The Digital Pathology Revolution: What It Is and How it Will Improve Your Pathology Practice

Executive War College

Digital Pathology Seminar

May 2019
Topics

- Disclosures
- Global landscape
- Revenue opportunities
- Decrease costs
- Questions?
Disclosures

- Own JAV Advisors Corp 100%
  - Digital pathology consulting company
  - 25 clients

- Digital Pathology Association member
  - Membership committee member
Pathologist shortage solved by digital pathology use cases

Pathologists shortage 'delaying cancer diagnosis'

Patients are facing delays in diagnosis because of severe shortages among pathology staff, according to a report seen by the BBC.

Trends in Pathology Graduate Medical Education Programs and Positions, 2001 to 2017

Aldis H. Petrucco, BA1 and Darren Swens, MD1,2

Abstract

The US medical workforce is facing an impending physician shortage. This shortage holds special concern for pathologists, as many senior practitioners are set to retire in the coming years. Indeed, studies indicate a “pathologist gap” may grow through 2030. As such, it is

New technology speeds up pathology workflows

Rapid precision-scanning technology to speed up medical diagnoses and help address Australia’s shortage of trained pathologists is being developed at the University of Queensland.

The University's Digital Pathology team is working to replace glass pathology slides with digital slides for faster analysis, distribution and storage.
Digital pathology landscape

- Digital imaging (WSI) is mature (~20 years)
- Numerous vendors (hardware ± software); 100
- Published literature validates the technology (20,000+)
- Regulatory (e.g. FDA, LDT, CLIA, CAP) for clinical use
- Pathology is rapidly approaching an era of AI
Vendor landscape

- 100 companies in digital pathology
- 20 mature & stable companies
- 10 with over $10MM USD Capital
- 15 with $1-$9MM in capital
- 20 raising a seed, or series A round
- 35 within academic or gov’t institution
Hardware scanner firms

- 25
- $5,000 to $300,000 Price
- Open & closed systems
AI digital pathology firms

- 25 USA
- 25 Europe
- 10 Middle East
- 10 India
- 30 China
AI Disease Focus

- 30 Breast
- 20 Prostate
- 15 Lung
- 20 Colon
- 5 Skin
- 5 Stomach
- 20 Cervix
- 1 Kidney
- 10 Urine
- 10 Blood
- 5 Malaria
- 5 TB
- 2 Fecal
- 1 Sickle Cell
Revenue opportunities

- Read cases remotely in new territories

- CRO for Digital/Computational Pathology AI firms
  - Provide annotated data sets
  - Organize validation trials
  - Organize clinical trails
Read Cases for China labs

Comparison of Pathology between US and China

Pathologists: 27,000
Pathologists: 10,025

Residency program, Pathology Board
Self-training, Lack of residency and board

Subspecialty, Precision therapy
No subspecialized pathologists

Gold Standard, Importance equal to other specialties
Not enough pathologists
China policy trend

The government released several policies to encourage private capitals co-construction the regional pathological center with public hospital, serving local secondary medical institutes by tele-pathology.

New model
digital remote pathology

Traditional model
pathologists on site
CRO to AI firms

- Sell annotated data for
  - Supervised learning AI (images with data)–250 cases
  - Unsupervised learning AI (images w/o data)–50K cases

- Organize trials
  - Prototype testing
  - Validation testing
  - Clinical trials
Decrease costs & risks

- Second opinion & 100% QA
- Move normal cases to lower cost resource
Second reads & 100% QA

**PERFORMANCE OF PROSTATE CANCER DETECTION ALGORITHM ON ALL-COMERS**

<table>
<thead>
<tr>
<th></th>
<th>Institute #2</th>
<th>Institute #3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AUC</strong></td>
<td>0.97</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>SENSITIVITY</strong></td>
<td>96%</td>
<td>99%</td>
</tr>
<tr>
<td><strong>SPECIFICITY</strong></td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td><strong>VALIDATION (# slides / cases)</strong></td>
<td>1333 / 107</td>
<td>728 / 48</td>
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</tbody>
</table>

**ERRORS IN RETROSPECTIVE CASES ORIGINALLY DIAGNOSED AS BENIGN**

<table>
<thead>
<tr>
<th>MISSED CANCERS IDENTIFIED</th>
<th>2/80</th>
<th>1/26</th>
<th>1/30</th>
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</thead>
</table>
Move normal to lower cost resource

SCAN PROSTATE BIOPSY  APPLY DL ALGORITHM  SORT SLIDES – “WORST FIRST”
Move normals to lower cost resource

- Cervical cancer & pap smears
- Blood differential analysis
- Skin cancer screening
  - BCC
  - Melanoma Nodular
Summary

- Many vendors
- Revenue opportunities
- Lower cost per test opportunities
- Improve patient care
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Steve Barbee

+1-213-258-6268

sdbarbee61@gmail.com