Wang	Demo Hospital 0413	2023-04-13 13:48:05	View edit Delete

KFBio

ASC-US
宽*高: 99.00 * 93.00 mm
面积: 0.00 mm²
周长: 0.00 mm
10
20x
10x
4x
2x
Fit
上例
下例
Positive
Back
全部
HSIL
ASC-H
LSIL
ASC-US
AGC-NOS
Trichomonas
Candida
Screenshot
ASC-H 0.56
ASC-H 0.53
ASC-H 0.46
ASC-H 0.46
ASC-H 0.45
ASC-H 0.45
ASC-H 0.39
ASC-H 0.39
ASC-H 0.34
ASC-H 0.33
ASC-H 0.32
ASC-H 0.32
ASC-H 0.31
ASC-H 0.31
ASC-H 0.30
1/1
Go to
24/page
2023-05-09_11_16_41
Check
未知
Menopause No
Satisfaction Degree for specimen
Satisfied
Epithelial Cells >5000
Endocervical Cells
Yes No
Metaplasia Cells Yes No
Inflammatory Degree
No
Actinomycetes
Flora Transform
Trichomonas
Candida
HPV
Herpes Virus
Squamous Cells
No SIL
Atypical Squamous Cells
Normal
No defined syndrome.
Inflammatory
Tendency to HSIL
Epidermal Atrophy
Tendency to IN
Intrauterine Device Reaction
LSIL
Gestation Reaction
HSIL
Radiotherapy Reactions
CIN-II
Others
CIN-III
Squamous Cell Carcinoma(SCC)
Glandular Cells
AGC
Tendency to AIS
No defined syndrome.
Tendency to Benign Change
Adenocarcinoma
Cervical Canals
Endometrium
Others
Atypical Gonads Cells
Endometrium
Unidentified Sources
Suspected Adenocarcinoma
选取截图
请选择诊断结果
请选择附注建议
是否需镜下复核
Preview

分析中 77% -- 剩余:463
Embedding | Working Step |
Post Attendee - Zoom
病理人工智能辅助诊断平台
新标签页
不安全 | xz.hzztai.com/diagnostic/doing
更新
1.3.3.2
21.40GB
ARTIFICIAL INTELLIGENCE CERVICAL CANCER SCREENING
77%
等待中: 463
DEMO
Registration
Deliver
Delivery List
Receipted
Slide List
Case List
Allocation
Diagnosis
Report List
Biopsy Result
质控管理
参数配置
Statistic
Logs
Users
843 diagnose
1066 review
2685 sign
Being Analyzed
462 To Be Analyzed
5381 Slide Produced
0.64
20x
10x
4x
2x
Fit
Negative
切换到整体排序
Follow
全部
HSIL
ASC-H
LSIL
ASC-US
AGC-NOS
Trichomonas
Candida
Screenshot
ASC-US 0.44
ASC-US 0.59
LSIL 0.56
ASC-US 0.49
ASC-US 0.48
ASC-US 0.80
ASC-US 0.78
ASC-US 0.47
Go to
1
20/page

分析中 6% -- 剩余:274
Embedding | Working Step | D
Post Attendee - Zoom
病理人工智能辅助诊断平台
新标签页
igai.hzztai.com/reading/thyriod/74?page=1&page_size=10&order_by=pathology_id&order_way=asc&date_type=diagnosis_at&diagnosis_status=已诊断&ananysis_result&is_qualified=-1&include=report&task_id=3&t...
更新
99.53
40x
20x
10x
4x
2x
Fit
SFN
宽*高: 93.00 * 96.00 mm
面积: 279.00 mm2
周长: 94.50 mm
上例
下例
沉浸
10um
X2017-02031
阳性
ASC-US
返回
Candidas
Trichomonas
不纳入统计
显示已审核
已审核数量 0
全部 105
PTC 2
SFM 6
SFN 13
AUS 83
BFN 1
SFN 0.98
SFN 0.96
SFN 0.94
SFN 0.92
SFN 0.91
SFN 0.91
SFN 0.90
SFN 0.85
SFN 0.83
SFN 0.82
SFN 0.82
SFN 0.81
SFN 0.80
1/1
前往 1 页
24条/页
标本满意度
满意
上皮细胞数
请选择
颈管细胞
有
无
化生细胞
有
无
炎症程度
请选择
鳞状上皮细胞
腺上皮细胞
选取截图
2级良性病变
诊断结果
建议治疗后复查。
预览
诊断

Larger size of the image than histopathology

470 MB

2.3 GB

2.5 GB

27 GB

Difficulty in annotation (image patch/clusters)

Limited Z-stacked images & mode of preprocessing for z-stack images

- How many z-stack layer is good for AI training
- How do we process these z-stack images

Genius Digital Diagnostics System by Hologic Inc. for ThinPrep (2021)

Bui MM, Pantanowitz L (eds): Modern Techniques in Cytopathology.
Monogr Clin Cytol. Basel, Karger, 2020, vol 25, pp 84–90 (DOI: 10.1159/000455775)

Genius Digital Diagnostics System*

Digital imager

HOLOGIC®

Imaging cytology presents unique challenges because of 3-dimensional cell groupings.[1]

The Digital Imager's next generation technology quickly converts ThinPrep® cytology slides into high resolution, all-in-focus digital images.[2] Overcoming the challenges of imaging cytology to produce exceptional image quality.

HOW IT WORKS

Next Generation Imaging Technology[3]

Volumetric Scan

A single scan simultaneously acquires up to 14 focal planes, eliminating the need to scan each layer individually.

Adaptive Focus

Curve-following scanning method minimises local focus errors, providing higher quality cytology images.

Focus Merge

Powerful image processing merges in-focus pixels from multiple planes into a single layer.

1. Hanna MG, Pantanowitz L. Why is digital pathology in cytopathology lagging behind surgical pathology? Cancer Cytopathol. 2017 Jul;125(7):519-520. doi: 10.1002/cncy.21855. Epub 2017 May 5. PMID: 28475271.
2. Digital Diagnostics Digital Imager MAN-06738-001. Hologic, Inc; 2020.
3. Hologic Data on File Ref: GeniusDigitalDiagnosticsDataRev001

* May not be available in all markets. Contact your local Hologic representative for availability in your country.

Diagnostic Solutions

PRE-01429-EUR-EN Rev 002

Review Station Software

HOLOGIC

Z-stacking -> Volumetric scanning

Non-GYN Applications

Image ThinPrep® Non-Gyn slides and UroCyte® slides for a complete digital workflow

Quickly access cases of critical patients without waiting for physical slide transport.

Simplify collaboration across locations so each patient benefits from the collective expertise of the lab team.

Tag and bookmark interesting slides to ease case location and sharing for cytology education.[1]

Diagnostic Solutions

1. Digital Diagnostics Review Station Manual MAN-06184-001. Hologic, Inc; 2020.

Multi layer, multi focus image fusion

856

IEICE TRANS. INF. & SYST., VOL.E96–D, NO.4 APRIL 2013

PAPER *Special Section on Medical Imaging*

Multi-Layer Virtual Slide Scanning System with Multi-Focus Image Fusion for Cytopathology and Image Diagnosis

Hiroyuki NOZAKA[†a)], ***Member***, **Tomisato MIURA**[†], ***and*** **Zhongxi ZHENG**[†], ***Nonmembers***

ECNN: Ensemble of CNN for Multi-Focus Image Fusion

Fig. 2. The schematic diagram of generating three datasets according to the proposed patch feeding which is used in the training procedure.

Multiple instance learning

Weakly supervised learning for classification of lung cytological images using attention-based multiple instance learning

Scientific Reports 11, Article number: 20317 (2021)

CLAM
(Clustering-constrained Attention MultipleInstance Learning)

- CLAM : A new deep learning method for computational pathology using WSIs.
- CLAM efficiently learns from WSIs with whole slide-level labels.
- Adaptable to independent cohorts, smartphone microscopy, and diverse tissue contexts.

Difficulty in annotation (image patch/clusters)

Malignancy

Benign

Bounding box annotation?
Image patch-level annotation?
Free drawing annotation?

Whole slide level annotation

Artificial Intelligence Improves Accuracy of Urine Cytology for Bladder Cancer Detection : Largest Dataset Study

Training dataset

	WSI
Benign	2484
Malignant	251

5-fold Monte Carlo cross validation

Fold 0	Train	Validation	Test
Benign	1507	191	186
Malignant	201	22	28

Fold 1	Train	Validation	Test
Benign	1506	198	179
Malignant	202	15	35

Fold 2	Train	Validation	Test
Benign	1506	194	183
Malignant	202	19	31

Fold 3	Train	Validation	Test
Benign	1507	191	185
Malignant	201	22	29

Fold 4	Train	Validation	Test
Benign	1507	185	191
Malignant	201	28	22

Test dataset

	WSI
Benign	946
Malignant	123

External validation dataset

	WSI
Benign	600
Malignant	307

- 30 epochs
- Early stopping
  - validation acc 기준
- Adam Optimizer
- Dropout
- 5-fold cross validation
  - fold 4의 학습 결과를 이용하여 test 진행
- Weighted sampling

Artificial Intelligence Improves Accuracy of Urine Cytology for Bladder Cancer Detection : Largest Dataset Study

Results

- 11581 image patches from 4711 urine cytology cases
- Clustering-constrained Attention Multiple Instance Learning (CLAM-MIL) model used for whole slide level prediction
- Overall accuracy: 97.0%
- Area under the curve (AUC): 0.99

Model	AUC	ACC
Clam_sb	0.98	0.95
Clam_mb	0.99	0.97

		label		
		Benign	Malignant	Total
prediction	Benign	931	17	948
	Malignant	15	106	121
	Total	946	123	1069

	Precision	recall	F1-score
Benign	0.98	0.98	0.98
Malignant	0.88	0.86	0.87

Clam_mb

Heatmap results

Today's talk includes…

An Overview of the Quality Assurance Program (QAP) in Korea and Digital Proficiency Tests

Comprehensive assessment on the image quality of whole slide images of cytology samples by scanners

The most recent advancements within the field of digital cytopathology

- Volumetric scanning / multilayer multifocus image fusion
- Clustering attention multiple instance learning
- National Cytopathology AI dataset projects
- **Collaboration between platform and startup companies**

Burgeoning role of AI in cytopathology

Summary

HOLOGIC®

Digital Diagnosic Collaboration Opportunities

- Hologic is the global leader in cervical cancer screening and has provided the best-in-class fully integrated imaging and AI solution to improve laboratory efficiency and patient care.
- Digital Pathology is an immediate adjacency which can leverage Hologic's market leadership position in Digital Cytology.
- Opportunities for collaboration are being explored while assessing technical and business feasibility.

Partnership Opportunities

- Feedback and input during the development process with early access to prototype software in test (not for clinical use)
- Integration of 3rd party AI tools and applications
- Co-development of novel AI tools which address high unmet clinical need and improve overall efficiency

*Genius Digital Diagnostics is CE-marked for diagnostic use in Europe and is not currently available for sale in the U.S. May not be available in all markets. Contact your local Hologic representative for availability in your country.

1. Digital Diagnostics System Instructions for Use. AW-22317-001. Hologic, Inc; 2020

Roche Digital Pathology portfolio vision

Interoperable and open to support third party content for the clinical use

Scanning

VENTANA DP 200 and
DP 600* Slide Scanners

Interoperable with DICOM images and other open formats from third party scanners

"PLATFORM"
Pathologist interface

NAVIFY® Digital Pathology platform (Cloud)
Or ***uPath enterprise software (on-premise)***
manages the full pathologist workflow

"MARKETPLACE"
Image analysis

Roche uPath Image Analysis Algorithms
PD-L1 (SP263) lung, Her2 Dual ISH, Breast, Her2, Ki-67, ER*, PR*

Open API* on NAVIFY DP platform (Cloud) to support third party image analysis algorithms

Bristol Myer Squibbs - PathAI Roche Collaboration

NEWS

Roche announces collaboration with Bristol Myers Squibb to advance personalised healthcare through digital pathology solutions

Partnerships with PathAI/BMS

- Support advancement of 2 assays with DP algorithms for use in clinical trials

Focus

- Roche is creating AI-based image analysis algorithm to aid pathologists on VENTANA PD-L1 (SP142) for BMS
- Partnering with PathAI to integrate PathAI-developed algorithm for CD8 assays in Open API environment

TechCyte

TECHCYTE
Ben Cahoon
Pap Smear Cells
ASC-US Parabasal
Neutrophil Cell
Unknown
Female0001
Reviewed
ASC-US Parabasal
ARUP
LABORATORIES
TECHCYTE

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Burgeoning role of AI in cytopathology

Summary

First golden age for cytopathology

The number of the participants and Total cytopathologic exams in Korea

About 3 times increase in 15 years reaching 10 million exams a year
Compounded annual growth rate 7.0 %

DP systems market share in Korea

Promising performance of AI in histopathology

Promising performance of AI in histopathology

Deep Learning-based Histopathological Segmentation for Whole Slide Images of Colorectal Cancer in a Compressed Domain

Hyeongsub Kim
Pohang University of 18 Science and Technology (POSTECH)
Hongjoon Yoon
Deepnoid Inc
Nishant Thakur
The Catholic University of Korea, Uijeongbu St. Mary's Hospital
Gyoyeon Hwang
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Eun Jung Lee
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Chulhong Kim (chulhong@postech.edu)
Pohang University of 18 Science and Technology (POSTECH)
Yosep Chong
The Catholic University of Korea, Uijeongbu St. Mary's Hospital

Automatic pattern recognition using deep learning techniques has become increasingly important. Unfortunately, due to limited system memory, general preprocessing methods for high-resolution images in the spatial domain can lose important data information such as high-frequency information and the region of interest. To overcome these limitations, we propose an image segmentation approach in the compressed domain based on principal component analysis (PCA) and discrete wavelet transform (DWT). After inference for each tile using neural networks, a whole prediction image was reconstructed by wavelet weighted ensemble (WWE) based on inverse discrete wavelet transform (IDWT). The training and validation were performed using 351 colorectal biopsy specimens, which were pathologically confirmed by two pathologists. For 39 test datasets, the average Dice score was 0.852 ± 0.086 and the pixel accuracy was 0.962 ± 0.027. We can train the networks for the high-resolution image (magnification x20) compared to the result in the spatial domain (magnification x10) in same the region of interest ($6.25 \times 10^{-2}\ \mu m^{2}$). The average Dice score and pixel accuracy are significantly increased by 6.4 % and 1.6 %, respectively. We believe that our approach has great potential for accurate diagnosis in pathology.

FDA approved/CE marked pathology AI models

2020

deepbio

DeepDx-Prostate
(Korea)

KFDA

Paige

Paige Prostate
/Breast Suite
(USA)

FDA

2021

aetherAI

aetherAI IHC
(Taiwan)

aetherAI Hema
(Taiwan)

CE FDA

VUNO
View the Invisible, Know the Unknown

Vuno Med-PathQuant
(Korea)

KFDA

2022-2023

Paige

Breast lymph node
Prostate Biomarker panel
HER2 complete

VISIOPHARM®

ER/PR/HER2/Ki-67

indica labs

HALO AI for prostate
detection/gleason scoring

IBEX

Galen Prostate /
Breast / Gastric

HOLOGIC® genius AI™ DETECTION

Genius system for GYN cytology

CE

Importance of AI application in cytopathology

Why AI in cytology other than histology?

Advantages

- Simple testing
- Rapid testing
- Less-invasive
- Cheap testing

Challenges

- Labour-intensive
- Time-consuming
- Limited accuracy

What if cytology results can be more accurate?

Poor diagnostic performance is the main target for AI !!!

What if we can classify subtypes and do molecular classification on cytologic samples?

Small cell carcinoma

Squamous cell carcinoma

Adenocarcinoma

EGFR

ALK

KRAS

NONE

Cancers **2023**, *15*(3), 752; https://doi.org/10.3390/cancers15030752

cancers

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Article

Deep Learning-Based Classification and Targeted Gene Alteration Prediction from Pleural Effusion Cell Block Whole-Slide Images

Wenhao Ren, Yanli Zhu, Qian Wang, Haizhu Jin, Yiyi Guo and Dongmei Lin *

Simple Summary: For many patients with advanced cancer, pleural effusion is the only accessible specimen for establishing a pathological diagnosis. Some pleural effusion cell blocks have not undergone adequate morphological, immunohistochemical, or genetic analysis due to problems with the specimen itself or cost. Deep learning is a potential way to solve the above problems. In this study, on the basis of scanning whole slide images of pleural effusion cell blocks, we investigated the identification of benign and malignant pleural effusion, the determination of the primary site of pleural effusion common metastatic carcinoma, and the alteration of common targeted genes using a weakly supervised deep learning model. We achieved good results in these tasks. Although deep learning cannot be the gold standard for diagnosis, it can be a useful tool to aid in cytology diagnosis.

Whole slide images
Extracted tissue regions
Division of dataset
Training set augmentation
Training set
Validation set
Test set
Training set
Validatio n set
Test set
Benign
Malignant
ALK
EGFR
KRAS
NONE
Lung carcinoma
Breast carcinoma
Gastric carcinoma
Classification and targeted gene alteration prediction
Deep learning model
WSIs patching

A
600
400
200
0
Cases
14-29
30-49
50-69
70-91
Age

B
325 Malignant and male
449 Malignant and female
330 Benign and male
203 Benign and female
Total=1307

Malignancies=774
410 Lung adenocarcinoma
94 Breast invasive ductal carcinoma
56 Gastric adenocarcinoma
27 Malignant tumor of unspecified subtype
24 Malignant mesothelioma
22 Small cell lung carcinoma
18 Malignant melanoma
15 Ovarian serous carcinoma
13 Lymphoma
13 Renal clear cell carcinoma
9 Colorectal adenocarcinoma
9 Esophageal squamous cell carcinoma
7 Lung squamous cell carcinoma
6 Breast Invasive Lobular Carcinoma
6 Pancreatic adenocarcinoma
5 Breast Invasive Micropapillary Carcinoma
4 Cervical squamous cell carcinoma
3 Lung large cell carcinoma
3 Complex small cell lung cancer
3 Urothelial Carcinoma
3 Renal Cell Carcinoma, Unclassified
2 Lung adenosquamous carcinoma
2 Hepatocellular carcinoma
2 Osteosarcoma
2 Soft tissue sarcoma
2 Lung large cell neuroendocrine carcinoma
2 Thymic squamous cell carcinoma
2 Cholangiocellular carcinoma
1 Lung papillary cystadenocarcinoma
1 Lung adenoid cystic carcinoma
1 Ovarian clear cell carcinoma
1 Renal collecting duct carcinoma
1 Small cell esophageal carcinoma
1 NSCLC-NOS (not otherwise specified)
1 Cervical adenocarcinoma
1 Endometrioid adenocarcinoma
1 Submandibular gland carcinoma
1 Squamous cell carcinoma of sphenoid sinus

A
Gene alterations=358
215 EGFR
23 ALK
7 RET
53 NONE
11 ROS1
6 HER2
31 KRAS
7 BRAF
5 MET
B
Cases
150
100
50
0
18 G719X
19 del
19 del+20 T790M
20 T790M
20 ins
21 L858R
21 L858R+20 T790M
21 L858R+20 ins
21 L858R+18 G719X
Mutant subtypes of EGFR

A
Accuracy
Epoch
Fold0
Fold1
Fold2
Fold3
Fold4
Fold5
Fold6
Fold7
Fold8
Fold9
B
Rate
Sensitivity
Specificity
PPV
NPV
F1-score
Accuracy
AUC
C
True Classes
Benign
Malignant
0.864
0.090
0.136
0.910
D
E

A
Sensitivity
1 - Specificity
ROC curve of class GC (0.946)
ROC curve of class LC (0.910)
ROC curve of class BC (0.844)
B
Accuracy rate
GC
LC
BC
Common metastatic carcinomas
C
True Classes
Predicted Classes
GC
LC
BC
0.955
0.045
0.000
0.043
0.807
0.128
0.058
0.205
0.737
D
E
F

A
Rate
1.0
0.5
0.0
ALK
EGFR
KRAS
NONE
Accuracy
AUC
PPV
NPV
B
True Classes
ALK wild-type
ALK fusion
0.851
0.460
0.149
0.540
Predicted Classes
C
EGFR wild-type
EGFR mutation
0.583
0.405
0.417
0.595
D
KRAS wild-type
KRAS mutation
0.828
0.417
0.172
0.583
E
NONE alteration
Ten gene alteration
0.645
0.243
0.355
0.757

ALK
EGFR
KRAS
NONE
2mm
4mm
40μm

AI-assisted cytopathology :
New golden age for cytopathology

Advantages

- Simple testing
- Rapid testing
- Less-invasive
- Cheap testing

Challenges

- Labour-intensive
- Time-consuming
- Limited accuracy

+ AI

Super test

- Simple, fast, less-invasive, and cheap testing with high accuracy

Promising but there are several challenges…

Summary

- Cytologic exams have become a favored screening method due to their rapidity, minimal invasiveness, and affordability. In recent years, the application of Artificial Intelligence (AI) in this field has shown promise, particularly in potentially enhancing the accuracy of cytopathology. However, the journey to fully integrate AI into cytopathology isn't without its challenges. These include issues with large file sizes, a lack of adequate datasets, insufficient external validation, suboptimal preprocessing of z-stack images, and the scarcity of publicly available datasets.
- Fortunately, recent AI advancements, such as volumetric scanning and clustering attention multiple instance learning, are poised to be game-changers in addressing these hurdles. Furthermore, the utilization of a robust, national-level dataset, paired with comprehensive external validation, could be a significant step forward.
- By integrating these solutions, AI-assisted cytopathology has the potential to revolutionize the field. This approach could enhance the quality of cytopathology, provide more reliable results, and ease the workload of cytotechnicians and cytopathologists, ultimately leading to a more efficient and effective practice.

Thank you

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