IMPLEMENTATION OF AN AUTOMATED ELECTRONIC MEDICAL RECORD TOOL TO IDENTIFY PATIENTS WITH SEPSIS

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Background

- Sepsis is a frequent cause of ICU admission and a leading cause of morbidity and mortality.
- Early recognition and intervention are keys to a favorable outcome.[1]
- Harnessing the Electronic Medical Record (EMR) reduces provider and researcher burden in collecting/integrating data and will lead to improved patient outcomes.[2-5]
- Clinical trials have evaluated real-time electronic algorithms to identify patients with sepsis, prompt caregivers with text and EMR notifications, & provide recommendations.[6,7]
- The University of Tennessee Medical Center has implemented the St. John Sepsis Agent by Cerner which provides active surveillance of the EMR with up to date recommendations.[8]
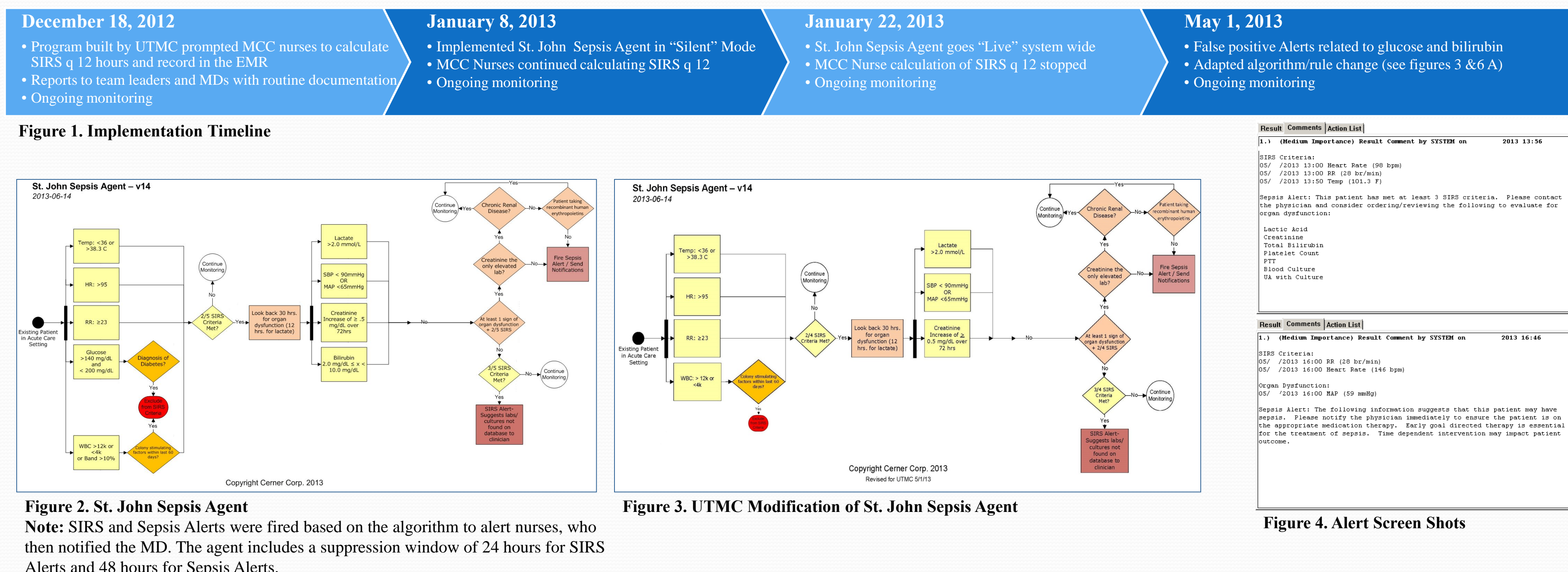
Purpose

Purpose: (1) To validate our ability to capture data from the EMR, (2) to describe implementation of an automated early warning system that notifies nurses when patients meet severe sepsis criteria, and (3) to identify Sepsis Alert patterns among patients admitted directly to the Medical Critical Care (MCC) with and without sepsis.

Hypothesis: Patients admitted with sepsis will trigger a higher number of early warning alerts.

Methods

- Retrospective IRB approved pilot study
- Electronic MCC data captured for 2 months
- Data pulled from Health Level Seven International interfaces between EMR systems and retained on the UTMC protected server.
- Groups divided electronically:
  - Group 1 (transfers in or LOS < 48h)
  - Group 2 (direct admission, known or suspected sepsis)
  - Group 3 (direct admission, no known or suspected sepsis)
- Manual review to confirm & correct classifications.
- Missing records identified for analyst.
- Standard descriptive statistics b/w gp 2 & 3 (α =0.05)
- Calculated SIRS and organ failures for these subjects who had MD Notification Alerts triggered by St. John Sepsis Agent during the implementation period.

Implementation of Early Warning System

Figure 1. Implementation Timeline

December 18, 2012
- Program built by UTMC prompted MCC nurses to calculate SIRS q 12 hours and record in the EMR
- Reports to team leaders and MDs with routine documentation
- Ongoing monitoring

January 8, 2013
- Implemented St. John Sepsis Agent in "Silent" Mode
- MCC Nurses continued calculating SIRS q 12
- Ongoing monitoring

January 22, 2013
- St. John Sepsis Agent goes "Live" system wide
- MCC Nurse calculation of SIRS q 12 stopped
- Ongoing monitoring

May 1, 2013
- False positive Alerts related to glucose and bilirubin
- Adapted algorithm/rule change (see figures 3 & 6 A)
- Ongoing monitoring

Figure 2. St. John Sepsis Agent
Note: SIRS and Sepsis Alerts were fired based on the algorithm to alert nurses, who then notified the MD. The agent includes a suppression window of 24 hours for SIRS Alerts and 48 hours for Sepsis Alerts.

Figure 3. UTMC Modification of St. John Sepsis Agent

Figure 4. Alert Screen Shots

Results

Alerts Per Day During Project Period
Alert Rule Change

Alerts Per Day of ICU Stay

Figure 6. Alerts over study period (A) and ICU stay (B).
Note: We electronically captured Alerts at the point of MD notification.

Figure 5. Study Flow Diagram
Note: All subjects were identified and placed into groups electronically, and then charts were reviewed to verify/ correct classifications. Classifications were based on (1) presence or absence of sepsis at admission using H&P diagnosis and/or visit reason indicating sepsis, suspected sepsis, or none, (2) SIRS components, (3) cultures, (4) antibiotics, (5) length of stay, and (6) direct or indirect admission.

Table 1.

	Sepsis or Suspected Sepsis (n=72)	No Sepsis or Suspected Sepsis (n=39)	p
Alerts (all)	90	58	-
Patients with alerts	38 (52.8%)	24 (61.5%)	ns
Timing range of alerts (days)	0 – 18	1-34	-
Age (years, mean)	60.8 ± 15.8	60.0 ± 15.0	ns
Male	33 (45.8%)	20 (51.3%)	ns
Caucasian	66 (91.7%)	36 (92.3%)	ns
ICU LOS (days, med, range)	4 (2-19)	3 (2-31)	ns
Survival	59 (81.9%)	33 (84.6%)	ns
Any Organ Failure*	36 (94.7%)	22 (91.6%)	ns

Note: These groups were based on status at the time of ICU admission. Further review is needed to determine sensitivity and specificity of Alerts. Consider that MD Notifications occurred for both SIRS and Sepsis Alerts, and we were unable to separate these in our analysis.
*Organ failure calculations include only patients with Alerts, n=38 vs. 24. A high percentage of those with alerts had at least one organ failure, and 21 vs. 12 had two or more organ failures, respectively.

A Positive SIRS Components
Sepsis (Gp 2) | No Sepsis (Gp 3)

B Positive Organ Failures

C SIRS

D Organ Failures

Figure 7. Calculated SIRS Components (A), Organ Failure Components (B), SIRS (C) and Organ Failure Totals (D) for each Alert for patients with and without sepsis.
Note: We were not able to electronically obtain the reason for each Alert (see Figure 4), and these calculations were based on the minimum and maximum for the day of MD Alert notifications. SIRS calculations were based on the Figure 3 algorithm. MODS calculations were based on the Figure 3 algorithm with the exceptions of renal (creatinine > 2.0), hematologic (platelet count < 100), pulmonary/ALI (P:F < 300) and hepatic (total bilirubin > 2.0) failure. Data could not be automatically retrieved on 36 Alerts, and in those cases the data was retrieved manually from the Alert screens (Figure 4). It is important to note that Alert reports include the minimum criteria necessary to generate an alert, and other positive components may be present. Calculations include all known abnormal values.

Discussion

- RR & HR were the most common causes for SIRS Alerts.
- Hypotension was the most common reason for Sepsis Alerts.
- Hypoxemia (2nd most common organ failure) is also an important component to consider when evaluating for sepsis.[1]
- We did not detect more Alerts in the group admitted directly with sepsis, possibly related to suppression rules.
- This project focused on our ability to capture records and presents a limited description of Alerts.
- We successfully retrieved most records with some limitations.
- Automated data de-identification, conversion of dates to day numbers, and retrieval of previously corrected EMR records (i.e., lab value) are limitations to overcome in future research projects using the EMR.
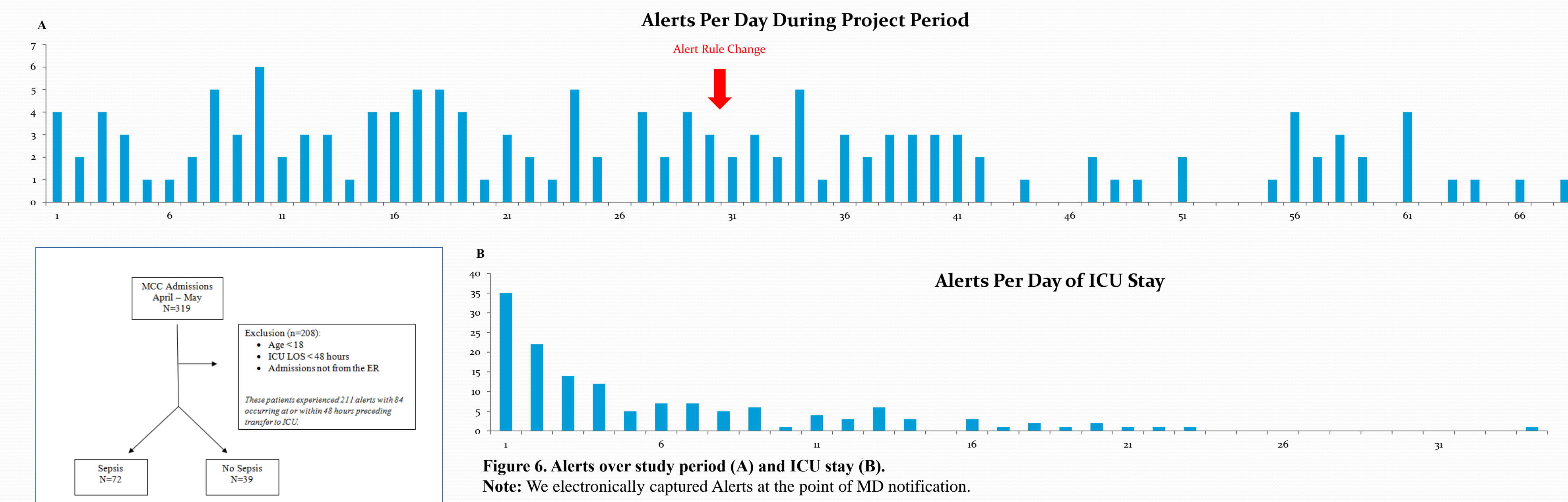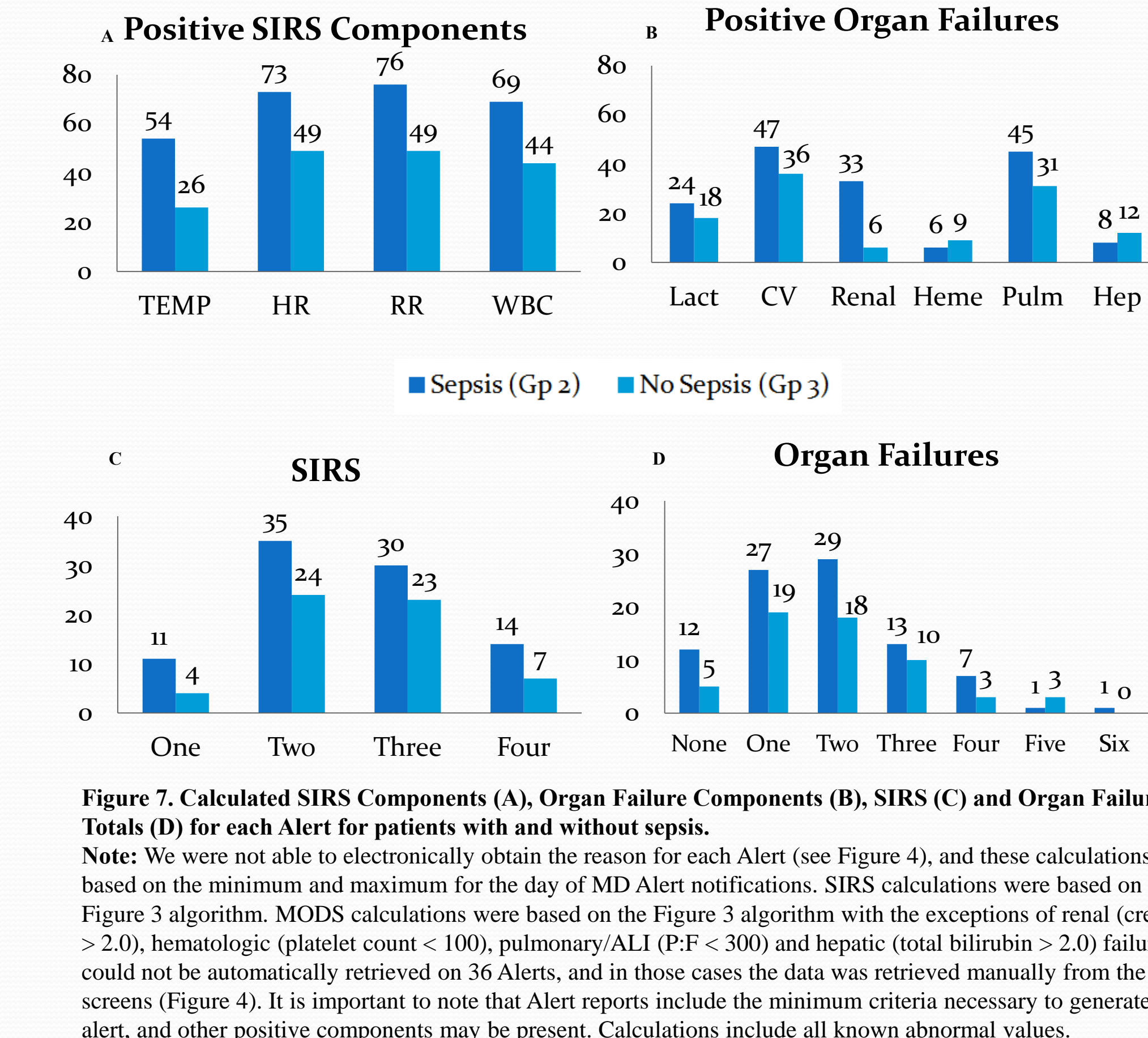
Conclusion

- Abstracting data from the EMR is a feasible method for collecting research data, and challenges identified during this project will strengthen future projects.
- Our preliminary descriptive findings were limited to a subset of patients, and future studies should include sensitivity and specificity of this innovative tool.
- Improving sepsis outcomes requires a dedicated team of professionals (from IT to all clinicians) applying best practices to meet patient centered needs.
- Nurses serve a vital role in early recognition.

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