

Mobile Technologies for the Surgical Pathologist



Douglas J. Hartman, MD

KEYWORDS

- Mobile technology • Education • Digital consultations • Mobile image analysis
- Barriers to implementation of mobile technology

ABSTRACT

Recent advances in hardware and computing power contained within mobile devices have made it possible to use these devices to improve and enhance pathologist workflow. This article discusses the possible uses ranging from basic functions to intermediate functions to advanced functions. Barriers to implementation are also discussed.

OVERVIEW

Recent advances in the hardware capabilities housed within cellular phones have led to the creation of so-called smartphones. These smartphones are being rapidly adopted and an emerging mobile health (mHealth) field has begun. This rapid growth represents an opportunity and a challenge for clinical laboratories.¹ Smartphones are cellular phones equipped with Internet functionality as well as having image capture capabilities through built-in cameras. Although smartphones are generally considered the predominant mobile device, tablet computers also run on the same operating systems (so-called mobile computing). For the purposes of this discussion, both smartphone technology and mobile computing are collectively referred to as mobile technologies. There are several mobile technologies now at the hands of the diagnostic surgical pathologist. These technologies can be grouped into 3 categories: (1) basic functions, (2) intermediate functions, and (3) advanced functions. Basic functions essentially represent electronic versions of paper documents or interfaces to clinical systems. Intermediate functions contain an interactive

component (ie, calculators that take in data and provide an output or simplify a process). Advanced functions are in early development and have not yet been realized, but several possible directions are discussed. Each month new developments are introduced within this arena. By 2020, some experts have predicted that 25% of all patient encounters could be through mHealth.²

BASIC FUNCTIONS OF SMARTPHONE APPLICATIONS

FLASH CARDS

Several applications for pathology have been created for educational purposes. Some of this educational material is tailored toward United States Medical Licensing Examination (USMLE) Board pathology study materials, including Flash Cards for Robbins, Rubin's, Lange Medical, and McGraw-Hill (**Box 1**). Additionally, there is an application for Pathology Case Files from McGraw-Hill.

PUBLICATIONS

Some applications have been created for pathology publications. This is likely to increase in the coming years because it brings the educational material to the pockets/hands of the people who need the information. These advances mimic the increased consumer use of tablets/readers. Current pathology journals with mobile applications connected to published articles include *Journal of Pathology*, *American Journal of Clinical Pathology*, and *Cancer Cytopathology* (**Box 2**). The American Society for Clinical Pathology has also

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Department of Anatomic Pathology, University of Pittsburgh Medical Center, 200 Lothrop Street, A-607, Pittsburgh, PA 15213, USA

E-mail address: hartmandj@upmc.edu

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Box 1**Electronic versions of traditionally paper-based resources**

- Robbins Pathology Flash Cards
- Rubin's Pathology Flash Cards
- McGraw-Hill Flash Cards
- McGraw-Hill Pathology Case Files
- Lange Medical Flash Cards

published several e-books. More journals are likely to respond to this increased demand and offer their articles on a mobile platform.

NATIONAL MEETINGS/CONFERENCES

Some applications have been created to facilitate attendee experience at pathology conferences. These include PathVisions national meetings in 2012 and 2013, American Pathology Foundation meetings, and the American Society for Clinical Pathology national meeting (**Box 3**). These applications are intended to enhance the users' experience at the conference/meeting. They assist to digest/organize the numerous educational opportunities that are presented at national meetings.

**LABORATORY INFORMATION SYSTEMS
MOBILE APPLICATIONS**

Several applications have been created to interface with pathology laboratory information systems and whole-slide imaging platforms. The most mature available whole-slide imaging product is the Aperio product, and a mobile application to view images on smartphones is available through the ePathViewer application. There is also a mobile application available for interface with PathX laboratory information system. Pathologists can use this application to view and sign out

Box 2**Journals/professional society meetings with mobile applications**

- *Journal of Pathology*
- *American Journal of Clinical Pathology*
- *Cancer Cytopathology*
- American Society of Clinical Pathology e-books
- PathVisions Meeting (2012 and 2013)
- American Pathology Foundation
- American Society for Clinical Pathology national meeting

Box 3**Interfaces with machines/whole-slide imaging platforms**

- SlidePath (Leica)
- PathX
- Mobile version of PathXchange
- InterPath (Aperio)
- ePathViewer (Aperio)

cases and follow their case queues; other clinicians also can view the current stage for pathology reports. Mobile applications to interact with the electronic medical record have recently been developed.^{3,4} Within the University of Pittsburgh Medical Center Health System, we have piloted the use of a new mobile platform for accessing electronic health record systems.^{4,5} This has received good reviews although it is still in the early phase of adoption.^{4,5}

EDUCATION

There is great interest in increasing health education of the population with the use of mobile devices.⁶⁻⁹ Some investigators, however, have implemented mobile-based teaching platforms for the education of future physicians. For instance, podcasting of medical lectures has become a popular activity in anatomy classes.¹⁰⁻¹⁵ These devices offer resources at students' fingertips whenever they like to tap into resources. Mobile technology resources have also been developed to facilitate house staff and/or hospital staff education as well.¹⁶⁻²¹

INTERMEDIATE FUNCTIONS OF SMARTPHONE APPLICATIONS

Intermediate functions of smartphone applications can be seen in 3 subgroups: (1) electronic calculators (an application that returns a clinical recommendation based on user input), (2) differential diagnoses tools (differential diagnoses are proposed based on user input), and (3) digital consultations (streamlined process for more rapid processing of consultations).

ELECTRONIC CALCULATORS

In the era of evidence-based medicine, many clinical guidelines/algorithms have been developed for patient management. The complexity of these guidelines/algorithms reflects the increasingly specialized level of medical care now considered

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