AUTOMATED HEMATOLOGY IN THE CLINICAL LAB

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Objectives of Automation

- Increase efficiency; streamline workflow
- Increase productivity
- Increase test volumes with no additional FTEs
- Decrease turnaround time; improve service
- Decrease costs
Hematology Analyzer System
Automation Objectives

- Further automate body fluid cell count analysis
- Further automate differentials
- Implement middleware as link to LIS instead of separate instrument LIS interfaces. GH lab will also link to YH middleware.
- Add a return line and tube sorter for repeats of critical results, certain instrument flags, & delta check values

YH Hematology Automation

- First HST line installed March 1998 (2 SE-9500s, SP-100) and stand-alone R-2000. Reduction of 2 FTEs/attrition.
- Used Ves-Matic 20 automated sed rate analyzer during this time.
- Transitioned to a new HST line (2 XE-2100s, SP-1000, and InteRRliner module (automated sed rate analysis using StaRRsed Compact analyzer) in January 2006.

YH Hematology Automation

- In July, 2012, implemented new Sysmex HST line (2 XE-5000s, 1 SP-1000/ slide maker/stainer, TS-500 (tube sorter/archiver), conveyor system with return line.
- Implemented WAM (work area manager) middleware; LIS is Cerner Millenium
- Implemented CellaVision (automated digital cell morphology)
- 3 WAM/CellaVision workstations plus CellaVision computer
Sysmex HST-N Automation Line

YH Hematology Testing

- Testing profiles: CBC (includes diff), WCBC (10 parameters, no diff); Reticulocyte Count, Immature Platelet Fraction (IPF)
- Automated body fluid analysis: serous fluids & CSF
- Lamellar body testing on amniotic fluid
- Testing of specimens for donor center, including platelet-rich plasma
- Automated sed rate analysis

YH Hematology Statistics

- Annual volume of blood counts: 313,579
- Annual volume of retic counts: 3520
- Annual volume of sed rates: 19,650
- Annual volume of body fluid cell counts: 2100
- Total FTEs: 5-6 FTE in Heme/Coag/Urines on 1st & 2nd shift
- 65% of volume is outpatient
- Annual statistical growth: 3%
History of Processes
In Hematology Lab

- Eliminated reporting of band counts in 1985; began reporting of absolute differential counts at that time.
- Prior to WAM, instrument flagging sent by computer interface. Visible to tech at differential and instrument stations. Smear scans or manual diffs done in LIS. Autoverification was performed in LIS. Used Sysmex LASC to determine if autoverification occurred.
- Paperless system

Sysmex XE Technology

- Fluorescent flow cytometry technology
- 7 part differential (including IG and NRBC)
- Fluorescent NRBC with automated WBC correction

Sysmex XE Technology

- Reticulocyte analysis: Retic %, Retic #, Immature Reticulocyte Fraction (IRF), and Reticulated Hemoglobin (RET-He)
- Advanced clinical information: Optical Platelet, Immature Platelet Fraction (IPF)
- Instrument and operator-defined flagging
Current Processes in Hematology Lab

- Reportable IG parameter (IG#/IG%)
- NRBC quantitation; automatic WBC correction
- Reduced review rate for differentials with advanced cell identification technology & improved flagging of abnormal samples

Current Processes in Hematology Lab

- Reticulocyte analysis available on same analyzer (Gold Standard of reticulocyte analysis)
- Fast throughput XE-5000: 150 samples/hr
- Increased WBC & PLT linearity
- Automated body fluid analysis using separate body fluid channel

SP-100i Slide Maker/Stainer
SP-1000i Slide Maker/Stainer

- Use 2 different colored slides: 1 color for routine samples & 1 color for priorities
- Use 3 lines of patient demographics on slides and 2-dimensional barcode
- Can prepare smear from microtainer sample
- Consistent smear quality
- Only prepares smear is needed

TS-500 (Tube Sorter/Archiver)

- Rapid pre- and post-analytical sorting and archiving of lavender-top tubes
- Automatically routes samples for re-run/reflex testing based on WAM rules to the return line
- Manages samples on & off the Sysmex HST automation line
- Sorting customized based on lab’s needs
YH TS-500 Sorting Bed Layout

- TS Barcode error
- Error
- Time Out
- Heme Hld
- SP Heme
- Sendout
- Chem
- A1C

Sysmex WAM
Decision Support Software

- Middleware software that sits between LIS & hematology analyzers or automation.
- Patient orders and demographics come to WAM from LIS but WAM manages the analyzers, smears, manual diffs, specimens including tube sorting/archiving, reflex/re-runs, and results.
- When WAM determines that no additional steps or testing is required, based on configured rules, results are sent to the LIS as final, validated results. In addition, WAM can send the analyzer ID, date and time, tech ID if manually reviewed, and external reportable comments.
- 2 year data storage online in real time; storage of analyzer results, graphics, flags, & diffs performed in WAM in single database.
Sysmex WAM Rules

- Rules on the Order Level
  - Location, Unit, Requestor, Age, Sex, Priority

- Rules on the Result Level
  - Present, outside/inside range, coded comment, instrument flags e.g. hold test results for review if certain flags or instrument function errors
  - Check previous results/orders-% or absolute
  - Check result/absence/presence of another parameter

 Sysmex WAM Rules

- Rules for reruns
  - First run, all runs, group/single tests for runs
  - Specimen requiring a rerun automatically goes to the return line from the tube sorter and re-analyzed. Both sets of results are displayed in WAM after rerun. e.g. rerun for optical platelet

- Action Rules
  - Rules to create comments, operator alerts, add/delete tests e.g. add blood smear, add manual diff

 Sysmex WAM Rules

- Create rules for critical results & calculations, such as absolute differential results
- Create rules for autoverification & handling of CellaVision results
- 122 rules are defined for York Hospital
- Rules provide standardization of processes across shifts
Additional WAM functions

- Manual differentials
- Result & RBC morphology comments
- Critical call comments
- Internal specimen comments for technologists
- Specimen tracking/specimen archived locations
- Continue to process specimens during computer downtime

SYSMEX WAM MANAGEMENT REPORTS

- Count statistics report
- Turnaround time report
- Rules statistics report
- Results statistics report
CellaVision DM96
Automated Digital Cell Morphology

- Performs differentials on blood & body fluid smears with automatic identification of WBCs utilizing a neural network of cell images from a reference library
- Pre-characterizes RBC morphology & platelet estimation on blood smears
- Permanently stores images of each patient
CellaVision DM96

- Continuous feed of bar-coded cassettes holding 12 slides per cassette
- Slides can be prepared manually or from automated slide maker/stainer.
- Peripheral blood & body fluid slides processed.
- Walk-away processing of 35-60 slides/hr.

CellaVision DM96

- Windows XP operating system
- Remote review stations
- Large database to archive results
- Bi-directional LIS support, ASTM
- Remotely share cell images with pathologists and oncologists
- Competency assessment software available for technologists or used stored images for training or educational purposes.

CellaVision DM96

- Pre-classifies 18 WBC cell classes, 6 RBC morphology characterizations, & non-WBCs, such as NRBCs, smudge cells
- Cells grouped, sorted, & displayed for tech on a full screen.
- Click on cells to magnify & see details & to move images.
- WBC, RBC, and morphology comments can be defined
- CBC results/flags visible for fast confirmation of diffs.
Hematology Automation Benefits

- Potential to increase workload by at least 15% without the need for additional FTEs
- Automation of previous manual processes: differentials on blood & body fluid smears and further automation of body fluid analysis
- More flexibility with the use of middleware
- Reduction of turnaround time for CBCs & body fluid analysis; improved patient service
- Continue to process samples when LIS is down with WAM middleware

Hematology Automation Benefits

- Reduction in number of differentials by 600 slides/week: 31,200/year
- Slide reduction supply savings: $1872/year
- Increased productivity with Cellavision:
  - Fast confirmation of auto-diff.
  - Cell location easier in leukopenic samples
  - Less time finding/transporting slides
Operational Efficiencies

- Fewer tubes & tube touches
- Automatic sample management: hands-free repeat/reflex analysis using WAM rules and conveyor return line; sample routing/tracking with the TS-500 Tube Sorter
- In-lab receipt of all lavender-top tubes on automation line: hematology and reference lab testing

Operational Efficiencies

- Application of user defined & manufacturer’s defined intelligent automation rules via Sysmex WAM middleware
- Efficiencies of labor by eliminating manual result review & standardizing data review by technologists
- Promotes LEAN
  - Reduces process waste
  - Single piece sample & data flow; automated decision logic
### Operational Efficiencies

- Reduction in the number of manual diffs performed from 20-25% prior to WAM/CellaVision to 8-9%
- Autoverification rates increased from ~50% to ~97.5%
- Samples not autoverified are delta checks, critical results, samples with certain instrument flagging

### Operational Efficiencies

- Majority of body fluid analysis is automated; eliminates manual cell counts requiring a minimum of 20 minutes vs. 40 seconds for an automated count
- Decreased biohazard exposure with automated body fluid analysis & automated reflex testing for CBCs

### Future Addition to the HST-N Line

- **VARIANT™ II TURBO Link Hgb A1C Analyzer** will be added to the Sysmex Hematology HST-N Automation Line.
- The automated sedimentation rate analyzer currently on the Hematology Automation Line will be removed due to space constraints in the Hematology Department to allow the addition of the Hgb A1C Analyzer. A benchtop automated sed rate analyzer will be purchased.
Benefits of Hgb A1C Analyzer on HST-N Line

- Eliminates manual delivery to Referral Dept.
- Eliminates scanning each barcoded specimen to a packing list for reference lab by Referral Dept., packaging of samples, & courier delivery to the reference lab
- Helps with blood conservation requiring only a single lavender top tube for hematology and Hgb A1C analysis
- Reduction in turnaround time for results from within 24 hours to on-demand results 24/7
- Increased statistics & revenue for Core Lab

Thank You
Questions?