Increasing Lab Efficiency and Productivity with Middleware: A Case Study Approach

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A Zen Definition of Middleware
A Functional Definition of Middleware

A growing family of utilities which enable data to interoperate within diverse information systems.
3 Case Studies of Implemented Middleware with Outcomes

1) **Global** - Layers of MW integrated into the clinical enterprise for connectivity & decision support (e.g. comparative clinical effectiveness)

2) **Integrative** – Application of blood gas instrument enterprise server to connect LIS and CV-OR and to “lean” the testing process

3) **Focused** - Use of a web tool for displaying real time lab test “pending lists” via enterprise **intranet**
1. LIS foundation “info-structure”

- WAN routers connect to Data Center and “Rack & Stack” Client Server LIS (SunQuest)
- 28 (virtual)CS apps from Lab alone
- $80M spent on EHR (EpicCare)
1. LIS foundation “info-structure”

- Single LIS on WAN
- LIS – standardized “lean informatics”
- Connected to billing, EHR “mainstream”
- Middleware embedded for connectivity & functionality
1. Integration into IDN “Mainstream”

“Outcomes Institute”

- Lab parameters key to EHR Clinical Repository (CDS)
- Clinical Effectiveness Division
- Outcome parameters for reimbursement under P4P
- “ProvenCare” Outcome warranty
- Incentivized best practice in EHR
- System dashboards for best practice
- AHRQ grant for “RHIO”
- CDS collaboration with IBM
- NIH grants for population studies
- Translational “D&I”
- “MyCode” Biorepository
- Diagnostics & Pharma collaboration
- Excellent Outcomes & Health Care
1. LIS foundation “info-structure”
   “Enterprise Analytics”

- Scaleable Chem/Immuno (23), Heme, Coag, ABG, POCT on WAN
- Shared LIS test codes, methods, calibrator lot #, reference ranges, critical limits ("lean informatics")
- Common lot # QC (400+ Chem/Immuno channels); affiliate QC reports; CAP web PT
- POCT Interleaved in EHR
- Group purchased savings & efficiency
- Benefits go on and on and on and on…
Alert-specific Order Sets

Attached to each BPA is a SmartSet which allows you to quickly order the appropriate labs.
## Highly-reliable Diabetes Care

(“All or None” Composite Measures)

### Diabetes "Bundle"

<table>
<thead>
<tr>
<th>Measures</th>
<th>GHS Quality Targets</th>
<th>Performance Criteria</th>
<th>Standard</th>
<th>CPSL FY07</th>
</tr>
</thead>
<tbody>
<tr>
<td>HgbA1C measurement</td>
<td></td>
<td>Every 6 months</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>HgbA1C control</td>
<td></td>
<td>&lt; 7 7 to 9 &gt;9</td>
<td>&lt; 7.0</td>
<td>X</td>
</tr>
<tr>
<td>LDL measurement</td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>LDL control</td>
<td></td>
<td>&lt; 100 &lt;130 &gt;=130</td>
<td>&lt; 100</td>
<td>X</td>
</tr>
<tr>
<td>Blood pressure control</td>
<td></td>
<td>&lt; 130/80 &lt; 140/90 &gt;=140/90</td>
<td>&lt; 130/80</td>
<td>X</td>
</tr>
<tr>
<td>Retinal exam</td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>Urine (protein) exam</td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>Foot exam</td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Influenza immunization</td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>Pneumococcal immunization</td>
<td></td>
<td>Once*</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td>Non-smoker</td>
<td>100%</td>
<td>X</td>
</tr>
<tr>
<td>Use of ACE/ARB for microalbuminuria/DM nephropathy</td>
<td></td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Use of ACE/ARB for hypertension</td>
<td></td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td><strong>Patients who receive/ achieve ALL of the above</strong></td>
<td></td>
<td>Yearly</td>
<td>100%</td>
<td>X</td>
</tr>
</tbody>
</table>
ProvenCare™ - Diabetes
(comprehensive care; whole-System >20,000 patients)
Diabetes Outcomes

*(resulting from comprehensive care)*
2. Centralized Blood Gas Labs

- Centralized vs POCT
- Pneumatics tubes
- “Critical tests”
- Process-overload
- “Vein to Brain”
- TAT/integration
- Enterprise-wide integration
## Components of Turnaround Time from “Vein to Brain” (V to B)

<table>
<thead>
<tr>
<th>A. CV-OR (min:sec)</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Specimen Collection</td>
<td>1:48</td>
<td>0:35</td>
<td>3:30</td>
</tr>
<tr>
<td>2) Test Ordering</td>
<td>1:44</td>
<td>0:53</td>
<td>3:05</td>
</tr>
<tr>
<td>3) Results Receipt</td>
<td>3:54</td>
<td>0:59</td>
<td>6:23</td>
</tr>
</tbody>
</table>

Total "V to B" TAT | 15:23 | 12:12 | 22:16 |

## B. Stat Lab (min:sec)

| 1) Specimen Receipt | 1:41 | 0:31 | 3:41 |
| 2) Specimen Testing | 0:36 | 0:20 | 1:16 |
| 3) Result Reporting | 1:37 | 0:45 | 4:24 |

Total “In Lab” TAT | 2:36 | 1:19 | 5:36 |

## C. Pneumatic Tube (min:sec)

| 1) Derived Transport Time | 4:08 | 1:40 | 9:55 |
Efficient, Safe Order Entry

1. Patient Barcode

2. Syringe Barcode

3. Operator Barcode
CV-OR ABG Process Improvement

Existing vs. Prototype

- Paper Order Entry (OE)
- Print/affix syringe label
- OR staff “choreography”
- Pneumatic tube transport
- Lab LIS accessioning
- Open syringe sampling
- LIS verification
- Telephonic result report
- 15 min “vein to brain”

- Wireless electronic OE
- Pre-barcoded syringe
- 3 barcodes wanding pass
- Pneumatic tube transport
- e-accessioned
- Closed autosampling
- IGO LIS (auto)verification
- Wireless flash report
- est 8 min “vein to brain”
2. Advantages of Client Server Middleware Connectivity

- Minimizes hardware “feetprints” in lab
- Enables & Encourages Enterprise Standardization
- Simplifies IT maintenance (esp with SANS, virtual servers)
- Centralizes data storage (i.e. scientific record)
- Single point of vendor connection (e.g. QC)
- It works
3. Enhancements for Outreach

“Real-time” TAT Monitor

• Developed in-house with “Cold Fusion” (Now Adobe Flex) web tool
• Each lab location manages via its own URL
• URL includes user test, time windows, 24/7 large screen location
• can add sound (e.g. .wav file) and color for alerts
• Embraced by all but sound quickly turned off
TAT Monitor “Dashboard”
Visual Graphics Specific to Workstation
Please select an application below to proceed. To bypass this step in the future, select an application as your default application to automatically launch at the time of sign-on. Welcome, Gregory
2. Enhancements for Outreach

“Real-time” Pending Test Display - Large Screen
Global views are defined as views created by a limited set of super-users that are available to all users that have access to GML MMON. These may also be referred to as "public" views. The end user may select which global view to display at any given time on the "Global View" tab. The "Global View" tab is the first tab that the user will see when accessing GML MMON. Global views may also be used for use on a wall monitor.

<table>
<thead>
<tr>
<th>Name</th>
<th>Owner</th>
<th>Location(s)</th>
<th>Test(s)</th>
<th>Status</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMC Stat Lab Monitor 2</td>
<td>ewroall</td>
<td>A1E,AICU,CICU,SCU</td>
<td>MB,TROFT</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>GMC Stat Lab Monitor 3</td>
<td>ewroall</td>
<td>OPER,AICU,CICU,SCU,NICU,PICU,A1E,SCU3,SCU4,INTR</td>
<td>P02,P02C,P02V,GLUWB,LACWB</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>GMC Stat Lab Monitor 4</td>
<td>ewroall</td>
<td>WP2FER</td>
<td></td>
<td>S</td>
<td>N/A</td>
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<tr>
<td>GMC Stat Lab Monitor 5</td>
<td>ewroall</td>
<td>A1E,AICU,CICU,SCU</td>
<td>CK,NA</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
Display view settings: GMC Stat Lab Monitor 3

Name of view: GMC Stat Lab Monitor 3
View owner: ewcroall
View type: Global

Location filter: COPER, AICU, CICU, SCU, NICU, PICU, A1E, SCU3, SCU4, INTR
Test filter: PO2, PO2C, PC2V, GLUWB, LACWB

Priority Codes: [ ] Only show priority codes of "stat".

Red threshold: 7 minutes
Yellow threshold: 4 minutes

Audible alert: [ ]

Active? [ ] Yes

Last updated by: ewcroall
Last updated: 03/25/2008 10:41:00

Save
“Real-time” TAT Monitor, Outcome

- Saved labor by avoiding pulling hourly pending logs
- Especially outlier TAT misadventures decreased (Mean merged into Mode TAT)
- Changing TAT to encompass collect time → result time (compliant with JC requirement to monitor total TAT for “critical tests”)

“IVD Industrial Connectivity Consortium (IICC)”

- Organizing sponsored by AACC
- Broad goal is to promote interoperability between instruments and their host IT systems with defined standards
- Patterned after CIC-1
- Organizational meeting Oct 2007 in Tarrytown, NY
- Governance now being formalized
NCCLS POCT1-A Connectivity

- Connectivity Industrial Consortium (CIC) now sunsetted
- Formal Governance structure in 2004
- Funded by voting CIC members
- Well documented specs in a year
- Handoff to NCCLS (now CLSI)
Final Thoughts

• As you layer in Middleware applications, think about how they fit into the entire enterprise
• Middleware is in a germinal state and will accelerate its growth with associated maintenance issues
• Plan and budget for licenses at Middleware “touch points”
• Try to keep it as simple as possible