The Promise and Challenges of mPathology

Toby C. Cornish, MD, PhD
Assistant Professor of Pathology
The Johns Hopkins Medical Institutions
Disclosures

• All
  – Digipath, Inc. Medical Advisory Board
  – Digipath, Inc. Shareholder

• Relevant
  – None
Objectives

• At the conclusion of this activity, the learner should:
  – Understand options for application deployment
  – Understand the current state of mobile pathology (“mPathology”) applications
  – Recognize challenges to the creation and use of mPathology applications, including technical and regulatory challenges
  – Recognize future areas for expansion of mPathology applications
Background
Development
Deployment
Challenges
Current
Future
Background
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Challenges
Current
Future
Alan Kay

- Proposed the Dynabook in *A Personal Computer for Children of All Ages* (August, 1972)
- Xerox PARC scientist and principle designer of Smalltalk, the first true object-oriented programming language
- The Dynabook was never built
The PDA Era

• 1984: Psion Organizer II
• 1991: Psion Series 3
• 1992: “Personal Digital Assistant” coined to describe Apple Newton
• 1994: IBM releases a PDA/phone hybrid, Simon
• 1996: Nokia releases the 9000 communicator, a landmark PDA Phone
• 1996: Palm releases the Palm Pilot
• 1996: Microsoft debuts WinCE
• 1999: RIM releases the BlackBerry 850, an email pager

The Early Smartphone Era

• 2000: Ericsson R380 is marketed as a “smartphone”
• 2003: BlackBerry “Quark” with integrated phone
• 2003: PalmOne Treo
• 2003: Windows Mobile debuts
• 2007: iPhone
• 2007: Android
Apple iOS

- Steve Jobs led the team that extended the iPod platform to create the iPhone (2007) and later the iPad (2010)
- These were market-defining mobile devices
- Created the mass market for modern smartphones and tablets
Abundance of mobile devices

• According to Pew Research, as of January 2014:
  – 58% of American adults have a smartphone
  – 42% of American adults own a tablet computer

## Market share by OS

<table>
<thead>
<tr>
<th>Operating System</th>
<th>3Q13 Units</th>
<th>3Q13 Market Share (%)</th>
<th>3Q12 Units</th>
<th>3Q12 Market Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android</td>
<td>205,022.7</td>
<td>81.9</td>
<td>124,552.3</td>
<td>72.6</td>
</tr>
<tr>
<td>iOS</td>
<td>30,330.0</td>
<td>12.1</td>
<td>24,620.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Microsoft</td>
<td>8,912.3</td>
<td>3.6</td>
<td>3,993.6</td>
<td>2.3</td>
</tr>
<tr>
<td>BlackBerry</td>
<td>4,400.7</td>
<td>1.8</td>
<td>8,946.8</td>
<td>5.2</td>
</tr>
<tr>
<td>Bada</td>
<td>633.3</td>
<td>0.3</td>
<td>4,454.7</td>
<td>2.6</td>
</tr>
<tr>
<td>Symbian</td>
<td>457.5</td>
<td>0.2</td>
<td>4,401.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Others</td>
<td>475.2</td>
<td>0.2</td>
<td>683.7</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>250,231.7</strong></td>
<td><strong>100.0</strong></td>
<td><strong>171,652.7</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Gartner (November 2013)
Background
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Who develops mPathology apps?

- Publishers
- Individuals
- Academic centers
- Reference labs
- Private labs
- “Digital Pathology” vendors
- EMR vendors
- LIS vendors
Mobile development

- Three types of mobile app development:
  - Native apps
  - Cross-platform toolkits
  - Web apps
Native app development

- Native apps are written and compiled to target the specific device they are running on
- iOS: Objective-C, Android: Java
- Pros:
  - faster execution
  - full access to hardware and native APIs
- Cons:
  - have to re-code an app for each mobile platform
Cross platform development

• Use of third party toolkits that create native hybrid apps that run on multiple platforms
• ex. PhoneGap, Titanium

• Pros:
  – Code once
  – Can access hardware features
  – Often indistinguishable from a native app

• Cons:
  – May not support all hardware features on every platform
Web apps

• Use of HTML (usually HTML5) to create apps to run on multiple platforms
• Target mobile devices using mobile specific versions or so-called responsive design
• Pros:
  – Code once
  – Works for non-mobile applications
  – Consistent look and feel across platforms
  – Instantly update code
• Cons:
  – No access to hardware features
  – Getting web apps to render well on all devices is not trivial
Which approach is used?

• Most apps are native apps, but you can’t really know which are built with cross platform
• Most LIS vendors tend to not have native apps, and instead rely on web portals that may or may not be mobile-friendly
• Another approach is to skip mobile development all together and use a Citrix or RDP client on the mobile device
Deployment
iOS deployment

• Apple App Store
• The Volume Purchase Program
  – Private business-to-business apps
• Ad hoc
  – up to 100 devices per developer license
• In-house development & distribution
  – “Distributing in-house apps can be done either by hosting your app on a simple web-server you create internally, or by using a third-party Mobile Device Management solution.”
Android App Deployment

- Google Play
- Google Play Private Channel
  - choose which users can access your Private Channel to download internal applications
- 3rd party marketplaces
- Open distribution, a.k.a. “sideloading”
  - Direct installation of an app via APK format
Web App Deployment

- Nothing special is needed for deployment
- Serve content from standard webserver/web framework
Challenges
Challenges in mPathology

- Security/privacy
- Data connection coverage
- Data connection bandwidth
- Hardware interfacing
- Employer vs. employee devices
- Regulation of medical apps (FDA)
- User interest
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Google play: “pathology”
iTunes Store: “pathology”
Current mPathology apps

• Education
• Reference/Clinical decision support
• Societies/Meetings
• Virtual microscopy
• Marketing
• Provider ordering and resulting
  – Lab-based CPOE and reporting
  – EMR-based CPOE and reporting
  – LIS-based CPOE and reporting
• Patient portal
Education
• Apps providing reference information or in some cases interactive clinical decision support (CDS)
Society meetings
Journals
Virtual microscopy
Aperio ePathViewer

- Connect to an eSlideManager or slide sharing service
- Navigate a whole slide image using the touch UI
Teleconsultation

- Take an image with an iPhone and upload it to the UPMC digital consultation site
Marketing

- Mayo Clinic MML
  Lab Catalog for iPad
  Medical

- Solstas Lab Finder
  Medical

- Solstas Test Compendium...
  Medical
Solstas Lab Finder

- The Solstas Lab Finder uses location data to help patients find the nearest Solstas Lab Patient Service Center.
Mayo Clinic Lab Catalog
Mayo Clinic Lab Catalog

B-Cell Lymphoma, FISH, Blood or Bone Marrow

Useful For
- Detecting an abnormal clone associated with the common chromosome anomalies seen in patients with B-cell lymphoma, specifically Burkitt, mantle cell, follicular, diffuse large B-cell, and MALT lymphoma.
- Individual probes can also be utilized to identify specific chromosome anomalies in patients with B-cell lymphoma and track the response to therapy.

Clinical Information
Lymphoid neoplasms are known to be complex and the prognosis and clinical course of patients with lymphoma is highly variable. Genetic aberrations have emerged as one of the most reliable criteria for categorizing lymphomas. Several chromosome anomalies and variants of these anomalies have been associated with various kinds of lymphomas (see Table).

Common chromosome anomalies in lymphomas

<table>
<thead>
<tr>
<th>Lymphoma Type</th>
<th>Chromosome Anomaly</th>
<th>FISH Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkitt</td>
<td>t(8;14)(q24;q32)</td>
<td>MHC/IGH</td>
</tr>
<tr>
<td></td>
<td>t(11;14)(q22;q32)</td>
<td>MHC/IGK</td>
</tr>
<tr>
<td></td>
<td>t(22;12)(q11.2;11)</td>
<td>IGL</td>
</tr>
<tr>
<td>mantle cell</td>
<td>t(14;18)(q32;q21)</td>
<td>JGH/BCL2</td>
</tr>
<tr>
<td>follicular</td>
<td>t(14;18)(q32;q21)</td>
<td>JGH/BCL2</td>
</tr>
<tr>
<td>diffuse large B-cell</td>
<td>t(14;18)(q32;q21)</td>
<td>JGH/BCL2</td>
</tr>
<tr>
<td>t(14;18)(q32;q21)</td>
<td>t(2;8)(q11.2;q21)</td>
<td>BCL6</td>
</tr>
</tbody>
</table>

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Lab-based CPOE and resulting

- Lab-specific mobile apps
- All support resulting, some support ordering
• Beacon allows providers to review LabCorp results as they become available
EMR-based CPOE and Reporting

- EMR vendor supplied mobile apps
- All support resulting, some support ordering
Epic Canto

- Secure access to Epic EMR information including lab results, patient lists, health summaries, and notes. Canto also supports dictation and In Basket access.
Bedside POC verification

- Mobile app for medication administration, specimen collection
- Other mobile solutions for this exist
Epic Rover

- Rover supports medication administration, specimen collection, vitals, and I/O at the bedside.
LIS-based CPOE and Reporting

- LIS vendor-supplied mobile apps
- PathX is for AP report; Pathology, Inc is for Atlas LabWorks (?middleware)
- Web-based portals discussed later
• PATHX web portal users can see their work queue as well as review and sign out pending reports. They can also search released cases.

• From Physicians Independent Management Services
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• From Physicians Independent Management Services
Web-based physician portals

- **Sunquest** – physician portal: place orders and electronically view results necessary

- **SCC SoftLab** – SoftWeb: electronically view results

- **Meditech** – Mobile rounding: electronically sign orders/reports and review results

- **Orchard Software LIS**
  - Webstation: for Orchard Harvest LIS; web access to users within one entity
  - Copia: for labs doing reference lab work from multiple customers
Patient Portal

- LIS vendor-supplied mobile apps
- PathX was the only example found and is for AP repor
• MyChart gives each patient access to the complete medical record, including lab results
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Future

• mPathology is in its infancy

• Areas for improvement:
  – Tools for closed-loop reporting of patient results, but especially of critical action values
  – Improved tools for telediagnostics
  – Clinical decision tools integrated with mobile access to lab results