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Comparative Analysis between the Sepsis Nurse Screening Tool and the Newly Developed Sepsis "Sniffer" Algorithm

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Background

- Sepsis affects more than 650,000 individuals in the US annually, with estimated costs at $17 billion.
- To identify sepsis early, nurses use the Nurse Screening Tool (NST), a manual querying method, to screen all patients, admitted to the hospital, to detect the two percent of the population at high-risk for sepsis.
- Nurses complete patient assessments within four hours of admission and every twelve hours thereafter, with results manually entered into the electronic medical record (EMR). Nurses also use the NST to determine changes in a patient's clinical condition that warrant action to prevent deleterious outcomes.
- Manually screening all patients for sepsis risk may not be a prudent use of nurses' time. The current NST process is very labor intensive, and may be performed too late or not at all.
- It is unknown whether an automated digital sepsis sniffer algorithm (SSA), as a by-product of the nurse's documentation and patient prognostic findings, will accurately identify patients at risk for sepsis, facilitate timely clinical decision-making, and improve patient outcomes as well as nurse workforce management.

Significance

- Hospitalizations for sepsis have more than doubled in the past decade, with 65 percent of the patients age 65 years or older.
- Mortality rates for sepsis have increased over the past decade despite the availability of evidence-based treatment guidelines.
- Sepsis recognition requires timely identification of signs and symptoms, immediate intervention, and coordination among caregivers. Early risk detection and intervention may improve outcomes and reduce subsequent mortality due to sepsis.

Objectives and Research Questions

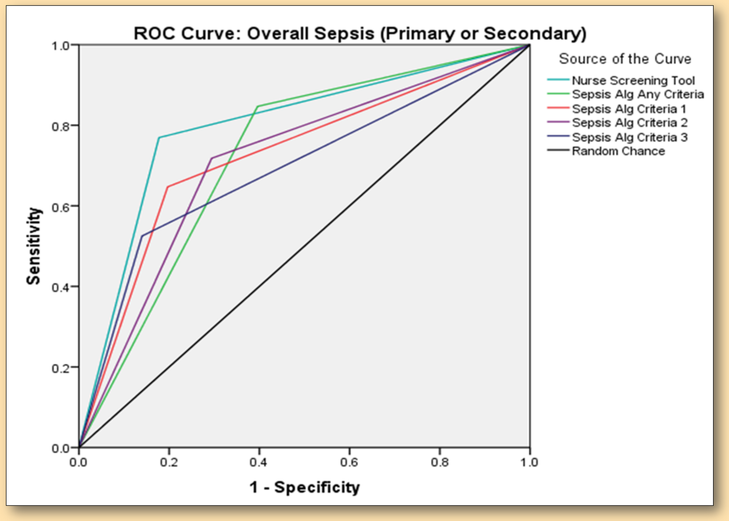
This study aimed to compare the SSA to the NST on predictive accuracy and timely identification of patients at high-risk for sepsis. Research questions included:

1. Is there a significant difference in the predictive accuracy (AUC) for sepsis risk detection between the SSA and the NST?
2. Is there a statistical and clinical difference in the average time to first detection of sepsis risk between the SSA and the NST?

Evaluation Strategy

- A descriptive design with secondary data analysis was used.
- Sepsis diagnosis coded by HIS staff, on the patient's final bill submitted for payment, was used as the sepsis standard to compare both the SSA and the NST.
- A convenience sample of records (*N*=20,959) for patients discharged, Jan 2011 through Dec 2012, with a diagnosis of sepsis was included.

Findings



Sepsis Screening Method	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Nurse Screening Tool (NST)	76.92	82.26	26.17	97.76
SSA 1	64.71	80.33	21.20	96.53
SSA 2	71.79	70.58	16.63	96.84
SSA 3	52.50	86.01	23.48	95.68
SSA Any	84.68	60.40	14.88	97.97

Overall Inpatient Sample with Sepsis ED Admission Only

Protocol	N	Mean	SD	Median	Min	Max	Median Difference	$Z_{Wilcoxon}$	Significance
Nurse Screening Tool	1006	30.18	71.01	7.56	0.08	1073.53	5.51	-16.70	<.001[1]
SSA Any		13.15	38.04	2.05	0.03	608.37			

[1]Statistically significant difference

Overall Inpatient Sample with Sepsis with ED or non-ED Admission

Protocol	N	Mean	SD	Median	Min	Max	Median Difference	$Z_{Wilcoxon}$	Significance
Nurse Screening Tool	1149	39.34	95.04	8.38	0.08	1359.25	6.00	-17.59	<.001[1]
SSA Any		16.81	53.80	2.38	0.03	956.03			

[1]Statistically significant difference

Results

- Face Validity – A panel of physicians identified clinically relevant criteria, easily interpreted by clinicians, to construct EPIC alert triggers.
- Negative predictive value (NPV = 97.97) for SSA (Any) is similar to the NST (NPV = 97.76), for overall sepsis (primary and secondary). Patients with a negative screen, using the Sepsis "Sniffer" Algorithm, are very unlikely to have sepsis documented on the final bill.
- Predictive accuracy (AUC =.725 [95% CI .714, .737] for SSA (Any) is lower than the NST (AUC = .796 [95% CI .784, .808] for overall sepsis.
- The median time to detection difference between the SSA (Any) and the NST is significant ($p \leq .05$). The median time until sepsis detection is significantly shorter (approximately 5.5 hours) for the SSA (Any) than the NST, across type of admission and type of sepsis diagnosis.

Conclusions and Implications

Early risk detection and intervention may improve outcomes and reduce subsequent mortality due to sepsis.

- The SSA may offer an alternative screening method to identify patient deterioration early in the disease process, and reduce the manual work of the NST.
- Manual data collection may be directed at a much smaller at-risk population, rather than all patients in the hospital, improving nurse workforce management.
- Embedding predictive analytics, such as the SSA, in EMRs may reduce morbidity and mortality for this vulnerable population through improved clinical decision-making.
- The project is congruent with the Institute of Medicine's focus on technology as a research priority for transforming nursing. The identification and testing of new and existing technologies, like the SSA, intended to support nurses' decision-making and care delivery will be even more important as healthcare organizations provide cost effective care, thereby enabling nurses to prioritize their work flow to enhance workforce management.

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