Equitable Nurse Assignments Within the Context of Census-Driven Staffing Models

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Patient workload distribution influences quality of care, patient safety, and nursing satisfaction. PANT, a rule-based algorithm, informs equitable daily nurse-patient assignments in the context of census-driven staffing models.

Nurses advocate for staffing systems that equitably distribute patient workload across the care delivery team, are sensitive to patients' holistic needs, do not require manual data entry, and control practice variation (Al-Dweik & Ahmad, 2019). Equitably distributed nursing assignments are important because nurse workload distribution influences patient

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Literature Summary

- Nursing assignments informed by census-driven staffing models, room proximity, patients' medical diagnoses, and continuity of care during admissions may not translate accurately into equitable nursing workload (Meyer et al., 2020).
- Existing literature on nursing workload measurement tools (WMTs) yields numerous examples, each with their own strengths: identification of key patient care elements with the ability to score acuity proactively for the next shift (Kidd et al., 2014), tool development using an inclusive team of nursing experts to define patient care elements based on direct and indirect nursing care (Daraiseh et al., 2016), and use of the electronic health record to leverage nursing documentation (Larson et al., 2017).
- Limitations precluding WMT use at this project site included redundant manual data entry (Kidd et al., 2014); assessments based on retrospective data only, targeting a specific patient population (Daraiseh et al., 2016; Navarra et al., 2016); and infrequent updates to workload assessments, or limited generalizability across geographic regions (Larson et al., 2017; Meyer et al., 2020).
- Because patient census and requisite workload change constantly, nurse assignment models must be flexible and updated with near-real-time patient information to inform use of a daily decision support tool (Navarra et al., 2016).

CQI Model

Six Sigma DMAIC Process: Define, Measure, Analyze, Improve, Control (Silvestrini & Burke, 2018)

Quality Indicator with Operational Definitions & Data Collection Methods

- Site-developed Nursing Order Intensity Survey measured direct and indirect patient care needs.
- PANT, an automated rule-based algorithm, measured nursing care across the inpatient spectrum in a valid, reliable, and comprehensive manner.

Clinical Setting

42 medical-surgical units, totaling 1,200 patient beds, across a 12-hospital integrated health system

Program Objective

Develop and validate a nursing workload algorithm to inform daily nurse assignments in the context of census-driven staffing models using nursing hours per patient day.

TABLE 1.
Critical to Customer (CTC) Aspects of PANT Algorithm

CTC Aspect		Justification/Reasoning
CTC 1	Based on workload rather than patient acuity	Acuity generally reflects severity of illness, while workload reflects needed time to deliver reliable, safe, quality care (Jiang et al., 2016).
CTC 2	Use best practice guidelines and policies defined by nursing standards of care, in addition to clinical practice standards, defined by SMEs across the system.	Example: Infusion Nurses Society defines infusion therapy standards of practice related to intravenous catheter care. SMEs provided input related to institution-specific standards, equipment.
CTC 3	Leverage nursing and physician orders within discrete fields in the EHR.	Does not require additional manual data entry
CTC 4	Provide near-real-time workload scores.	Enables charge nurse to consult real-time data to influence decisions
CTC 5	Include both prospective and retrospective data.	Accounts for current workload and anticipates upcoming workload
CTC 6	Include only workload items provided exclusively by nursing.	Work accomplished by non-nursing personnel (e.g., respiratory therapy, physical therapy) was not included in overall workload score to avoid skewing nurse workload requirements.

EHR = electronic health record, SMEs = subject matter experts

Adapted from Silvestrini & Burke, 2018

quality and safety, as well as nurse satisfaction (Larson et al., 2017). Given the substantial portion of the nursing workforce represented by medical-surgical nurses amid the continuing nursing shortage, tools that can assess the amount of work required and aid in assignment decisions may be key to decreasing staffing turnover. Moreover, the process of using census-based staffing grids may not consider patient-centric needs, medications, psychosocial needs, care transitions, and requisite documentation, all of which may vary during the shift (Meyer et al., 2020). Staffing grids are used to project annual nursing labor requirements for budgeting purposes. The grids, along with patient census, impact the number of nurses allotted to the nursing unit per shift. Staffing grids guide the schedule but are not helpful with assignments (Sobaski, 2018).

Project Site and Reason for Change

Historically, nurses at the project site lacked a reliable method to measure and manage care complexity. Charge nurses created nurse assignments based on judgment, patient daily census, and the number of staff at the beginning of each shift. This method inconsistently accounted for nursing workload and patient care needs.

In 2016, two medical-surgical clinical nurses approached the hospital's nursing research forum to propose creation of a tool to quantify patient workload and ensure equitable distribution of patient care needs among nursing staff. Project approval was obtained from the system's Chief Nursing Officer (CNO) and Nurse Executive Council. The CNO served as the project's executive sponsor and incorporated the algorithm into the nursing strategic plan, with time and resources allocated for development, testing, and integration within the health system.

An interprofessional team created an automated rule-based algorithm (PANT) to capture the time required to provide safe, quality patient care in near real-time. The PANT team consisted of clinical nurses, nurse project manager, electronic health record (EHR) system analysts, health services researchers, biostatistician, and nurse scientist. The system institutional review board deemed the project a quality improvement initiative.

Program

Following CNO endorsement, the PANT team used a customized DMAIC strategy to determine nursing workload, develop the EHR algorithm, and analyze workload data. These data were collected from the EHR and the staffing database for 2016-2019 for all patients in medical-surgical units across the health system.

During the *define* phase (Silvestrini & Burke, 2018), a project charter and Nursing Order Intensity Survey (NOIS) were developed. The project charter defined the clinical

Acknowledgements: The authors acknowledge David Jones, MSN, RN, and James Figuera, CNMT, for their work in building the algorithm within the health system's electronic health record; Patricia Ver Schneider and Kacie Rehpelz, BS, for their expertise in data analytics; Dheeraj Kohli, MSIE, and Beth Delaney, BSME, ME, PE, for their expertise in process improvement; and C.J. Robison, BSN, RN, for her clinical leadership and vision during the initial stages of PANT development.

problem to be solved, clarified the project goals, and proposed a project timeline. The NOIS defined nursing workload on medical-surgical nursing units across the health system. The PANT team identified six Critical to Customer (CTC) aspects of algorithm development (see Table 1).

During the *measure* phase (Silvestrini & Burke, 2018), the PANT team used the NOIS to quantify average time required for direct and indirect care on 140 specific medical-surgical orders and procedures. *Direct care* was defined as the average amount of time required to perform orders and procedures within the medical-surgical level of care. *Indirect care* was defined as the average amount of time required to gather materials and document on those activities. Survey items were based on clinical practice guidelines published in the system's EHR (Elsevier, 2015). The NOIS was piloted by a select group of registered nurses to confirm survey validity; it was emailed to 1,904 nurses employed across the health system, with 425 (22%) responding to the survey. Direct and indirect care provided across 42 medical-surgical units was captured. After removal of incomplete surveys, data from 372 (20%) responses were included in analyses. The final step weighted each order aggregated per patient, per shift within the EHR.

Evaluation and Action Plan

During the *analyze* phase (Silvestrini & Burke, 2018), PANT team members and a medical-surgical panel of subject matter experts (SMEs) representing the 12 hospitals (urban, suburban, rural regions) analyzed NOIS results. SMEs identified time estimate variations in nursing care and then evaluated factors that made a difference in reported task times across nurses and hospitals. There were instances when the SMEs' assessment of time to complete a particular nursing task disagreed with survey results. When this occurred, SMEs proposed alternative times for consideration. For example, NOIS survey results for *perform blood glucose accu-check* resulted in a mean time of 14.2 minutes (median 11 minutes); SME assessment indicated 5 minutes. SMEs discussed NOIS survey results with system medical-surgical nursing teams for final approval.

Having determined a method to quantify nursing work per order per shift, the PANT team returned to the *measure* phase (Silvestrini & Burke, 2018) to use the NOIS and SME panel results to develop the PANT algorithm in the EHR. This process included determining workload values for orders based on time estimates, assigning workload values to specific EHR location (physician order or flow row), and determining length of time each workload item remains active within the 12-hour shift and if the item was best suited as a prospective or retrospective value. For example, *medication administration* addresses the next 12 hours to determine how many scheduled medications are due during the upcoming shift. A percentage of the workload score is given upfront; the remaining percentage of the workload score is given during medication administration. The goal of the algorithm was to account for workload being performed and estimate upcoming workload for charge nurse consideration in making assignment decisions.

During the final *analysis* phase (Silvestrini & Burke, 2018), PANT team members performed a series of descriptive analyses (basic descriptive statistics on distribution of workload data, normality, missingness, outliers) to validate algorithm functionality using data from two medical-surgical units in one hospital. Data quality validation required a three-tiered approach. First, the team performed live audits of patient medical records to ensure workload points summed correctly. Patient care data captured by the PANT algorithm were compared to care documented in the EHR. This audit process was iterative, with discrepancies investigated and PANT refined as needed.

Second, retrospective PANT scores were abstracted at the beginning of each shift (7:00 a.m., 7:00 p.m.) over a specified period. Team members evaluated retrospective data to identify outlier scores and contributing factors. PANT was modified as needed, and a second round of analyses was performed. One example demonstrating the importance of outlier score reviews identified high point values associated with pressure injuries (PIs). Originally, points were calculated based on the number of PIs documented in the EHR, which inaccurately reflected care required for patients with multiple PIs. The algorithm was modified to differentiate among PI attributes, recognizing nursing care varies depending on number and stage of PIs (e.g., stage 1 vs. stage 4).

Finally, analysis of PANT workload scores compared to each medical-surgical staffing grid was performed. The average PANT workload scores were translated into nursing hours per patient day (NHPPD) and compared to the predetermined NHPPD defined in the staffing grids (see Table 2). The comparison of PANT to staffing grid NHPPD informed the overall functionality of PANT. The PANT algorithm was deemed valid and reliable when outlier scores were remedied, scores summed correctly, and SMEs noted differences between the PANT and grid NHPPD were within three standard deviations.

During the *improve* phase (Silvestrini & Burke, 2018), team members identified and prioritized a list of improvements to build an implementation plan. First, algorithm enhancements, including additional workload items, reflected variations across medical-surgical units. Second, prioritization of near-real-time documentation was critical to capture the work performed throughout the shift. Typically, nurses waited until the end of a shift to chart patient assessments or document patient care interventions. Accurate, near-real-time charting was required to reflect appropriately the current shift's workload. Otherwise, workload points were attributed to the following shift. Finally, the team identified the need for

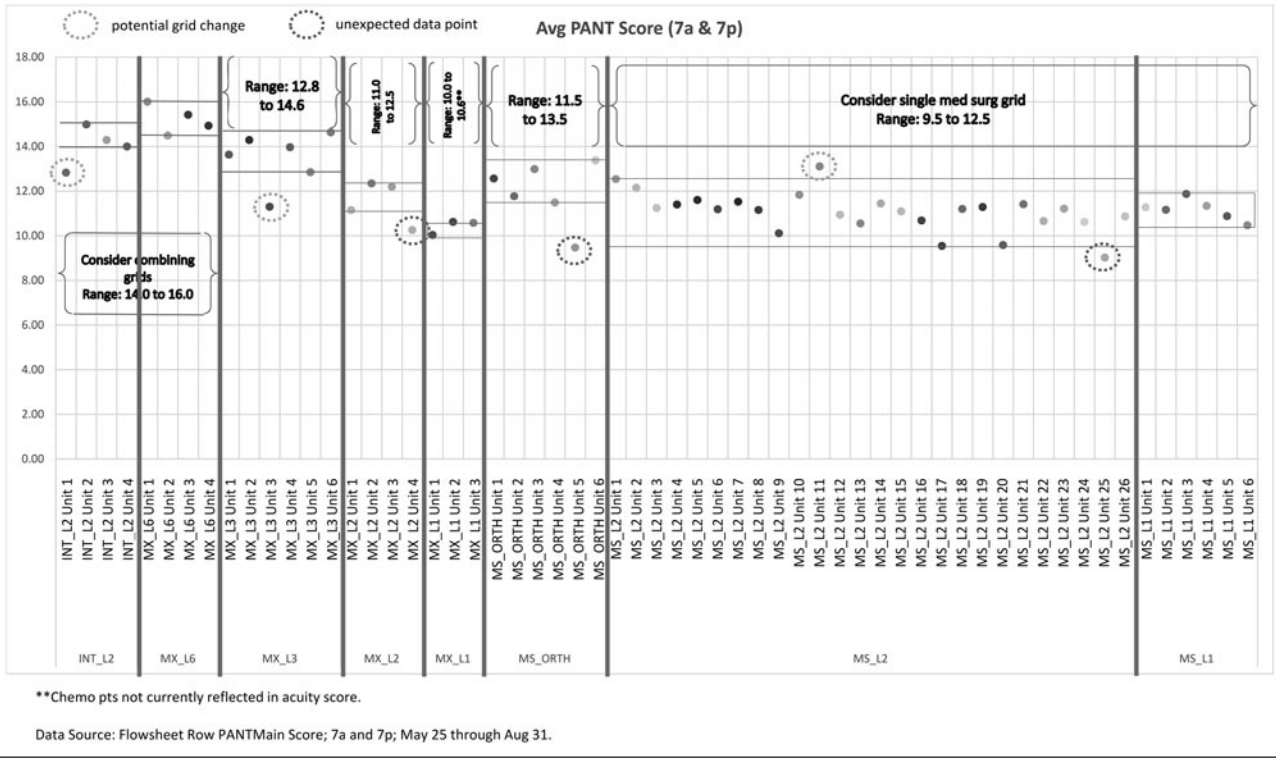
TABLE 2.
Comparison of PANT Scores to Medical-Surgical Hours Per 12-Hour Shift

Medical Surgical Unit Example July-December 2018										
Shift	Number of PANT[1] Scores	Average PANT[1] Hours	Target[2]	Actual[3]	Target Diff.	Actual Diff.	Direct Care Target[4]	Direct Care Actual[5]	Target Diff.	Actual Diff.
7:00 a.m.	2968	4.73	4.64	4.27	0.09	0.46	4.26	3.91	0.47	0.82
7:00 p.m.	2736	5.18	4.64	4.27	0.54	0.91	4.26	3.91	0.92	1.27
Weighted Mean	5704	4.95	4.64	4.27	0.31	0.68	4.26	3.91	0.69	1.04

[1]Direct care required per patient, based on PANT workload assessment
[2]Targeted hours, including RN, LPN, NCP, and 100% AA and Manager (estimated AA and Manager spend 20% of their time in direct care)
[3]Actual hours provided, including RN, LPN, NCP, and 100% AA and Manager (estimated AA and Manager spend 20% of their time in direct care)
[4]Targeted hours, including RN, LPN, and NCP, but excluding AA and Manager
[5]Actual hours provided, including RN, LPN, and NCP, but excluding AA and Manager

AA = administrative assistant, LPN = licensed practical nurse, NCP = nurse care partner, RN = registered nurse

FIGURE 1.
2019 Staffing Grid Comparison



nursing staff to operationalize the PANT score, allowing charge nurses to use these data to inform their decisions for daily nurse assignments. Charge nurses were advised to review the PANT score and distribute workload equitably among staff when creating upcoming shift assignments. Other contributing factors, such as room location, number of available staff, nurse experience level, and previous shift assignments, also should be considered.

Results and Limitations

During the *control* phase (Silvestrini & Burke, 2018), a quality control plan was created to include annual comparison of the PANT NHPPD to the established staffing grid NHPPD. Data-driven outliers identified by PANT (e.g., extremely low, extremely high scores) were evaluated along with subset workload calculations based on hospital, unit, and patient types. For example, when a unit was identified as scoring above or below established average NHPPD, the process improvement team and leaders explored root causes. In 2019, staffing grid assignments were changed for several nursing units based on PANT workload scores to align nursing resources more precisely with patient care needs.

Several limitations for this project may lead to workload underestimation. A formal work sampling audit was not performed due to financial and labor constraints. PANT does not consider differing geographic layouts of the medical-surgical units. Due to lack of discrete EHR documentation, PANT currently does not quantify nursing workload related to patients' level of consciousness, state of mind or emotions, family support and involvement, or education.

Lessons Learned/Nursing Implications

PANT impacts hospital operations from unit and system perspectives. Unit-level charge nurses review PANT scores when creating daily assignments, stressing the importance of distributing workload equitably among nursing staff. However, charge nurse clinical judgment remains an overriding factor in assignment decisions (e.g., resources available, previous shift assignments). PANT also reinforces accurate, near-real-time charting to reflect patient care needs appropriately within the shift, which directly affects total unit workload. PANT team members continue to expand the foundational work of the medical-surgical algorithm to include intermediate care, oncology, stroke, and critical care patient populations. By analyzing unit-level workload requirements at the system level, team members provided clarity on how nursing units differ within the same nursing census-staffing matrix.

Initial and ongoing support from clinical staff proved critical to implementing PANT successfully. This ground-up approach resulted in a more effective, valued tool (Kidd at al., 2014). Including representatives from all 12 hospitals allowed workload estimates to be based on varying patient populations and nursing expertise. Initially, PANT adoption was slow due to limited nurse education during early months of implementation. Development of PANT educational materials (e.g., computer-based learning modules) and incorporating PANT during orientation improved awareness, knowledge, and use of the algorithm. Executive support from the system CNO, hospital CNOs, and the nurse scientist proved invaluable. PANT team members worked horizontally across 12 hospitals and vertically from clinical nurses to the corporate suite in ways that positively championed this systemic change. This process also served to mentor future leaders within the nursing division.

PANT team members continue to validate workload scores using real-time feedback on scores that appear to be misrepresented throughout the shift. They also formally evaluate workload that appears anomalous or outside the range of expected values to determine if outliers are related to PANT structure or are a true representation of patient workload changes. When nurses believe workload scores are inaccurate, they review the chart with PANT team members. Their concerns are addressed, or an opportunity for PANT improvement is identified. Modifications are made to the PANT algorithm accordingly.

Conclusion

PANT challenged the existing census-based model by offering an alternative that provides near-real-time workload data to inform nursing practice. PANT, a rule-based algorithm that incorporates prospective and retrospective nursing documentation and physician orders, does not require additional manual data entry and adjusts scores in near real-time as nurses document care. More importantly, PANT is a testament that clinical nurses can transform a healthcare system. Given executive support, the right resources, and a vision that resonates with nurses, medical-surgical nurses deployed a highly sophisticated decision support tool that is changing nursing practice across the healthcare system. MSN

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