Telepathology and Digital Pathology

Ronald S. Weinstein, M.D.

Professor of Pathology and Public Policy
(Chair 1990-2007)
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Founding Director, Arizona Telemedicine Program
President, Association of Pathology Informatics
Past President, USCAP
President Emeritus, American Telemedicine Association
Inventor: Telepathology Diagnostic Network

Tucson, Arizona, USA
Disclosure

• **Ronald S. Weinstein, M.D., FCAP**
  - *DMetrix* - *Stock – Scientific Advisory Committee*
  - *Apollo Telemedicine – Stock Options*
Informatics for practicing anatomical pathologists: marking a new era in pathology practice

Manal Y Gabril¹ and George M Yousef²,³

¹Department of Pathology, London Health Sciences Centre, London, Canada; ²Department of Laboratory Medicine, and the Keenan Research Centre in the Li Ka Shing Knowledge Institute St Michael’s Hospital, Toronto, Canada and ³Department of Laboratory Medicine and Pathobiology, University of Toronto, Toronto, Canada

Informatics can be defined as using highly advanced technologies to improve patient diagnosis or management. Pathology informatics had evolved as a response to the overwhelming amount of information that was available, in an attempt to better use and maintain them. The most commonly used tools of informatics can be classified into digital imaging, telepathology, as well as Internet and electronic data mining. Digital imaging is the storage of anatomical pathology information, either gross pictures or microscopic slides, in an electronic format. These images can be used for education, archival, diagnosis, and consultation. Virtual microscopy is the more advanced form of digital imaging with enhanced efficiency and accessibility. Telepathology is now increasingly becoming a useful tool in anatomical pathology practice. Different types of telepathology communications are available for both diagnostic and consultation services. The spectrum of applications of informatics in the field of anatomical pathology is broad and encompasses medical education, clinical services, and pathology research. Informatics is now settling on solid ground as an important tool for pathology teaching, with digital teaching becoming the standard tool in many institutions. After a slow start, we now witness the transition of informatics from the research bench to bedside. As we are moving into a new era of extensive pathology informatics utilization, several challenges have to be addressed, including the cost of the new technology, legal issues, and resistance of pathologists. It is clear from the current evidence that pathology informatics will continue to grow and have a major role in the future of our specialty. However, it is also clear that it is not going to fully replace the human factor or the regular microscope.

Modern Pathology (2010) 23, 349–358; doi:10.1038/modpathol.2009.190; published online 15 January 2010

Keywords: informatics; pathology; telepathology; digital imaging; virtual microscopy; computer
Figure 1. A schematic showing the possible scenarios of the incorporation of informatics into the field of anatomical pathology.
Definitions of Telepathology

**Word:** Telepathology is the practice of pathology at a distance.

**Term:** Telepathology is the practice of pathology at a distance by visualizing an indirect image on a video monitor screen rather than viewing a specimen directly through a microscope.

_Weinstein, R.S., “Prospects for Telepathology” (editorial) Human Pathology 17: 433-434, 1986._
Telepathology Technologies

- Television Microscopy
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  - Bird (1968)
- Robotic-Dynamic Telepathology
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- Static TP (Store and Forward-SF)
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- WSI plus Z-Stacks
  - Various companies
- Hybrid WSI/Robotic Microscopy
  - Various companies
- Fusion WSI/Robotic Microscopy
  - Various companies
### Evolving Telepathology Technologies

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Prospects for Telepathology

Telepathology, the practice of pathology by visualizing an indirect image on a television screen rather than viewing a specimen directly through a microscope, is at an embryonic stage of development. Progress in the field is accelerating, due to rapid advances in key technical and analytical arenas, including computerization, digital imaging, robotic light microscopy, multiplex fiberoptic communications, and the analytical methods available for the scientific comparison of the performance of physicians using competing diagnostic technologies. Furthermore, health care planners envision the creation of comprehensive telehealth networks that could serve many functions, including the provision of the diagnostic services of pathologists and radiologists at remote sites. Such networks would provide an added impetus to the growth of telepathology and affect patterns of delivery of health care services.

The field of teledicine is not new, although telepathology per se is clearly a latecomer. In 1959, Dr. Albert Jutra experimented with teleradiology when he linked two Canadian hospitals, five miles apart, with coaxial cable to transmit stored images of telefluoroscopy examinations. At about the same time, the Nebraska Psychiatric Institute was linked with the University of Nebraska College of Medicine across the street for teleconferencing. Since that

nostic systems, for example, comparison of light box readings with television monitor readings of chest radiographs. Investigators have shown that the Relative Operating Characteristic (ROC) technique has both utility and robust statistical power for evaluating diagnostic systems. The ROC method provides a valid index of the accuracy of a diagnostic system, independent of any inherent decision bias. Also relevant is teleradiology research on instrumentation. Teleradiology studies have examined the question of system resolution requirements. At issue is the number of lines of resolution on a television monitor required either to duplicate the image of the primary specimen or, when the image does not completely duplicate the original specimen, to produce images of quality at least sufficient to permit the rendering of an accurate diagnosis. Resolution requirements directly influence equipment design and image transmission costs and, ultimately, the feasibility of teleradiology or telepathology.

Prototype telepathology systems are being built today for anatomic pathology applications in co-operative ventures between academic centers and industry. The initial aim is to develop microscopy/telecommunication systems for analyzing frozen sections prepared at remote sites. Frozen section diagnoses are a priority item since they are generally per-
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Definitions of Telepathology

- **Word**: “The practice of pathology at a distance”

- **Term**: The use of telecommunications technology to facilitate the transfer of image-rich pathology data between remote locations for the purposes of diagnosis, education, and research.
Telepathology and the Networking of Pathology Diagnostic Services

Ronald S. Weinstein, MD; Kenneth J. Bloom, MD; L. Susan Rozek, RN

Telepathology is the practice of pathology over a long distance. Components of a telepathology system include the following: (1) a remote-controlled light microscope attached to a high-resolution video camera; (2) a pathologist workstation incorporating controls for manipulating the microscope and a high-resolution video monitor; and (3) a telecommunications linkage. An immediate challenge is to establish the specifications for a telepathology system. Breast tissue has served as a model.

Telepathology is defined as the practice of pathology at a distance by visualizing an image on a video monitor rather than viewing a specimen directly through a microscope. Although in its infancy, several trends in laboratory medicine seem to favor the development of telepathology. These include the emergence of centralized reference laboratories, the creation of financial incentives to spin-off certain in-house hospital operations including some laboratory services in radiology are applicable to pathology, although the transfer of the technology from one specialty to the other is just beginning to take place. For example, advances in the development of the digitalized radiology department and the introduction of teleradiology as an approach to delivering radiology diagnostic services off-site may foretell what could happen to the practice of anatomic pathology in the future. Dramatic improvements in the technology

Arch Path Lab Med 111: 646-652, 1987
Issues in Robotic Microscopy

- Synchronous
- Fully control motorized light microscope
- Lack of interoperability standards
- Relatively expensive equipment
- User satisfaction
Dynamic Robotic Telepathology
Robotic Microscope

Gross Specimen Camera

PC with Videoconferencing

Robotic Microscope

Dynamic Robotic Telepathology
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Static Imaging Systems

- Asynchronous
- Batch paradigm
  - Arizona International Telemedicine Network
  - AFPI
  - UICC
- Dependence on screener for microscopic field and magnification selection
- Minimal opportunity for interactive field selection
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Hybrid Dynamic Store-and-Forward Systems (HDSF)

- Integrated dynamic robotic and store-forward systems (*T. Eide and I. Nordrum, Univ. of Tromso, Norway*)
- Efficient and user friendly
- High diagnostic accuracy
- 2 Mb/sec bandwidth
Light Microscopy

Robotic Microscopy
Arizona Dynamic-Robotic Telepathology QA Program

Havasu Regional Medical Center

316 Miles

University Medical Center, Tucson, AZ
## Dynamic-Robotic Telepathology QA Program

<table>
<thead>
<tr>
<th>Case Read-Outs</th>
<th># of Cases</th>
<th>% of Cases</th>
<th>Average Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMC on-service telepathologist</td>
<td>1692</td>
<td>90.87%</td>
<td>3.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1-33 minutes)</td>
</tr>
<tr>
<td>Deferred for glass slide review</td>
<td>170</td>
<td>9.13%</td>
<td>6.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1-18 minutes)</td>
</tr>
<tr>
<td>Total</td>
<td>1862</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis of 1862 QA Cases
(University of Arizona)

- Discordance rate- 5.73 per cent
  ~1/3 Major Discordances
  ~2/3 Minor Discordances

- Deferrals for glass slide review-
- 9.13 per cent of cases
## Hybrid DR/SF Deferral Rates

<table>
<thead>
<tr>
<th>Pathologists</th>
<th>Total cases in general</th>
<th>Deferred cases</th>
<th>Total cases excluding the pathologist’s subspecialty</th>
<th>Total deferred cases excluding the pathologist’s subspecialty</th>
<th>Deferral rate in general</th>
<th>Deferral rate excluding pathologist’s subspecialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastro Intestinal</td>
<td>501</td>
<td>24</td>
<td>344</td>
<td>17</td>
<td>4.79%</td>
<td>4.94%</td>
</tr>
<tr>
<td>Heart and Lung</td>
<td>369</td>
<td>30</td>
<td>321</td>
<td>25</td>
<td>8.13%</td>
<td>7.78%</td>
</tr>
<tr>
<td>Renal</td>
<td>188</td>
<td>24</td>
<td>150</td>
<td>22</td>
<td>14.79%</td>
<td>14.67%</td>
</tr>
<tr>
<td>Soft Tissue</td>
<td>174</td>
<td>37</td>
<td>165</td>
<td>36</td>
<td>21.26%</td>
<td>21.81%</td>
</tr>
<tr>
<td>GYN</td>
<td>166</td>
<td>12</td>
<td>161</td>
<td>12</td>
<td>7.23%</td>
<td>7.45%</td>
</tr>
<tr>
<td>Renal</td>
<td>139</td>
<td>12</td>
<td>109</td>
<td>10</td>
<td>8.63%</td>
<td>9.17%</td>
</tr>
<tr>
<td>Endocrine</td>
<td>85</td>
<td>9</td>
<td>83</td>
<td>9</td>
<td>10.59%</td>
<td>10.84%</td>
</tr>
<tr>
<td>ENT Path</td>
<td>84</td>
<td>6</td>
<td>76</td>
<td>6</td>
<td>7.14%</td>
<td>7.89%</td>
</tr>
<tr>
<td>Dermatology</td>
<td>58</td>
<td>7</td>
<td>50</td>
<td>5</td>
<td>12.07%</td>
<td>10%</td>
</tr>
<tr>
<td>Breast</td>
<td>51</td>
<td>4</td>
<td>50</td>
<td>4</td>
<td>7.84%</td>
<td>8%</td>
</tr>
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Light Microscopy

Virtual Slides (WSI)
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Whole Slide Image Network

Adapted from Kayser et al., 1999
“Whole Slide Imaging” Telepathology
Bacus Labs, Lombard, Illinois

- Complete slide digitization
- Storage on a server
- Internet access
- Imaging via a browser
Virtual Slide Telepathology
Developed by 31 Companies
Bacus Laboratories – Large Patent Portfolio
University of Arizona

Virtual Slide Telepathology
Innovations in Virtual Slide Processors

Weinstein et al, Human Pathology, 2001
Innovations in Virtual Slide Processors

Weinstein et al., Human Pathology, 2001
Miniaturized microscope
Array Microscope Concept
University Physicians Hospital
Tucson, Arizona

DMetrix DX
Scanner
Innovations in Virtual Slide Processors

Weinstein et al., Human Pathology, 2001
Applications of WSI

Education
Surgical pathology consultations
Quality assurance programs
(Clinical trials)
Research
Acute Inflammation – Laboratory

Anna R. Graham, M.D.

Wednesday, August 2, 2006

Laboratory Objectives

1. To observe the morphologic changes in tissue with acute inflammation.
2. To identify (when possible) the underlying process which induced the acute inflammation.
3. To recall the cellular events, which produced the microscopic appearance observed (chemotaxis, margination, etc.).
4. To relate the microscopic findings to gross and clinical findings.

Microscopic Slides

Slide #40 (Acute appendicitis): This is a cross-section of an appendix. If you look at it on low power, you can see the mucosal ulceration (discontinuity), which gave rise to the inflammatory response. This is an area where the normal colonic mucosal glands are missing. Something (perhaps a hard fragment of stool termed a fecolith) injured the mucosa and allowed the bacterial flora of the gut access to the underlying connective tissue of the appendix wall. Notice the sea of white blood cells (granulocytes) around the area of the
# 313 Consecutive QA Cases

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Primary diagnosis</td>
<td>290</td>
<td>90.6%</td>
</tr>
<tr>
<td>Major discrepancies</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>Minor discrepancies</td>
<td>9</td>
<td>2.8%</td>
</tr>
<tr>
<td>Deferred for additional testing</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>Deferred for glass slide review</td>
<td>6</td>
<td>1.9%</td>
</tr>
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Kino-UPH Hospital to University Medical Center
# 313 Consecutive QA Cases

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Kino-UPH Hospital to University Medical Center
## 151 Breast QA Cases

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<th>Type of Discrepancy</th>
<th>Number</th>
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<tr>
<td>Minor discrepancies</td>
<td>3</td>
<td>1.9%</td>
</tr>
<tr>
<td>Deferred for immunohistochemistry</td>
<td>3</td>
<td>1.9%</td>
</tr>
<tr>
<td>Deferred for glass slide review</td>
<td>2</td>
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Kino-UPH Hospital to University Medical Center
# 151 Breast QA Cases

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*Kino-UPH Hospital to University Medical Center*
Question: Is dynamic-robotic telepathology obsolete?
Question: Is dynamic-robotic telepathology obsolete?

Answer: Not at all!
2011 Grant Program
VA National Project Implementation
Dynamic-Robotic Telepathology

US Dept. of Veterans Affairs (2011)
New Grant Program ($2.5 million dollars)

1. VISN 20 – Spokane VA, Spokane, Washington
2. VISN 18 – Amarillo VA, Amarillo, Texas
3. VISN 12 – Iron Mountain VA, Iron Mountain, Michigan
4. VISN 6 – Beckley VA, Beckley, West Virginia
5. VISN 15 – Topeka VA, Topeka, Kansas
6. VISN 15 – Leavenworth VA, Leavenworth, Florida
7. VISN 8 – Bay Pines VA, St. Petersburg, Florida
8. VISN 8 – San Juan VA, Puerto Rico
9. VISN 4 – Pittsburgh VA, Pittsburgh, Pennsylvania
10. VISN 4 – Altoona VA, Altoona, Pennsylvania
VA 2010 - Choice of Robotic Telepathology for New Networks

- Diagnostic Accuracy Issues
- Z-Axis Sampling Issues
- VA Legacy Programs
  (Dunn, Carrington)
Apollo Telemedicine
Question: What is the next frontier in telepathology system development?

Answer: Up-and-down focusing
(Options: Z-Stacks vs. Robotic Dynamic Telepathology + WSI)
Synergy of Robotic Microscopy and WSI

Weinstein X,Y,Z-Axis

Robotic Microscopy

Bacus X-, Y-Axis

Virtual Slides (WSI)

1986
Interplay between robotic microscopy and virtual slide concepts

Weinstein Z-Axis

Bacus X-, Y-Axis
Synergy of robotic microscopy and whole slide image concepts
Interplay between robotic microscopy and virtual slide concepts

Light Microscopy

hybrid virtual slide + robotic imaging
Interplay between robotic microscopy and virtual slide concepts

Light Microscopy

hybrid virtual slide + robotic imaging
Aperio
LIVE TELEPATHOLOGY

Conduct Dynamic Telepathology Sessions

Spectrum's TelePath Live functionality is useful in cytology specimens and other "thick tissue" applications. It enables you to:

- Directly connect to your ScanScope to see a live video feed from a remote location
- Capture Z-stacks to view specimens in multiple focal planes
- Perform a scan directly from ImageScope

TelePath Live offers many advantages over robotic microscopes. With TelePath Live, a pathologist can effectively conduct a dynamic telepathology session without a dedicated microscope. While traditional robotics-based telepathology systems can be difficult to use, TelePath Live takes advantage of digital slide technology to improve the slide navigation process, delivering near-instantaneous results. The pathologist is able to quickly navigate to regions of interest on a remote digital slide, and then capture and view a Z-stack interactively with no loss in image fidelity and no frustrating time lag.

Live Video

Live video allows a remote client to click anywhere on a digital slide and focus at any location.

What Is A Z-Stack?

A Z-stack is a three-dimensional image that allows you to view a specimen by moving up and down in the focal planes. This is especially useful for viewing "thick" specimens. TelePath Live enables real-time through-focus (depth) viewing of a specimen through the use of Z-stack images, which are cataloged in the Spectrum database and linked to the original digital slide as an annotation. This enables subsequent post-scan 3-D viewing.
Aperio

“Tele Path Live” feature
LIVE TELEPATHOLOGY

Conduct Dynamic Telepathology Sessions

Spectrum's TelePath Live functionality is useful in cytology specimens and other "thick tissue" applications. It enables you to:

- Directly connect to your ScanScope to see a live video feed from a remote location
- Capture Z-stacks to view specimens in multiple focal planes
- Perform a scan directly from ImageScope

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Telepathology Technologies

- Television Microscopy- RCA Sarnoff Labs (1952)
- Television Microscopy-Clinical Bird (1968)
- Static TP (Store and Forward-SF) Dusserre (1987)
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- Whole Slide Imaging (WSI) Bacus (~1991)
- Rapid WSI (< 1 hour) Becich (2000)
- WSI plus Z-Stacks Various companies
- Hybrid WSI/Robotic Microscopy Various companies
- Fusion WSI/Robotic Microscopy Various companies
## WSO Digitizer Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Class 4A (&gt; 10 min)</th>
<th>Class 4B (&gt; 10 min)</th>
<th>Class 5A (&gt; 10 min)</th>
<th>Class 5B (1-10 min)</th>
<th>Class 5C (&lt; 1 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance learning</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Proficiency testing</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Low-throughput telepathology</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Routine surgical pathology (low volume)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FNA specimen adequacy</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Intraoperative frozen sections</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Routine surgical Pathology (high volume)</td>
<td>yes</td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Interactive proficiency testing</td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Targeted therapy diagnostics</td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Pathology PACS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
</tr>
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</table>
WSI-Enabled Dynamic Robotic Telepathology ("WSIRT")

Pronounced: "Wizirt"
Figure 1. A schematic showing the possible scenarios of the incorporation of informatics into the field of anatomical pathology.
The FAQ Initiative Explaining Pathology
Reports to Patients

Jonathan I. Epstein, MD

Concern has been expressed by pathologists about the
lack of visibility of our profession and our role as
clinicians by both the general public and the medical
community despite the fact that our contribution to
the care of patients with cancer and other diseases has
never been greater. In an attempt to reach the goal of
enhanced visibility, an international group of patient-
centric pathologists organized by Juan Rosai met in
Sirmione, Italy on May 2 to 4, 2008. One outcome of this
meeting concerned the recognition that patients are
becoming more active participants in their health care.
Not only are they using the internet to research their
disease and find specific pathologists to offer second
opinion reviews, but increasingly patients are also reading
their pathology reports.

No matter the clarity of the report, patients are
often confused by the medical terminology they encounter
in their reports. For example, in a prostate biopsy report
with favorable grade adenocarcinoma on 1 core and high-
grade prostatic intraepithelial neoplasia on another core,
I am aware of cases where patients may have focused on
and worried about high grade prostatic intraepithelial
neoplasia, as they read that high grade tumors are bad.
Pathologists are the best physician group, to help patients
better understand their reports, as many clinicians
themselves, do not fully understand pathology reports.
Furthermore, based on my daily experience of discussing
pathology reports with patients, clinicians are busy and
integrate what they have been told. Being able to carefully
review their report at home allows them to better digest
the information and more meaningfully discuss the
findings with their treating physicians.

Although there are several excellent websites devoted
to cancer in general and organ-specific cancer sites,
these sites are insufficient in and of themselves. None of
the sites are aimed at deciphering biopsy pathology
reports on specific cancers, but rather provide informa-
tion in general about various cancers.

To address these issues, a series of “Frequently Asked
Questions and Answers (FAQs)” were developed for the
most common cancer biopsy reports, modeled after FAQs
that the lay public is familiar with at the end of most
technical instructional manuals. All the FAQs begin with
the introductory statement: “When your (prostate, colon,
esophagus, etc) was biopsied, the samples taken were
studied under the microscope by a specialized doctor with
many years of training called a pathologist. The pathology
report tells your treating doctor the diagnosis in each of the
samples to help manage your care. This FAQ sheet is
designed to help you understand the medical language used
in the pathology report.”

It was decided that the FAQs would first be
Am J Surg Path 34: 1058-1060, 20
Figure 1. A schematic showing the possible scenarios of the incorporation of informatics into the field of anatomical pathology.
Question: Is the spread of telepathology world-wide?
Question: Is the spread of telepathology world-wide?

Answer: Yes
25 years of telepathology research: a bibliometric analysis

Vincenzo Della Mea

From The 10th European Congress on Telepathology and 4th International Congress on Virtual Microscopy, Vilnius, Lithuania. 1-3 July 2010

Abstract

Background: The first appearance of the word “telepathology” in a scientific paper can be tracked down to 1986, in a famous editorial of Ronald Weinstein. Since that paper, research in telepathology grew up developing different subfields, including static and dynamic telepathology and more recently virtual microscopy. The present work attempts an analysis of research in telepathology, starting from the tools provided by bibliometrics.

Methods: A query has been developed to extract papers related to telepathology and virtual microscopy, and it has been then submitted to Pubmed by means of Entrez Utilities functions. Results obtained in XML have been processed through ad-hoc developed PHP scripts, in order to extract data on Authors, countries, and keywords.

Results: On PubMed, 967 papers related to telepathology and virtual microscopy have been retrieved, which involved 2904 Authors corresponding authors were from 37 countries. Of those authors, 2213 co-authored just one paper. Papers were published on 344 different journals, of which only 52 from the Pathology field. An analysis of papers per year has been also attempted, that demonstrates variable research output in time.

Conclusions: From the proposed analysis, telepathology seems to have been consistently studied, in time, by about 400 researchers, with occasional participation of many other people. Telepathology research seems also to have varied in time, although some peaks in paper publishing are certainly related to the proceedings of the European congress on telepathology series, when they have been published on journals. However, some clear sign appears that suggests research in traditional telepathology, after a peak in 2000, showed some decline until virtual microscopy became mainstream, topic that currently pushes research again. The low number of clinical trials calls for more randomized studies in telepathology, to enable evidence-based application.

Background

The first appearance of the word “telepathology” in a scientific paper can be tracked down to 1986, in a famous editorial of Ronald Weinstein [1]; in 1996 it was then inserted into the MeSH term list. Since that paper, research in telepathology grew up developing different subfields, including static and dynamic telepathology, and more recently also virtual microscopy.

Telepathology, as also related research topics as wider pathology field, with contributions coming from medical informatics and biomedical engineering areas, in an interdisciplinary way. It is also a subspecialty of the larger field of telemedicine, where more historical fields include telediagnosis and telecardiology.

Bibliometrics utilizes quantitative analysis and statistics to describe patterns of publication within a given field or body of literature. It is becoming a tool for research evaluation and management, through the use
Telepathology
Experience in Africa

Martine RAPHAEL
Université paris Sud
AMCC/INCTR

Workshop : Lymphoma, what can we learn from Africa
New insights to classification, epidemiology, biology and research

Institut Curie, Paris, May 9-10, 2011
Telepathology, in Francophone African Countries, Diagnosis support et links with clinics : Present

- **Two centers** are usually sending cases for diagnosis support: Lubumbashi and Vanga Hospital
  - Experience will be reported in this round table
    - Exchanges between african, (anglophone and francophone), european, and north american pathologists
    - Discussion and final diagnosis mostly on morphology: cytology and histology

- Sporadic cases from others centers
Telepathology in Francophone African Countries
Plans for the future

GFAOP Pathology Committee

Centers to be set up and perspectives

• Bamako, Mali
• Abidjan, Côte d’Ivoire
• Ouagadougou, Burkina Fasso
• Nouakchott, Mauritanie
• Others pilots units of GFAOP

Centers having equipment (microscope+camera+computer), need of i-Path

• Rabat, Casablanca, Maroc
• Alger, Algérie
Telepathology in Francophone African Countries
Plans for the future

- Others pathologies and clinical trials
  Subcommittees
  - Hodgkin disease
  - Nephroblastoma
  - Retinoblastoma
  - Leukemia?

- To set centers for diagnosis support
  - Niamey, Niger
    Experience of video and picture send by internet
  - Cotonou, Benin
    Exchanges with Angers, Tours, Paris
CONGO DR AND LUBUMBASHI

CONGO IN AFRICA

LUBUMBASHI IN CONGO
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Challenges and Barriers

General

- Goals and expectations
- Standards of care
- Language
- Time zones
- Sustainability
Challenges and Barriers

Patient Information

• Privacy
• Confidentiality
• Security
• Informed Consent
Challenges and Barriers

Regulatory

- Medical Licensure
- Hospital Credentialing
- Malpractice
  - Individual insurance
  - Vicarious liability
“International” Telemedicine Consultant

Qualifications

1. ECGMG
2. English Competency
3. USMLE Parts 1, 11, and III
4. JI Visa (waiver sponsor)
5. 4-5 year pathology residency
6. American Board certification examination
7. State license
8. Job offer
9. HI or O1 Visa (Working visa)
10. Hospital Credentialing
Challenges and Barriers

Telecommunications

• Access
• Costs
• Compatibility
• Scalability
Challenges and Barriers

Reimbursement

- Professional services
- Technical component
- Telecommunications
Status of Telemedicine

Issues

Sustainability

- Quality of services
- Local needs
- Entitlements
- Incentives
- Priorities
Future of Telemedicine

- Standards
- Broad band Internet
- Integration of Services
- e-health
- m-health (mobile health)
Globalization of Telemedicine

Issues

1. Technology diffusion and adaptation
2. Multicultural factors
3. Human resources
4. Institutionalization
5. Sustainability
Current Big Issues in Pathology and Medical Informatics

- “Meaningful use” of EHR
- ICD-10 replaces ICD-9 (bigger challenge than Y2K for healthcare systems) *(ICD- International Classification of Diseases/WHO)*
- Application modernization (wrap the existing applications to services, then bring it into Service Oriented Architecture (SOA) environment; mobile tools and tele-health; empower individuals; cloud solutions for organization of IT central management and cost control)
- Harmonize standards and measures (i.e., DICOM rad & DICOM path)
- Connected healthcare (EHR/HIE, Medicaid / Medicare, IHS/VA/ DOD private payers, other administration systems, and many more)
- Transformational models of healthcare delivery *(US Lab Model)*
- New education paradigms (i.e., Interprofessional Education, CAB III)
- “Health Literacy” promotion *(2004 IOM Report, U of A Sir William Osler Summer High School Fellowship Program)*
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- William C. Russum
- Pixuan Zhou
Thank you!

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