Early Sepsis Detection and Evaluation through Predictive Modeling

Sebastian Busto – LSSBB Project

June 2022

Table of Contents

Project Charter:

**Click the arrow to return to the Table of contents

UTSouthwestern Medical Center

Project Title:
Early Sepsis Detection and Evaluation through Predictive Modeling

Project Champion	Executive Sponsors
Sterling Overstreet, MD, FACEP	William Daniel, MD, MBA Susan Hernandez, MBA, BSN, RN

Problem Statement

- UT Southwestern (UTSW) All Sepsis Mortality Observed/Expected (O/E) Index is 1.05 (September 2019 – July 2020) placing us just below the 50th percentile rank of other academic medical centers (50th percentile is 1.22). Late identification of sepsis potentially contributes to difficult medical management and poor outcomes
- At beginning of 2021 UT Southwestern was ending a contract with a former sepsis predictive modeling tool, Wolters Kluwer. There was a need to create a modeling tool that would replace Wolters Kluwer and assist with the early identification of sepsis patients

Project Scope

In scope:

- Patients who are in one of the following unit's 12th floor (Blue, green and Orange Tower), 10th & 11th floor (Green and Orange Tower) and have a suspected source of infection and meet SIRS criteria (sepsis patients)

Out of scope:

- Patients who meet Sepsis criteria who are in the Emergency Department
- Patients who had a sepsis risk score under 10

Benefits/Business Case

- Potential financial impact with changes and/or optimization and savings according to 2017 Quality Analytics Department data analysis:
  - Decrease Sepsis case average length of stay by one day
  - Cost avoidance in Sepsis case costs of $3.2 million
- Severe sepsis and septic shock are major healthcare problems, affecting millions of people around the world each year, killing one in four (and often more), and increasing in incidence (1–5). Similar to Polytrauma, acute myocardial infarction, or stroke, the speed and appropriateness of therapy administered in the initial hours after severe sepsis develops are likely to influence outcome[i]
- Septicemia treatment resulted in an estimated $20.3 billion or 5.2 percent of the total cost for all hospitalizations and was the most expensive condition treated in the year 2011[ii]
- Sepsis outcomes affect UTSW in several ways:
  - Post-operative sepsis is calculated using the AHRQ Patient Safety Indicator software. Known as PSI 13, post-operative sepsis is one of ten safety indicators aggregated in the overall Safety Composite score. The weight of PSI 13 in the Safety Composite is 22% and negative performance in this indicator affects UTSW in Value Based Purchasing and Hospital Acquired Condition Penalty program. UTSW's performance in PSI 13 is worse than the Vizient 50th percentile
  - Sepsis bundle treatment is a required measure in core measure reporting. Known as SEP-1, this measure examines timeliness of interventions for severe sepsis and septic shock. UTSW's performance over last 12 months is 29% (July 2018–June 2019), which is below the Texas and national average of 62% and 59%, respectively (October 2018–September 2019)
  - Sepsis represents a large portion of UTSW observed deaths, where nearly 1/3 of the patients who expire have a sepsis diagnosis

Primary Metric

Definition	Goal
Sepsis Mortality Observed/Expected (O/E) • **Benchmark Data Source:** Vizient • **Comparator Group:** 2018 USNWR Honor Roll Hospitals • **Benchmark Timeframe:** 09/01/2018–06/30/2019 • **Measure Steward:** CMS: SEP-1/SWHR	• **Meets Target**: 1.00 O/E (25th percentile) • **Minimum**: 1.22 O/E (50th percentile) • **Maximum**: 0.82 O/E (10th percentile)

Dellinger RP, Levy MM, Rhodes A, et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2012. Critical Care Medicine. 2013 Feb;41(2):580-637.
National Center for Health Statistics Data Brief No. 62 June 2011. Inpatient care for septicemia or sepsis: a challenge for patients and hospitals. Retrieved on 11/14/16 at www.cdc.gov/nchs/data/databriefs/db62.pdf.
Min equals baseline FY 2020

Project Aim Statement

Implement the Epic Sepsis Predictive Model (ESPM) pilot on 7 units at CUH starting May 24 to increase the number of interventions per chart review and patient rounding hours with an end goal to decrease sepsis length of stay overserved/expected for patients in these units from a baseline of 1.17 on April 1st, 2021.

Project Timeline

Milestones	Tasks	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Marc	April	May
Define	Group consensus	■													
	RRT Sepsis Process Development	■	■												
	Standardize Patient list – loop in informatics		■												
	Select Pilot Units	■													
	Meet with Medical director & Providers of Pilot Unit		■												
	Meet with Pilot Unit Leaders/Team		■												
	Education of RRT – Process Discussions		■												
Measure	Initiate and conduct pilot (Phase 1)		■	■											
	Data Collection		■	■											
	Collect Process Feedback RRT/Med Director/Providers		■	■											
Analyze	Simulation Analysis			■	■										
	Data Review of Phase 1			■	■										
Improve	Develop EPIC / IR tools			■	■	■									
	RRT Workgroup for development of EPIC tools (Beta Testing)					■	■	■	■						
	Plan Phase II of the Pilot							■	■	■					
	Initiate and Conduct Pilot (Phase 2)									■	■				
Control	Data Analysis (Phase 2)										■	■	■		
	Control / Sustain												■	■	■

Team Members

Name	Project Role	Name	Project Role
B. Abraham	Sr. Analyst	C. Pulliam	Nursing
S. Busto	Engineer	C. Nixon	Nursing
M. Block	Sr. Project Mgr.	I. Hannah	Nursing
Y. Ma	Sr. Analyst	M. Alford	Nursing
C. Orrick	PI Coord.	J. Earnest	Nursing
S. Overstreet	Physician Lead	T. Heineman	Nursing
S. Sutton	Nursing Lead	K. Wang	Informatics
A. Muchiri	Nursing Lead	A. Carrington	Informatics
L. Nieto	Nursing		

CHAMPION SIGNATURE

DocuSigned by:
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Date: 6/30/2022

Sterling Overstreet, MD, FACEP
Quality Officer, Health System Affairs
Assistant Medical Director, Emergency Department
Assistant Professor, Department of Emergency Medicine

Methodology – DMAIC – Gantt Chart

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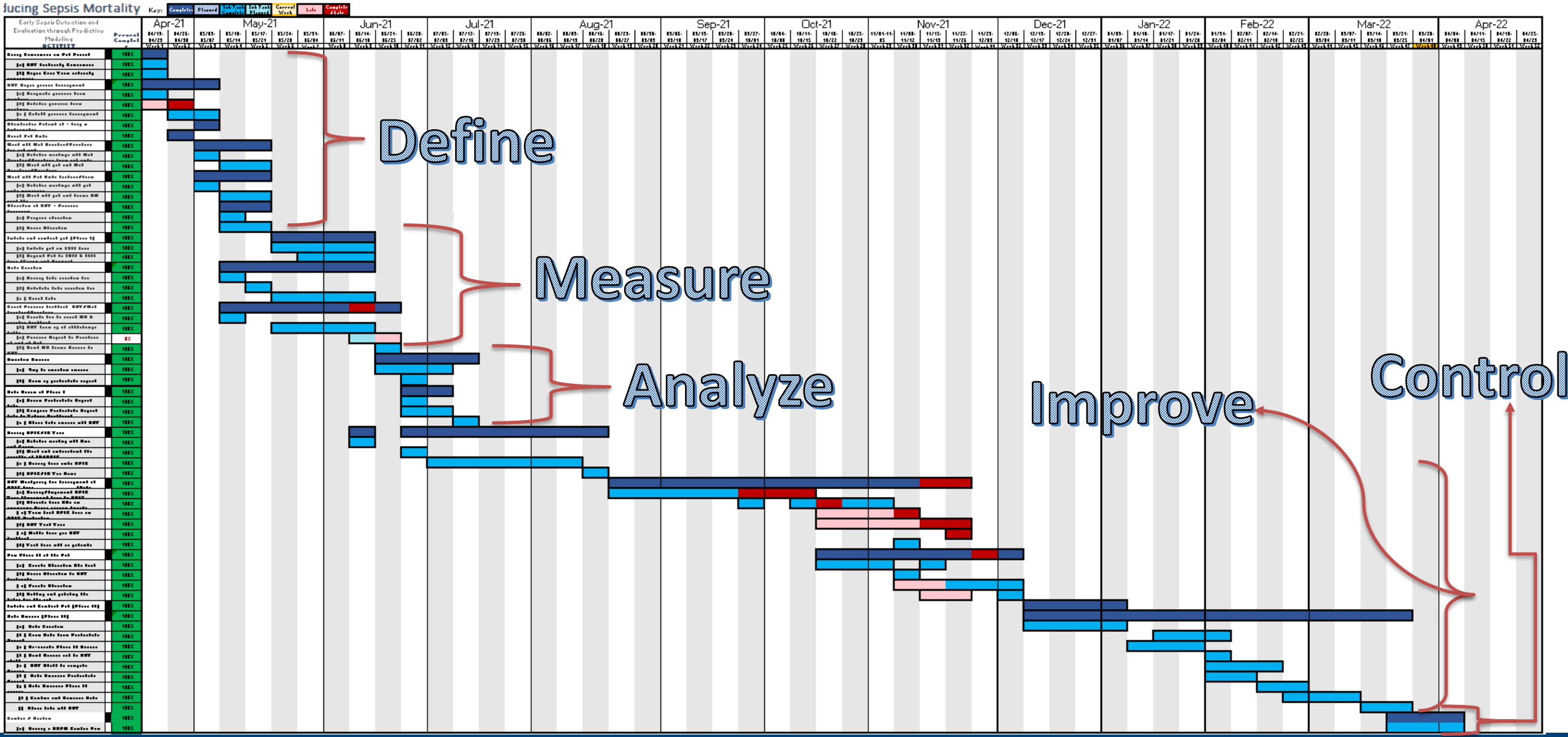

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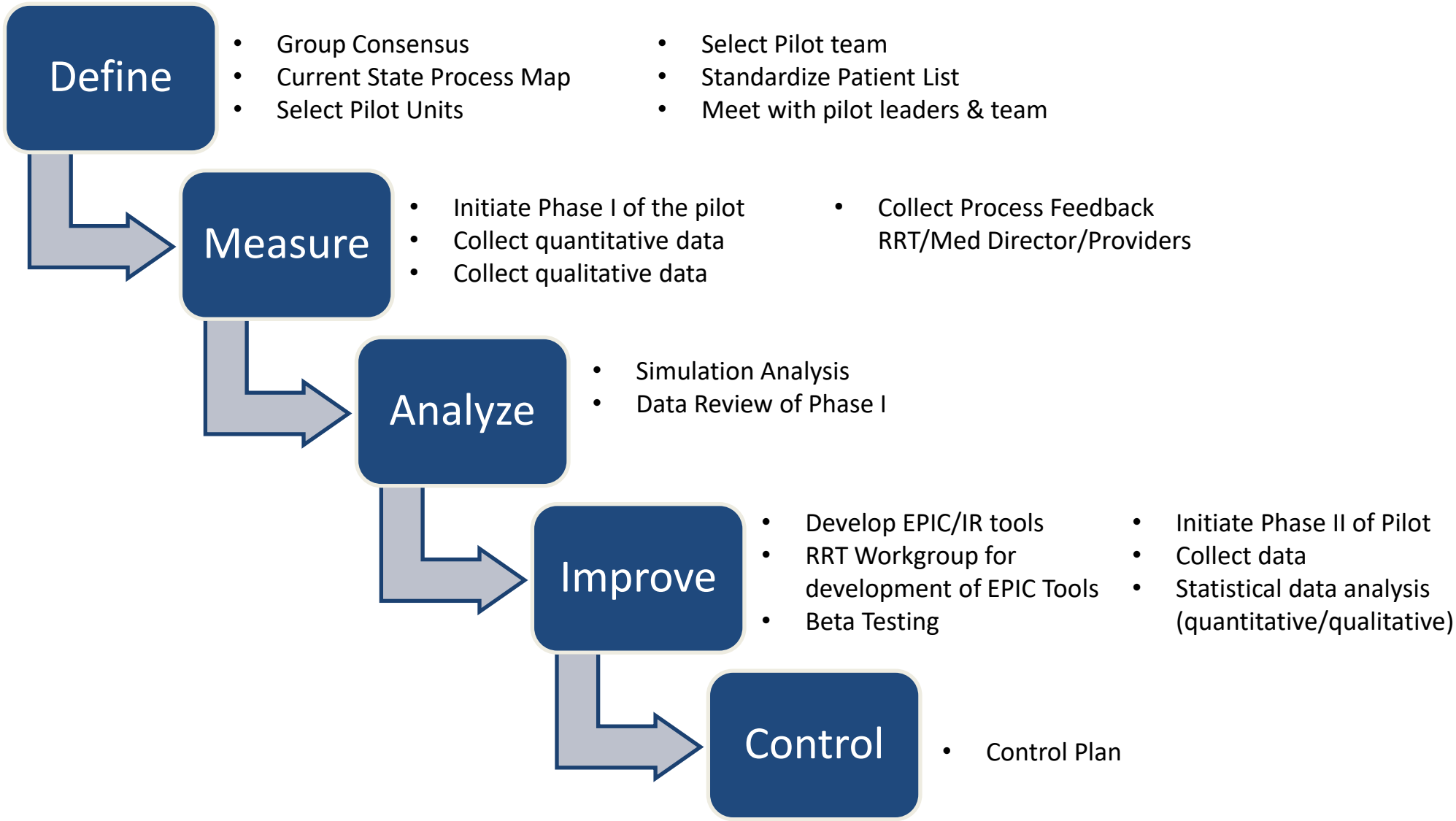
Methodology – DMAIC



**Click the arrow to return to the Table of contents

Define.

Measure.

Analyze.

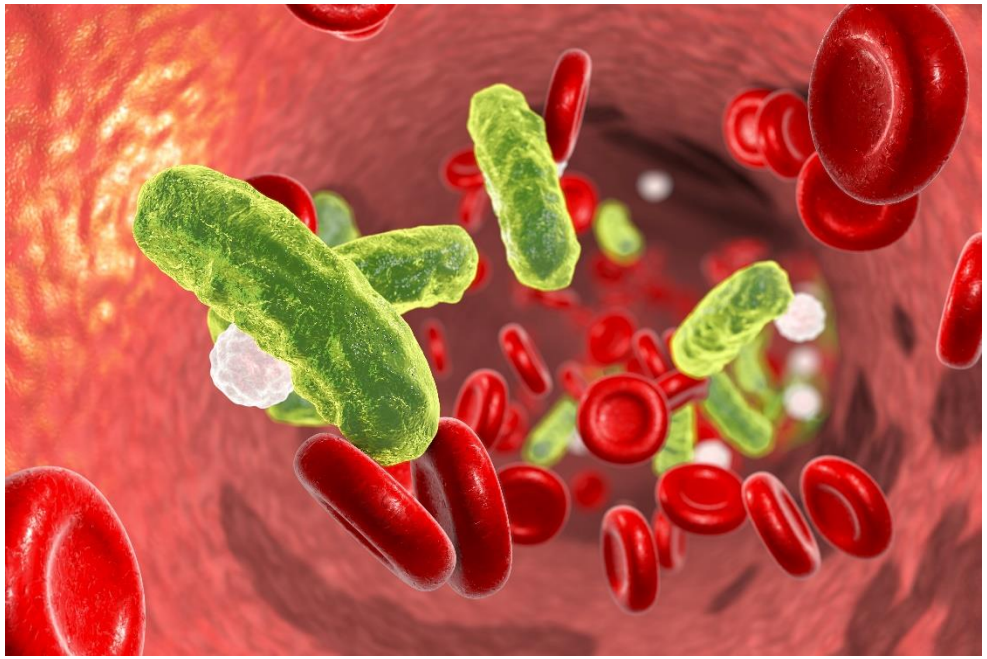
Improve.

Control.

Sepsis

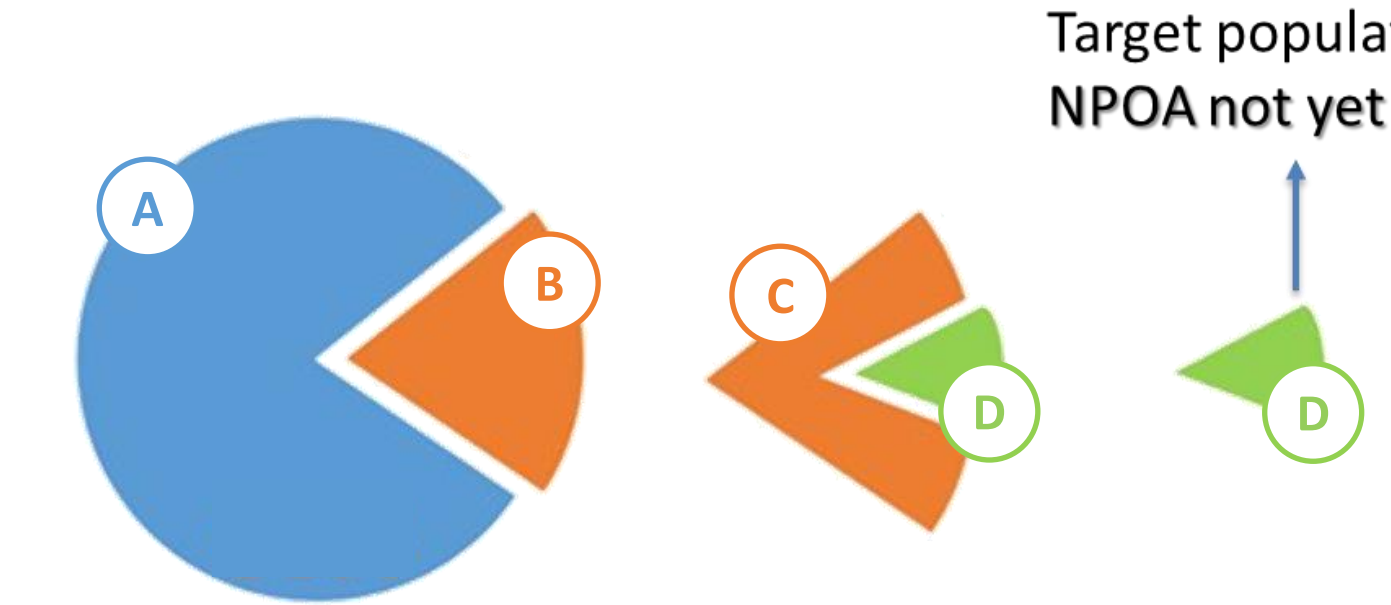
What is Sepsis?

In short, sepsis is the body's overreaction to an infection, leading to organ dysfunction and possibly death. It is a true medical emergency, and it is the sixth most common reason for hospitalization in the United States



- Without timely treatment, sepsis can rapidly cause tissue damage, organ failure and death
- About 250,000 Americans die from sepsis each year
- 1 in 3 patients who die in a hospital have sepsis
- 6th most common reason for hospitalizations in the US

Target Population



A. Sepsis Present on Arrival (POA)

B. Sepsis Not Present on Arrival (NPOA)

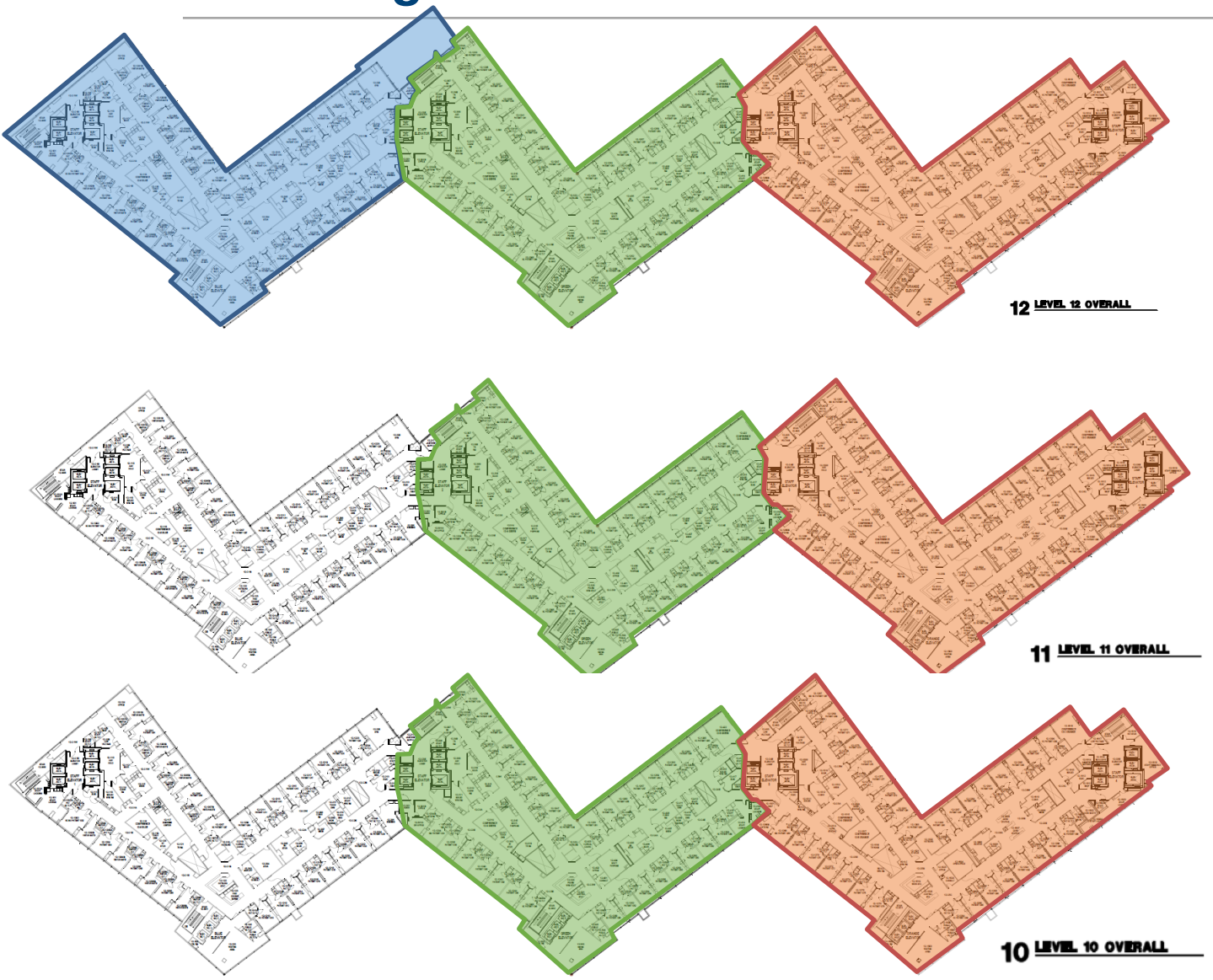
C. NPOA Treated for Sepsis

D. NPOA Not Yet Treated for Sepsis

Focus:

Even though around 80% of our sepsis patients are Present on Arrival (POA), we decided to focus on Non-Present On Arrival (NPOA) sepsis patients who have yet been treated for sepsis and that are in one of our seven pilot units. This is because these patients usually fly under the radar and are identified when it is too late

Selecting the Pilot Units



12th Floor:
- Blue Tower – Med/Surge
- Green Tower – Med/Surge
- Orange Tower – Med/Surge

11th Floor:
- Green Tower – Medical Oncology
- Orange Tower – Surgical Oncology

10th Floor:
- Green Tower – Med/Surge
- Orange Tower – Med/Surge

Why this units?

These floors were selected because based on a previous rollout of a former mode, point of care advisor (POCA), these units were higher in rule out sepsis. These were also free of the complexities of specialty care (LVAD, BMT, etc.) that made the earlier model less effective.

Selecting the Pilot Team – Rapid Response Team (RRT)

Code Blue

Code Stroke

Patient Fall

Code Sepsis

Why RRT?:

The rapid response team is a team of highly experienced nurses with critical thinking skills, they are respected communicators. The team's role is one of monitoring and identifying patients who require intervention to stabilize those who can remain outside the ICU or intervene and support the transfer of patients that will require a higher level of care. In total there are around 30 nurses and 5 per shift. They are optimally positioned to monitor and offer urgent response to those patients identified as needing sepsis intervention.

Pulling the Team Together:

Analyst

Nursing

System Engineer

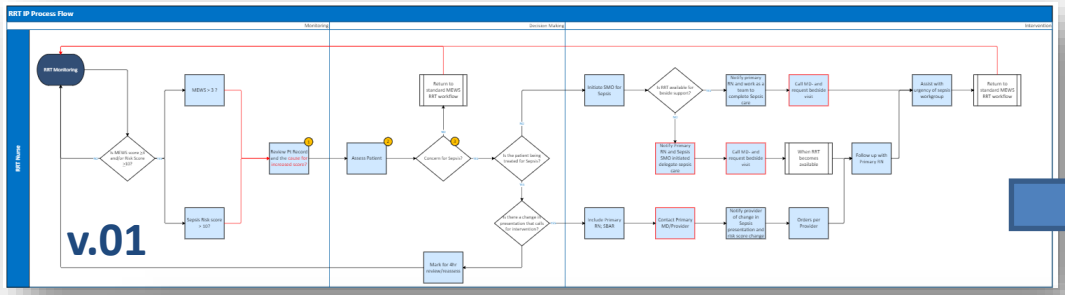
Physician

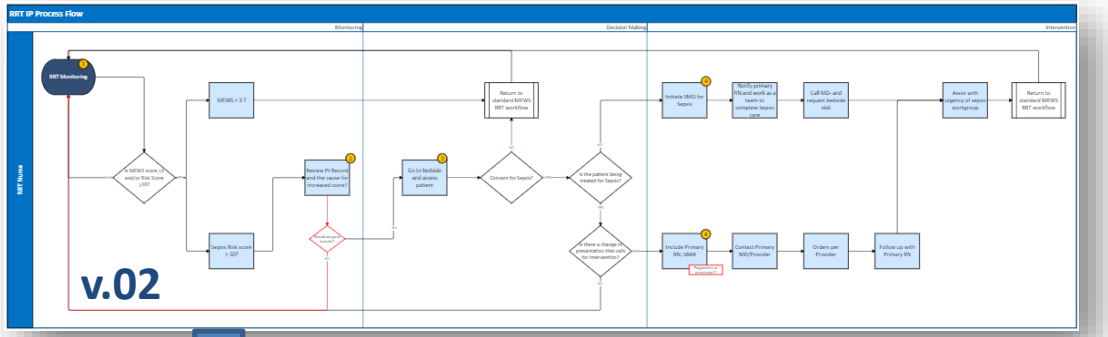
Project Manager

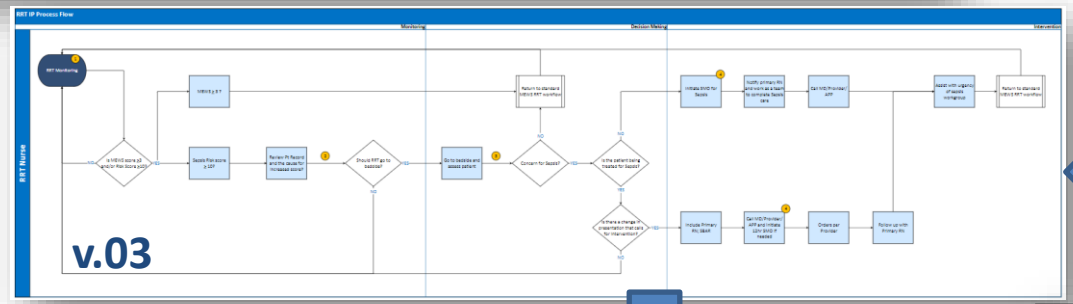
EMR BUILD TEAM

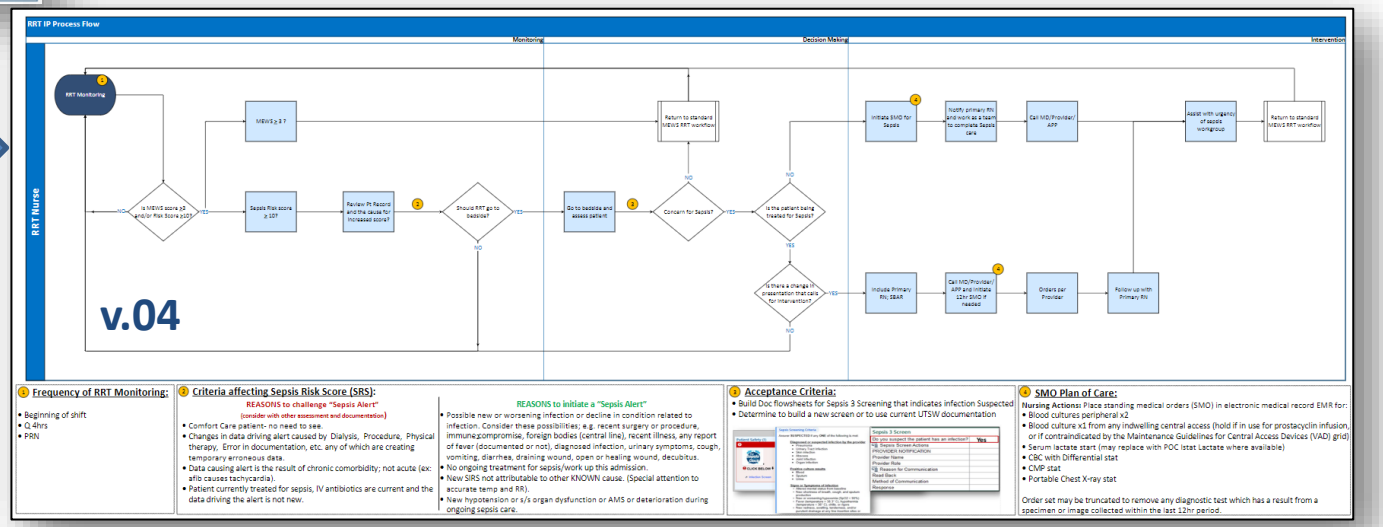
Team Members: ● Morgan Block; ● Sebastian Busto; ● Ying Ma, PhD; ● Betty Abraham, RN; ● Hannah Fullington; ● Marjorie Morales; ● Cary Orrick, RN; ● Sherry Sutton, RN; ● Ambrose Muchiri, RN; ● Linda Nieto, RN, ● Cara Pulliam, RN; ● Lillian Otieno, RN; ● Cindy Nixon, RN; ● Ihab Hannah, RN; ● Melinda Alford, RN; ● Julie Earnest, RN; ● Sterling Overstreet, MD; ● Mujeeb Basit, MD; ● Richard Medford, MD; ● Samuel McDonald, MD; ● Karen Wang; ● Angela Carrington

Understanding the existing RRT Workflow

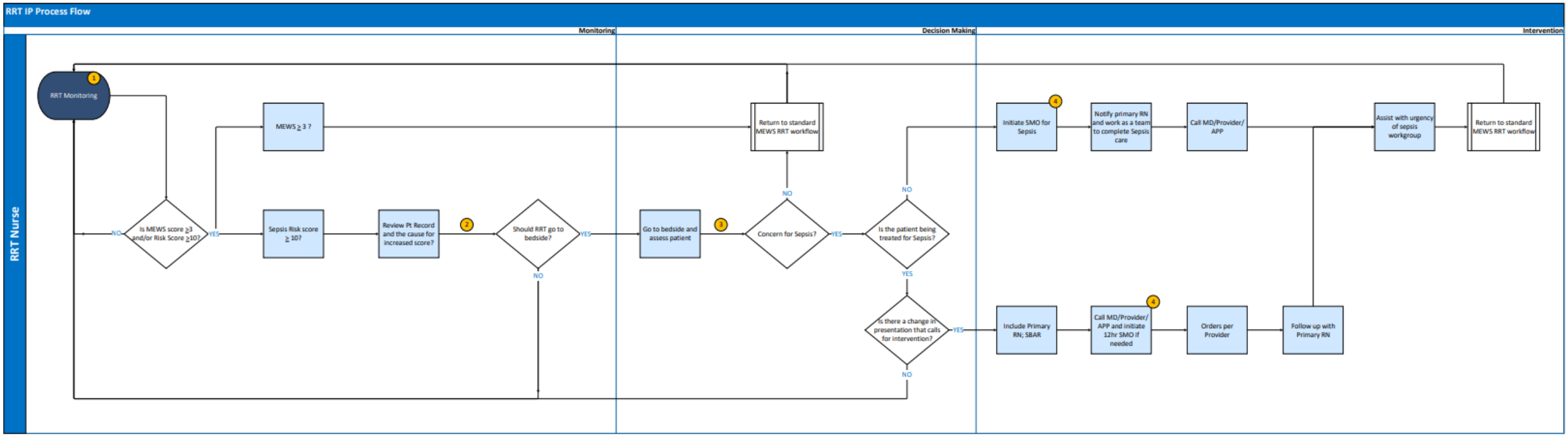








Understanding the existing RRT Workflow



1 Frequency of RRT Monitoring:

- Beginning of shift
- Q 4hrs
- PRN

2 Criteria affecting Sepsis Risk Score (SRS):

REASONS to challenge "Sepsis Alert"
(consider with other assessment and documentation)

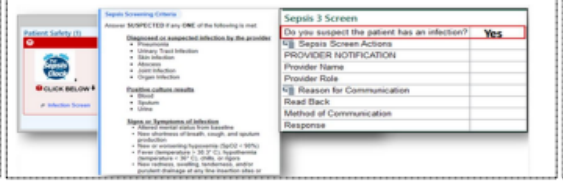
- Comfort Care patient- no need to see.
- Changes in data driving alert caused by Dialysis, Procedure, Physical therapy, Error in documentation, etc. any of which are creating temporary erroneous data.
- Data causing alert is the result of chronic comorbidity; not acute (ex: afib causes tachycardia).
- Patient currently treated for sepsis, IV antibiotics are current and the data driving the alert is not new.

REASONS to initiate a "Sepsis Alert"

- Possible new or worsening infection or decline in condition related to infection. Consider these possibilities; e.g. recent surgery or procedure, immune compromise, foreign bodies (central line), recent illness, any report of fever (documented or not), diagnosed infection, urinary symptoms, cough, vomiting, diarrhea, draining wound, open or healing wound, decubitus.
- No ongoing treatment for sepsis/work up this admission.
- New SIRS not attributable to other KNOWN cause. (Special attention to accurate temp and RR).
- New hypotension or s/s organ dysfunction or AMS or deterioration during ongoing sepsis care.

3 Acceptance Criteria:

- Build Doc flowsheets for Sepsis 3 Screening that indicates infection Suspected
- Determine to build a new screen or to use current UTSW documentation



4 SMO Plan of Care:

Nursing Actions: Place standing medical orders (SMO) in electronic medical record EMR for:

- Blood cultures peripheral x2
- Blood culture x1 from any indwelling central access (hold if in use for prostacyclin infusion, or if contraindicated by the Maintenance Guidelines for Central Access Devices (VAD) grid)
- Serum lactate start (may replace with POC Istat Lactate where available)
- CBC with Differential stat
- CMP stat
- Portable Chest X-ray stat

Order set may be truncated to remove any diagnostic test which has a result from a specimen or image collected within the last 12hr period.

Understanding the existing RRT Workflow – High Level View

CDS produces scores every 15 minutes for each patient;

Predictive variables do not indicate if patients already identified or treated

Scores above a selected threshold sent to EPIC front-end application

Scores not specific enough to rule out patients with other conditions;

No business rules to further filter already treated patients

A dedicated clinician expert acts as "human in the loop" in the prediction/ machine learning cycle;

Knowledge gained further transformed to the business rules in the next phase pilot

Rapid response team receives triaged scores from the clinical expert and further assess the patients from a centralized location;

RRT nurses communicate with floor nurses to coordinate patient diagnostics and care

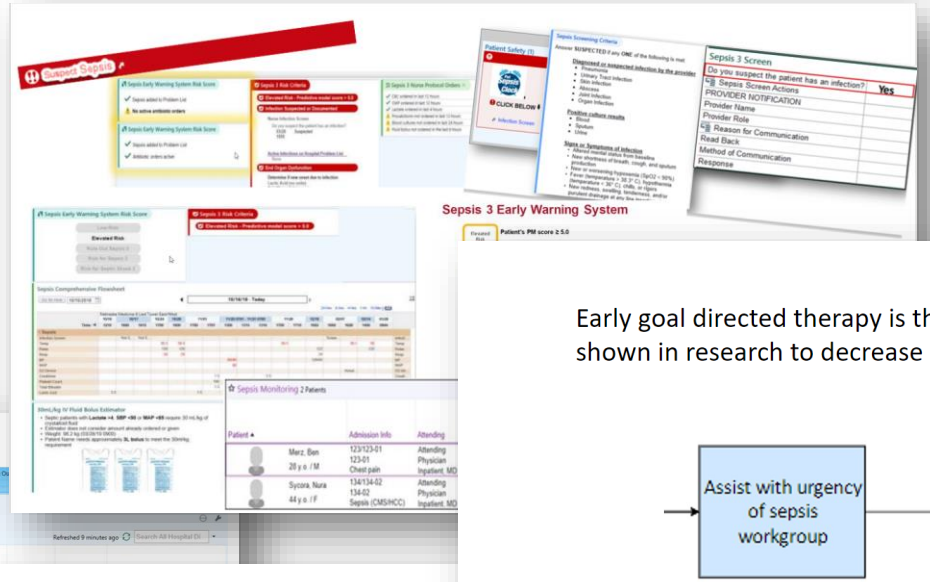
Floor nurses work with RRT nurses to place sepsis related orders;

Identified potential sepsis patients earlier

Gaining Consensus through education

Why?

1. We learned from POCA:
   a) RRT attends the majority of "code sepsis" events when an inpatient becomes septic after arrival
   b) RRT is assertive with SMO use, where unit nurses are less willing to enter orders
   c) Decision support tools (DST) have low positive predictive values (PPV). Placing an experienced human "filter" in the process could improve application of the DST
2. Sepsis is still the #1 cause of in hospital mortality



"RISK SCORE" is our current tool. Other tools are coming.

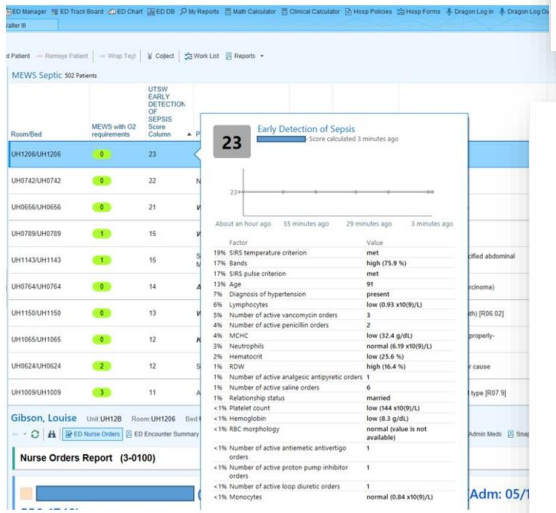
Summary Report

Sepsis Side Bar

Sepsis Narrator
This may offer one stop documentation for all RRT charting.

Sepsis Risk Score

New Infection screen



One of the reasons for RRT monito

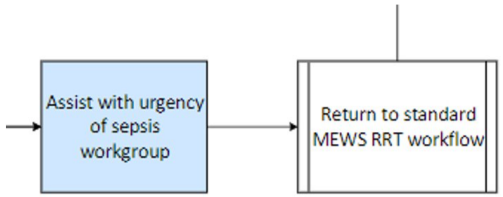
Looking for trends in labs and vital

Sepsis by definition includes organ
catch changes prior to "failure".

Infection plus one of the following (which suggest organ dysfunction):

- Mental status changes
- Platelet count < 100000
- Lactate > 2 mmol/L
- INR > 1.5
- PTT > 60 secs
- Bilirubin > 3.9 mg/dL
- Creatinine > 2 mg/dL
- SBP < 80 mm Hg

Early goal directed therapy is the only intervention that has shown in research to decrease mortality.



Stick around long enough to drive the urgency of antibiotic therapy for stable patients and, of course, until a return to stable or ICU for others.

**Click the arrow to return to the Table of contents

Define.

Measure.

Analyze.

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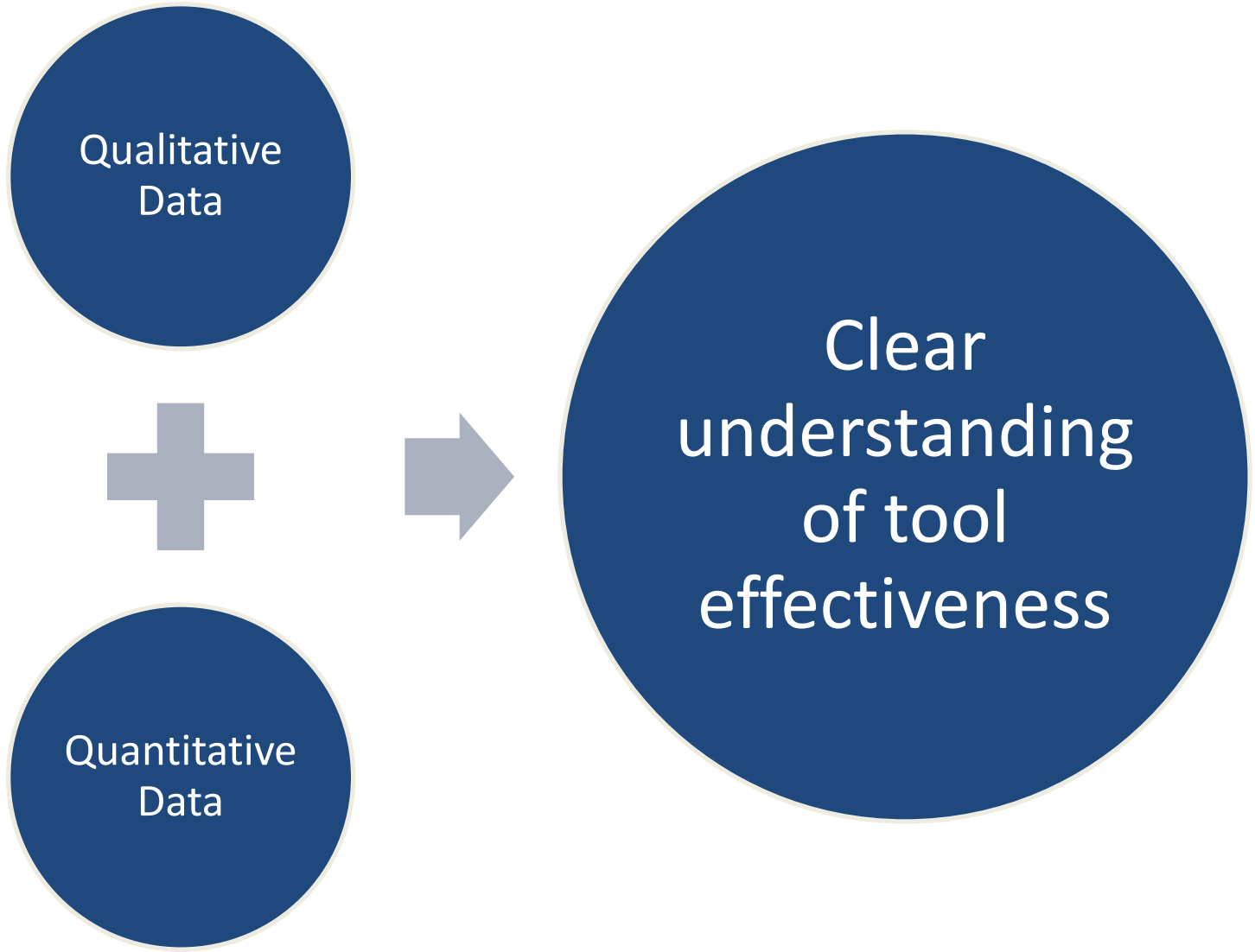
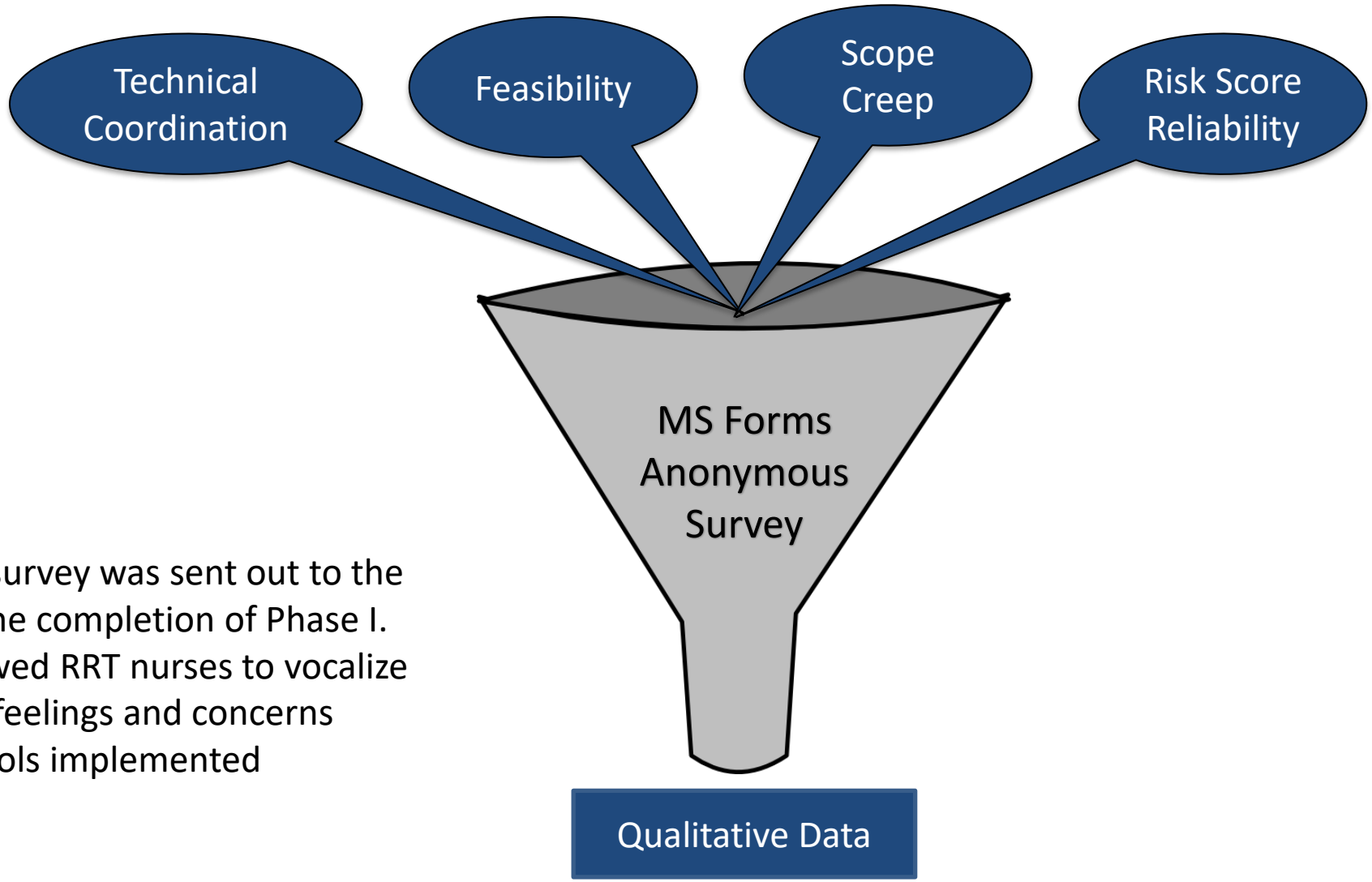
Control.

Data collection

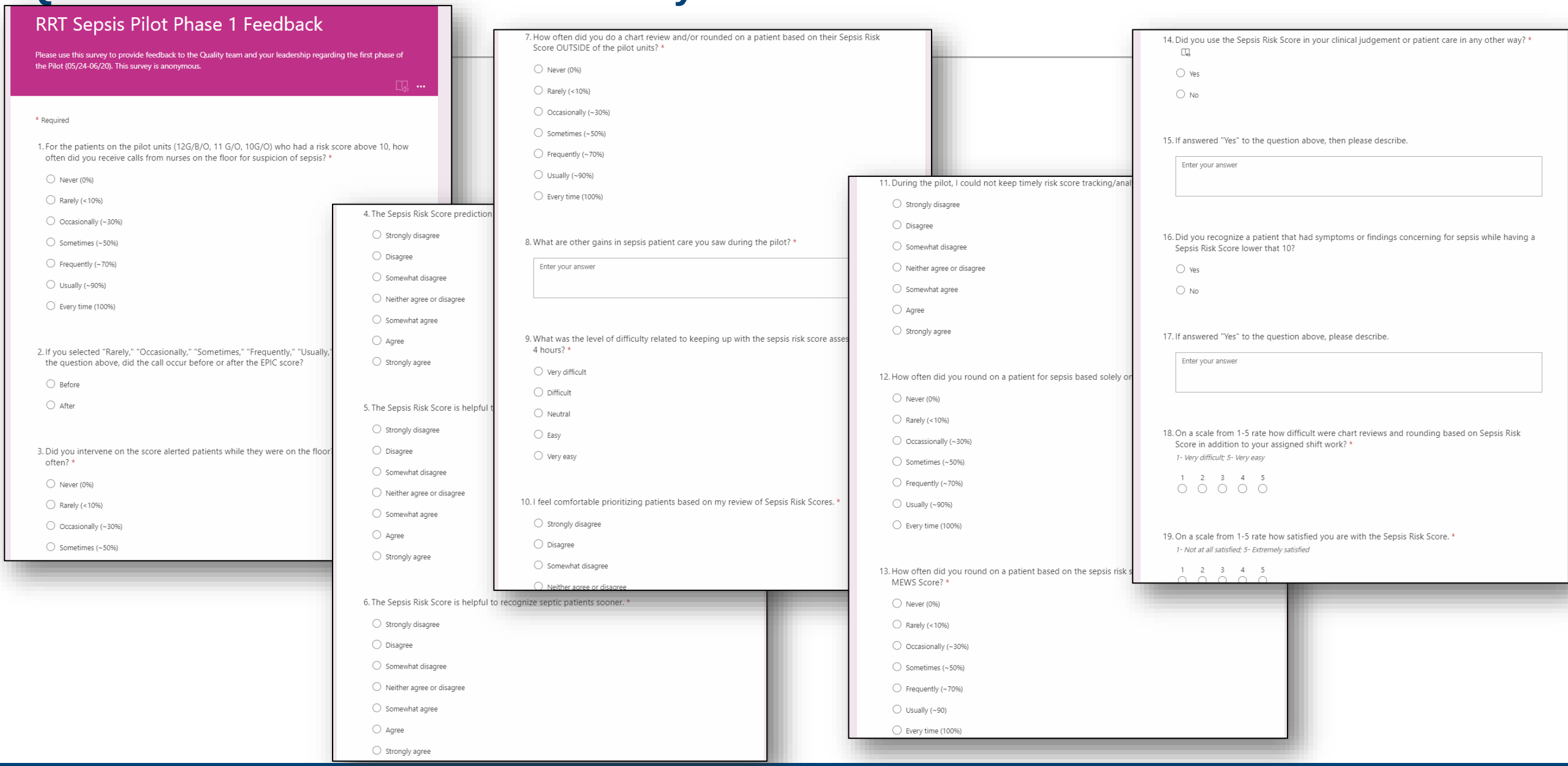


Qualitative Data Collection



An anonymous survey was sent out to the RRT staff after the completion of Phase I. This survey allowed RRT nurses to vocalize their, thoughts, feelings and concerns regarding the tools implemented

Qualitative Data Collection – Survey Preview



RRT Sepsis Pilot Phase 1 Feedback

Please use this survey to provide feedback to the Quality team and your leadership regarding the first phase of the Pilot (05/24-06/20). This survey is anonymous.

* Required

1. For the patients on the pilot units (12G/B/O, 11 G/O, 10G/O) who had a risk score above 10, how often did you receive calls from nurses on the floor for suspicion of sepsis? *
   - Never (0%)
   - Rarely (<10%)
   - Occasionally (~30%)
   - Sometimes (~50%)
   - Frequently (~70%)
   - Usually (~90%)
   - Every time (100%)

2. If you selected "Rarely," "Occasionally," "Sometimes," "Frequently," "Usually," the question above, did the call occur before or after the EPIC score?
   - Before
   - After

3. Did you intervene on the score alerted patients while they were on the floor often? *
   - Never (0%)
   - Rarely (<10%)
   - Occasionally (~30%)
   - Sometimes (~50%)

4. The Sepsis Risk Score prediction
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neither agree or disagree
   - Somewhat agree
   - Agree
   - Strongly agree

5. The Sepsis Risk Score is helpful t
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neither agree or disagree
   - Somewhat agree
   - Agree
   - Strongly agree

6. The Sepsis Risk Score is helpful to recognize septic patients sooner. *
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neither agree or disagree
   - Somewhat agree
   - Agree
   - Strongly agree

7. How often did you do a chart review and/or rounded on a patient based on their Sepsis Risk Score OUTSIDE of the pilot units? *
   - Never (0%)
   - Rarely (<10%)
   - Occasionally (~30%)
   - Sometimes (~50%)
   - Frequently (~70%)
   - Usually (~90%)
   - Every time (100%)

8. What are other gains in sepsis patient care you saw during the pilot? *
   - Enter your answer

9. What was the level of difficulty related to keeping up with the sepsis risk score asses 4 hours? *
   - Very difficult
   - Difficult
   - Neutral
   - Easy
   - Very easy

10. I feel comfortable prioritizing patients based on my review of Sepsis Risk Scores. *
    - Strongly disagree
    - Disagree
    - Somewhat disagree
    - Neither agree or disagree

11. During the pilot, I could not keep timely risk score tracking/anal
    - Strongly disagree
    - Disagree
    - Somewhat disagree
    - Neither agree or disagree
    - Somewhat agree
    - Agree
    - Strongly agree

12. How often did you round on a patient for sepsis based solely or
    - Never (0%)
    - Rarely (<10%)
    - Occasionally (~30%)
    - Sometimes (~50%)
    - Frequently (~70%)
    - Usually (~90%)
    - Every time (100%)

13. How often did you round on a patient based on the sepsis risk s MEWS Score? *
    - Never (0%)
    - Rarely (<10%)
    - Occasionally (~30%)
    - Sometimes (~50%)
    - Frequently (~70%)
    - Usually (~90)
    - Every time (100%)

14. Did you use the Sepsis Risk Score in your clinical judgement or patient care in any other way? *
    - Yes
    - No

15. If answered "Yes" to the question above, then please describe.
    - Enter your answer

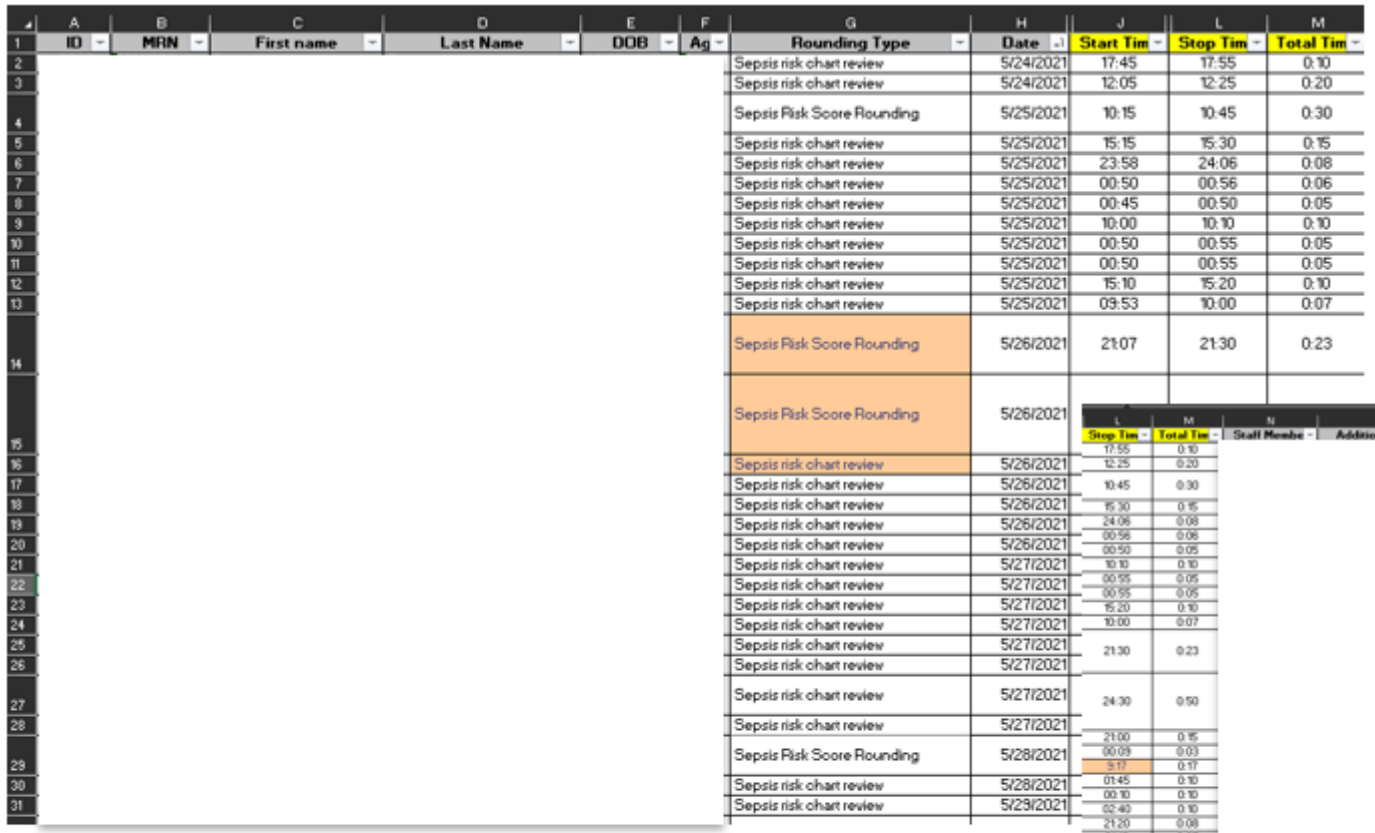
16. Did you recognize a patient that had symptoms or findings concerning for sepsis while having a Sepsis Risk Score lower that 10?
    - Yes
    - No

17. If answered "Yes" to the question above, please describe.
    - Enter your answer

18. On a scale from 1-5 rate how difficult were chart reviews and rounding based on Sepsis Risk Score in addition to your assigned shift work? *
    1- Very difficult; 5- Very easy
    1 2 3 4 5

19. On a scale from 1-5 rate how satisfied you are with the Sepsis Risk Score. *
    1- Not at all satisfied; 5- Extremely satisfied
    1 2 3 4 5

Quantitative Data Collection



ID	MRN	First name	Last Name	DOB	Ag	Rounding Type	Date	Start Tim	Stop Tim	Total Tim
						Sepsis risk chart review	5/24/2021	17:45	17:55	0:10
						Sepsis risk chart review	5/24/2021	12:05	12:25	0:20
						Sepsis Risk Score Rounding	5/25/2021	10:15	10:45	0:30
						Sepsis risk chart review	5/25/2021	15:15	15:30	0:15
						Sepsis risk chart review	5/25/2021	23:58	24:06	0:08
						Sepsis risk chart review	5/25/2021	00:50	00:56	0:06
						Sepsis risk chart review	5/25/2021	00:45	00:50	0:05
						Sepsis risk chart review	5/25/2021	10:00	10:10	0:10
						Sepsis risk chart review	5/25/2021	00:50	00:55	0:05
						Sepsis risk chart review	5/25/2021	00:50	00:55	0:05
						Sepsis risk chart review	5/25/2021	15:10	15:20	0:10
						Sepsis risk chart review	5/25/2021	09:53	10:00	0:07
						Sepsis Risk Score Rounding	5/26/2021	21:07	21:30	0:23
						Sepsis Risk Score Rounding	5/26/2021			
						Sepsis risk chart review	5/26/2021			
						Sepsis risk chart review	5/26/2021			
						Sepsis risk chart review	5/26/2021			
						Sepsis risk chart review	5/26/2021			
						Sepsis risk chart review	5/26/2021			
						Sepsis risk chart review	5/27/2021			
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						Sepsis risk chart review	5/27/2021			
						Sepsis risk chart review	5/27/2021			
						Sepsis risk chart review	5/27/2021			
						Sepsis risk chart review	5/27/2021			
						Sepsis Risk Score Rounding	5/28/2021			
						Sepsis risk chart review	5/28/2021			
						Sepsis risk chart review	5/29/2021			

Stop Tim	Total Tim	Staff Membe	Additional staff members	Unit/Dep	Room Numb	MEWS Sco	Sepsis Risk Sc	Interventions	Comment Section
17:55	0:10			12O	1295	0	15	Chart reviewed	
12:25	0:20			12G	1239	0	16	Chart reviewed	
10:45	0:30			11B	1123	3	10	Chart reviewed, Note placed in chart, Other(please comment), Reassessed vital signs	
15:30	0:15			12G	1242	1	10	Chart reviewed	
24:06	0:08			12G	1242	0	10	Chart reviewed	
00:56	0:06			12O	1293	0	11	Chart reviewed	
00:50	0:05			12B	1209	1	12	Chart reviewed	
10:10	0:10			12B	1209	0	13	Chart reviewed	
00:55	0:05			12B	1218	0	15	Chart reviewed	
00:55	0:05			12G	1239	1	16	Chart reviewed	
15:20	0:10			12O	1283	0	18	Chart reviewed	pt in dialysis
10:00	0:07			12G	1252	1	23	Chart reviewed	
21:30	0:23			12O	1267	4	13	Call provider, Chart reviewed, Increased Oxygen requirement, New orders received, Note placed in chart, Reassessed vital signs	
24:30	0:50			5B LDRP	507	8	16	Additional labs ordered, Call provider, Chart reviewed, Increased Oxygen requirement, New orders received, Note placed in chart, Reassessed vital signs, Sepsis workup initiated	Rocephin stopped. Zosyn commenced
21:00	0:15			12B	1205	3	11	Chart reviewed, Note placed in chart	
00:09	0:03			12G	1252	1	10	Chart reviewed	
5:17	0:17			12G	1252	1	11	Chart reviewed	
01:45	0:10			12B	1217	0	12	Chart reviewed	
00:10	0:10			12O	1278	1	21	Chart reviewed	
02:40	0:10			12G	1243	1		Chart reviewed	
21:20	0:08			12B	1202	0	10	Chart reviewed	
21:12	0:07			12G	1252	1	10	Chart reviewed	
20:47	0:07			12G	1237	0	11	Chart reviewed	
21:05	0:10			12G	1236	0	12	Chart reviewed	
20:55	0:08			12G	1265	1	13	Chart reviewed	
10:40	0:10			12B	1219	1	14	Chart reviewed	VSS, already on antibiotics, last BC negative, WBC stable at 16-17, last lactate WNL, alternate dx of uterine
20:40	0:10			12G	1243	1	19	Chart reviewed	
04:47	0:27			12O	1281	3	13	Additional labs ordered, Call provider, New orders received	Requested Blood Cultures
15:20	0:10			12B	1202	0	19	Chart reviewed	
13:10	0:10			12O	1294	0	10	Chart reviewed	

Due to confidentiality patient and staff specific information has been removed

- RRT Staff use a Productivity Report where they enter necessary shift information
- From the report we were able to extract information like type of rounding (chart review vs rounding), total time, unit, sepsis risk score (and for Phase II, Sepsis risk level)

**Click the arrow to return to the Table of contents

Define.
Measure.
Analyze.
Improve.
Control.

Concerns and suggested interventions (Summary of Qualitative)

Sepsis score vs nurse call:

- Not too many nurse calls for patients scored 10+. The calls, if any, came after the score
- The score may help to recognize some patients earlier

Sepsis score vs MEWS:

- MEWS is more intuitive and clinical relevant;
- Many more RRT nurses performed rounding when used MEWS score alongside sepsis score

Gains of sepsis scores:

- Found septic patients not otherwise recognized;
- Good for identifying patients for chart review, even though patients may not be septic;
- Trending of score allows seeing tipping/onset of sepsis;
- Elevated score leads to looking for subtle change in patient deterioration;
- Score breakdown highlights specific signs for potential sepsis or need for diagnostic testing

Drawbacks of sepsis score:

- Score does not match clinical judgement.
- Obvious sepsis patients scored much lower than 10 and could have been missed; Patients scored 10+ are not septic;
- Many patients scored 10+ are already treated;
- Relatively long chart review time
- Repeated or re-alerted patients without clear reasons for “why again”

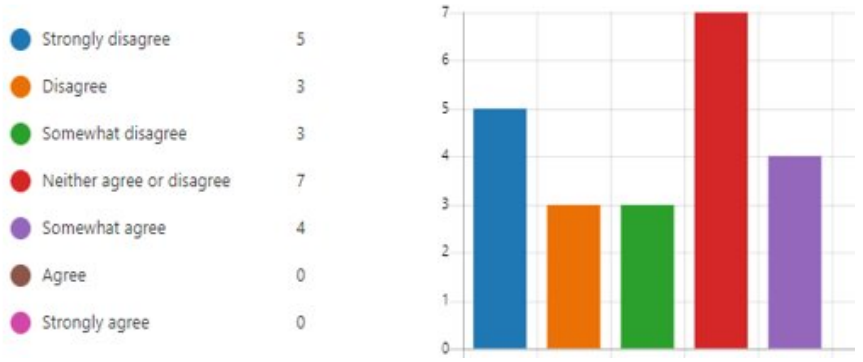
Other concerns:

- Vital signs not entered timely by floor nurses leading to delay in sepsis identification
- Lack of shared responsibilities in sepsis patient care with floor nurses
- Current productivity tool lacks chart review lock control
- Keeping up score-based chart review every 4 hours remains challenging and taking time away from other tasks

Q9: What was the level of difficulty related to keeping up with the sepsis risk score assessment every 4 hours?

Q16: Did you recognize a patient that had symptoms or findings concerning for sepsis while having a Sepsis Risk Score lower that 10?

Q4: The Sepsis Risk Score prediction is accurate.



Concerns and suggested interventions (Summary of Qualitative)

Technical/Coordination

- RRT's General Concern: Staff cited the inefficiencies of the current chart review process, which can result in multiple staff unknowingly reviewing the same chart during the same shift.
- Project Team Response: Explore a technical fix that would help prevent simultaneous chart review (e.g., the addition of an icon or flag to indicate how long it has been since a score/patient was evaluated). We will also discuss options to improve RRT coordination with Ambrose and Sherry to see if there are changes we can implement to eliminate these workflow inefficiencies.

Feasibility

- RRT's General Concern: Don't have the bandwidth to perform chart review based on the Sepsis Risk Score in addition to their current responsibilities (responding to calls and MEWS rounding).
- Project Team Response: The addition of the summary report (shows the data trends and the delta change in risk score), navigator (displays clinical information such as vitals), and side bar (lists out interventions) will improve the efficiencies around the chart review process and decrease the time requirements. These tools are going through final validation and will be available to staff by August.

Scope Creep/Need for IP staff accountability

- RRT's General Concern: The process is very reliant on RRT. Inpatient nursing should be more heavily involved. The sepsis risk scores will lack reliability so long as inpatient staff fail to accurately document.
- Project Team Response: **Feedback needed from Sherry/Ambrose**

Risk Score Reliability

- RRT's General Concern: The sepsis risk score lacks the positive predictive value of MEWS and many patients are already being treated when the score (10+) triggers.
- Project Team Response: The risk score is not perfect, but RRT's feedback and collaboration will allow us to improve and fine tune it to better align with RRT's work flow by sending more relevant patients. The team is working with IR and Informatics to add business rules that will provide objective criteria to enhance the positive predictive value of the risk score.

Sepsis Orders Placed by RRT

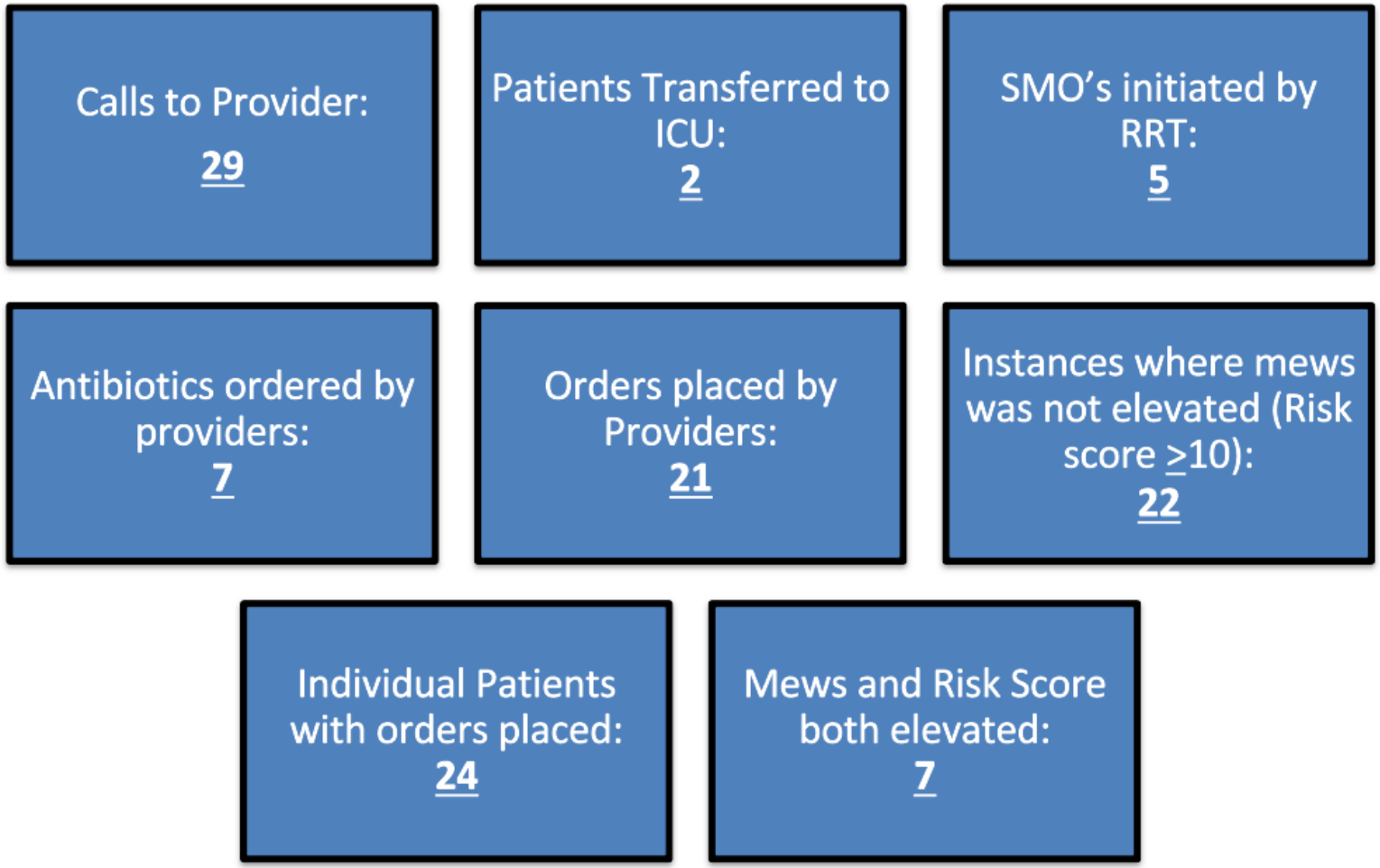
*Pre: Feb 19 to May 23
*Post: May 24 to Jun 24

Time Period	Units	Patients	Patients with Sepsis orders	% of Patients with Sepsis Orders	Patients with Sepsis Orders placed by RRT	% of Sepsis orders placed by RRT
Pre	Non-Pilot	803	319	39.7%	4	1.3%
Post	Non-Pilot	237	107	45.1%	0	0.0%
Pre	Pilot	850	271	31.9%	21	7.7%
Post	Pilot	250	86	34.4%	8	9.3%

Time Period	Units	% of Patients with Sepsis Orders	% Increase	% of Sepsis orders placed by RRT	% Increase
Pre	Pilot	31.9%	7.9%	7.7%	21%
Post	Pilot	34.4%		9.3%	

For the pilot units, besides higher percentage of patients with score >= 8 received sepsis orders in the post intervention period, we also observed a **21% increase** in the percentage of sepsis orders placed by RRT

Summary Phase I



Time rounding and doing chart reviews during Phase I

RRT Sepsis Pilot - Week 1-4 (5/24-6/20)				
12B, 12G, 12O, 11G, 11O, 10G, 10O				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	35		Number of charts reviewed	324
Total Rounding Time (hrs)	17:15:00		Total chart review Time (hrs)	48:46:00
Average rounding time (min)	0:29:34		Average chart review time (min)	0:09:02

RRT Sepsis Pilot - Week 1-4 (5/24-6/20)				
ALL UNITS				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	43		Number of charts reviewed	371
Total Rounding Time (hrs)	20:19:00		Total chart review Time (hrs)	56:39:00
Average rounding time (min)	0:28:21		Average chart review time (min)	0:09:10

RRT Sepsis Pilot - Week 1 (05/24-5/30)				
12B, 12G, 12O				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	3		Number of charts reviewed	29
Total Rounding Time (hrs)	1:30:00		Total chart review Time (hrs)	4:34:00
Average rounding time (min)	0:30:00		Average chart review time (min)	0:09:27

RRT Sepsis Pilot - Week 2 (5/31-6/6)				
12B, 12G, 12O, 11G, 11O, 10G, 10O				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	19		Number of charts reviewed	117
Total Rounding Time (hrs)	8:44:00		Total chart review Time (hrs)	17:44:00
Average rounding time (min)	0:27:35		Average chart review time (min)	0:09:06

RRT Sepsis Pilot - Week 3 (6/7-6/13)				
12B, 12G, 12O, 11G, 11O, 10G, 10O				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	6		Number of charts reviewed	115
Total Rounding Time (hrs)	2:26:00		Total chart review Time (hrs)	19:12:00
Average rounding time (min)	0:24:20		Average chart review time (min)	0:10:01

RRT Sepsis Pilot - Week 4 (6/14-6/20)				
12B, 12G, 12O, 11G, 11O, 10G, 10O				
Rounding & chart review for patients with a risk score of 10 or greater				
Sepsis Risk Score Rounding			**Sepsis Risk Score Chart Review**	
Number of pts rounded	7		Number of charts reviewed	69
Total Rounding Time (hrs)	4:35:00		Total chart review Time (hrs)	9:42:00
Average rounding time (min)	0:39:17		Average chart review time (min)	0:08:26

**Click the arrow to return to the Table f contents

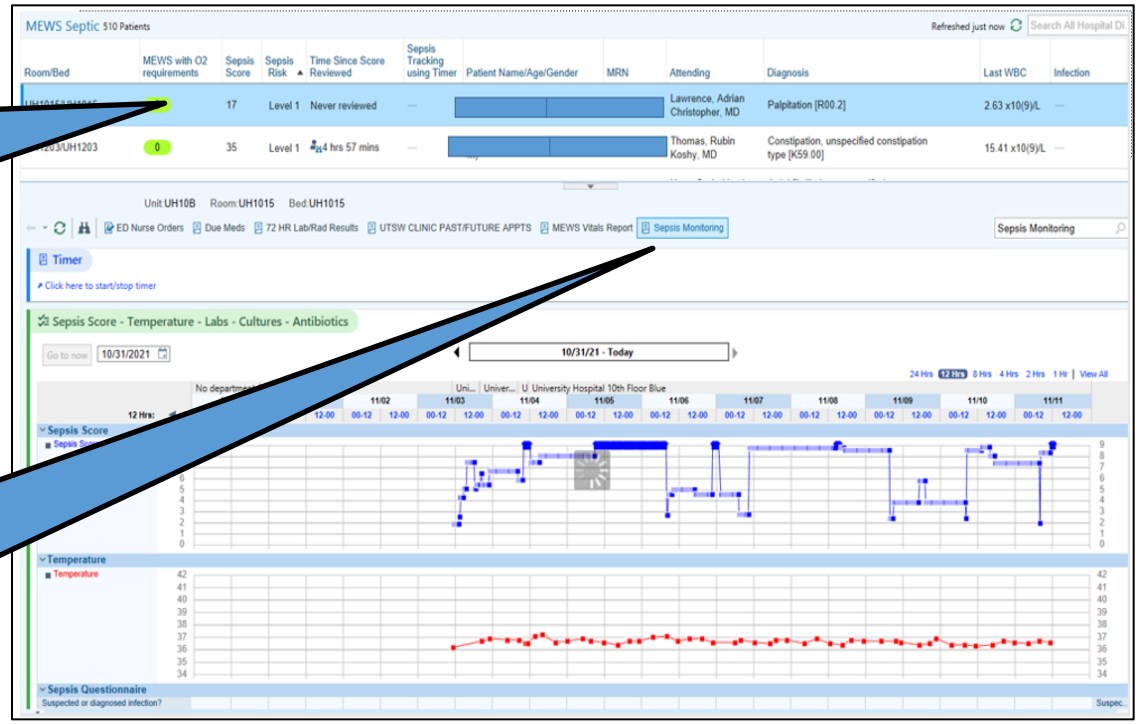
Define.
Measure.
Analyze.
Improve.
Control.

Improve

From Phase 1 we can conclude that it is within the capacity of the RRT to utilize predictive modeling to monitor for inpatient sepsis, however, ESPM output will require added filtering, of the identified population, to reduce chart review time in already identified sepsis patients. On the next couple of slides, you will see the tools that we Improved in Phase II.

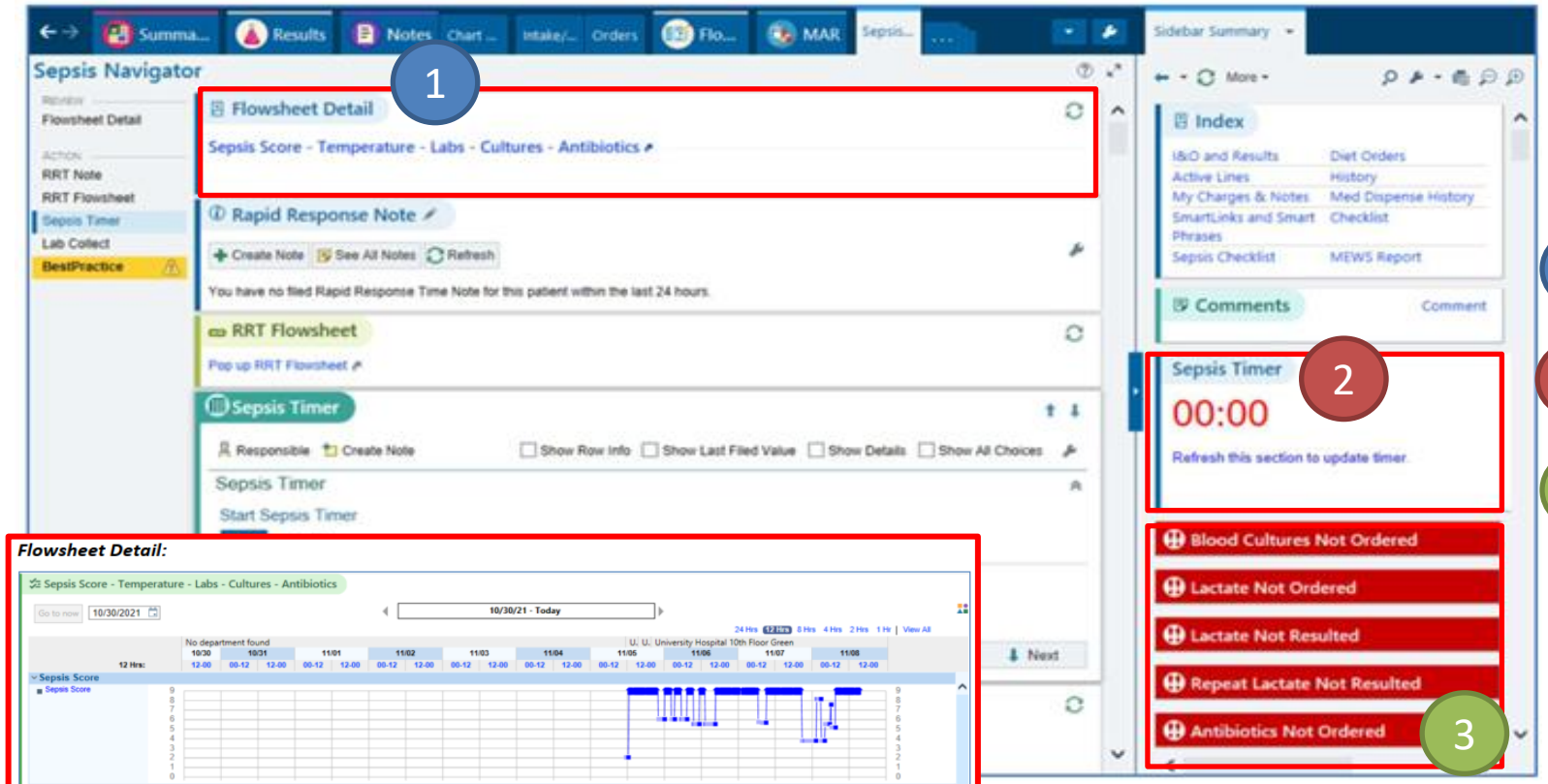
The *Patient List* is normal workflow for RRT to monitor our patient population. ESPM score was added for Phase 1 to monitor for sepsis and *Sepsis Risk* Levels in Phase II to identify treated sepsis and higher risk cases.

Phase 1 Pilot revealed a need for quick sepsis data.
Addressed in Phase II with this "Sepsis Monitor". This can be seen without opening the chart; decreasing time spent in chart review.



Improve our Electronic Medical Record (EMR) system

Navigator & Sidebar Checklist:



Flowsheet Detail:

1. **Flowsheet Detail:** Trends Sepsis Score and temperature and view lab/culture results
2. **Sepsis Timer:** Start the timer manually or through a code sepsis order
3. **Sidebar Checklist:** Red banners will appear for orders that need to be placed

Improve

Sepsis Monitoring Report

- **Sepsis Risk:** Sepsis Risk is driven by varying components including the Sepsis Score, lab results, flowsheet values, etc.
- **Sepsis Score:** Algorithm that predicts the likelihood of patient currently being septic. During beta testing of the tools, the Sepsis Risk levels will consider patients with a score >10
- **Change in Sepsis Score:** Indicates change in score since last reviewed

Improve: Creation of Sepsis Risk Levels

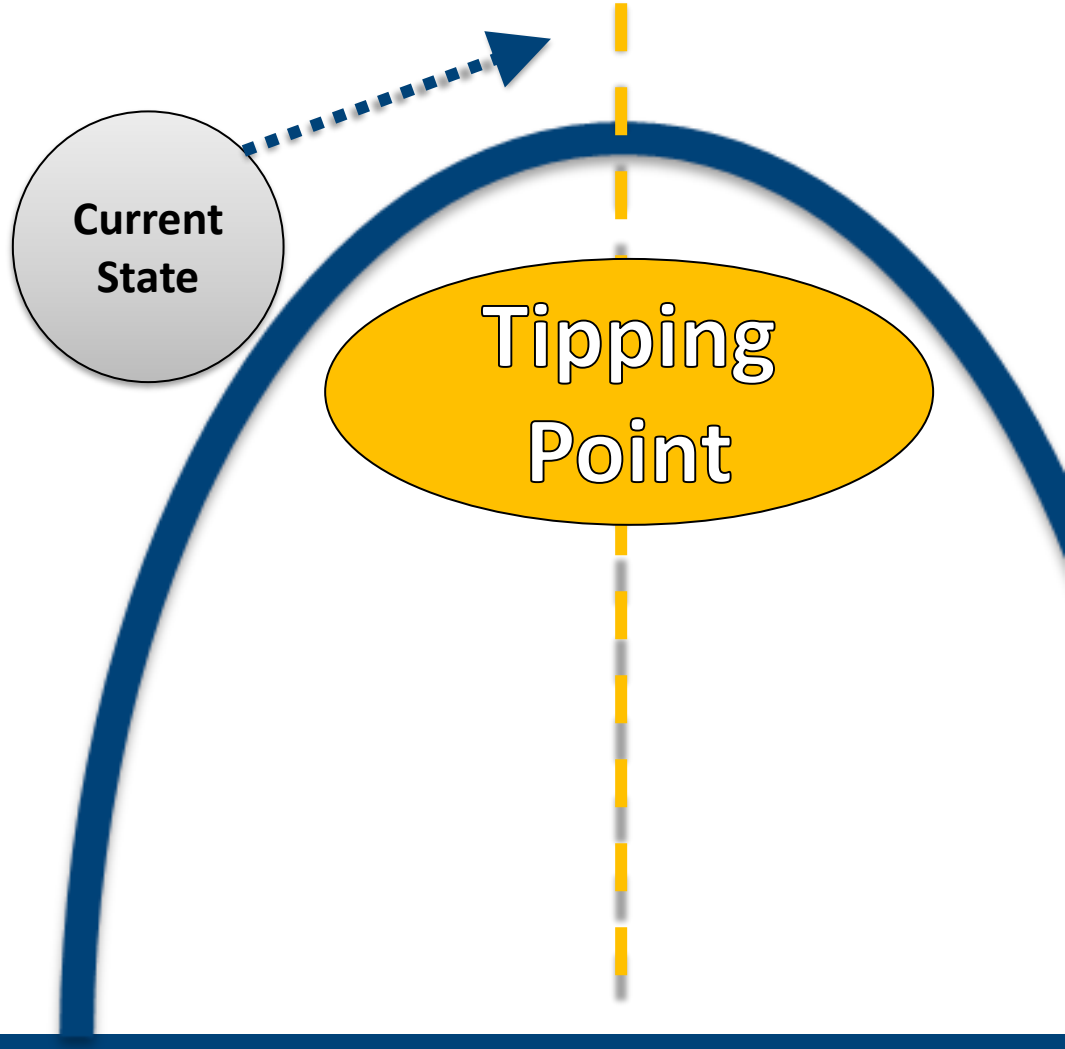
Elevated Risk **Patient's PM score ≥ 10**	**LEVEL 1:** To make the rest of the process work, the primary RN and/or EPIC will need to complete the infection risk screen if the RISK SCORE is ≥10
Rule Out Sepsis Currently being Treated **Patient's PM score ≥ 10**	**LEVEL 2:** A patient meeting the RISK SCORE with + Infection Screen , HOWEVER, they are currently being treated for sepsis and do not show organ dysfunction or hypotension/shock.
Rule-Out Sepsis 3 **Positive infection screen or infection on problem list**	**LEVEL 3:** When the RISK SCORE is ≥ 10 and the patient has a known or suspected infection other questions need answers; 1) is the patient currently on IV sepsis antibiotics 2) when were the last sepsis labs ordered. The output to RRT will need to indicate these with visual flags and/or be verified.
Risk for Sepsis 3 **Positive end organ dysfunction** ○ **Lactate, Bilirubin or Creatinine > 2.0** ○ **Platelets < 100**	**LEVEL 4:** When the RISK SCORE is ≥ 10, the patient has a known or suspected infection and we have organ dysfunction labs or documentation as then verified by RRT. Current or recent treatment not withstanding.
Risk for Septic Shock 3 **Hypotension** ○ **SBP < 90** ○ **MAP < 65** **Lactate ≥ 4.0**	**Level 5:** Sepsis or infection + RISK SCORE ≥ 10 + hypotension AND/OR lactate ≥ 4. Current or recent treatment not withstanding.

Improve

Where do we want to be?

Reach the **tipping point:**

The usefulness of the predictive model consistently and accurately predicts sepsis before the care provider suspects, screens or intervenes on the patient and in a way where the workflow can be implemented, adopted, and spread to other areas of the organization.



Statistical Analysis: Paired Comparison

Paired comparison was used to test for significant differences between the results of Phase I and Phase II. In order to have an accurate study, we ensured that the population of nurses taking the survey was the same. Additionally, the survey questions used for this analysis remained consistent for when the survey was sent out for both Phase I and Phase II. Since the survey collected qualitative data the data had to be adjusted in order to perform the analysis. (e.g. 1=Strongly Disagree; 7=Strongly Agree)

Responder ID	The Sepsis Risk Score is helpful to identify which charts to review.(1:Strongly disagree; 2:Disagree; 3:Somewhat disagree; 4:Neither agree or disagree; 5:Somewhat agree; 6:Agree; 7:Strongly Agree)			
	Phase 1	Phase 1	Phase 2	Phase 2
1	Somewhat agree	5	Somewhat agree	5
2	Disagree	2	Agree	6
3	Somewhat agree	5	Agree	6
4	Disagree	2	Agree	6
5	Strongly disagree	1	Strongly agree	7
6	Disagree	2	Somewhat agree	5
7	Agree	6	Strongly agree	7
8	Disagree	2	Agree	6
9	Agree	6	Agree	6
10	Agree	6	Somewhat agree	5
11	Neither agree or disagree	4	Agree	6
12	Somewhat agree	5	Agree	6
13	Somewhat agree	5	Somewhat agree	5
14	Neither agree or disagree	4	Somewhat disagree	3
15	Neither agree or disagree	4	Strongly agree	7
16	Somewhat agree	5	Agree	6
17	Disagree	2	Agree	6
18	Neither agree or disagree	4	Agree	6
19	Disagree	2	Agree	6
20	Disagree	2	Somewhat disagree	3
21	Agree	6	Somewhat agree	5
22	Somewhat agree	5	Agree	6
23	Neither agree or disagree	4	Somewhat agree	5

Phase 1	Phase 2	delta	Average	1.739
5	5	0	Stdev	1.936
2	6	4	n	23
5	6	1		
2	6	4		
1	7	6		
2	5	3		
6	7	1		
2	6	4		
6	6	0		
6	5	-1		
4	6	2		
5	6	1		
5	5	0		
4	3	-1		
4	7	3		
5	6	1		
2	6	4		
4	6	2		
2	6	4		
2	3	1		
6	5	-1		
5	6	1		
4	5	1		

dbar:	1.73913
standard deviation:	1.93573
sample:	23
alpha:	0.1
t test:	4.309
1 tail t table:	1.32124
2 tail t table:	1.71714

Conclusion		
Ttest= 4.309	>	Ttable= 1.321237

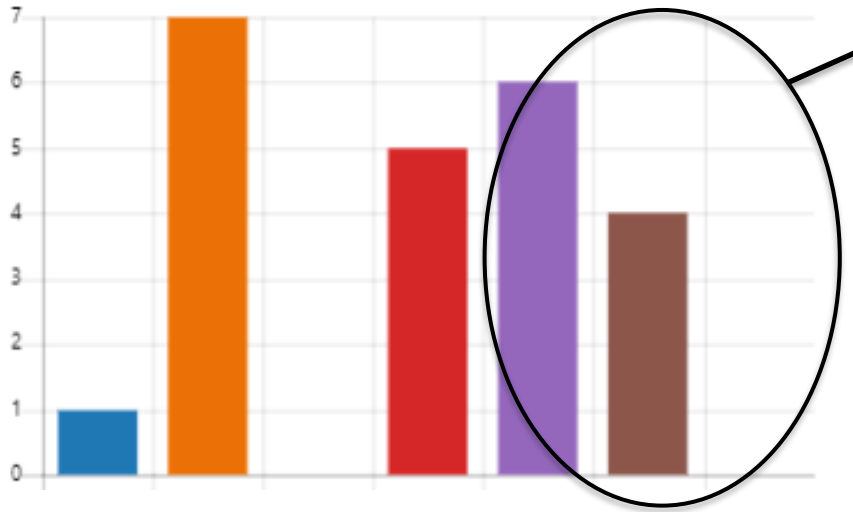
Since the Ttable value is larger than the Ttest value, we fail to reject the null and **we can say with 99% confidence that the changes implemented for Phase II had a statistically significant impact in this question**

The Sepsis Risk Score/level is helpful to identify which charts to review:

(Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree)

Phase I

Strongly disagree	1
Disagree	7
Somewhat disagree	0
Neither agree or disagree	5
Somewhat agree	6
Agree	4
Strongly agree	0



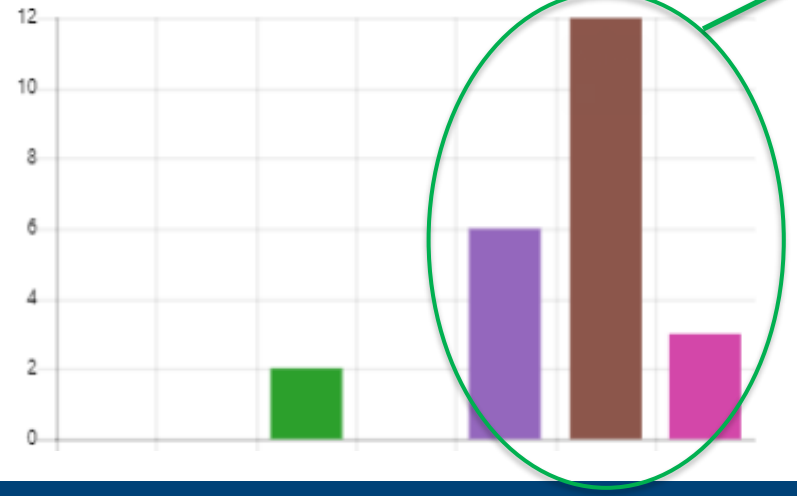
43.48%

110% Increase

91.3%

Phase II

Strongly disagree	0
Disagree	0
Somewhat disagree	2
Neither agree or disagree	0
Somewhat agree	6
Agree	12
Strongly agree	3



Phase 1	Phase 2	delta	Average	1.739
5	5	0	Stdev	1.936
2	6	4	n	23
5	6	1		
2	6	4		
1	7	6		
2	5	3		
6	7	1		
2	6	4		
6	6	0		
6	5	-1		
4	6	2		
5	6	1		
5	5	0		
4	3	-1		
4	7	3		
5	6	1		
2	6	4		
4	6	2		
2	6	4		
2	3	1		
6	5	-1		
5	6	1		
4	5	1		

dbar:	1.73913
standard deviation:	1.93573
sample:	23
alpha:	0.1
t test:	4.309
1 tail t table:	1.32124
2 tail t table:	1.71714

Conclusion		
Ttest= 4.309	>	Ttable= 1.321237

Since the Ttable value is larger than the Ttest value, we fail to reject the null and **we can say with 99% confidence that the changes implemented for Phase II had a statistically significant impact in this question**

On a scale from 1-5 rate how satisfied you are with the Sepsis Risk Score/Level.

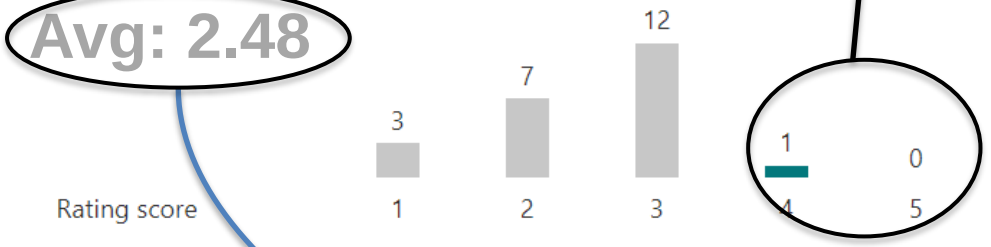
(1- Not at all satisfied; 5- Extremely satisfied)

1600% Increase

Phase I

Score distribution

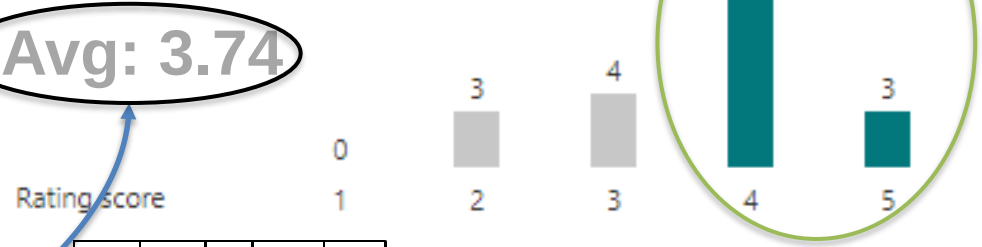
Avg: 2.48



4.35%

Phase II

Avg: 3.74



73.91%

50.81% Increase

Phase 1	Phase 2	delta
3	2	-1
1	4	3
3	4	1
3	4	1
1	5	4
3	4	1
3	4	1
1	4	3
2	4	2
4	4	0
2	3	1
3	4	1
3	4	1
3	2	-1
3	3	0
3	5	2
2	4	2
2	4	2
2	4	2
2	2	0
2	3	1
3	5	2
3	4	1

Average	1.2609
Stdev	1.2142
n	23

dbar:	1.26087
standard deviation:	1.21421
sample:	23
alpha:	0.1
t test:	4.980
1 tail t table:	1.32124
2 tail t table:	1.71714

Conclusion

Ttest= 4.980 > Ttable= 1.321237

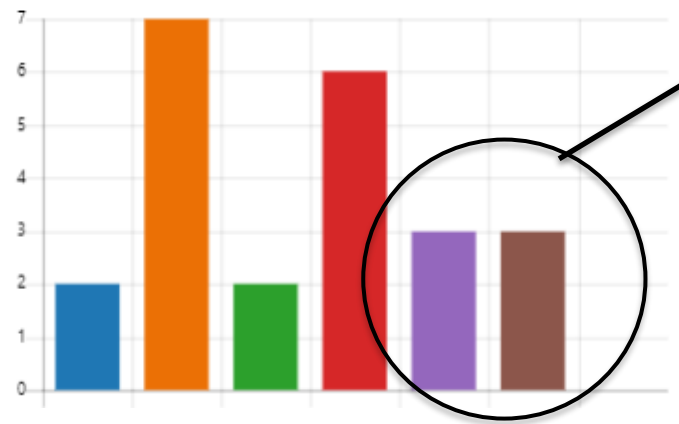
Since the Ttable value is larger than the Ttest value, we fail to reject the null and **we can say with 99% confidence that the changes implemented for Phase II had a statistically significant impact in this question**

The Sepsis Score/Risk level is helpful to recognize septic patients sooner.

(Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree)

Phase I

Strongly disagree	2
Disagree	7
Somewhat disagree	2
Neither agree or disagree	6
Somewhat agree	3
Agree	3
Strongly agree	0

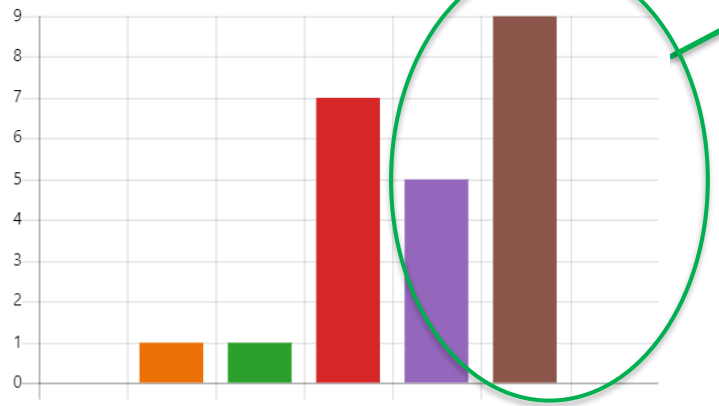


26.09%

133.31% Increase

Phase II

Strongly disagree	0
Disagree	1
Somewhat disagree	1
Neither agree or disagree	7
Somewhat agree	5
Agree	9
Strongly agree	0



60.87%

Phase 1	Phase 2	delta	Average	1.435
4	5	1	Stdev	1.903
2	4	2	n	23
5	5	0		
2	4	2		
1	6	5		
2	6	4		
4	6	2		
1	5	4		
2	4	2		
6	4	-2		
3	5	2		
3	6	3		
6	5	-1		
4	3	-1		
4	4	0		
5	6	1		
2	6	4		
4	4	0		
2	6	4		
2	2	0		
4	4	0		
5	6	1		
6	6	0		

dbar:	1.43478
standard deviation:	1.90278
sample:	23
alpha:	0.1
t test:	3.616
1 tail t table:	1.32124
2 tail t table:	1.71714

Conclusion

Ttest= 3.616 > Ttable= 1.321237

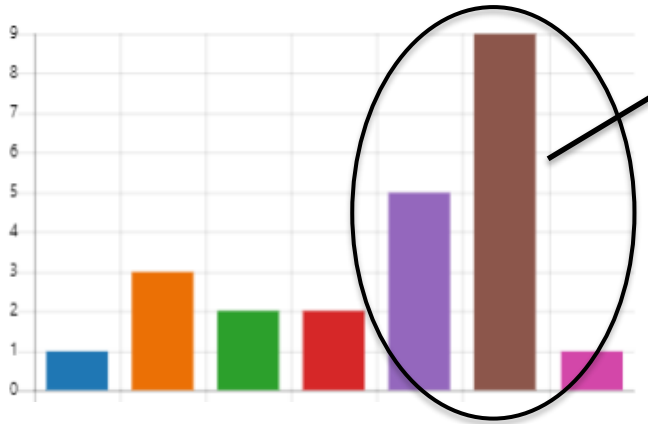
Since the Ttable value is larger than the Ttest value, we fail to reject the null and **we can say with 99% confidence that the changes implemented for Phase II had a statistically significant impact in this question**

I feel comfortable prioritizing patients based on my review of Sepsis Risk levels

(Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree)

Phase I

Strongly disagree	1
Disagree	3
Somewhat disagree	2
Neither agree or disagree	2
Somewhat agree	5
Agree	9
Strongly agree	1

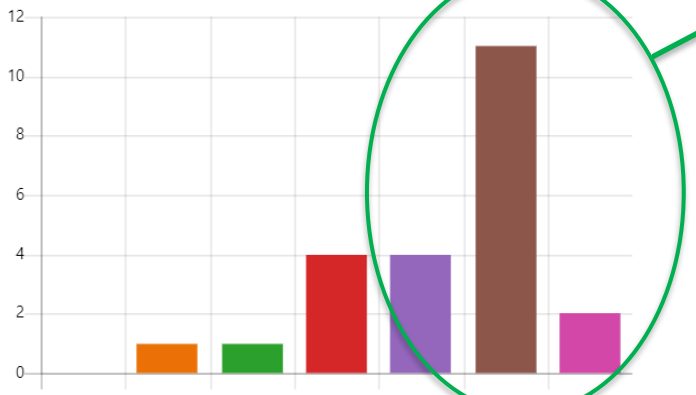


65.21%

13.34% Increase

Phase II

Strongly disagree	0
Disagree	1
Somewhat disagree	1
Neither agree or disagree	4
Somewhat agree	4
Agree	11
Strongly agree	2



73.91%

Phase 1	Phase 2	delta	Average	0.522
4	7	3	Stdev	2.086
2	6	4	n	23
5	6	1		
6	5	-1		
2	5	3		
5	4	-1		
5	6	1		
1	6	5		
5	6	1		
6	6	0		
3	5	2		
6	6	0		
6	5	-1		
2	3	1		
7	4	-3		
6	6	0		
4	5	1		
6	4	-2		
5	6	1		
6	2	-4		
3	4	1		
6	6	0		
6	6	0		

dbar:	0.52174
standard deviation:	2.08609
sample:	23
alpha:	0.1
t test:	1.199
1 tail t table:	1.32124
2 tail t table:	1.71714

Conclusion

Ttest= 1.199 < Ttable= 1.321237

value, we fail to reject the null and **we cannot say with 99% confidence that the changes implemented for Phase II had a statistically significant impact in this question**

Decrease in average chart review time:

With the addition of EPIC tools (sepsis monitor, sepsis level, change in ESPM, time since last review, etc.), added specifically for this pilot phase, will there be a **statistically significant** decrease in the amount of time spent per chart reviewed for sepsis monitoring?

*Baseline data: Average time per chart reviewed on Phase I: **9min 02seconds***

Prediction - **Yes, we predict that chart review will be decreased by categorizing charts with the leveling system**. Level 1= Negative sepsis questionnaire, Level 2= untreated R/O sepsis, Accurate Level 3= TREATED R/O sepsis, Level 4= Triage for R/O sepsis in the face of organ dysfunction, Level 5 R/O sepsis with s/s hypotension or shock. The levels will guide chart review and save time. Sharing notes between RRT with time since last review should decrease repeat chart reviews. Sepsis Monitor should give information while in Patient List view that will decrease the need to open the chart for review; again, saving time. We predict a minimum of 40% decrease in time spent per chart reviewed.

Sepsis Risk Score Chart Review	Phase I	Phase II	Sig Diff
Number of charts reviewed	371	187	
Total chart review Time (hrs)	56:39:00	25:48:00	
Average chart review time (min)	0:09:10	0:08:17	Yes

Ftest < Ftable ; Therfore we fail to reject the null hypothesis ->
Two Sample Means Unequal Variances
Ztest = 1.673 - Ztable 2.576
Ztest < Ztable -- We fail to reject the null. **We can say with 99% confidence that the Decrease in time spent doing sepsis chart reviews was statistically significant.**

We saw **a decrease of 53seconds** on the average time taken to review charts when comparing Phase 1 to Phase 2. A 9.64% decrease. **This is a statistically significant decrease.**

Decrease in total number of charts reviewed:

Does the ESPM leveling system help decrease the number of charts that need to be reviewed?

Baseline data: The total number of charts reviewed on Phase I: 324 charts.

Prediction - With the ability to tag charts on the patient list with a "time since chart reviewed" note as well as the ability to see identified and treated patients as level 3. Yes, we expect that duplicate review of charts and review of charts were the patient is already receiving treatment will decrease by 10-20 percent.

Sepsis Risk Score Chart Review	Phase I	Phase II	Sig Diff
Number of charts reviewed	371	187	
Total chart review Time (hrs)	56:39:00	25:48:00	
Average chart review time (min)	0:09:10	0:08:17	Yes

We saw **a decrease of 184** the total number of charts reviewed when comparing Phase 1 to Phase 2. A 49.59% decrease.

Ftest < Ftable ; Therfore we fail to reject the null hypothesis ->
Two Sample Means Unequal Variances
Ztest = 1.673 - Ztable 2.576
Ztest < Ztable -- We fail to reject the null. **We can say with 99% confidence that the Decrease in time spent doing sepsis chart reviews was statistically significant.**

Feasibility in a normal day:

Will RRT indicate (per the RRT Phase II Survey) that chart reviews and rounding is feasible based on Sepsis Risk Level in addition to their assigned shift work is easy or very easy on a normal day?

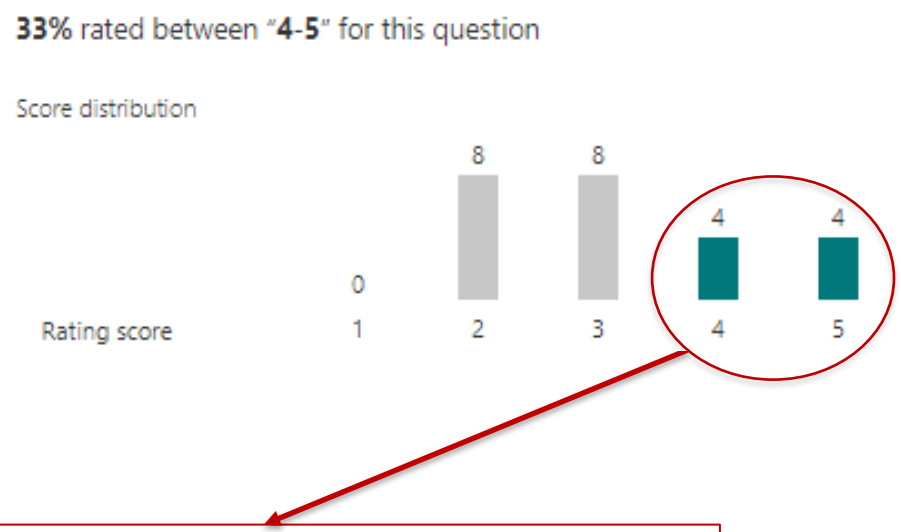
Prediction - Yes, we predict that most phase II survey respondents will indicate that chart reviews and rounding based on Sepsis Risk Level in addition to their assigned shift work is easy or very easy on a normal day.

13. On a scale from 1-5 rate how difficult were chart reviews and rounding based on Sepsis Risk Level in addition to your assigned shift work on a normal day?

More Details Insights

23
Responses

3.09
Average Number



Only 33% of the respondents voted "Easy" or "Very Easy" to this question.

Feasibility in a busy day:

Will RRT indicate (per the RRT Phase II Survey) that chart reviews and rounding is feasible based on Sepsis Risk Level in addition to their assigned shift work is easy or very easy on a busy day?

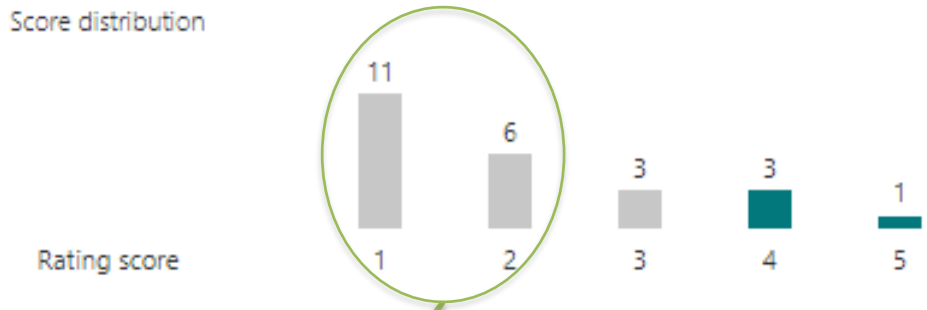
Prediction - No, we predict that most phase II survey respondents will indicate that chart reviews and rounding based on Sepsis Risk Level in addition to their assigned shift work is difficult or very difficult on a busy day

14. On a scale from 1-5 rate how difficult were chart reviews and rounding based on Sepsis Risk Level in addition to your assigned shift work on a busy day (e.g., 18 back-to-back rapids)

More Details | Insights

23	2
Responses	Average Number

17% rated between "**4-5**" for this question



Even though our prediction was accurate, this shows we still have some room for improvement on Feasibility

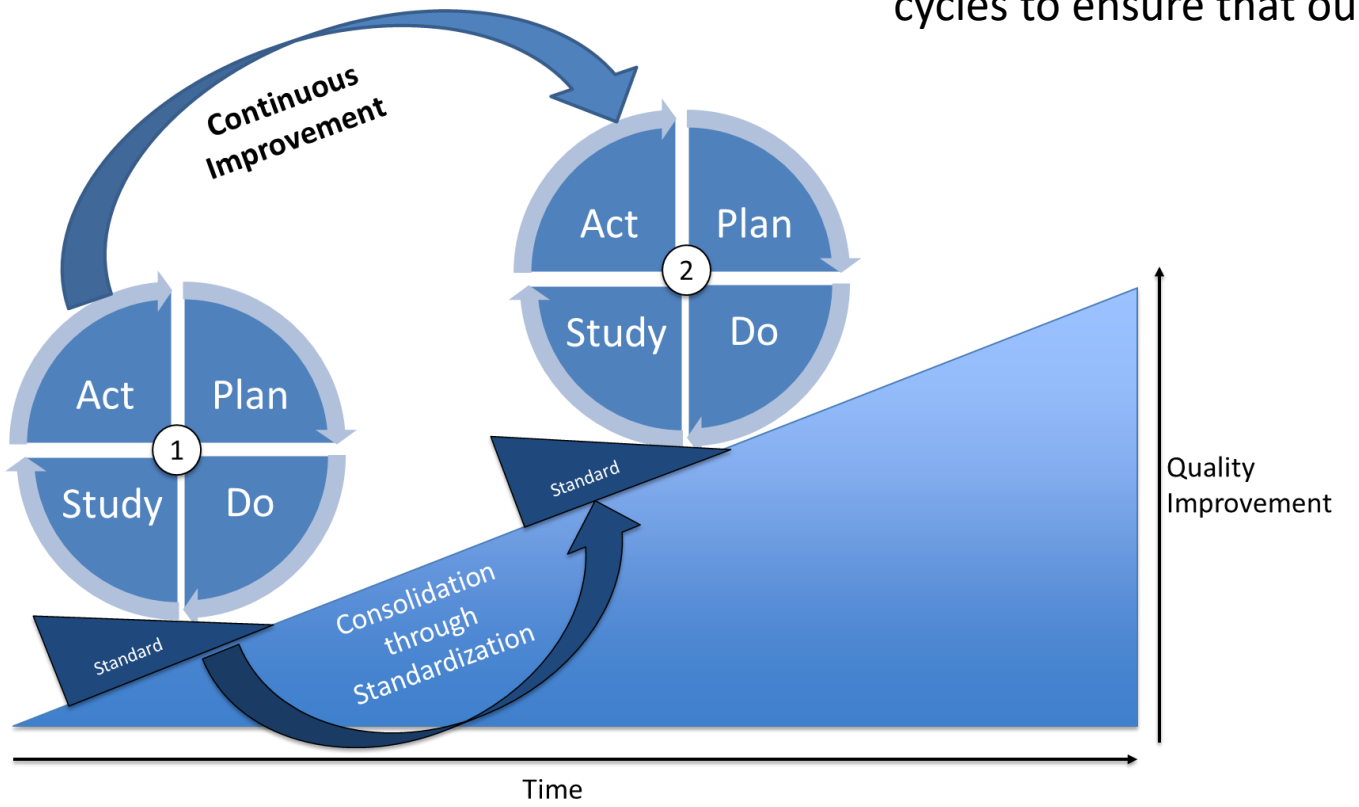
74% of the respondents voted "Difficult" or "Very difficult" to this question.

**Click the arrow to return to the Table of contents

Define.
Measure.
Analyze.
Improve.
Control.

Control Plan

Our main goal is decrease sepsis length of stay Observed/Expected (O/E) for patients with sepsis in our pilot units. We used and will continue to use PDSA cycles to ensure that our target population does not revert to our past O/E rates



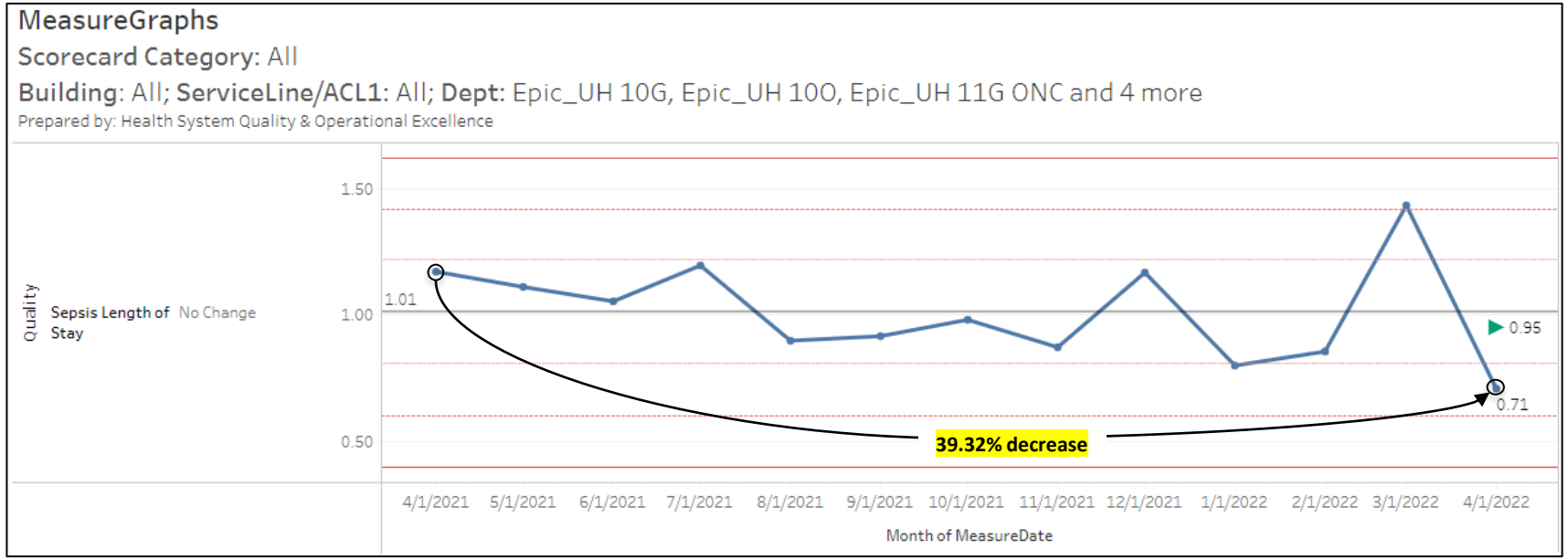
Here are some examples of ways we've used PDSA cycles and ways we will continue to use them:

- Test feasibility of RRT Staff for this project
- Improve the Sepsis Risk Score
- Improve the existing EMR system
- Create Sepsis Risk Levels
- Monitor percentage of charts reviewed based on sepsis risk score/level
- EMR System for sepsis was standardized
- RRT staff will continue to be educated on the ESPM Tools based on standardized onboarding
- Created process metrics, trigger thresholds and trigger responses to ensure that the gains seen from this projects are sustained

**Click the arrow to return to the Table of contents

Summary:

Summary of Results & Financial Impact



Sepsis length of Stay (Observed/Expected)	
April 1, 2021	1.17
April 1, 2022	0.71

A **39.32%** decrease was seen on sepsis length of stay when comparing the baseline data to the final data after the end of Phase II

Sepsis Risk Score Chart Review	Phase I	Phase II
Number of charts reviewed	371	187
Total chart review Time (hrs)	56:39:00	25:48:00
Average chart review time (min)	0:09:10	0:08:17

We saw **a decrease of 184** the total number of charts reviewed when comparing Phase 1 to Phase 2. A 49.59% decrease. **This is a statistically significant decrease.**

We saw **a decrease of 53 seconds** on the average time taken to review charts when comparing Phase 1 to Phase 2. A 9.64% decrease. **This is a statistically significant decrease.**

Financial Impact:

Based on a **39.32% decrease** in sepsis length of stay it was calculated that this process improvement project resulted in **$2,422,080.00** in financial savings. (calculations on next slide)

DISCLAIMER: All financial calculations are rough estimates

Financial Impact Calculations

Observed data from 4/1/2021 - 4/1/2022							
MeasureDisplayName	Month of MeasureDate	Observed/Expected	Observed Display	Hospital expenses ($) *	Avg. patient cost	Avg. # of sepsis patients **	Total Sepsis Cost
Sepsis Length of Stay	4/1/2021	1.17	10.47	$4,800	$50,256	10	$502,560
Sepsis Length of Stay	5/1/2021	1.11	9.95	$4,800	$47,760	10	$477,600
Sepsis Length of Stay	6/1/2021	1.05	9.3	$4,800	$44,640	10	$446,400
Sepsis Length of Stay	7/1/2021	1.19	10.62	$4,800	$50,976	10	$509,760
Sepsis Length of Stay	8/1/2021	0.90	9.44	$4,800	$45,312	10	$453,120
Sepsis Length of Stay	9/1/2021	0.91	10.07	$4,800	$48,336	10	$483,360
Sepsis Length of Stay	10/1/2021	0.98	9.91	$4,800	$47,568	10	$475,680
Sepsis Length of Stay	11/1/2021	0.87	8.7	$4,800	$41,760	10	$417,600
Sepsis Length of Stay	12/1/2021	1.17	11.54	$4,800	$55,392	10	$553,920
Sepsis Length of Stay	1/1/2022	0.80	8	$4,800	$38,400	10	$384,000
Sepsis Length of Stay	2/1/2022	0.85	9.34	$4,800	$44,832	10	$448,320
Sepsis Length of Stay	3/1/2022	1.43	12.12	$4,800	$58,176	10	$581,760
	Annualized	1.04	9.96	$4,800	$47,784	10	**$5,734,080**

Future Data 4/1/2022 - 4/1/2023 ***							
MeasureDisplayName	Month of MeasureDate	Observed/Expected	Observed Display	Hospital expenses ($) *	Avg. patient cost	Avg. # of sepsis patients **	Total Sepsis Cost
Sepsis Length of Stay	4/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	5/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	6/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	7/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	8/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	9/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	10/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	11/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	12/1/2022	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	1/1/2023	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	2/1/2023	0.71	5.75	$4,800	$27,600	10	$276,000
Sepsis Length of Stay	3/1/2023	0.71	5.75	$4,800	$27,600	10	$276,000
	Annualized	0.71	5.75	$4,800	$27,600	10	**$3,312,000**

The observed sepsis length of stay was reduced from a baseline of 10.47 days to 5.75 days. Assuming that we can keep an observed sepsis length of stay shorter or equal to 5.75 days for the next 12 months it is predicted that this project would result in financial savings of at least **$2,422,080.00**

Total Sepsis Cost	$5,734,080
Total Sepsis Prediction cost	$3,312,000
Total savings (Predicted)	**$2,422,080**

* Hospital Expenses calculated by using a national average of $2,607.00 and adding to that the average costs of treating patients with sepsis of $2,193.00 for a total of **$4,800.00** spent in average per patient per day

** An average of **10 sepsis patients** was assigned for every month based on historical data of the pilot units

*** Future Data is a prediction, assuming the observed sepsis length of stay stays at 0.71 for the next 12months

DISCLAIMER: All financial calculations are rough estimates

Epidemiology and Costs of Sepsis in the United States—An Analysis Based on Timing of Diagnosis and Severity Level* - PMC (nih.gov)
Hospital and Surgery Costs – Paying for Medical Treatment (debt.org)