



COLLEGE of AMERICAN
PATHOLOGISTS

Digital Pathology Resource Guide

The Digital Pathology Resource Guide highlights resources that provide awareness and understanding of this technology.

Opinions expressed in this document are the authors' own and do not necessarily reflect an endorsement by the CAP of any organization, equipment, reagents, materials, or services used by participating laboratories.

© 2017 College of American Pathologists. All rights reserved. None of the contents of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise) without the prior written permission of the publisher.

Goal of this Resource Guide and How to Use It

What is the Resource Guide?

The Digital Pathology Resource Guide is one of four CAP Resource Guides that bring a set of resources together in one place to focus on a specific hot-topic technology important to pathologists. Each comprehensive guide highlights current resources, such as a curated set of journal articles, and a collected set of CAP resources, that includes learning opportunities, proficiency testing, and accreditation that are related to this technology. Also, each Resource Guide includes an “Insights from Adopters” section to gain perspective from pathology leaders in the field. In sum, each Resource Guide provides a one-stop resource that will assist busy pathologists to find valuable information about a dynamic and important emerging technology.

How to Use This Digital Pathology Resource Guide

This Resource Guide is designed in a modular manner to facilitate its use in several different ways. For example, the guide may be used in its entirety as a comprehensive guide to the rapidly evolving field of digital pathology. Conversely, it may be used by a pathologist to focus on and gain a current understanding of the application of digital pathology to a very specific organ system or disease process. The tables are designed not only to organize and summarize the contents of a section but also to serve as stand-alone, quick reference guides to a topic. To some, these tables may hold the greatest value and become a frequently used reference. The Adopters sections will undoubtedly prove to be of great value to those contemplating or actually taking the plunge into the enhanced application of digital pathology approaches to their practice.

Special Features of the Digital Pathology Resource Guide

The Digital Pathology Resource Guide includes an introduction to the basic principles behind and instrumentation used for digital pathology, as well as

regulations inside and outside the US. The curated journal articles cover whole slide imaging (WSI), workflow considerations, and clinical applications. A section suggesting how pathologists can get started in digital pathology is also included. The Resource Guide highlights a number of digital pathology-related activities that pathologists can take advantage of such as textbooks, mobile pathology apps, societies, and conferences.

Editors of the Digital Pathology Resource Guide

The CAP's Digital Pathology Committee has put together this resource guide to promote the use of digital tools in the practice of pathology. The authors are the members of this committee and a group of non-member advisors who are practicing users of digital pathology; each member has unique experience/expertise. Our target audience includes practicing pathologists and educators.

Jason Hipp, MD, PhD (Senior Editor)

Thomas W. Bauer, MD, PhD, FCAP – Cleveland Clinic Foundation

Marilyn M. Bui, MD, PhD, FCAP – H Lee Moffitt Cancer Center

Toby C. Cornish, MD, PhD, FCAP – University of Colorado School of Medicine

Andrew J. Evans, MD, PhD, FCAP – University of Toronto

Eric F. Glassy, MD, FCAP – Affiliated Pathologists Medical Group

Mark Lloyd, PhD, MSM – Inspirata, Inc.

Robert S. McGee, Jr., MD, PhD, FCAP – Covance Clinical Laboratory Services

Doug Murphy, MT (ASCP) – College of American Pathologists

Dennis G. O'Neill, MD, FCAP – Manchester Memorial Hospital

Liron Pantanowitz, MD, FCAP – UPMC

Anil V. Parwani, MD, PhD, MBA, FCAP – Ohio State University, Wexner Medical Center

B. Alan Rampy DO, PhD, FCAP – University of Texas, Dell Medical School

Mohamed El-Sayed Salama, MD – ARUP Laboratories

Rebecca Waters, DO - University of Texas Medical Branch

Kelly Westfall – College of American Pathologists

The authors would like to acknowledge the many contributions of Ms. Westfall to develop this Resource Guide and thank her for her steadfast dedication and patience.

The CAP has four Pathology Resource Guides:

Pathology Resource Guide: Precision Medicine

Pathology Resource Guide: Digital Pathology

Pathology Resource Guide: In Vivo Microscopy

Pathology Resource Guide: Clinical Informatics

Table of Contents

Section 1 Digital Pathology: The Basics	 Page 1
1.1 Background and Framework	Page 1
1.2 Components of Whole Slide Imaging	Page 2
1.3 Current and Emerging Applications of Digital Pathology	Page 3
1.4 Why Use Digital Pathology?	Page 9
 Section 2 Clinical Applications of Digital Pathology: Current and Emerging	 Page 19
2.1 Clinical Application Overview	Page 20
2.2 Frozen Section Interpretation	Page 22
2.3 Primary Diagnosis	Page 32
2.4 Consultation/Expert Second Opinion/ Intrapractice Consultation	Page 38
2.5 International In-sourcing	Page 43
2.6 Clinical Conferences	Page 52
2.7 Digital Image Analysis Algorithms	Page 54
2.8 Cytopathology	Page 70
2.9 Clinical Pathology	Page 93
2.10 Veterinary Pathology	Page 98
2.11 Multiplex High Medical Value Assays/ Decision Support	Page 104
 Section 3 Business Justifications with a Positive Return on Investment	 Page 105
3.1 Workflow Considerations	Page 105
3.2 Technology Considerations	Page 115
3.3 Digital Pathology Informatics Standards	Page 121
3.4 Reimbursement	Page 124

Section 4 Getting Started and Beyond	 Page 127
4.1 Setting up Your Digital Pathology Lab	Page 127
4.2 Validating Your Digital Pathology System	Page 134
4.3 Training	Page 140
4.4 Quality Assurance	Page 147
 Section 5 Regulatory Resources	 Page 149
5.1 Regulatory Resources	Page 150
 Section 6 Tips for Including Whole Slide Images into Medical Courses and Publications	 Page 153
6.1 Medical Education	Page 153
6.2 Online Digital Image Sharing	Page 188
6.3 Mobile Pathology Apps	Page 197
6.4 Publications Supplemented with Digital Images	Page 209
 Section 7 Insights from Current Users of Digital Pathology	 Page 213
7.1 Eric F. Glassy, MD, FCAP	Page 213
7.2 Keith J. Kaplan, MD, FCAP	Page 216
7.3 Andrew Evans, MD, PhD	Page 224
7.4 Liron Pantanowitz, MD, FCAP	Page 230
7.5 David C. Wilbur, MD, FCAP	Page 250
7.6 Mohamed E. Salama, MD, FCAP	Page 255
7.7 Thomas W. Bauer, MD, PhD, FCAP	Page 261
7.8 Paul J. van Diest, MD, PhD	Page 267
7.9 Scott W. Binder, MD, FCAP and W. Dean Wallace, MD, FCAP	Page 276
7.10 Anil V. Parwani, MD, PhD, FCAP	Page 280

Section 8 Insights from Digital Pathology Adopters Outside the United States	 Page 287
8.1 Canada	Page 287
8.2 Asia	Page 291
8.3 Europe	Page 296
8.4 Emerging Markets	Page 303
Section 9 Resources	 Page 307
9.1 CAP Center: Guidelines	Page 307
9.2 Guidelines	Page 309
9.3 CAP Proficiency Testing (PT)	Page 312
9.4 CAP Laboratory Accreditation Program	Page 314
9.5 CAP Education Programs	Page 315
9.6 Digital Pathology Organizations	Page 318
9.7 Industry Conferences	Page 320
9.8 Archived Webinars	Page 321
9.9 Platform and Vendor Overview	Page 323
Contributor Acknowledgement	 Page 327
Bibliography	 Page 329



325 Waukegan Rd.
Northfield, IL 60093
800-323-4040 | cap.org

