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Impact of Geographical Cohorting in the ICU: An Academic Tertiary Care Center Experience

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Objectives: ICU is a multifaceted organization where multiple teams care for critically ill patients. In the current era, collaboration between teams and efficient workflows form the backbone of value-based care. Geographical cohorting is a widespread model for hospitalist rounding, but its role in ICUs is unclear. This study evaluates the outcomes of geographical cohorting in a large ICU of an Academic Health Center.

Design: This is a retrospective analysis of quality metrics collected 12 months pre- and post-implementation of geographical cohorting.

Setting: A total of 130 bedded ICU at tertiary academic health center in Midwest.

Patients: All patients admitted to the ICU.

Interventions: Our institution piloted the geographical cohorting model for critical care physician rounding on September 1, 2018.

Measurements: The quality metrics were categorized as ICU harm events and ICU hospital metrics. Team of critical care providers were surveyed 12 months after implementation.

Main Results: The critical care utilization in the pre- and post-implementation numbers were similar for patient days (pre = 34,839, post = 35,155), central-line days (pre = 17,648, post = 19,224), and Foley catheter days (pre = 18,292, post = 17,364). The ICU length of stay was similar (4.9 d) in both pre- and post-intervention periods. Significant reduction in the incidence of *Clostridium difficile* infection (relative risk, -0.50; 95% CI, 0.25–0.96; $p = 0.039$),

hospital-acquired pressure injury (relative risk, -0.60; 95% CI, 0.39–0.92; $p = 0.020$), central line-associated bloodstream infection incidence (relative risk, -0.19; 95% CI, 0.05–0.52; $p = 0.008$), and catheter-associated urinary tract infection (relative risk, -0.52; 95% CI, 0.29–0.93; $p = 0.027$). Healthcare providers perceived optimal utilization of their time, reduced interruptions, and improved coordination of care with geographical rounding.

Conclusions: Geographical cohorting improves coordination of care, physician workflow, and critical care quality metrics in very large ICUs.

Key Words: burnout; collaboration of care; critical care quality metrics; geographical cohorting

ICUs are complex and high-cost spaces in a hospital system along with high acuity of patients. Due to the complexity of the ICUs, there is a constant search for “holy grail” of physician rounding models to enhance collaboration of care, reduce healthcare personnel burnout, and improve mortality in current era of value-based care. ICU care models over the last several decades have evolved. ICU physician role has transformed from being a consultant (open format) to becoming the primary caregiver (closed ICU), a change that has shown improvement in patient outcomes (1). Although, effects on length of stay and indirect reduction of cost are equivocal within different studies (2, 3). Leapfrog initiatives were introduced with similar ideology (4, 5). The momentum is growing for 24/7 intensivist staffing models, especially in level 1 critical care units (6) and majority of these models have demonstrated cost savings by reducing length of stay and efficient utilization of ICU resources (5).

ICU physicians along with direct patient care have myriad of other responsibilities including patient triage, responding to codes and other emergent situations, medical student and resident teaching, and administrative duties (7). The workforce requirements and workloads vary between institutions. The high acuity and unpredictability inherent in the ICU setting seeds frustration and dissatisfaction which could lead to burnout syndrome (BOS). The juggling of these activities in limited time coupled with high demands of patient care result in a high prevalence of BOS among critical care health professionals (7). The BOS impacts the entire

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workforce of critical care including intensivists and ICU nurses (8). Emerging literature has cited perceived lack of control and rapidly changing daily work as modifiable risk factors for BOS (9). Organization level interventions that could modify the aforementioned risk factors have a higher likelihood of reducing burnout than individual-level interventions, along with the potential of efficient scalability. Many national and local staffing strategies incorporating organizational level interventions have been implemented to reduce BOS among intensivists (9).

Geographical cohorting (Gch) is defined as limiting physicians to a single geographical location, is a well-established organizational level intervention. It has been successfully implemented among the hospitalist workforce with improved quality outcomes and coordination of care (10). At present, the application and impact of Gch on critical care outcomes remain unexplored. Our academic health center piloted this physician-staffing model in the ICUs. Herein, we present our results outlining the barriers to implementation of Gch and its impact on quality of care at a tertiary care ICU.

MATERIALS AND METHODS

This is a retrospective study of quality metric data from a 130-bed ICU with an average of 150 ICU admissions per month at an academic, tertiary care center, affiliated with Indiana University School of Medicine. Gch was implemented on September 1, 2018. The quality metrics were compared pre and post 12-month time after the September 1, 2018, implementation date. The study was approved by the Institutional Review board.

The healthcare providers—physicians and advance providers were surveyed 12 months after model implementation. The survey was distributed in the monthly meeting and collected at the end. The responses were anonymous.

Nongeographical Physician Staffing

Our ICU classifies as a “very large ICU (> 30 beds) (11). The staffed beds are spread across five separate floors within two buildings. Nursing units are categorized based on specialty care provided—cardiovascular critical care, neurocritical care, surgical trauma critical care, cardio-medicine critical care, and multispecialty ICU critical care. Pre-implementation of Gch, each nursing unit had an average of 5–6 teams sharing patients. The ICU provider team consisted of a critical care physician, medical students, residents, and nurse practitioners. ICU provider teams cared for patients across all the ICUs.” Other members of the multidisciplinary team, including pharmacist, social worker, nurses, and case manager, were stationed on the nursing units. The patients were assigned to the nursing units depending on the specialty care needed and availability of beds. The admissions center allocated the patients to ICU team depending on area of interest or census of the team.

Pre-implementation, a typical ICU of 23 beds would have five physicians led teams sharing patients and resources. The physicians were spending significant time traveling among floors for patient care. Nurses were spending significant time identifying the correct team for communication. Due to the spread-out catchment area for each ICU team, the daily huddle scheduling was inconsistent

with delaying of time-sensitive communication. Communication was occasionally stacked and triaged by the nurses.

These pitfalls were identified based on verbal discussions with various stakeholders including—nurses, case managers, social workers, pharmacists, and comanaging surgical teams (**Box 1**).

Implementation of Geographical Cohorting

The ICU leadership, including medical directors and nursing managers, agreed to pilot Gch for intensivist rounding. The Gch model resulted in the implementation of the ICU teams consisting of physicians, residents, or students with advanced practice providers to be geographically limited to a single nursing unit. The ICU physician was stationed for 3 months, whereas other team members rotated monthly. The significant difference post-implementation was that only 2–3 ICU teams shared patients in a nursing unit as compared with 5–6 teams in the previous model. **Figure 1** describes the transition of the rounding model.

Nursing managers collaborated with assigned physicians to formulate protocols. In comanaged critical care units (cardiovascular and neurocritical care), the service lines sent notification introducing the designated physician. It reduced the variability and the number of physicians to communicate. The physician was briefed on the “nuts and bolts” of specific ICU. They were accountable for the coordination of care with multidisciplinary teams and consultants. Physicians were assigned to the medical units based on specializations (i.e., neurocritical care certification, trauma certification) and areas of interest.

Daily ICU huddles addressed protocols, treatment, and concerns. These were scheduled around physician’s availability encouraging participation. Nurses, physical therapists, occupational

Box 1. Pitfalls of Previous Model Identified by Stakeholders (Personal Communication)

Stakeholders
Physician
Traveling between floors
Sharing resources, e.g., ultrasounds
Time crunch
Teaching medical learners
Patient bumped to different critical care units
Compensation
Huddle times
Consulting team
Communication with critical care team
Premature transfers
Nursing/pharmacy/case managers
Identification of primary team
Communications with physician
Huddle times overlap

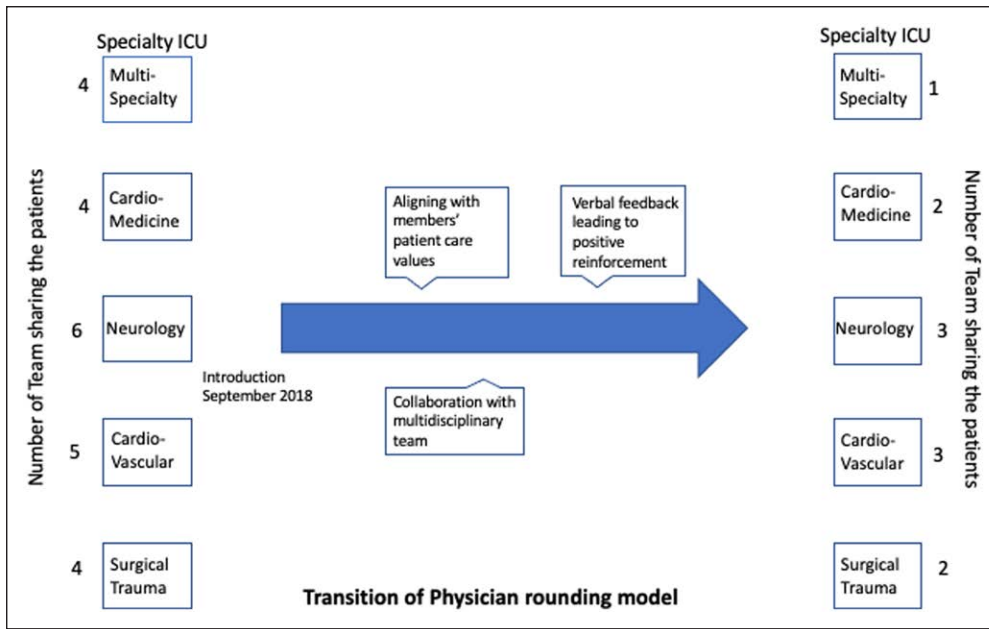


Figure 1. Transition of physician rounding model.

therapists, dietitians, pharmacists, case managers, respiratory therapy, and physician attended the huddles. The critical care director and nursing manager discussed protocol changes and quality metrics monthly. The group acted on feedback and concerns.

Quality Metrics

The data on quality metrics within the critical care is compiled by clinical nurse specialists for every critical care unit. These data are available in the systemwide quality metric dashboard and unit information boards. Quality metrics data compiled were based on the accepted Centers for Disease Control and Prevention National Healthcare Safety Network definitions—central line-associated bloodstream infections (CLABSIs) (12), catheter-associated urinary tract infections (CAUTIs) (13), hospital-acquired pressure injury (HAPI) (14), *Clostridium difficile* Infections (15), and falls (16). The ICU length of stay for patients was obtained from the hospital data registry, which reported ICU bed occupancy. Length of stay was defined by the physical location of the patients, irrespective of the level of care.

Provider Surveys

Survey was developed to assess perception of the providers toward the change in the rounding pattern. The survey was based on American College of Chest Physicians, American Thoracic

Society, and Society of Critical Care Medicine Physicians joint statement on burnout of Workforce (9). Questions cover utilization of time, perception of daily workflow, and collaboration of care. The responses were collected on a Likert scale (consent and survey details - **Supplement 1**, <http://links.lww.com/CCX/A340>; and **Supplement 2**, <http://links.lww.com/CCX/A341>).

Physicians and nurse practitioners participated in the survey. All participants had been working within the group throughout the pre- and post-intervention period. The survey along with the consent was distributed in the monthly meeting. All responses were anonymous and no personal identifiable information was included.

Statistics

Data were collected in Microsoft Excel spreadsheet by Microsoft Office 365 (Microsoft Corporation, Redmond, WA). Continuous and categorical data summarized with descriptive statistics including means and frequencies were analyzed Mann-Whitney *U* test was used to utilization between the two periods. Poisson regression was used to compare pre- and post-implementation quality rates. A *p* value of less than or equal to 0.05 considered significant. All analyses were performed using SAS v9.4 (Statistical Analysis Software by SAS Institute, Cary, NC).

RESULTS

Critical care utilization was similar in the pre- and post-implementation duration (**Table 1**). The critical care utilization in the pre- and post-implementation numbers were similar for patient days (pre = 34,839, post = 35,155, *p* = 0.471), central-line days (pre = 17,648, post = 19,224, *p* = 0.977), and Foley catheter days (pre = 18,292, post = 17,364, *p* = 0.436). The ICU length of stay was similar (4.9 d) in both pre- and post-intervention periods.

Quality Metrics

Critical care quality metrics were tracked in the pre-intervention and post-intervention 12-month duration. The monthly variation of the quality metrics including CLABSI, CAUTI.

TABLE 1. Critical Care Utilization Pre- and Post-Intervention

Critical Care Workload Metrics	Pre-Intervention (September 2017 to August 2018)	Post-Intervention (September 2018 to August 2019)	<i>p</i>
Patient days	34,839	35,155	0.471
Central-line days	17,648	17,773	0.977
Foley catheter days	18,292	17,634	0.436
ICU length of stay (d)	4.9	4.9	0.346

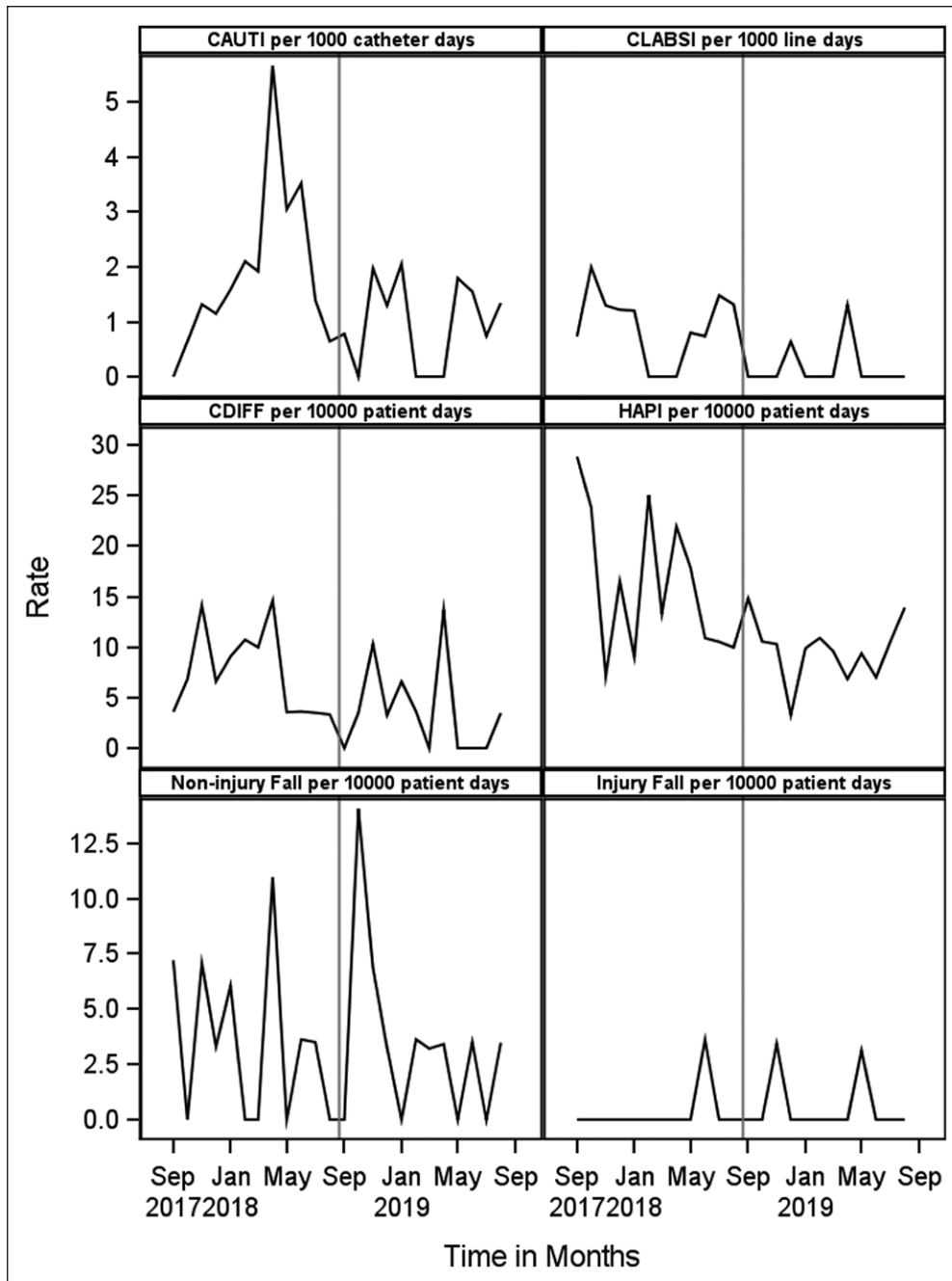


Figure 2. Rates of monthly adverse events during the pre- and post-intervention period. X-axis—Pre- and post-intervention months. Date of intervention (September 1, 2018) is marked as a straight line. Y-axis—Rate of events per month. CAUTI = catheter-associated urinary tract infection, CDI = *Clostridium difficile* infections, CLABSI = central line-associated bloodstream infection, HAPI = hospital-acquired pressure injury.

HAPI and clostridium infection was plotted along time (Fig. 2).

Cumulative incidence of critical care adverse events was measured. Pre- and post-intervention analysis showed a statistically significant reduction in the incidence (per 1,000 patient days) of *C. difficile* infection (relative risk [RR], -0.50; 95% CI, 0.25–0.96; $p = 0.039$) and HAPI (RR, -0.60; 95% CI, 0.39–0.92; $p = 0.020$). CLABSI incidence (RR, -0.19; 95% CI, 0.05–0.52; $p = 0.008$) and CAUTI (RR, -0.52; 95% CI, 0.29–0.93; $p = 0.027$) per 1,000 catheter days were also significantly reduced (Table 2).

Physician Survey

The Survey was completed by 11 out of 14 providers. Providers uniformly felt an improvement in the perceived quality of care they were able to provide the patients (Fig. 3). They felt that they were able to use more time for family discussions and trainee education. The time spent traveling between different critical care units and floors was felt to be reduced along with an increased perception in the coordination of care. A reduction in the number of daily interruptions was also noticed since the provider team was immediately available in the critical care unit.

DISCUSSION

Implementation of physician Gch in critical care units was associated with a reduced cumulative incidence of adverse events including CAUTI, CLABSI, *C. difficile* infection, and HAPI. The model also improved physicians and advanced practice provider's perception of time used for patient care and decreased daily interruptions.

The Donabedian principles describe three domains: structure, process, and outcome as pathway to assessing quality of healthcare (17). The physician rounding is component of structure, which is defined as conditions under which patient received care. National Quality Forum describes CAUTI, CLABSI, *C. difficile* infection, and HAPI as outcomes for assessing quality of ICU care. Our study shows significant cumulative reduction in the incidence of adverse events including CAUTI, CLABSI, *C. difficile* infection, and HAPI. The patient ICU days were similar both pre- and post-intervention suggest-

ing similar patient census. The Gch increased the amount of time spent in patient—physician interaction and communication with patients during hospitalist rounding (10). We believe that cohorting improved physician oversight and reduced interruption resulting in efficient decisions as reflected in survey results.

The majority of academic tertiary centers have closed ICUs. There is a certain subset of patients which are comanaged by surgical specialties and critical care teams (11). Gch assembled unique interdisciplinary ICU teams to engage in a time-efficient manner, which resulted in enhanced communications and less disruptions

TABLE 2. Calculated Rates (95% CIs) of Hospital-Acquired Harms and Regression Results

Critical Care Quality Markers (Incidence Rate)	Baseline (September 2017 to August 2018)	Implementation (September 2018 to August 2019)	Implementation vs Baseline (Relative Risk [95% CI])	p
Catheter-associated urinary tract infection ^a	1.86 (1.33–2.60)	0.96 (0.60–1.55)	0.52 (0.29–0.93)	0.027
Central line-associated bloodstream infection ^b	0.91 (0.56–1.48)	0.17 (0.05–0.52)	0.19 (0.05–0.64)	0.008
<i>Clostridioides difficile</i> infections ^c	7.46 (5.08–10.96)	3.70 (2.15–6.37)	0.50 (0.25–0.96)	0.039
Hospital-acquired pressure injury ^c	16.07 (12.37–20.89)	9.67 (6.91–13.54)	0.60 (0.39–0.92)	0.020
Noninjury falls ^c	3.44 (1.96–6.07)	3.41 (1.94–6.01)	0.99 (0.45–2.21)	0.982
Injury falls ^c	0.29 (0.04–2.04)	0.57 (0.14–2.27)	1.98 (0.18–21.86)	0.576

^aPer 1,000 Foley catheter days.

^bPer 1,000 central-line days.

^cPer 10,000 patient days.

Poisson were used to compare implementation to baseline periods for each quality metric.

engaging interdisciplinary teams and enhance communication (18). The interdisciplinary team planned daily huddles around the providers availability that enabled physicians to attend. The advantage of added cohorting over a closed ICU alone lies in identifying the consistent leader of a diverse team in a multispecialty critical care unit. This assists in concentration of resources like multidisciplinary teams and comanagement of care. Reduction in practice variation and enhanced team communication improves outcomes independent of size or composition of workforce (19).

Another aspect is developing expertise in specialty ICUs, which could attract the trainees. The downfall could be restricted patient case-mix exposure, although at present, there is no consensus that specialty critical training could improve patient outcomes (20). Critical care unit assignments were based on certifications and areas of interest. Every 3–6-month rotations were introduced for teams that requested a diverse experience. Gch was still maintained by a reciprocal handoff of patients. Less than one third of the teams were rotated on a quarterly interval. Presence of team members with required certifications and areas of interest (i.e.,

neurosurgical, cardiovascular surgery, trauma) assisted with gaining systemwide stroke center, trauma center certification.

In our study, the physician group perceived optimal utilization of their time for patient care and educational activities. Improved perception of daily workflow could promote engagement and reduce burnout. Our physicians were stationed in an ICU for 3 months, stabilizing the workday schedule. Many of them felt reduced interruptions in routine activities and more time for coordination of care. Gch is an organizational intervention, which is proposed as the most impactful intervention in reducing BOS (7). Verbal positive reinforcement from nurses, pharmacy, and consultants further improved engagement.

Introducing the change was a significant step forward and like any change was faced with initial resistance. Physicians were comfortable seeing a variety of clinical cases, whereas geographical limitation was posing a threat to their patient care values. The team members introduced issues spanning from insufficient clinical exposure, lack of interest in a specific field, inadequate case-mix, and effect on the compensations. Introducing the change as a

possibility to improve quality metrics resulted in better alignment with the team member values (21). We believe that aligning the team member patient care values allowed the Gch transition to proceed smoothly. The alignment of patient care values is a potential strategy for implementing changes in multidisciplinary health-care teams.

The lack of change in the ICU length of stay with the proposed intervention could be related to multiple factors. Our center is not immune to the patient flow-related logistic problems. The supply of step-down ICU rooms was a rate-limiting step in patient disposition. The length of stay was calculated based

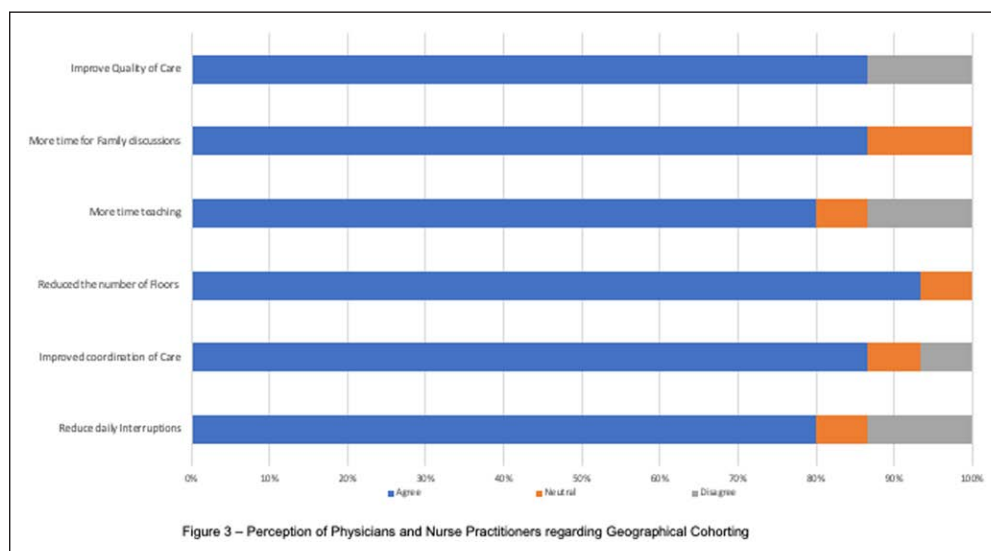


Figure 3. Physician and advanced practice providers perception of geographical cohorting.

on the physical location rather than the level of care provided to the patients. Critical care teams continued to manage the patients physically in the critical care units at 7 AM irrespective of the level of care assigned. Further studies are needed to characterize impact of Gch on length of stay.

Our study has limitations, including being the single-center and retrospective analysis. We did not compare mortality pre- and post-change. Health systemwide quality improvement initiatives confounded our metrics improvement. The number of physicians surveyed was small; other multidisciplinary team members were not interviewed. We did not quantify the direct time physician spent in each encounter. The concept of Gch applies to larger ICUs with multiple teams rounding and may not be applicable to smaller centers.

Gch is a novel concept for critical care rounding that promotes timely communication, cooperation, and collaboration. Further studies examining the impact on mortality and financial implications are needed.

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