What Does Lean Surgical Pathology Look Like?
The way it was is!

Cycle time = 14 hrs

1909 Arendt

1893 Blum

1850s Virchow

Cycle time = ? hrs
Identify the Goal
Articulate the Vision & Means & Goals

• All specimens from any Operating Room or client within are transported, grossed and processed within the day of surgery at Core AP Lab

• Continuous flow processing for Biopsies & Large Specimens using Lean processes with short cycle times

• 80% of all Biopsy reports within 2 days & all Large specimens reports in 3 days
Educate the Leaders & Teams
How Do You Get There?

Management system
- That mines creativity of people, educated and structured to contribute to improving the work daily

- PDCA (Plan Do Check Act)-based
  - Customer focused continuous improvements

- Continual work redesign (to achieve):
  - Continuous flow
  - With minimal waste,
  - Defined connections, &
  - Defined pathways
Know What is Ideal Work
Strive for the IDEAL Condition

Production that is

- **Defect Free** (goal is zero, meets customer expectation)
- **On demand** (supplied when you want it, in right version)
- **Immediate** (now, no waiting)
- **One at a time** (single piece flow, batch size of 1)
- **Continuous flow** (no batches, queues)
- **Minimal waste** (materials, labor, energy, other resources)
- **Safely for every employee**
  - Physical, emotional, professional

Delivery of products & services should pursue the Ideal
Focus teams on Eliminating the Wastes
LEAN Tools to Improve Workflow

- Standard work
- Mistake proofing
- Batch size reduction
- Level load
- Work simplification, posted job aides
- Visual displays, controls & and color coding
- White boards, Deviation Management Process, Daily Management Boards
- Kanban inventory and production signals
- “Stop the line” (Specimen labeling and acceptability rehabilitation process)
Structure the Teams
Identify the Defects
Survey Defects Work In-Process

Poor quality of service or product that makes you:

- Stop your work
- Reject it
- Return it to sender
- Delay your work to fix it yourself
- Not pleased, could be better

= variation = bad
= poor quality
Defect Board- Make Defects & Resolution Visible

- Histology Core lab weekly Quality Huddle
- Lab meets to review past week’s defects
- Defects are posted on white board with resolution for all to see, obtain clarification, suggestions and for all to learn from

Rework Pathway for Corrective Actions
Even More Sophisticated Daily Management Board
Simplify
Rid Un-needed Process Steps
Lean Principle- Start with Work Simplification

“Every well thought-out process is simple.”

– Henry Ford
Transition to Paperless Barcoded Workflow in AP

Process modified
Process eliminated

Accesion
Requisition
Gross
Label cassettes
Gross Dictate
Batch Tissue
Embed
Pencil label slides
Cut

Transcription
Return report + lab tags
Sign paper report
Return paper edits
Micro Dictate
Assemble
Match lab tag + paper gross
Match paper labels
Stain + coverslip

2004-5
2006-7

16 => 11 steps, 31% reduction

Accession
Label cassettes
Gross
Tissue q 15 min.
Embed
Pre label slides
Cut
Stain + coverslip

Computerized Database
Requisition

Edit + sign E-report
E-synoptic report
Assemble Distribute
Process Map 2004-5

5. Accession
   - Verify patient ID, info
   - Obtain SP # from LIS
   - Pencil write SP # on container & lab tag
   - Place many Lab Tags & containers in baggies in bucket for Gross pick up
   - Retype SP # & part into standalone cassette printer

6. Gross
   - Pencil write tissue type & cut directions on side cassette
   - Dictate clinical information
   - Dictate gross description
   - Deliver cassettes in batches to Processor
   - Deliver tapes & lab tags to Transcription

7. Transcription
   - Transcribe gross dictation
   - Deliver gross dictation to Histology
   - Transcribe microscopic dictation
   - Deliver micro dictation to Pathology
   - Transcribe corrections
   - Enter Snomed codes
   - Finalize signed reports

8. Pathology
   - Verify & dictate Pat. Info from lab tag & gross
   - Dictate DX & microscopic
   - Deliver tape to transcription
   - Edit paper report
   - Return edits to transcription
   - Sign paper report
   - Return report & lab tags to transcription

9. Histology
   - Embed large batches
   - Match master list & assemble cases
   - Pencil write all slides w/ SP # & part & level
   - Cut each cassette to protocol log sheet or penned cassette directions
   - Stain & coverslip
   - Retype SP # & part into standalone label printer
   - Reassemble slide cases by matching lab tag & dictated paper gross
   - Match & stick paper labels to pencil labeled slides
   - Verify w/ gross & lab tags, assemble on trays & distribute to pathologists

35 = number of steps
Process Map 2009

Accession
- Verify patient ID, info
- Obtain SP # from LIS
- Assign part type to ea. container tied to cut protocol & bill code
- Enter all clinical information
- Print & affix barcode lab tag label
- Print & affix barcode container label
- Collate barcode etched cassettes w/ container
- Place barcoded lab tag, containers, cassettes in work tray
- Image barcoded lab tag into LIS

Gross
- Open Case in LIS by lab tag barcode
- Verify cassette ID
- Enter gross -2 numbers- into LIS template
- Deliver cassettes in q 15 min. to Processor

Transcription
- 100%

Histology
- Embed small batches
- Match master list & assemble cases
- Print Stainershield labels for ea. cassette by barcode
- Cut each cassette to slide label directions
- Stain & coverslip
- Verify in LIS, assemble labeled slides on trays & distribute to pathologists

Pathology
- Open case in LIS by slide barcode
- Use LIS synoptic or Quiktext or type DX
- Electronic Sign-out

- 50%

29% reduction overall steps

24 = number of steps

31% reduction overall

© 2014 Henry Ford Health System, Pathology and Laboratory Medicine
Simplify = Safer
Safer Work Simplification Redesign

3 FTE Transcription

1.4 FTE Manual labeling

1.3 FTE Mis-ID corrections
Standardize Activities, Connections & Pathways
Key Lean Process Changes 2004-2008

- Organized workflow, visual standard work, priority specimen streams
Key Lean Process Changes 2004-2008

- Laboratory structural redesign, work cell design & standardization

- Linear flow
- U-shaped individual workcells
Standard Work
Standard Work

Posted at work stations

- Written
- Visual
- Sequential
- Agreed
This case is submitted in 3 specimen containers consisting of:
part A - sigmoid colon biopsy,  
part B - transverse colon biopsy and  
part C - stomach biopsy with standing preorder for Helicobacter pylori immunostain.

Protocol driven information is reflected in the slide labels dictating 2 levels cut for each part.

The stomach biopsy protocol, part C, calls for an additional 2 blanks slides to be cut, one for the immunostain & a 4th left unstained.
Workplace Design Follows Standardization
Gross Lab Process Map - January 2007

1 year

Volume 45,000

Countermeasure STATE #2

Histology

Transcription

Sort Station

Color Coded Buckets

Specimen Tracking

Specimen Rehab

To Gross Lab

Accession #1

Accession

Scanner

Cassette Printer

Accesion #2

PC

Scanner

Cassette Printer

Cutting Stations

Storage

Cutting Station 2

Computers

Specimen Buckets

Cassette Printers

Cutting Station 4

Delays

1 year

Volume 45,000
Designing Pull
Designing Pull for Histology Bottleneck

Time delay waiting for stainer rack to fill

Cut slides → Stainer

- Reduce Batch Size from Cutter to Stainer
  - Goal: Level throughput
  - Rate limiting step: Stainer capacity = 60 slides every 20 mins.
  - Set auditory timer to signal pull of cut slides
  - To stainer every 20 minutes, regardless batch
  - Measure TAT from slide delivery to sign-out
  - End outcome measure = influence on Pathologist signout (global goal)
### SP Major Processes

<table>
<thead>
<tr>
<th>Processes</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopsy/Label</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accession</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tissue Gross Exam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staining/Cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Collation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microscopic Exam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report Sign-out</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Histology - Internal Specimen Pull Report TAT Outcome  March 2006

**Current:** No time schedule for hand-off, wait for full rack of 60 slides

**Change:** Pull biopsies, via auditory timer, whenever cut slides are ready q 20 mins from Cutting to Staining stations (run rate 60 per run, q 20 mins)

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th></th>
<th>Post</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=</td>
<td>327</td>
<td></td>
<td>N=</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>Signout Time</td>
<td>#</td>
<td>cases</td>
<td>% by hrs</td>
<td>Cum %</td>
<td>#</td>
<td>cases</td>
</tr>
<tr>
<td>1 hour</td>
<td>66</td>
<td>20</td>
<td>1 hour</td>
<td>42</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2 hrs</td>
<td>88</td>
<td>27</td>
<td>2 hrs</td>
<td>29</td>
<td>17</td>
<td>42</td>
</tr>
<tr>
<td>3 hrs</td>
<td>24</td>
<td>7</td>
<td>3 hrs</td>
<td>23</td>
<td>14</td>
<td>56</td>
</tr>
<tr>
<td>4 hrs</td>
<td>20</td>
<td>6</td>
<td>4 hrs</td>
<td>23</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>5 hrs</td>
<td>27</td>
<td>8</td>
<td>5 hrs</td>
<td>5</td>
<td>3</td>
<td>73</td>
</tr>
<tr>
<td>6 hrs</td>
<td>11</td>
<td>4</td>
<td>6 hrs</td>
<td>2</td>
<td>1</td>
<td>74</td>
</tr>
<tr>
<td>7 hrs</td>
<td>6</td>
<td>2</td>
<td>7 hrs</td>
<td>3</td>
<td>2</td>
<td>76</td>
</tr>
<tr>
<td>8 hrs</td>
<td>15</td>
<td>5</td>
<td>8 hrs</td>
<td>18</td>
<td>10</td>
<td>86</td>
</tr>
<tr>
<td>9 hrs</td>
<td>5</td>
<td>2</td>
<td>9 hrs</td>
<td>11</td>
<td>7</td>
<td>93</td>
</tr>
</tbody>
</table>

**Improvement:** 12%
Production Kanbans
Production Kanban Cards - Visual Aids

- **Decal placeholder card**
  - To alert tech that block from case will be missing at cutting

- **Re-embed card**
  - Alerts embedder why block is melting on embedding center;
  - Has tech’s name so it can be returned for cutting

- **Instrument status card**
  - Alerts tech that solutions are not changed yet
Inventory Kanbans
Reorder Kanbans for Inventory
Continuous Flow
Lean Operational Efficiency

• Continuous flow goal
  – **Centralized production** for Accession, Gross, Histology, all Stains and Slide disbursement

• Operational challenges

  **Work simplification and mistake-proofing**
  – **Original condition**- Barcoded operation with transcription-less & paper-less gross, histology and signout
  – **Challenge**- same-day metrics of successful production and defect resolution between hospitals

  **Load leveling**
  – **Original condition**- 1 histology shift
  – **Challenge**- Match courier with specimen availability and workers with volumes of work around the clock

  **Batch size reduction**
  – **Original condition**- overnight large specimen batch processors, same-day rapid cycle processing of small biopsies only since 2004
  – **Challenge**- rapid cycle processing of large specimens & biopsies
Lean = Minimal Batch Sizes & No Waiting
Common Challenges

Key Problems

– Core AP Lab operations
  • Specimen accession, gross exam, histology, IHC, molecular studies
  • Serving 4 hospitals up to 30 miles away
  • Specimen delivery efficiency
  • Production efficiency
  • Timeliness of slide production & return delivery
– Large specimen resections timely triage to Tumor Board presentations at 4 hospitals
In Search of a Batch

“All this waste adds up quickly. Here’s where your bonus went!”
7 AM SP Core Lab- Accession & Gross

To be accessioned same day arrival

Accessioned previous evening

Gross from previous evening
7 AM SP Core Lab - Histology

To be embedded

Cutting, 3 of 15 stations

1 2 3

Blocks to be cut

Slides to be stained

Cases delivered
4 PM SP Core Lab- Level Load, Pull

- courier
- "pull"
- sort
- accession

- Case triage station
- 3 of 6 stations working
- Outbound hospital slides
Promoting Technology
SP Bottlenecks & Challenges

Comm Hosp 1 → Courier
Comm Hosp 2 → Courier
Comm Hosp 3 → Courier
Tertiary Hosp → Walk
Outreach → Courier
Regional Clinics 30 → Courier

Accession Core → Gross 1 → Histology Core → Gross 2 → Gross 3 → Gross 4 → Gross 5 → Gross 6

Courier → Comm Path 1
Courier → Comm Path 2
Courier → Comm Path 3

LIS → EMR
Core Path → Walk

© 2014 Henry Ford Health System, Pathology and Laboratory Medicine
Continuous Flow Promoted by Technology

Small Batches, Rapid Cycle Times Promote Flow

Rapid Cycle, Microwave Processors

Courier Deliveries

Accession

Gross Exam

Gross Exam

Embed Cut Stain

Deliver Slides

Report Signout

Deliver Slides

Report Signout
MoTown Motion- Continuous Flow

Bergamo Boulevard

Woodward Avenue
## Histology Processing Flow

<table>
<thead>
<tr>
<th>Processor Finish Time</th>
<th>Conventional Overnight Medium</th>
<th>Conventional Overnight Large 1</th>
<th>Conventional Overnight Large 2</th>
<th>Conventional Overnight Breast</th>
<th>Conventional Overnight Prostate</th>
<th>Conventional Midday Medium</th>
<th>Microwave Biopsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>4am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycle Time 10-12 hrs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycle Time 4 hrs</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycle Time 1.5 hrs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycle Time</td>
<td></td>
</tr>
<tr>
<td>12am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conventional**

Overnight processing
Large & Medium & Derm

**Microwave**

Same Day processing
Biopsies from previous day and early same day Biopsies in mornings except Prostate and Breast

Before
### Histology Processing Flow

<table>
<thead>
<tr>
<th>Processor Finish Time</th>
<th>Convntal Overnight Cell Block</th>
<th>Convntal Overnight Large 1</th>
<th>Convntal Overnight Breast</th>
<th>Convntal Overnight Large 2</th>
<th>Convntal Midday Large</th>
<th>Microwave Large 1</th>
<th>Microwave Large 2</th>
<th>Microwave Macroblock Prostate 1</th>
<th>Microwave Macroblock Prostate 2</th>
<th>Microwave Biopsy 1</th>
<th>Microwave Biopsy 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cycle Time**

- **Convntal Overnight**
  - **Cell Block**: 10 hrs
  - **Large 1**: 7 hrs
  - **Breast**: 10 hrs
  - **Large 2**: 5 hrs
- **Convntal Midday**
  - **Large**: 1.5 hrs
- **Microwave**
  - **Large 1**: 5 hrs
  - **Large 2**: 7 hrs
  - **Macroblock Prostate 1**: 5 hrs
  - **Macroblock Prostate 2**: 7 hrs
  - **Biopsy 1**: 5 hrs
  - **Biopsy 2**: 7 hrs

*After*
“Your methods are formed by what you are trying to do; they do not determine your purpose. To my mind it is starting wrong to put methods ahead of purpose.”

– Henry Ford
Creating Flow = Faster
“Time waste differs from material waste in that there can be no salvage. The easiest of all wastes, and the hardest to correct, is the waste of time, because wasted time does not litter the floor like wasted material.”

– Henry Ford
LEAN LESSON

People solving problems continuously

Don’t Be Overwhelmed

“Nothing is particularly hard if you divide it into small jobs.”

– Henry Ford