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ALTOSOFT DASHBOARD: REAL-TIME MONITORING OF RESPIRATORY ILLNESS DURING FLU SEASON.

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ABSTRACT

INTRODUCTION: The clinical laboratory often functions as the gatekeeper of epidemiological data for respiratory virus (RV) infections in order to help support clinical decision making during the RV season; however, most organizations base surveillance on retrospective data. To improve access to actionable data, we aimed to convert excel-based retrospective surveillance to a real-time monitoring system, document the epidemiology of RVs, and follow their associated workflow. Real-time data support decisions for employee health furloughs, infection prevention cohorting practices, antiviral and antimicrobial stewardship, staffing, and quality assurance.

METHODS: Geisinger Medical Laboratories is an eight hospital integrated health service organization, serving >2.6 million residents throughout 44 counties in Pennsylvania. Between Aug 2013 and Feb 2014, molecular RV results were extracted from the Sunquest laboratory information system (ver. 7.1) and imported into the Altosoft software (ver. 4.3). Altosoft dashboards were created to display data via graphic interfaces in near real-time and filter data according to viewer preferences so that baseline data could be collected during the 2014 RV season. Productivity metrics such as turnaround time (TAT), test volumes by day and time, and workload performed per technologist were monitored. Traditional and molecular methods approved by system leadership as part of a reflex testing algorithm were used. Inpatients and outpatients with high risk factors were tested with the FilmArray Respiratory Viral Panel (BioFire Diagnostics; RVPCR). Outpatients in low-risk groups were tested with Simplexa Flu A/B & RSV (Focus Diagnostics; PCRABR).

RESULTS: Interactive filters allowed data to be displayed by virus, hospital location, resulting laboratory, resulting technologist, time received, time reported, and test code. The first influenza (flu) A of the season occurred on Nov 10th and prevalence increased through 2014, weeks 4-6; mainly H1N1 2009. Overall, peak testing and incidence of positive results were observed in Jan and early Feb; total n= 2803 and 1580, respectively. In Feb, the number of tests performed decreased by 44%, but the prevalence of flu A and RSV remained stable, suggesting appropriate test utilization even after RV peak. The average TAT (received to result) for RVPCR was 4.3 hr (3.7-4.8 hr). Workload data demonstrated increased test volumes during 4PM until midnight. Productivity metrics demonstrated that a small proportion of technologists performed greater than 60% of the test volume, indicating increased risk for ergonomic injury.

CONCLUSIONS: To our knowledge, this is the first report of real-time RV data analytics in any U.S. healthcare system and data provided useful associations to better prepare for upcoming respiratory seasons. Altosoft provides simple solutions for data visualization and can be applied in a variety of ways to any section of the laboratory as a means to identify targets for quality improvement. This tool helps manage performance benchmark standards, as well as epidemiological data. Real-time monitoring serves to better define seasonal onset of virus groups in local communities and alerts clinicians to the actual start of the influenza season, with aims to improve utilization of antiviral therapy. Together with laboratory information technology, computer software programs can be harnessed to track laboratory performance and report epidemiological data in real-time.

HISTORICAL DATA

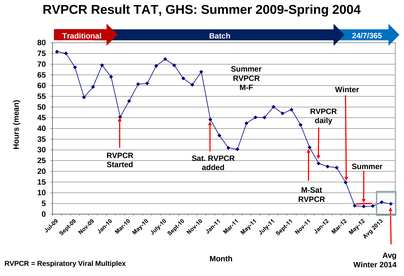

Figure 1. Timeline of respiratory pathogens testing by molecular multiplex methods. Monthly mean TAT for Geisinger Health System.

MATERIALS AND METHODS

Experimental Aim: To compare the utility of near real-time monitoring of respiratory virus testing to the typical retrospective analysis of laboratory performance data in a healthcare system using pre-admission viral testing to support infection control practices , bed management, and antimicrobial use (viruses tested in Figure 2).

Study Design: A quality improvement study was designed to monitor epidemiology and compare within-lab TAT, prevalence, and workload for RVPCR testing performed in Geisinger Medical Laboratories (couriers feed specimens to central laboratory from 43 counties in central and northeast PA.).

Dates: Jan 2013-Apr 2014.

Software: Altosoft software was used to extract near real-time data (lag = 8 hours) from Sunquest Laboratory Information System and present data in web-based dashboards (Figures 3-5) instead of weekly data dumps to providers (Figure 8). JMP ver 10. and Excel were used for data validation, statistical analysis, and specialty graphs (Figure 6-8 and Table 1).

Altosoft filters for webviews: Hospital location (HID), resulting laboratory, technologist, time collected, time received, time reported, test, organism, patient location, patient age, month, year and corresponding CDC week.

Laboratory Methods (Figure 2): FilmArray Respiratory Viral Panel (BioFire Diagnostics; RVPCR) and Simplexa Flu A/B & RSV (Focus Diagnostics; PCRABR).

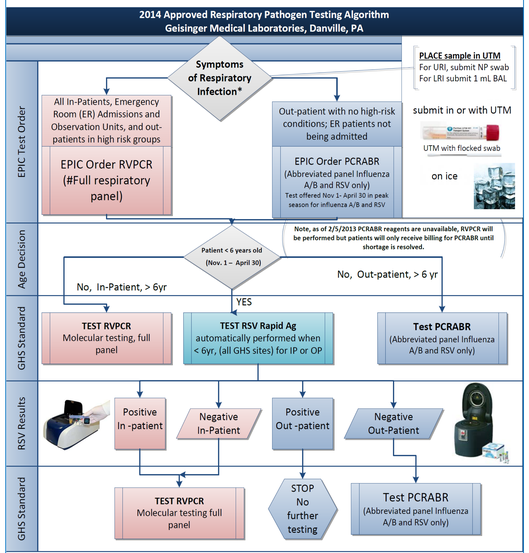

Figure 2. 2014 Approved respiratory pathogen testing algorithm for Geisinger Health System.

RESULTS

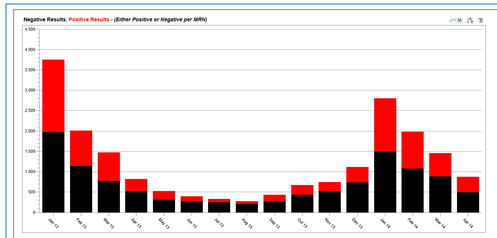

Figure 3. Positive and negative results displayed by month in Altosoft. Total resulted, negative, positive and percent positive data are reflected in table format (data not shown). Data represents all test sites (HID). *Impact: prevalence and workload.*

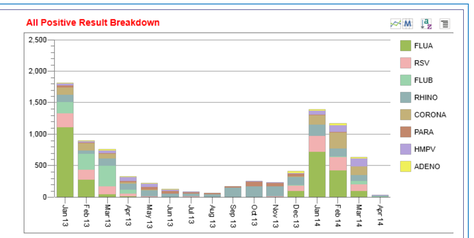

Figure 4. Positive respiratory pathogen results displayed in Altosoft. Hovering over individual virus' with mouse will display number (n) and percent positive values. *Impact: epidemiology and prevalence.*

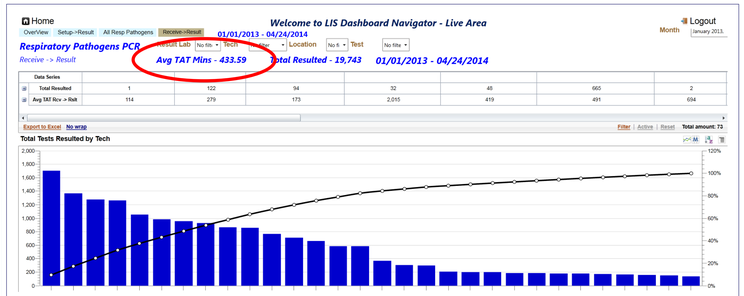

Figure 5. Screenshot view of total tests resulted by technologist. Average TAT displayed as separate result unit (minutes). Line graph displays cumulative percent workload per technologist. *Impact:* workload and potential risk for ergonomic injury.

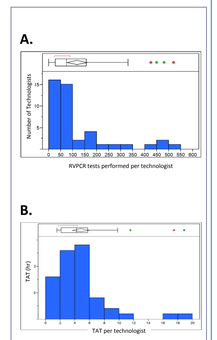

Figure 6. Number of tests performed per technologist; system-wide in 2014 (A).

TAT per technologist; system-wide in 2014 (B).

Note: Outliers per shift, blue=1st shift, green=2nd shift, red=3rd shift.

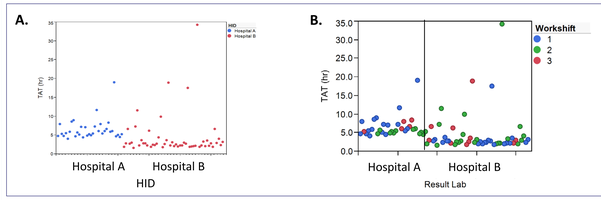

Figure 7. Distribution of TAT (received to result) by hospital for 2013 and 2014 (A). Distribution of TAT (received to result) by hospital, by workshift for 2013 and 2014 (B). Percentage of work performed per shift: 1st=24.3%, 2nd= 46.4%, 3rd= 29.3%.

Turnaround Time (TAT): Receive to Result		
System-wide	**2013**	**2014**
n	42.0	44.0
median (hr)	4.2	4.2
min (hr)	1.8	1.6
max (hr)	34.3	18.9
90th %	8.7	9.2
mean ± SEM	5.6 ± 0.9	4.8 ± 0.6
Hospital A	**2013**	**2014**
n	17.0	17.0
median (hr)	6.0	5.3
min (hr)	4.0	4.4
max (hr)	19.0	8.6
90th %	13.1	7.5
mean ± SEM	7.4 ± 0.9	5.5 ± 0.3
Hospital B	**2013**	**2014**
n	25.0	27.0
median (hr)	2.8	2.4
min (hr)	1.8	1.6
max (hr)	34.3	18.9
90th %	6.8	12.8
mean ± SEM	4.5 ± 1.3	4.3 ± 0.9

Table 1. Receive to result (TAT) statistical analysis. A Wilcoxian-Rank Sum test was performed and hospital TAT by year was found to be statistically significant: $\chi^2(1, N=86) = 18.0$, $p<0.0001$.

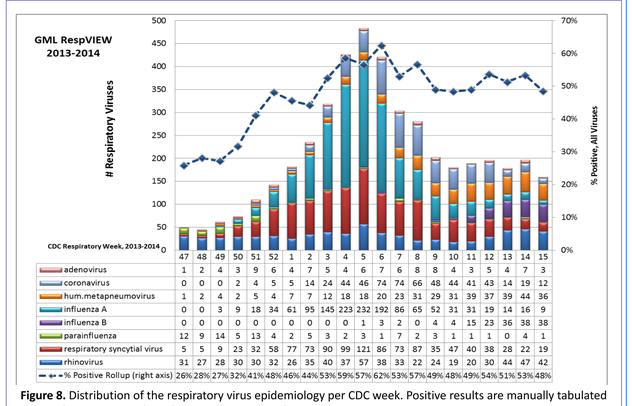

Figure 8. Distribution of the respiratory virus epidemiology per CDC week. Positive results are manually tabulated per week, retrospectively and entered into an Excel spreadsheet.

CONCLUSIONS

1. **Altosoft dashboards allow for rapid monitoring and characterization of epidemiology, positivity rate, workloads and TAT. can (Received to result time and setup to result time can be monitored by HID, shift, technologist, and ward location).**
2. **Altosoft data can be rapidly disseminated to clinical providers in 42 PA counties via web-based dashboards, improving awareness of circulating viruses from 7 days to 8 hours (95% improvement).**
3. **RVPCR significantly improved TAT from batch testing every 24 hours to a median of 4.2 hours in both 2013 and 2014 ($p<0.05$).**
4. **Despite adequate number of instruments per test volume, continuous on-site testing (hospital B compared to hospital A) significantly improved within-laboratory TAT ($p=0.0001$). Large courier drops at hospital A (reference laboratory) resulted in backups in instrument availability and thus delayed TAT with night shift specimens delayed until the next day.**
5. **Most (76%) specimens were performed on second and third shift, placing technologists at risk for ergonomic injury.**

DISCUSSION

1. **Real-time monitoring can support decisions for several departments:**
   - **clinical support/patient care**
   - **antimicrobial stewardship**
   - **infection prevention**
   - **bed management**
   - **employee health**
   - **pharmacy**
   - **supplies chain**
   - **finance**
   - **stewardship**
   - **quality assurance**
   - **Insurance (workman's comp)**
2. **Impact to care (for future analysis):**
   - **receive more timely diagnosis**
   - **reduce isolation time**
   - **reduce room wait time**
   - **reduce antimicrobials utilization**

ACKNOWLEDGEMENTS

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