

## ORIGINAL RESEARCH

# Reducing sepsis-related unplanned 30-day readmissions at a hospital-based skilled nursing facility

Yu Wang\*<sup>1</sup>, Irma Alvarado<sup>2</sup>

<sup>1</sup>Houston Methodist Hospital, Houston, TX, United States

<sup>2</sup>School of Nursing, University of Texas Medical Branch, Galveston, TX, United States

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## ABSTRACT

**Background:** Sepsis is a common and costly medical emergency, often leading to unplanned readmissions. The purpose of this quality improvement project is to integrate staff education, every 4 hours vital signs monitoring guided by sepsis screening score, and structured response via a process map to reduce unplanned 30-day readmission rate by 25% from baseline at a hospital-based skilled nursing facility (HBSNF).

**Methods:** This project was conducted at an 18-bed HBSNF. Prior to implementing this project, all registered nurses and patient care assistants received education on sepsis. Registered nurses were also trained in the proper use of *Nursing Sepsis Management Order Set* and *How to Respond: A Patient with Suspected Sepsis Process Map*. From September 1 to November 30, 2020, the project gradually increased vital signs monitoring frequency from every 12 hours to every 4 hours based on patients' sepsis risk stratified by sepsis screening score in 3 phases. Systemic Inflammatory Response Syndrome criteria was used to identify sepsis-related unplanned readmissions.

**Results:** Overall, the 3-month vital signs monitoring compliance rate was 96% (5019/5223). The sepsis-related unplanned 30-day readmission rate was reduced from baseline 47% (17/36) to 21% (4/19) at the end of this project, about a 55% decrease from baseline.

**Conclusions:** The combination of an evidence-based electronic surveillance system and change in management strategies significantly reduced sepsis-related unplanned 30-day readmissions at this HBSNF. Dissemination of these innovations could improve sepsis management in other HBSNFs and positively impact patients' health outcomes and healthcare costs.

**Key Words:** Sepsis, Unplanned readmissions, Vital signs, Hospital-based skilled nursing facility

## 1. INTRODUCTION

### 1.1 Background and significance

Sepsis is a life-threatening medical emergency caused by body's extreme response to an infection. Each year, at least 1.7 million adults in America develop sepsis, among which 265,000 cases are fatal.<sup>[1]</sup> Sepsis is also the leading cause of unplanned readmissions in American hospitals and among nursing home residents.<sup>[2,3]</sup> New and lasting morbidity and

mortality are common after sepsis. Twenty-two percent of sepsis survivors suffer late deaths not explained by pre-sepsis health statuses<sup>[4]</sup> and about 40% of them are re-hospitalized within 90-day of discharge.<sup>[5]</sup> Older severe sepsis survivors are at higher risk for long-term cognitive impairment and physical problems. They have a higher 1-year mortality when being discharged to a skilled nursing facility (SNF) compared with those admitted to a SNF for other conditions.<sup>[6]</sup> From

\*Correspondence: Yu Wang; Email: [ywang9@houstonmethodist.org](mailto:ywang9@houstonmethodist.org); Address: 6565 Fannin St. Houston, TX 77030, United States.

calendar year 2012- 2018, among Medicare beneficiaries, the cost of SNF care for sepsis survivors rose from \$3.9 billion to \$5.6 billion.<sup>[7]</sup> Beginning on October 1, 2018, the Centers for Medicare and Medicaid Services (CMS) adjusted payments to SNFs based on their performance in unplanned 30-day readmissions.<sup>[8]</sup> Thus, it is important for organizations to examine readmission rates because of their significant quality and financial impact.

## 1.2 Literature review

The timing of sepsis diagnosis and treatment is critical. Poor sepsis outcomes are observed when diagnosis and treatment are delayed. Overall sepsis mortality is 12.5% but varies by severity: 5.6%, 14.9%, and 34.2% for sepsis, severe sepsis, and septic shock, respectively. Costs follow a similar pattern, increasing with severity level: \$16 324, \$24 638, and \$38 298.<sup>[9]</sup> For Medicare beneficiaries with a sepsis inpatient admission, the six-month mortality rates remain higher than average: 27%, 36%, and 60% for sepsis, severe sepsis, and septic shock, respectively.<sup>[7]</sup> Although the early signs of sepsis are vague and often difficult to detect, the use of an evidence-based electronic surveillance and alerting system, combined with changes in management strategies, result in earlier detection of sepsis and significant reduction in mortality and 30-day readmissions after sepsis.<sup>[10]</sup> Funded by the CMS, Houston Methodist Hospital (HMH) led the Sepsis Early Recognition and Response Initiative (SERRI) project from 2012 to 2016 to reduce sepsis-related mortality and costs. The sepsis screening tool, an achievement of this project, was created to identify sepsis risk. The leaders of the project suggested considering SNF patients with sepsis screen score  $\geq 3$  to have a high risk of developing sepsis.<sup>[11]</sup>

Changes in vital signs prior to clinical deterioration are well documented and are essential for early detection of deterioration and prevention of adverse events which may lead to unplanned readmissions.<sup>[12]</sup> The 30-day unplanned readmission rate is about 20% for patients admitted to a SNF, and 8% of patients are re-hospitalized within 48 hours of SNF admission. Among those quick returns, abnormal vital signs, altered mental status, and shortness of breath are three common reasons for readmission.<sup>[13]</sup> Among the four classic vital signs (heart rate, temperature, blood pressure, and respiratory rate), respiratory rate (RR) is a powerful predictor of disease severity and early indicator of patient deterioration. However, RR is the most neglected vital sign in clinical practice.<sup>[14,15]</sup> Furthermore, vital signs monitoring is frequently delayed or missed, particularly in high acuity patients.<sup>[16]</sup> Thus, there is a pressing urgency to re-emphasize vital signs practice.

The surviving sepsis campaign's international guidelines do

not make specific recommendations on the frequency of vital signs monitoring for management of sepsis.<sup>[17]</sup> Continuous vital signs monitoring can detect clinical deterioration in an earlier phase.<sup>[18]</sup> However, this practice usually happens in an Intensive Care Unit (ICU) or with utilization of new devices, which can be limited by resources. Although the new devices require substantial initial investment, they are promising for long-term cost-saving and cost-effectiveness because of potential shortened hospital stays, reduced hospital readmissions, and decreased mortality.<sup>[19]</sup> In resource-limited settings, the Integrated Management of Adolescent and Adult Illness guidelines, developed by the World Health Organization, recommend monitoring blood pressure, heart rate, and RR every 30 minutes to every hour in the first 6 hours of hospitalization, and every 1 to 2 hours thereafter for the next 24 hours for patients with severe sepsis or septic shock. Additionally, temperature should be measured every 6 hours. After the first 24 hours of resuscitation, vital signs monitoring is recommended to be every 8 hours to daily.<sup>[20]</sup>

## 1.3 Local problem

Houston Methodist Hospital Skilled Nursing Facility (HMH-SNF) is an 18-bed hospital-based SNF (HBSNF) within Methodist's system. It is closely connected to HMH, the academic medical center located in the Texas Medical Center. The adult/geriatric patients treated at HMHSNF are vulnerable as a result of high disease acuity. Most patients are admitted for continuing management of complicated medical problems and extensive therapy service after being discharged from HMH. These problems include but are not limited to complications after general surgery/organ transplant/stroke, heart failure exacerbation with and/or without ventricular assist device implantation, multiple drug resistant infections, complicated wound care, cancer with chemotherapy and/or radiation therapy. Most attending physicians or their nurse practitioners (NPs)/ physician assistants follow up with patients at HMHSNF at least 4-5 times per week. Each patient also has several specialists on board. During weekdays, a unit NP is on site as an extra layer of surveillance. Additionally, the HMH Rapid Response Team (RRT) backs up all rapid response events at HMHSNF 24/7. All HMHSNF patient care is provided by registered nurses with a 1:5 nurse/patient ratio. When patients need higher-level care due to deterioration, they will be readmitted to HMH.

Sepsis is the leading cause of unplanned 30-day readmissions at HMHSNF, accounting for 47% (17 out of 36) of all-cause unplanned 30-day readmissions from June 1, 2019, to March 31, 2020. Moreover, sepsis is the most common cause of organ failure and clinical deterioration among patients at HMHSNF, often leading to activation of RRT and rehospi-

talization, with 47% requiring intermediate or intensive care services at the time of readmission to HMH. The overall unplanned readmission rate at the HMHSNF has consistently approached the national benchmark since 2014. The Protecting Access to Medicare Act of 2014 requires the CMS to implement the Skilled Nursing Facility Value-Based Purchasing (SNF-VBP) program, an effort that links Medicare Part A payments to a SNF's rehospitalization rate.<sup>[8]</sup> There is an urgent need to reduce the unplanned readmission rate at HMHSNF to avoid CMS penalty since the majority of HMHSNF patients are insured by Medicare.

The commitment of efforts and resources directed towards sepsis management diminished after the SERRI project concluded at HMHSNF. There were no longer any functional sepsis champions. In addition, the sepsis screening tool was not properly used most of the time, as evidenced by many nurses choosing "I am not the appropriate nurse" when the sepsis best practice alert popped out. In the meanwhile, HMHSNF had been accepting more complicated and sicker patients over the past five years. Moreover, the early signs of sepsis are vague and often difficult to detect. Some nurses, especially new employees, rely heavily on automatic sepsis alerts which usually generate every 12 hours at HMHSNF based on the previous vital signs monitoring protocol. Furthermore, many vital signs were recorded incompletely, and respiratory rate was frequently ignored. All those may contribute to increased sepsis-related unplanned 30-day hospital readmissions at HMHSNF.

With the intention of early recognition and management of sepsis at HMHSNF and overall goal of preventing unplanned readmissions, improving quality of life, and lowering healthcare-related costs, a quality improvement (QI) project was implemented from September to November 2020. The purpose of this 3-month project was to reduce the sepsis-related unplanned 30-day readmission rate by 25% from baseline through staff education, every 4 hours vital signs monitoring guided by sepsis screening score, and structured response via a process map by November 30, 2020.

## 2. METHODS

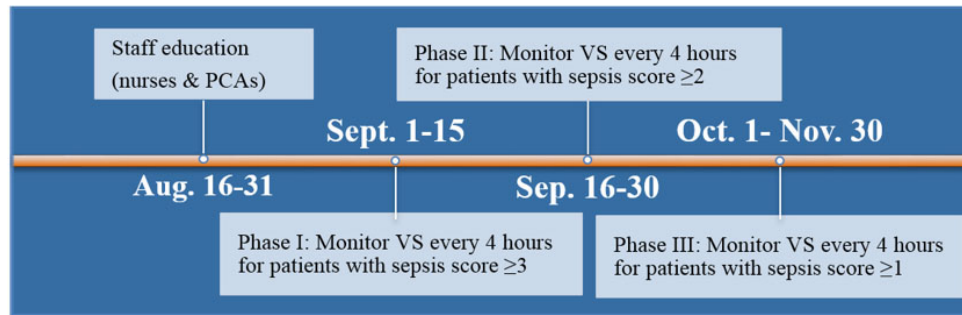
### 2.1 Interventions

The utilization of an evidence-based electronic surveillance and alerting system, combined with changes in sepsis management strategies, formed the backbone of this QI project. The project integrated staff education, every 4 hours vital signs monitoring (VSM) guided by sepsis score, and structured response via a process map. One of the authors, the unit NP, a Doctor of Nursing Practice (DNP) student at the University of Texas Medical Branch (UTMB) at Galveston,

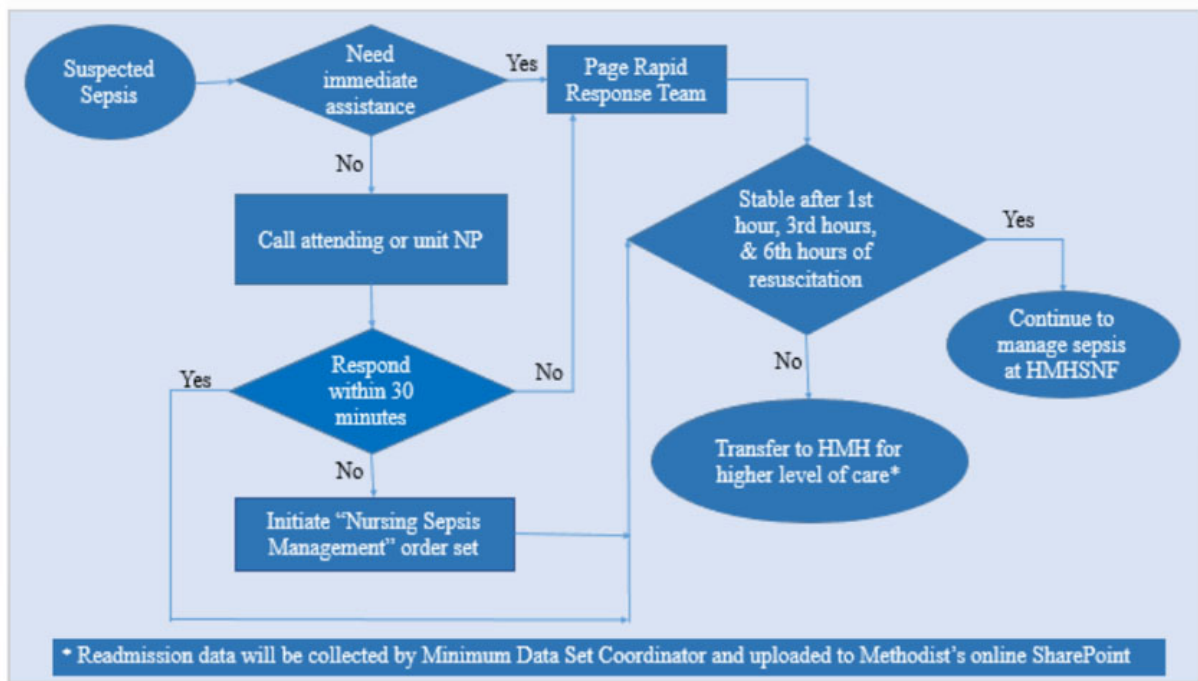
developed this QI project as her DNP scholarly practice project and obtained Institutional Review Board waivers from HMH and UTMB. Prior to implementing this project, the unit NP inquired about current VSM policy in HMH acute units with similar patient populations as those admitted to HMHSNF, since no specific VSM recommendations for SNF patients were found from Methodist PolicyTech and literature review. She spoke to HMHSNF leaders/key physicians to secure their support for increasing VSM frequency and initiating this QI project. She developed two educational packages along with pre- and post-test for nurses and patient care assistants (PCAs), respectively. From August 16, 2020, to August 31, 2020, the unit NP provided in-service for all nursing staff (bedside nurses, unit nursing director/managers, and unit minimum data set coordinator) and PCAs at HMHSNF about sepsis, unplanned readmissions, and potential clinical/financial impacts of the project.

Sepsis score is available on nurses' work lists and automatically generated from 5 variables (temperature, respiratory rate, heart rate, latest white blood cell count, and mentation) through the sepsis screening tool embedded in Methodist electronic health record (EHR) system EPIC. The sepsis scores at 8:30 am and 8:30 pm were used to stratify patients' risks for developing sepsis and guide vital sign monitoring frequency. The higher the score, the higher the risk for developing sepsis. From September 1, 2020, to November 30, 2020, the project gradually increased the number of patients being investigated from only those with sepsis score  $\geq 3$  to all patients with sepsis score  $\geq 1$  in 3 phases, except those on comfort or hospice care. For a detailed timeline, see Figure 1.

The unit NP helped all PCAs set up a "Sepsis Score" on their work list. All PCAs were instructed to immediately report to nurses about temperatures  $< 96.8$  or  $> 100.4$  °F, heart rate  $> 90$ , respiration rate  $> 20$ , systolic blood pressure (SBP)  $< 90$  mmHg or SBP decreases by 40 points from baseline, acute alteration of mental status, or shortness of breath. For each case of suspected sepsis, if the patient is unstable and needs immediate provider's attention, the nurse is instructed to page RRT; otherwise, the nurse should notify the attending physician or the unit NP. If there is no response after 30 minutes of initial contact, the nurse should initiate *Nursing Sepsis Management Order Set* (see Appendix A) per Methodist protocol. The order set includes establishment of intravenous (IV) access, monitoring vital signs every 1 hour, collection of blood and urine for lab work and culture, and consultation of sepsis response team. If the patient's condition worsens during this time, page RRT immediately (see Figure 2).



**Figure 1.** Project timeline  
PCAs: patient care assistants; VS: vital signs.



**Figure 2.** How to respond: A patient with suspected sepsis (Process Map)

**2.2 Measures**

The sepsis-related unplanned 30-day readmission rate is the outcome measure. Sepsis is defined by the presence of two or more signs of the systemic inflammatory response syndrome (SIRS) when there is a documented or suspected infection (Appendix B). The unit NP 1) extracted the medical record numbers of unplanned 30-day readmissions between September 1 and November 30, 2020 from HMHSNF SharePoint, where all planned and unplanned readmissions from HMHSNF to HMH were recorded; 2) explored EHRs and analyzed all those unplanned 30-day readmissions; 3) used sepsis definition to identify sepsis-related ones; 4) examined the level of care (LOC) required at unplanned readmissions such as general ward acute care, intermediate care, and intensive care.

Staff training participation rate prior to implementation of the project and VSM compliance rate are two process measures. Both can show whether the steps in the system are performing as planned to affect the outcome measure. Vital signs are tracked for clinical changes, which trigger escalation towards intervention. During implementation of the project, the unit NP audited VSM compliance daily. A full set of vital signs includes temperature, heart rate, respiratory rate, blood pressure, and oxygen saturation. Missing any component will be counted as non-compliant. However, compliance will still be counted if patients refuse to have their vital signs checked.

Percentage of post-sepsis readmissions requiring general ward acute care is used as a balancing measure. Readmissions to general ward can be problematic because the interventions designed to improve sepsis recognition may trigger

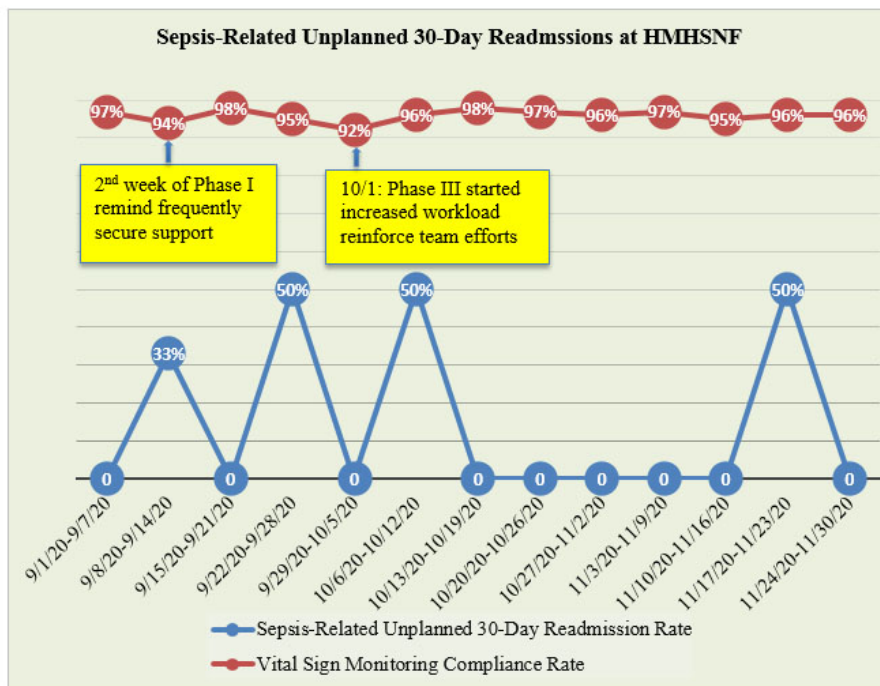
more alerts at early stages of sepsis. Patients at these stages can be potentially treated at HMHSNF, but are actually readmitted to HMH general wards per provider’s preference.

### 3. RESULTS

Throughout the course of the project, 102 unique patients qualified for every 4 hours VSM based on their sepsis score at 8:30 am and 8:30 pm. The ages ranged from 20 to 97 years, and the mean was 70.9, with 52% female and 48%

male distribution. Overall, the 3-month VSM compliance rate was 96% (5019/5223). The sepsis-related unplanned 30-day readmission rate was reduced from 47% (17/36) to 21% (4/19).

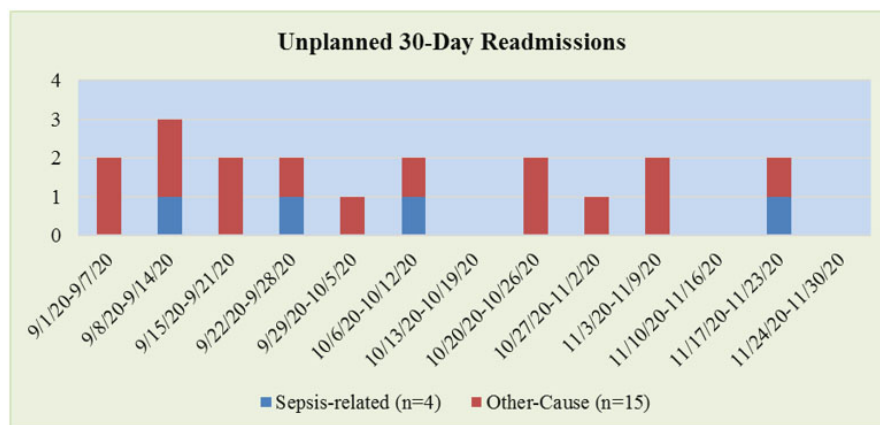
A run chart was used for analysis of sepsis-related unplanned 30-day readmission rate (the outcome measure) and VSM compliance rate (one of the process measures) (see Figure 3).



**Figure 3.** Sepsis-related unplanned 30-day readmission at HMHSNF

Since both weekly number of sepsis-related readmissions (numerator) and all-cause unplanned readmissions (denomi-

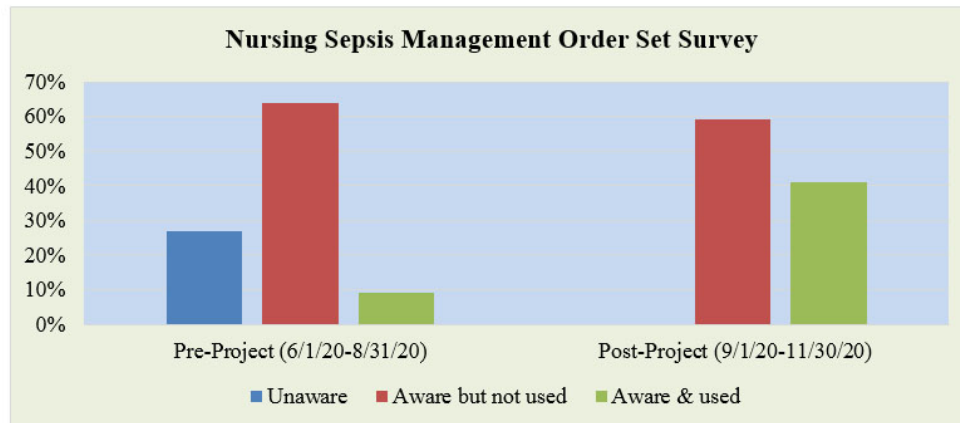
ator) were small, a stacked column chart was used to examine improvement (see Figure 4).



**Figure 4.** Sepsis-related vs. other-cause-triggered unplanned 30-day readmissions

All staff (nurses and PCAs) attended the educational in-service prior to the beginning of the project. The pre- and post-survey of *Nursing Sepsis Management Order Set Awareness* was used to investigate whether nurses were aware of

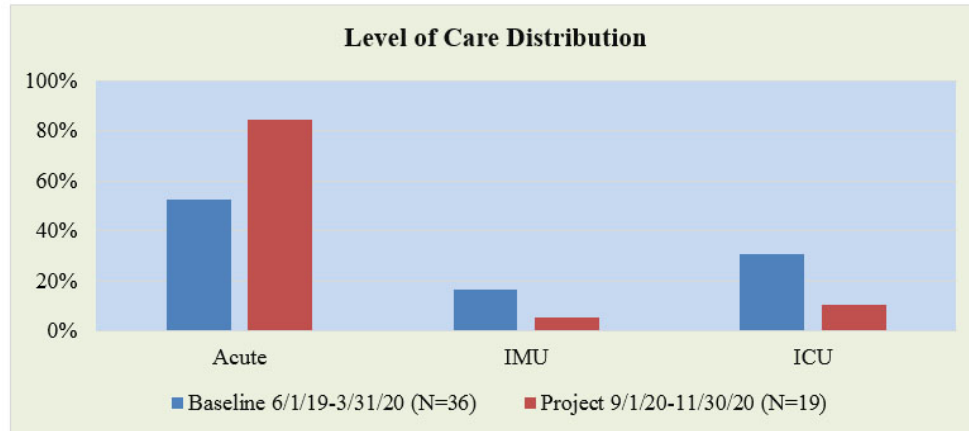
the order set and how often they used the order set in the past 3 months. The pre- and post-survey results were displayed in clustered columns (see Figure 5).



**Figure 5.** Nursing sepsis management order set awareness and usage survey

Among those 19 unplanned readmissions, 16 were readmitted to general wards for acute care, 1 was readmitted to intermediate care unit (IMU), and 2 were readmitted to intensive care unit (ICU). The balancing measure, percentage

of post-sepsis readmissions requiring general ward acute care, was compared with baseline and displayed as clustered columns (see Figure 6).



**Figure 6.** Level of care requested at unplanned readmissions

#### 4. DISCUSSION

The baseline data was analyzed from June 1, 2019, to March 31, 2020, instead of more recently because of the COVID-19 pandemic. The pandemic started roaming in the United States in March 2020. It has changed not only hospitals' practice focuses but also patient populations. HMHSNF saw its first COVID-19 case in April 2020, which had to be readmitted to hospital per state requirement. From September to November 2020, the second surge of COVID-19 was flattened in Methodist hospitals. The patients admitted to

HMHSNF were similar to the ones admitted from baseline time period. Many projects not directly related to COVID were able to be carried out in Methodist, this project being one of them.

The balance measure, defined as readmissions requiring general ward acute care, was increased from 52.7% (19/36) to 84.2% (16/19). This may be explained by earlier recognition and reflects the unique patient composition at HMHSNF. Due to the interventions designed to improve sepsis recognition, more alerts were triggered at earlier stages that could be

potentially treated at HMHSNF. However, providers' preferences resulted in an inclination towards readmission to HMH general wards, especially among transplant providers. Literature review found that solid organ transplant (SOT) recipients are at higher odds for unplanned readmissions.<sup>[21-23]</sup> This pattern was clearly observed in this QI project: 56.3% (9/16) of readmissions requiring acute care were post-SOT recipients. In addition, 66.7% (2/3) of readmissions requiring intermediate/intensive care were post-SOT recipients, too. This finding could reflect that SOT recipients have more pre-transplant comorbidities and post-transplantation complications compared to non-SOT patients.<sup>[24]</sup> In addition to these issues, studies found SOT recipients who are discharged to post-acute care facilities (SNF or rehabilitation facilities) have significantly increased risk for readmission compared to those discharged home.<sup>[25]</sup> Although readmission among SOT recipients is common and costly, more studies are needed to find clear strategies to prevent most of those readmissions, especially those admitted to post-acute care facilities.

The lowest VSM compliance rate was 92% when the third phase of this project started. This prompted an immediate investigation. The investigation found there was a significant increase in workload due to more patients qualifying for every 4 hours VSM (3-5 patients at phase II vs 13-16 patients at phase III per shift, on average). In addition, nurses and PCAs disagreed on who should monitor vital signs and hold accountability when VSM was not completed as planned. Nurses were informed that they should hold accountability per Rule §224.5 RN Accountability for Delegated Tasks. Moreover, teamwork was reinforced by the unit director and managers. With continuous feedback and reinforcement, the overall every 4 hours VSM compliance rate reached 96%, surpassing the expected 90%. Due to significant decrease in sepsis-related unplanned 30-day readmission rate, the unit director decided to expand every 4 hours VSM to all patients at HMHSNF and include sepsis education in annual competencies check-ups for nurses and PCAs. The substantiality of the project is hardwired by change in unit vital signs protocol, improvement of knowledge, and increase in usage of the structured sepsis process map.

#### 4.1 Limitations

The significant limitation of the project is the particular setting. The setting is a HBSNF with strong organizational support and resources. For instance, all patients are taken care of by registered nurses with a 1:5 nurse-patient ratio and covered by 24/7 RRT for rapid response events. However, many other SNFs may not have such a degree of staffing. In addition to frequent physician visits, the unit NP works 4 days per

week at this 18-bed unit, serving as visionary and operational leader with frequent interaction with staff and management to influence behavior change and team engagement. Therefore, it may be much more of a challenge for other SNFs, especially community-based SNFs (CBSNFs), to implement the quality improvement initiatives in this project if they lack the infrastructure or resources. The unique patient populations may also limit the dissemination of the project to other SNFs. For instance, SOT patients account for a large portion of unplanned readmission in this project. Other SNFs may lack interest in replicating the intervention if they have different patient populations. Furthermore, HMHSNF is closely connected to HMH, so readmission is relatively easy, which may have increased the number of readmissions compared to CBSNFs. A CBSNF may choose to attempt to manage a septic patient for longer if transferring to a hospital is not as easy as with HMHSNF.

The other limitation was unplanned readmission identification. This project only tracked unplanned 30-day readmissions from HMHSNF to HMH. If the patient is discharged from HMHSNF to the community and then re-hospitalized within 30 days of discharge, they will not be tracked/included in this project. The financial impact and improvement of patients' health outcomes were triggers to start this project. However, no measurements for these were included and could be considered for more in-depth analysis into this project in the future.

#### 4.2 Implication

While the importance of monitoring vital signs in clinical practice is indisputable, the optimal practice is yet to be determined. Although vital signs are currently measured on a routine basis in post-acute care facilities, there is a lack of research in vital signs monitoring for patients in those facilities, including HBSNFs. A systematic analysis only found two studies detailing intermittent vital sign monitoring. Both studied populations consisting of adult patients in hospital wards and in emergency departments, and both were retrospective analyses of pre-existing cohorts with complete heterogeneity.<sup>[14]</sup> Furthermore, how frequent vital signs should be measured in general wards varies among experts.<sup>[26]</sup> Some suggest vital signs monitoring frequency should be based on patient acuity and clinical assessment.<sup>[27]</sup> By exploring optimal vital sign practice in sepsis early recognition and prevention of avoidable readmissions, this QI project will provide an evidence-based perspective for vital sign frequency practice at HBSNFs. To adopt this evidence-based practice, most post-acute care facilities, especially HBSNFs, will need to check vital signs more frequently, which may increase the need for PCAs. However, considering the mean cost of

\$10,070 per unplanned 30-day readmission for sepsis,<sup>[2]</sup> the cost of PCAs should be viewed as a promising investment for long-term cost-saving and cost-effectiveness - after all, the average hourly pay for a PCA in the United States, who can take care of up to 7 patients in the same shift, is about \$16 an hour.<sup>[28]</sup> More importantly, the patient's hospital stay will likely be shortened due to a better health outcome. In short, dissemination of the innovations could improve sepsis prevention and management for patients in post-acute care facilities and positively impact health outcomes, costs, and reimbursements.

## 5. CONCLUSION

With the intention of early recognition and management of sepsis, this 3-month QI project integrated staff education, every 4 hours VSM, and structured response. The sepsis-related unplanned 30-day readmission rate at HMHSNF was significantly reduced from baseline 47% to 21%. Through

exploring optimal vital sign practice in sepsis early recognition and prevention of avoidable readmissions, the project will provide an evidence-based perspective into an ad hoc vital signs practice. In addition, dissemination of innovations has potential to improve sepsis prevention and management for patients admitted into SNFs, especially hospital-based ones.

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## CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest.

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