Mass General Brigham

Application of Practical Informatics to Cytology

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Overview

Introduction/definitions
Historical overview
Use cases, advantages, considerations
Challenges
Future state
Conclusions
Questions

Definitions

Informatics

The science of how to use data, information and knowledge to improve human health and the delivery of health care services. It is also referred to as applied clinical informatics and operational informatics.

Health information technologies (HIT) is part of informatics, but technology and technological considerations are only one component of the field.

Source: https://amia.org/about-amia/why-informatics/informatics-research-and-practice

Informatics

The application of data, hardware, software, and information technology to develop insightful and actionable tools for patients, physicians, researchers, and staff. Use these tools to support our mission: 1) clinical, 2) education, and 3) research.

Digital pathology

Subfield of pathology that focuses on data management based on information generated from digitized specimen samples

Digital pathology

Digital pathology – historical overview

Automated cytology screen devices – 1950s

SECTION OF BIOLOGY

THE CYTOANALYZER–AN EXAMPLE OF PHYSICS IN MEDICAL RESEARCH*

By W. E. Tolles

Airborne Instruments Laboratories, Inc., Mineola, N. Y.

Introduction

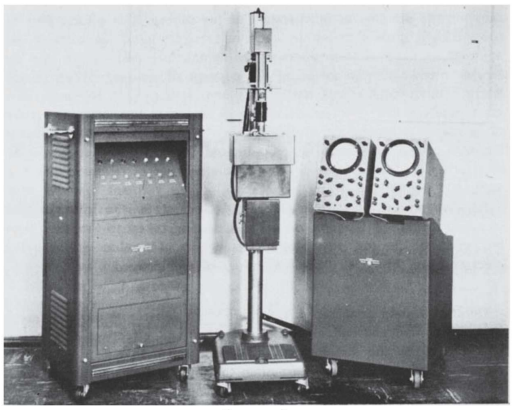


FIGURE 1

Source: Tolles, W.E. (1955), SECTION OF BIOLOGY: THE CYTOANALYZER—AN EXAMPLE OF PHYSICS IN MEDICAL RESEARCH. Transactions of the New York Academy of Sciences, 17: 250-256.

Digital pathology – historical overview

- Automated cytology screen devices – 1950s
- Telepathology – 1960s
- Digitization of photographic prints and 35 mm slides – 1980s
- Consumer-grade digital cameras – 1990s
- Whole-slide imaging systems – 2000s

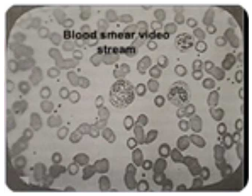
Source: Farahani N, Pantanowitz L. Overview of Telepathology. Clin Lab Med. 2016 Mar;36(1):101-12.; Madrigal E, Le LP. Digital media archive for gross pathology images based on open-source tools and Fast Healthcare Interoperability Resources (FHIR). Mod Pathol. 2021 Sep;34(9):1686-1695.

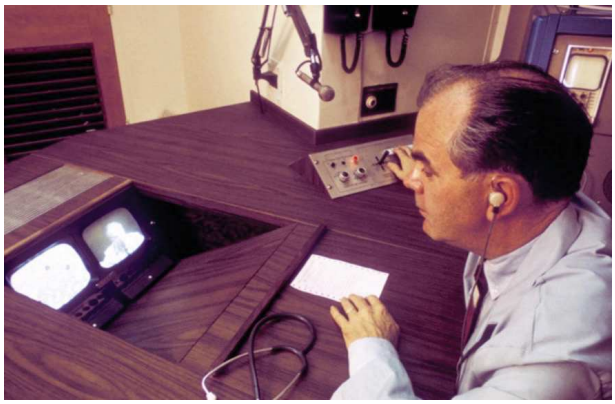
Use cases

- Clinical care
  - Initial reviews, rapid on-site evaluations, tumor boards
- Education
  - Teaching conferences, study sets
- Research
  - Digital image analysis, machine learning or deep learning applications

Telepathology

Boston Logan International Airport MGH Medical Station





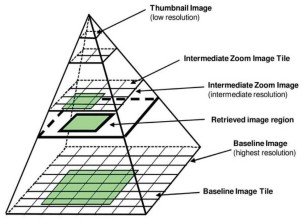
Source: https://twitter.com/MGHPathology/status/1258427300053422080; R.Latifi at al. (eds.), Telemedicine, Telehealth and Telepresence, https://doi.org/10.1007/978-3-030-56917-4

Telepathology

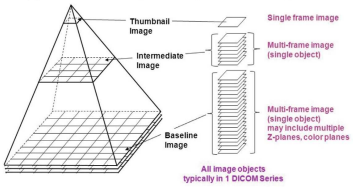
- Static images
- Live microscopy
- Whole slide imaging

Whole slide imaging

- Whole slide imaging (WSI; previously referred to as virtual microscopy) involves scanning (digitization) entire glass slides to produce digital slides
- Such digitization is performed on a WSI scanner



(a) Whole slide image as a "Pyramid" of image data.



(b) Correspondence of an image pyramid to DICOM images and series.

Fig. 1. Description of WSI organization and structure proposed by DICOM WG26 [5].

Source: PMID: 31443854 DOI: 10.1016/j.cmpb.2019.104983

Minimum requirements

- Acquisition device
  - WSI scanners, cameras
- Workflow management system
- Storage
- Viewer

Challenges

- Cost
- Infrastructure
- Laboratory information system integration
- Proprietary imaging formats
- Immature imaging standards

Future state

- More affordable on-premises and cloud-based storage solutions
- Improved network bandwidth
- Widespread applications of artificial intelligence and digital image analysis models
- Formally adopted imaging standards

Conclusions

- Digital pathology is not a new concept in our field
- Even with current limitations, there are several important applications
  - Clinical
  - Education
  - Research
- Improved imaging devices and more widely accepted standards will improve endorsement

Conclusions

Advantages of WSI

- Historical case review
- Teaching the next generation of pathologists
- Research projects
- Reimbursement
- Recruitment

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