Resource Optimization in the Intensive Care Unit Setting: A Staff Education and Scheduling Pilot Study to Improve Treatment Decisions and Staff Satisfaction

Study Protocol

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Project Title: Resource Optimization in the Intensive Care Unit Setting: A Staff Education and Scheduling Pilot Study to Improve Treatment Decisions and Staff Satisfaction

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PART 1: INTRODUCTION

Intervention Description

This intervention pilot study has been developed for Intensive Care Unit (ICU) physicians and nurses by the Resource Optimization Network (RON) for implementation in The Ottawa Hospital (TOH) Civic Campus and the Montfort Hospital. The intervention targets ICU staff and is designed to reduce overall costs associated with ICU health care service delivery and improve staff satisfaction through reducing stress and associated burnout without sacrificing quality of care and patient outcomes. The intervention involves two components that (a) build ICU staffs' (i.e. physicians and nurses) knowledge to facilitate cost-effective and evidence-based decision-making about patient care (including tests, treatments, and procedures); and (b) optimize nurse scheduling to ensure the presence of the appropriate number of nurses per shift, thereby reducing stress, burnout and limiting the need for overtime. To evaluate the impact of the intervention, a pre/post-intervention design will be employed, with a 3-month pre-intervention period, followed by a 6-month intervention period and a 3-month post-intervention period.

Rationale for the Intervention

It is estimated that care provided in the ICU in Ontario is approximately three times more costly compared to hospitalization in a regular ward, as patients in the ICU present complex and severe clinical issues that require intensive monitoring and the use of multiple health care resources. For instance, in Ontario, the average daily cost in the ICU at a teaching hospital is valued at $4,186, while an acute care bed costs $1,492 per day (1). With increasing life expectancies and an aging population in Canada, resource consumption in the ICU is expected to rise due to issues such as increasing complexity of conditions, need for increased surveillance and monitoring, and prolonged duration of stay in the ICU (2). According to data estimates by the Canadian Institute of Health Information (CIHI), it is predicted that by 2026, ICU usage may increase up to 80% (3).

Recently at TOH, expenditures have exceeded the annual budget and subsequent staffing changes have resulted in fewer positions for allied health professionals (e.g. physiotherapists, social workers) who often contribute significantly to improved and more efficient care of patients

in the ICU. Due to the elimination of such positions, ICU physicians and nurses are expected to take on more responsibilities in the ICU settings. These changes however may have contributed to the recently reported increased rates of absenteeism as well as burnout among ICU clinicians (4). This also has implications for patient care and hospital costs with several studies revealing clinical impacts of burnout to include decreased well-being, increased sick leave and lower self-rated performance among ICU staff (5,6). Furthermore, in 2016, it was estimated that the costs associated with nurse absenteeism and overtime totalled over $536 million[7]in Ontario (7).

Our research group (the RON) has studied a number of ICU interventions that have shown positive outcomes in terms of reducing costs while maintaining or even improving care. These include initiatives such as early palliative care involvement, early tracheostomy, and intensivist staffed NACU that once implemented, resulted in reduced ICU spending (8–10). In addition, Choosing Wisely Canada has launched a campaign to increase awareness around the appropriate use of clinical and treatment resources in critical care units by engaging and supporting health care professionals to take leadership in identifying and reducing unnecessary tests, treatments and procedures that are not supported by evidence and could harm patients (11). In terms of reducing burnout among staff, a systematic review investigating job satisfaction among critical care nurses found that shift worked and staffing were significantly correlated to critical care nurses' job satisfaction (12). Therefore, initiatives to optimize scheduling that effectively address staff burnout resulting from too much work with inadequate recovery are needed. We propose that the adoption of such programs in the ICU may result in savings of approximately one million dollars per year for both TOH and the Montfort Hospital.

The specific objectives of this intervention study are to:

1. Reduce ICU costs by reducing unnecessary ICU tests, treatments, and procedures and reducing the use of overtime
2. Improve staff satisfaction through reducing staff stress and burnout by optimizing staff scheduling

PART 2: DESCRIPTION OF INTERVENTION

Intervention Population

The intervention will target ICU staff, with one component geared generally for ICU staff (i.e. physicians and nurses) and one component geared specifically for ICU nurses.

Staff inclusion criteria: Employees who are a) aged 18 years or older; and b) providing direct patient care in the ICU at the Civic Campus of the Ottawa Hospital or the Montfort Hospital as a physician or nurse.

Recruitment

In order to recruit ICU staff for participation in the educational workshops, a recruitment email invitation will be sent to all eligible ICU staff (i.e. physicians and nurses) and posters will be posted in staff breakrooms and high traffic zones (i.e. washrooms, ICU hallways). These recruitment invitations will explain to staff that participation in all intervention activities is voluntary and light refreshments will be provided. The email will also inform staff that the workshop will be held during a routine departmental meeting thereby maximizing convenience to promote participation.

Setting

This is a multicenter study. Study sites include the ICUs at two teaching hospitals in Ottawa: The Ottawa Hospital, Civic Campus and the Montfort Hospital.

Intervention Components

During an initial project meeting, the RON, a multidisciplinary team that includes experts in clinical ICU, analytics and scheduling, health economics and human factor engineering collaborating across various disciplines (nursing, pharmacy, physiotherapy, administration and management) evaluated the current status of the ICU service delivery, clinical outcomes and associated costs. Based on this, the team identified areas that could be easily modified while having a significant impact and designed relevant interventions to address areas best-suited to the ICUs at The Ottawa Hospital - Civic Campus and the Montfort Hospital (i.e., factoring in the culture of the ICU in their decisions).

There are two specific components that will be implemented concurrently over the 6-month intervention period, one targeted for ICU staff (i.e. physicians and nurses) and one targeted specifically for ICU nurses.

Component 1 – Educational Workshop: An educational workshop to increase ICU staffs' (i.e. physicians and nurses) awareness of the current Choosing Wisely Canada Critical Care strategies and recommendations to facilitate cost-effective and evidence-based decision-making about patient care (including tests, treatments, and procedures).

Component 2 - Optimizing Staff Scheduling: A strategy to optimize staff scheduling for ICU nurse (e.g. "staffing up" approach where more staff will be scheduled) in order to reduce overtime, absenteeism, stress and burnout of ICU nurses.

We propose that the adoption of such programs in the ICU may result in savings of approximately one million dollars per year for both TOH and the Montfort Hospital. The two intervention components will be implemented with ICU staff members over the 6-month intervention period.

PART 3: EVALUATION PLAN

Goals of Evaluation

To evaluate the impact of this multicenter intervention, a pre/post-intervention design will be employed, with a 3-month pre-intervention period followed by a 6-month intervention period and a 3-month post-intervention evaluation period.

The evaluation will assess the extent to which the intervention achieves its' objectives. The results of the evaluation will help determine: (1) intervention effectiveness in reducing overall costs associated with ICU health care service delivery and reducing staff stress and burnout and (2) intervention feasibility.

We will evaluate the following study outcomes:

1. Primary outcomes: The primary outcomes of focus are ICU costs and ICU quality metrics.
2. Secondary outcomes: The secondary outcomes of focus are patient outcomes, ICU medical procedures, staff absenteeism, staff stress levels and burnout, and stakeholder perceptions.

Methods

Respondents

The evaluation will involve collecting data from intervention participants, namely ICU staff at the Ottawa Hospital Civic Campus and at the Montfort Hospital.

Staff inclusion criteria: Employees who are a) aged 18 years or older; and b) providing direct patient care in the ICU at the Civic Campus of the Ottawa Hospital or the Montfort Hospital as physicians, nurses, or allied health professionals (e.g., respiratory therapists, occupational therapists).

Stakeholder staff inclusion criteria: Employees who are a) aged 18 years or older; and b) whose roles provide them with direct knowledge of the ICU at the Civic Campus of the Ottawa Hospital or the Montfort Hospital and the interventions implemented during the study period (e.g., nurse managers, ICU managers, medical site lead).

Hospital administrative data, including patient data from all patients who are a) aged 18 years of older; and b) admitted to the ICU at the Civic Campus of the Ottawa Hospital or the Montfort Hospital during the 6-month study period will be collected to assess intervention effectiveness.

Sample Size

Patient Data: Based on historical data from TOH, we conservatively estimate there will be 120 potentially eligible patients admitted to the ICU at the Civic Campus per month. We therefore anticipate that data will be collected from approximately 360 patients in the 3-month pre-intervention and 3-month post- intervention phases, respectively, and 720 patients during the 6-month intervention phase, equating to a total sample size of 1440 patients accrued over 12 months. At Montfort we estimate that the total sample size will be 500 patients over 12 months.

Of note, the data collected during the intervention period will not be included in the pre-post-intervention analyses. However, it will be used for quality assurance (i.e., stopping rules during interim analysis) and to further contextualize changes using run charts, as needed (e.g., of albumin use).

ICU Staff: Currently, there are approximately 194 staff members (i.e., intensivists, fellows, nurses, allied health professionals) providing direct patient care in the ICU at the Civic Campus and 50 staff members at Montfort. Based on previous research on survey and questionnaire response rates (13), we anticipate that at each time point (i.e., pre and post-intervention), 30% of ICU staff will complete the questionnaire, for a total sample size of approximately 58 respondents at TOH and 15 respondents at Montfort per time point.

ICU Stakeholder: We will aim to recruit between 5 to 10 relevant ICU stakeholder staff members at TOH and 3-5 staff members at Montfort (i.e., nurse managers, ICU managers, medical site

lead) for the post-intervention interviews. This sample size will ensure sufficient representation of stakeholder experiences, while bearing in mind the feasibility and time-involvement of qualitative data collection. These stakeholders will be purposefully sampled in order to ensure they are sufficiently information-rich (i.e., have knowledge of the ICU and the interventions that were implemented during the study) (14).

Recruitment

Recruitment for the online survey will take place via email, whereby all eligible ICU staff (i.e. physicians and nurses) will be sent an email containing a recruitment invitation and link to an online questionnaire during the pre-intervention and post-intervention periods. They will be informed that their participation is voluntary, and that informed consent will be obtained prior to gaining access to the survey. Specifically, the link with take participants to a consent form online, where they must agree to participate in order to access the questionnaire. To maximize recruitment, incentives will be offered for the both the pre and post-intervention surveys. Specifically, at both time-points (pre/post intervention), staff who complete the questionnaire will be entered into a lottery draw for 2 Amazon gift cards valued at $250 each.

During the post-intervention period, relevant stakeholders will be identified by the study team and purposefully selected to participate in the semi-structured interviews. A study invitation will be emailed to these stakeholders directly. It will be made clear in the invitation that their participation is completely voluntary, and that informed consent will be sought at the time of the interview.

Data Collection

i. Tools

A mixed-methods approach to collect data will be utilized. Quantitative data will be collected at 3-timepoints: 3-month pre-intervention, 6-month intervention period and 3-month post-intervention. Qualitative data collection will be collected at intervention conclusion. Data collection techniques include: (1) hospital administrative data, including patient data collected from TOH Data Warehouse and Montfort's Department of Archives and Decision Support (2) a questionnaire comprised of validated instruments for ICU staff, (3) a post- educational workshop evaluation survey, and (4) key stakeholder interviews with ICU staff post-intervention.

Quantitative Data

1. TOH Data Warehouse and Montfort's Archives: We will use data collected from TOH Data Warehouse and Montfort Archives to measure costs, patient quality metrics, ICU medical procedures and staff absenteeism during the study period.

    ICU costs: Case costing will be used to determine the costs associated with ICU care during the study period, including: a) ICU total costs; b) ICU direct costs (i.e., all expenses to the hospital with fee codes linked to patient chart); c) ICU indirect costs (i.e., any overhead operational fees associated with service provided to patient); d) ICU cost/patient.

ICU Quality Metrics: The following outcomes will be included to evaluate the quality of ICU patient care during the study period: a) ventilator associated pneumonia; b) central line infections; c) C. difficile; d) number of patients receiving early mobilization

Patient outcomes: include a) length of stay (LOS); b) in-hospital mortality; c) patient and family satisfaction.

ICU medical procedures: Outcomes related to ICU medical procedures targeted in the educational intervention component will also be evaluated during the study period, including: a) albumin use; b) mechanical ventilation; c) chest radiographs; d) transfusion of red blood cells.

Staff absenteeism: We will collect data on ICU full-time staff absenteeism during the study period from the Data Warehouse and Montfort Archieves.

2. Questionnaire: We will use an online questionnaire to evaluate ICU staffs' levels of stress and burnout. A self-administered online questionnaire taking approximately 15-20 minutes to complete will be used to obtain/assess pertinent demographic variables information (i.e., age, sex, ICU role [physician, resident, fellow; nursing; allied health]). Two instruments will be used to measure ICU staffs' level of perceived stress and job burnout.

   The Perceived Stress Scale (PSS) (Appendix 1) (15) consists of 10 questions and is the most widely used psychological instrument for measuring perceptions of stress. The scale includes a number of direct questions to assess current levels of stress experienced and was designed to be non-content specific to any subpopulation.

   The Maslach Burnout Inventory (MBI) (Appendix 1) (16) consists of 22 questions composed of three dimension that make up the construct of burnout: emotional exhaustion, depersonalization, and personal accomplishment. The MBI is the most widely used tool to measure burnout among professionals in the human services and has been validated in studies involving ICU nurses and physicians (5,6,17).

3. Post-educational workshop survey: A short survey will be handed out to participants in-person at the end of the educational workshop and emailed the day after. A sign-up sheet will be circulated at the beginning of the workshop to collect participants information including name, title and email address. Participant information collected will solely be for the purpose of sending the post-educational workshop evaluation survey. Participation in the workshop in no way obligates participants to respond to the survey. The survey will be voluntary and has been indicated as such in the Educational workshop consent form.

Qualitative Data

1. Semi-structured interviews with Stakeholders (staff): Post-intervention semi-structured interviews will be conducted with staff stakeholders by trained research staff and will use an interview guide to assess the stakeholders' perceptions of the intervention outcomes. Stakeholders will be asked about their knowledge of the interventions implemented during the study period, their perceptions of the outcomes of these interventions, and any perceived changes in ICU care delivery in time period that corresponds to the post-intervention phase of the study. The interview will last approximately 30 minutes and will be digitally-recorded and transcribed.

ii. Ethical practices and confidentiality of data

Steps will be taken to ensure that ethical standards for research involving human participants are followed.

The MRN of included patients will be required in order to link to OHIP numbers. Research staff will not see the OHIP numbers as they are added by the Performance Measurement designate as part of the transfer process.

For both quantitative and qualitative data collection, written consent informing respondents of interview procedure, risks and benefits, and measures of confidentiality will be obtained at the time of the interview or survey dissemination (18). Respondents will be briefed on the research purpose, and request to audio-tape for transcription (for interviews) and reminded of the voluntary nature of participation. Respondents will be reminded of the voluntary nature to share experiences, their right to refuse to answer or skip a question and withdraw at any point during or after the interview. Lastly, the form will offer the principal researchers' name and contact information. Consenting will be conducted in accordance with N2 SOP-008-06 – Informed Consent Process. At the start of the interview, the research staff member conducting the interview will introduce themselves, confirm the identity of the staff member, and review the study details with the participant in a quiet, private location of their choosing (when possible). The participant will be fully informed of all pertinent aspects of the research in non-technical language. The participant will be provided with a copy of the informed consent form and given time to read the form and ask questions. The research staff member will confirm understanding by asking questions about the material. Finally, two copies of the informed consent form will be signed by both parties, with a copy given to the participant and the other retained by the research staff member.

Confidentiality measures included: a unique identification number assigned to participants to ensure full de-identification in reports, transcriptions, analysis and audio files. The electronic list linking participant names with their study ID and the digital audio-recordings of the interviews will be encrypted and only authorized research team members will have access to the files. Audio files will be stored on an encrypted external drive and deleted at the end of the intervention. Identifiable variables, such as name, occupation, and ethnicity, will be removed from transcripts. Consent forms will be stored separately by the principal researcher in a locked filing cabinet. Data files will only be accessible to research personnel.

The staff satisfaction questionnaire will be anonymous and no identifying information will be collected from participants. This multicenter study will be coordinated by the Principal Investigator. Data will not be transferred between institutions and no TOH PHI or PII will be shared externally with the Montfort Hospital.

Sign-up sheets circulated at the beginning of the Education workshop to collect participants information including name, title and email address will solely be for the purpose of sending the post-educational workshop survey. Sign-up sheets will be destroyed immediately after sending the follow-up emails.

iii. Data Analysis

Pre-post intervention analyses will be conducted to evaluate the outcomes of the intervention. Specifically, t-tests will be used to test for differences in continuous outcome measures, while

differences between categorical variables will be assessed using $\chi 2$ tests. Chi squared tests and t-tests will also be used to compare patient characteristics in the pre and post intervention periods to examine potential covariates (e.g., patient demographics, comorbidity scores). Based on these sensitivity analyses, multivariate regression models will be run to adjust for covariates in the study outcomes. A p-value < .05 will be considered statistically significant.

Interim analysis will be performed 3-months after the intervention period begins. The results of this analysis will be presented to a Data Safety Monitoring Board.

Post-intervention interviews with ICU staff members will be digitally recorded and then transcribed verbatim. A thematic analysis will be performed wherein the qualitative data will be coded and categorized into larger themes describing stakeholders' satisfaction and perceptions of the intervention outcomes (19).

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