Registered Nurses, Patient-Engaged Video Surveillance, and COVID-19 Patient Outcomes

Patricia A. Quigley
Lisbeth J. Votruba
Jill M. Kaminski

Registered nurses (RNs) across nursing specialties require expert skill sets to address acute and emergent healthcare needs for every patient. RNs experienced with patient-engaged video surveillance expertly repurposed the system as a rapid response intervention for 24-hour observation of patients suspected to have or diagnosed with COVID-19. This study provided insight into RNs' rapid action to meet patient and healthcare workforce needs when experiencing the unknown.

On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a global pandemic (Executive Office of the President, 2020). The fastest transformation of health care was witnessed worldwide to transition the population and healthcare workforce from usual care to urgent and emergent isolation care. As total positive cases increased exponentially, patients' morbidity and mortality escalated at the same rate, as did workforce demands for personal protective equipment (PPE) and high-acuity staffing. Leaders at every admitting hospital quickly realized the impact on an already stressed nursing workforce. In addition, healthcare systems faced the burden of full-scale infection control protective wear on direct patient care (Lagasse, 2020).

RNs on the front line commanded every resource to contain the virus, prevent spread of the disease, and protect patients and each other (Tsay et al., 2020). To perform life-saving and sustaining measures, they were gowned, gloved, masked, and shielded. However, their numbers were not enough to observe and respond to every fearful patient who typically was isolated from family and experiencing effects and complications of a new virus. Unable to meet the surge of admitted COVID-19 patients, RNs instinctively explored other options to observe and engage patients, monitor their response to treatment, examine their supply needs before entering a room, and fast-track response to emergent patient conditions (Spetz, 2020). Many turned to technology as a vital asset to comprehensive patient care (Whitelaw et al., 2020), including patient-engaged video surveillance (PEVS).

Since 2010, PEVS has supplemented nurses' need for continuous patient observation in hospitals. PEVS is a more interactive form of video surveillance with trained staff who monitor multiple patients simultaneously (Votruba et al., 2016), providing two-way audio communication between staff members and patients. Monitoring staff verbally interact and redirect patients, contact other staff and caregivers, and trigger an alarm if necessary. Patients are selected for PEVS based on bedside clinical assessment and urgent need for continuous observation. However, effectiveness of technology-supported patient observation and engagement in an acute, critical, and isolation environment has not been reported.

Patricia A. Quigley, PhD, MPH, APRN, is Managing Member, Patricia A. Quigley, Nurse Consultant, LLC, St. Petersburg, FL, and Independent Contractor and Fall Prevention Expert, AvaSure, LLC, Belmont, MI.

Lisbeth J. Votruba, MSN, RN, is Chief Clinical Innovation Officer, Clinical Quality and Innovation, AvaSure, LLC, Belmont, MI.

Jill M. Kaminski is Clinical Data and Systems Analyst, AvaSure, LLC, Belmont, MI.

Note: The data reported in this research study were extracted from the AvaSure, LLC, national database. Dr. Quigley has no direct influence on the vendor database, data entry or management, or data analysis. AvaSure is the producer of the Patient Engaged Video Surveillance technology used in hospitals. Ms. Votruba has no influence on data entry, management, or statistical analysis. Ms. Kaminski is a statistician employed by AvaSure, LLC, and is responsible for database design and testing, development of product data entry education tools used by clients, statistical analysis, and dissemination of results. This author has no influence on data entry, which occurs at the patient, unit, and hospital levels. No grant/research funding was received for this research.

Background

The surge of hospitalized patients infected with or suspected to have COVID-19 challenged the redesign of healthcare delivery into a full-scale isolation operation. This redesign required registered nurses (RNs) and hospital leaders to repurpose current front-line care structures and processes to augment nurse-directed patient observation and engagement, and reduce viral exposure and cross-contamination.

Aim

Gain insight into medical-surgical nurses' use of patient-engaged video surveillance (PEVS) to meet care needs of high-acuity patients during strict isolation for observation, engagement, and urgent/emergent medical-surgical nursing care during March-April 2020.

Method

Core data were collected and analyzed from the national data reporting system in a descriptive correlational study.

Results

RNs nationally admitted 4.8% of patients (n=1,625/32,130) to PEVS due to COVID-19, totaling 98,918 hours (4,121.58 days) of observation. Monitor observers verbally engaged with COVID-19 patients on average 17 times in 24 hours, which is higher than non-COVID-19 patients (10.6 times in 24 hours), and activated fewer alarms (1 alarm/patient day for COVID-19 vs. 1.8 for non-COVID-19; $p\leq0.0001$). A strong, positive, statistically significant correlation resulted between increasing age and increased monitoring length of stay (r=0.7398; $p\leq0.0001$). Within this COVID-19 sample, 39 patients (2.4%) experienced 42 adverse events: line dislodgements (29), falls (9), incidents of intentional self-harm (2), and physical abuse incidents (2).

Limitations

The current data collection system does not provide unit-specific data or have fixed fields for patient age. Re-engineering of PEVS to monitor patients with COVID varied within and across hospitals and units with diverse monitoring models.

Conclusion

Results demonstrated the value of RNs' expertise to expand use of PEVS for continuous patient observation during isolation and the benefits of PEVS as an essential component of successful nursing workflow, nurse-patient interaction, and patient safety.

Purpose/Research Questions

The purpose of this study was to gain insight into medical-surgical nurses' use of PEVS in the United States to meet care demands of high-acuity patients during strict isolation for observation, engagement, and urgent/emergent medical-surgical nursing care during March-April 2020 (surge months for COVID-19 hospital admissions) (Mandavilli, 2020). The study was conducted to answer the following research questions:

1. What are the enrollment and duration of monitoring trends of PEVS into patient care for COVID-19 across hospitals?
2. What is the relationship among patient gender identity, age, and duration of PEVS?
3. How is patient engagement (verbal interventions, alarm rate, timeliness of alarm response) different for patients with COVID-19 compared to patients without COVID-19 patients on PEVS?
4. What are the frequencies and types of adverse events experienced by patients with COVID-19?

Review of the Literature

A literature search was conducted for 2016-2020 to ascertain the science for PEVS on patient outcomes. The following search terms were used: *patient outcomes*, *engagement*, *video surveillance*, *video monitoring*, *current evidence*, *active surveillance*, *hospital*, *isolation*, and *nursing workforce*. Combinations of these terms and Boolean operations also were used. No systematic literature reviews or meta-analyses were found through the Cochrane Systematic Review database. Literature searches also were conducted via PubMed, CINAHL, and Google Advanced Scholar. One synthesized literature review related to video surveillance and fall prevention was located through Goggle Advanced Scholar (Ndoda et al., 2019). Results were narrowed to studies that specifically included video monitoring, adverse events, nurse response times, and verbal patient engagement. Published articles on PEVS reported nurse response time to urgent and emergent alarms, verbal patient engagement, and reduced patient adverse events (Cournan et al., 2016; Kroll et al., 2020; Quigley et al., 2019) and nurse safety (Quigley et al., 2020).

Nursing Response Time

Alarm response time represents the amount of time between activation and deactivation of an alarm. Quigley and coauthors (2019) conducted a descriptive correlational study to determine the effectiveness of PEVS on occurrence of adverse events, nurse response time, and verbal interventions from a large-scale national database. Among 15,021 patients enrolled in PEVS to prevent falls across 71 hospitals, average nursing staff alarm response time was 15.8 seconds. In a second descriptive correlational study of

150,434 patients enrolled for PEVS monitoring across 73 hospitals, average alarm response by nursing staff was 13 seconds for patients observed to have an abusive incident against nursing staff versus 15.9 seconds for patients with no abusive incident (Quigley et al., 2020). Both PEVS studies reported nursing staff response time that far exceeds previously published response times of 13 minutes 8 seconds (Tzeng et al., 2013). No located studies have documented nursing staff response time to bed alarms.

Verbal Patient Engagement

Patient engagement is achieved through two-way communication, collaboration, and advisement between patients and their healthcare teams. Frequency of verbal patient engagement has been reported only recently in the literature. When examining the effectiveness of PEVS on patient outcomes over 1 year, Quigley and coauthors (2019) found patients who experienced a fall (n=59) had 20.5 verbal interventions per patient day, compared with 15.7 verbal interventions per patient day for patients who did not fall (n=14,962) (p=0.0005). An average of 15.8 verbal interventions occurred per day for all 15,021 patients. In another study of patient aggressive incidence against nursing workforce, Quigley and colleagues (2020) found patients with an abusive incident (n=221) averaged 27.4 verbal interventions per patient day. This represented 15.5 additional verbal interventions by the monitor technicians per patient day compared to 11.9 verbal interventions for patients (n=150,213) who did not have an abusive incident. Among 39 patients on suicide monitoring who received PEVS, monitor staff verbally engaged general hospital patients (n=27) an average of 20 times per episode of care (approximately 30 hours); patients (n=12) in the emergency department (ED) only required an average of one verbal engagement per episode of care lasting 5 hours (Kroll et al., 2020). These results suggested virtual monitoring staff with eyes on patients provide real-time communication to inform, comfort, orient, and rescue them.

Reduced Adverse Events

The PEVS studies that focused on fall prevention reported a reduction of patient falls or a fall rate below national benchmarks of three to five falls per patient day as documented in a systematic literature review of six studies (Ndoda et al., 2019). Cournan and associates (2016) conducted a sequential cohort study to examine effectiveness of PEVS on fall rates on a 31-bed brain injury unit. Over the 21-month study, the fall rate reduced from 6.34 to 5.099 falls per 1,000 patient-days (p=0.016). Following a prospective descriptive study, Votruba and colleagues (2016) reported a reduction in falls from 85 to 53 on three medical-surgical units over 9 months (p<0.0001, 95% CI). This represented a 35% decrease in falls among 828 patients.

Quigley and coauthors (2019) reported an overall fall rate of 1.50 falls per 1,000 days of surveillance; for the oldest age group (age 85 and older) who were most vulnerable to injury, the fall rate was 0.38 falls per 1,000 days of surveillance. Among this population, an average of only 2.70 lines, tubes, or drains were dislodged per 1,000 patient days of surveillance, an important outcome measure for patients with COVID-19.

Using a retrospective descriptive analysis, Kroll and colleagues (2020) investigated the frequency of adverse events among select patients on suicide precautions and low impulsivity risk in a general hospital and ED observed through PEVS (June 2017-March 2018). No adverse events occurred (95% CI=0.000-0.090). Authors concluded suicide risk could be monitored feasibly using PEVS. This original study suggested engagement through PEVS could allow collection, trending, and tracking of incidents of harm or self-harm. Patient-initiated harm was analyzed nationally by descriptive correlation research across 73 hospitals using PEVS over 21 months (Quigley et al., 2020). Monitoring staff observed and documented 321 abuse events but reported 7,915 patient abuse incidents were prevented by their interventions. These interventions included initiating conversation with the patient to calm, ensure, and redirect the patient who was becoming more agitated. The monitor technicians also called the nursing staff to warn them of patients' escalating behavior before entering the room.

These studies suggest effective structures and processes significantly improve patient and workforce outcomes, and study further patients with COVID-19 in an isolation environment.

Ethics

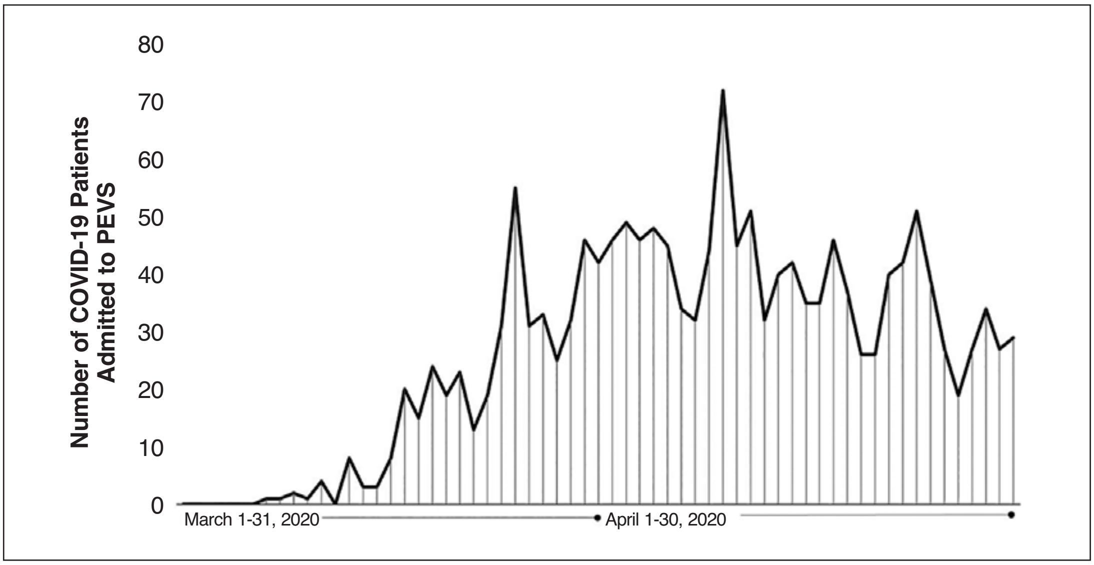
The PEVS system at the study sites does not record any audio or video feeds. The software, which is compliant with the Health Insurance Portability and Accountability Act, provides an electronic privacy screen that can be enabled to protect patient information during personal care. The system is hosted on a hospital's secured wireless networks. It uses TLS1.2 for all connections, giving it a high degree of security during data transmission and while data are at rest. Nurse leaders with active directory access can pull their organization's historical data from a web administrator secured with AES 256.

All participating hospitals executed an agreement for analysis and publication of aggregate data. Monthly, AvaSure LLC securely exported raw data from each hospital's servers. Because these data did not contain protected health information, as defined by the Safe Harbor method (U.S. Department of Health & Human Services, 2012), Institutional Review Board action was not required. The data then were aggregated to provide program metrics and national benchmarking for healthcare systems.

Sample Selection

A national sample of 97 participating hospitals throughout the United States was selected based on

Figure 1.
Progressive COVID-19 Admissions by Day (March 1-April 30, 2020)
(*N*=1,625 Admissions)



PEVS = patient-engaged video surveillance

adding at least one patient to monitoring with the description of COVID-19, coronavirus, person under investigation (PUI), or isolation. The study sample included all patients added to PEVS monitoring during the study period (*N*=32,130). Patients with COVID-19 accounted for 4.8% of patients (*n*=1,625).

Design and Method

To answer the research questions for this descriptive correlational study, core data from participating hospitals were collected and analyzed from a national data reporting system from March 1-April 30, 2020. Most participating hospitals had implemented PEVS before the pandemic for patient safety using dedicated unlicensed staff for continuous safety monitoring of patients at risk of adverse events, such as falls, suicide, elopement, or safety of medical devices. The manufacturer's clinical education team provided staff training for the PEVS system over 1-2 weeks. Also, all hospitals received the same eLearning modules for use by monitoring and nursing staff. With the onset of the pandemic, an urgent need became apparent for more nurses, doctors, and other clinicians to use the system to decrease exposure to patients in isolation and to conserve PPE. Remote training sessions were offered by vendor clinical educators for clinical staff to meet hospitals' increased demand for PEVS clinicians' education and training needs. Thirteen hospitals participated in 42 live, targeted training sessions. During the study period, clinicians completed 14,468 PEVS eLearning modules.

Data Collection

As hospital staff observed or interacted with patients, data were captured automatically from PEVS software and were collected into a national database. Data were stored securely via cloud for ease of export and analysis with RStudio.

Metrics

Monitoring staff software interactions were captured to provide the following patient engagement metrics:

- Verbal interventions: Occurrences of staff using the talk button to speak directly to patients
- PEVS alarm: Occurrences of monitoring staff activating the alarm
- Alarm response time: Amount of time elapsed between activation and deactivation of the PEVS alarm
- Adverse events: Short, free-text description of what the monitoring staff observed as an adverse event

Findings

Research Question 1: Monitor Trends

Over 2 months, 1,625 patients with COVID-19 were monitored for 98,918 hours (4,121.58 days) (see Figure 1 for progressive trend of patients added to monitoring). The first patient with COVID-19 was added to monitoring on March 7, 2020. This reason for monitoring accelerated over the next few weeks, peaking on April 9, 2020, with 72 patients added in a single day. During the rest of that month, admissions trended downward but with no less than 19 patients added each day. As of April 30, 120 patients still were being monitored actively; these were excluded from calculations to determine average length of stay (LOS) on monitoring. Of total monitored patients, 52% (*n*=852) were male and 48% female (*n*=773). A minimal difference was found in average LOS of monitoring (67.8 hours and 63.5 hours, respectively).

Research Question 2: Relationship among Gender Identity, Age, and PEVS Duration

Age was not recorded for 499 patients. For the remaining 1,126 patients with a recorded age who were discharged from PEVS during the study, average LOS was compared in Table 1. Of patients with age recorded, 73% (*n*=830) were over age 60; this was identified as the greatest risk for severe complications from COVID-19. The highest duration in hours of PEVS observation occurred in patients ages 60-69 (76.8 hours), followed by those ages 80-89 (74.4 hours). The shortest average duration of observation occurred in patients less than age 20 (17.4 hours). No relationship was found between gender identity and duration of PEVS. A strongly positive, statistically significant correlation was found between increasing age and increased monitoring LOS (r=0.7398; $p \leq 0.0001$).

Research Question 3: Differences in Patient Engagement

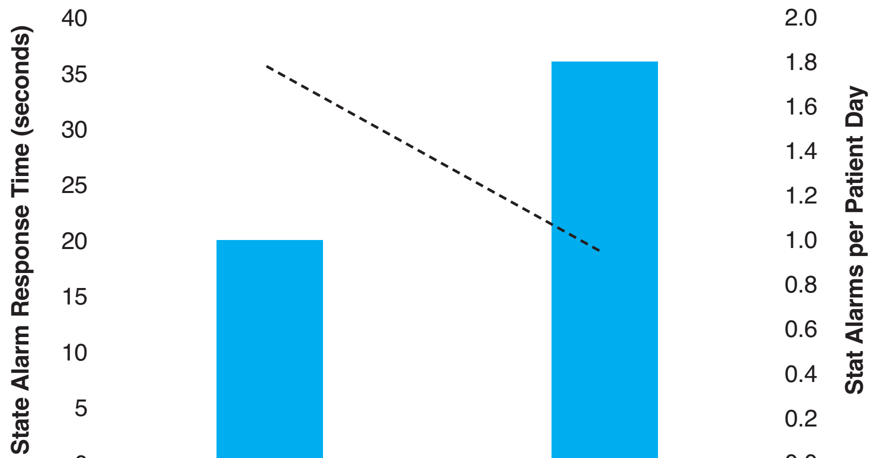
Verbal patient engagement was high for patients with COVID-19 (70,095 verbal interventions at rate of 17 times per day) compared to patients without COVID-19 (see Table 1). This demonstrated a higher level of communication than prior research findings of 15.8 verbal interventions per day (Quigley et al., 2019). In both groups, more than 50% of verbal interventions occurred in patients age 60 and older, with or without COVID-19. Patients ages 80-89 had the highest number of verbal interventions. Figure 2 depicts a lower alarm rate for patients with COVID-19 (1 alarm per patient day) than 1.8 alarms per patient days for patients without COVID-19 ($p \leq 0.0001$). Staff

TABLE 1.
Population Demographics, LOS, Verbal Interventions, and Outcomes (March 1-April 30, 2020)

Patient Age	Average LOS (hours)	Verbal Interventions		COVID-19 Admitted Patients Adverse Events			
	COVID-19 Admitted Patients	COVID-19 Admitted Patients	Non-COVID-19 Admitted Patients	Dislodgement	Fall	Intentional Self-Harm	Physical Abuse
Age not documented (499)	68.5	16,123 (23%)	297,614 (28.8%)	1	1	0	0
<20 (5)	17.4	14 (0)	3,679 (0.4%)	0	0	0	0
20-29 (19)	33.4	284 (0.4%)	8,221 (0.8%)	0	0	0	1
30-39 (29)	39.0	386 (0.6%)	17,305 (1.8%)	0	0	0	0
40-49 (75)	47.5	1,108 (1.6%)	30,645 (3.2%)	0	4	0	0
50-59 (168)	44.2	5,986 (8.5%)	77,551 (8%)	5	1	1	0
60-69 (214)	76.8	12,436 (17.7%)	144,764 (14.9%)	5	0	0	0
70-79 (262)	69.1	13,548 (19.3%)	167,611 (17.2%)	7	2	1	0
80-89 (257)	74.4	14,712 (21%)	172,534 (17.7%)	7	1	0	1
90+ (97)	66.2	5,498 (7.8%)	70,394 (7.2%)	2	0	0	0
Total (age documented)	64.7	53,972 (77%)	692,704 (71.2%)	26	8	2	2
Total (all patients)	62.0	70,095 (100%)	972,318 (100%)	27	9	2	2

LOS = length of stay

FIGURE 2.
Stat Alarm Response



	Patients Monitored for COVID-19	Patients Not Monitored for COVID-19
Stat Alarms per Patient Day	1.0	1.8
---- Average Stat Alarm Response Time (seconds)	35.4	19.0

average timeliness of alarm response to the COVID-19 patients was 35.4 seconds, 16.4 seconds longer than patients who were not in isolation where PPE application and removal were required.

Research Question 4: Frequencies and Types of Adverse Events

Forty-two adverse events were experienced by 39 patients (see Table 1). Dislodgment notes documented from monitor staff generally indicated they tried to redirect the patient from removing an IV, urinary catheter, or O_2 mask, but their efforts failed. Eight unassisted falls often occurred because the clinical staff could not apply appropriate PPE quickly enough to assist the patient. The fall rate on camera was 2.18/1,000 PEVS patient days. No patient fell more than once. Finally, four incidents occurred with two patients with COVID-19 involving self-harm or abusive events toward staff.

Discussion

Results provide insight into RNs' use of PEVS for observation and safety in a strict isolation environment for patients in respiratory and medical distress due to a highly contagious, life-threatening virus. Patients' trend line added to PEVS monitoring mirrors the national surge and hospital admissions of patients with COVID-19 over 2 months (Stam et al., 2020). While there was no significant difference in gender identity and monitoring LOS, a statistically significant positive correlation between monitoring LOS and age was found; this was consistent with increasing complexity and complications of COVID-19 among older adults (Bajwah et al., 2020; Stam et al., 2020).

Patients on isolation for COVID-19 received more verbal engagements and had lower alarm frequency than traditional PEVS for safety of patients without COVID-19. Reasons for alarms are unknown, but this would suggest verbal interventions were effective and alarm usage was not required as frequently to activate staff nurse response. Verbal interventions serve as a proxy for the number of interactions between staff and isolated patients. This likely represents a combination of episodes in which staff interacted remotely with the isolated patient, avoiding direct exposure, and interactions that would not have occurred without PEVS. Lower alarm rates may be due to differences in patient selection. Patients without COVID-19 generally are selected for monitoring because they are at higher risk for adverse events due to confusion or altered mental status. Patients with COVID-19 were not necessarily confused or experiencing altered mental status as the reason for PEVS.

Longer alarm response times for isolation patients are an expected outcome from the necessity of applying PPE before rescue. Adverse event rates for patients with COVID-19 were higher than prior research. Previous research on PEVS reported a fall rate on camera of 1.5 falls and 2.7 dislodgements per 1,000 patient days, with an alarm response time of 15.8 seconds (Quigley et al., 2019). The additional 18.7 seconds in the current study represents a data-driven estimate of how long it takes caregivers to apply PPE in urgent/emergent situations. Higher fall rate and dislodgement rate validates the findings that alarm response time greater than 19 seconds increases the likelihood of a fall on camera (Quigley et al., 2019). Finally, incidents of self-harm and violence against caregivers, while rare, underscore the importance of continued focus on the emotional well-being of isolated patients as well as awareness of staff safety.

Limitations

The current data collection system does not provide unit-specific data or have fixed fields requiring patient age. Re-engineering PEVS to monitor patients with COVID demonstrates the innovation of clinical, administrative, and patient safety staff. These efforts were varied within and across hospitals with diverse models of monitoring.

At the time of the study, the PEVS software did not offer *isolation* as a dropdown reason for monitoring. When the patient was added to the monitoring system, the trained dedicated monitoring staff or novice users (doctors, nurses, therapists) would have to select *other* and free-text COVID-19, PUI, or isolation as the reason for monitoring. The number of PEVS patients in isolation likely was under-reported. PEVS data were not reported by type of unit or location (patient room vs. ED hallway). The ED environment provides episodic information about patient observation and engagement in that setting, which is temporary, transitional, and generally lasts only a few hours. This environment varies from medical-surgical or intensive care settings, where patients are enrolled for their admission. As a result, average monitoring LOS may not represent each care setting accurately.

Recommendations for Future Research

This first study reports medical-surgical nurses' workflow and patient outcomes trended and impacted by PEVS for patients enrolled in PEVS due to isolation conditions. Further research should expand outcomes analysis to include prevented patient conditions and symptom relief, such as breathlessness, cough, delirium, and anxiety (Bajwah et al., 2020). Researchers should conduct qualitative studies to explore patient and family responses and perceptions about PEVS, and how this technology might address emotional isolation from family, caregivers, and visitors, bringing confidence that patients are not alone and thus reducing fear during isolation.

The value of PEVS to nursing workflow is another opportunity for quantitative and qualitative research. Medical-surgical nurses are positioned to study how PEVS further supported nurses' workflow and staffing, interprofessional collaboration, and telemedicine during the pandemic. All research opportunities should produce evidence-based solutions to support improved nursing and patient structures, processes, and outcomes. Results should move organizations away from continued use of technologies and interventions that are not evidence-based or secure, such as perfunctory hourly rounding, sitters, bed alarms, or baby monitors.

Nursing Implications

The progressive increase of PEVS matched the national surge increase and suggested RNs knew this program could help them keep eyes on patients in isolation and distress. The safety net provided by integration of this program must be expanded. Similar to nurses having insufficient PPE, they also did not have enough staffing for patients who required 24-hour observation. Nurses trust this program where adverse events are rare, and when they occur, are observed (Cournan et al., 2016). False alarms that waste nurses' time are eliminated. As experts and leaders in patient care management, nurses deserve hospital administrators who invest in proven technology that is value-added and effective. Use of proven technology expands crucial patient observation and interactions when other solutions are insufficient.

PEVS adds workflow efficiencies because one trained monitoring staff member observes and protects up to 16 patients simultaneously instead of traditional practice of one-to-one sitters. Hourly technology cost is less than $1.00 per patient. This cost includes hardware, software, around-the-clock program support, onboarding clinical education, and comparative program evaluation and data analytics. The hospital's monitor staff observation costs are less than $3.00 per hour (Abbe & O'Keefe, 2020).

Additional support for the monitoring staff's emotional well-being must be addressed during this healthcare crisis (Nowrouzi et al., 2015). These staff are witnessing patients who are afraid, in acute respiratory distress, have higher degrees of acuity, and even die alone. It would be easy for clinicians to overlook the emotional impact experienced by the monitoring staff as they witness the lonely passing of patients with COVID-19. Engaging pastoral care or crisis response teams for monitoring staff is one intervention to consider.

The nursing shortage was recognized widely before the pandemic but explosively exposed during the pandemic. The Bureau of Labor Statistics predicts the United States will need more than an additional 200,000 nurses per year from now until 2026, adding up to more than 1 million additional nurses (American Association of Colleges of Nursing, 2019). Solutions exist to address the nursing shortage and should be used to transform care delivery, workflow, satisfaction, and confidence while assuring patient confidentiality and privacy.

Conclusion

RNs across nursing specialties require expert skill sets to address acute and emergent healthcare needs for every patient. However, prior experience was mostly ineffective in addressing the COVID-19 pandemic. RNs experienced with PEVS expertly repurposed the system as a rapid response intervention for 24-hour observation of patients suspected to have or diagnosed with COVID-19. Nurses quickly expanded their ability to observe, interact with, and engage patients, helping them better deal with their isolation and know their nurses' presence. This study provided insight into RNs' rapid action to meet needs of patients and healthcare workforce when experiencing the unknown. The impact of PEVS on patient observation, engagement, and workforce staffing during widespread isolation measures confirmed the value of investing in proven technology at the point of care. MSN

REFERENCES

Abbe, J.R., & O'Keefe, C. (2020). Continuous video monitoring: Implementation strategies for safe patient care and identified best practices. *Journal of Nursing Care and Quality.* https://doi.org/10.1097/NCQ.0000000000000502

American Association of Colleges of Nursing. (2019). *Fact sheet: Nursing shortage.* https://www.aacnnursing.org/Portals/42/News/Factsheets/Nursing-Shortage-Factsheet.pdf

Bajwah, S., Wilcock, A., Towers, R., Costantini, M., Bausewein, C., Simon, S.T., ... Higginson, I.J. (2020). Managing the supportive care needs of those affected by COVID-19. *European Respiratory Journal, 55*(4), 2000815. https://doi.org/10.1183/13993003.00815-2020

Cournan, M., Fusco-Gessick, B., & Wright, L. (2016). Improving patient safety through video monitoring. *Rehabilitation Nursing, 43*(2), 111-115. https://doi.org/10.1097/rnj.0000000000000089

Executive Office of the President. (2020). *Declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak.* Proclamation 9994. Document citation 85 FR 15337. Document 2020-05794. https://www.federalregister.gov/documents/2020/03/18/2020-05794/declaring-a-national-emergency-concerning-the-novel-coronavirus-disease-covid-19-outbreak

Kroll, D.S., Stanghellini, E., DesRoches, S.L., Lydon, C., Webster, A., O'Reilly, M., ... Mulloy, D.F. (2020). Virtual monitoring of suicide risk in the general hospital and emergency department. *General Hospital Psychiatry, 63*, 33-38. https://doi.org/10.1016/j.genhosppsych.2019.01.002

Lagasse, J. (2020, April 6). COVID-19: Shortages of protective equipment, insufficient tests plague hospitals, OIG finds. *Healthcare Finance.* https://www.healthcarefinancenews.com/news/covid-19-shortages-protective-equipment-insufficient-tests-plague-hospitals-oig-finds

Mandavilli, A. (2020, August 13). In N.Y.C.'s spring virus surge, a frightening echo of 1918 flu. *New York Times*. https://www.nytimes.com/2020/08/13/health/coronavirus-flu-new-york.html

Ndoda, K., Fechner, J., Wordekemper, J., & Kniewel, M. (2019). Video monitoring for fall prevention in the hospital: Current evidence and considerations. *Journal of Informatics Nursing, 4*(4), 30-36.

Nowrouzi, B., Lightfoot, N., Larivière, M., Carter, L., Rukholm, E., Schinke, R., & Belanger-Gardner, D. (2015). Occupational stress management and burnout interventions in nursing and their implicaions for healthy work environments: A literature review. *Workplace Health & Safety, 63*(7), 308-315. https://doi.org/10.1177/2165079915576931

Quigley, P.A., Votruba, L., & Kaminski, J. (2019). Outcomes of patient-engaged video surveillance on falls and other adverse events. *Clinics in Geriatric Medincine, 35*(2), 253-263. https://doi.org/10.1016/j.cger.2019.01.005

Quigley, P.A., Votruba, L., & Kaminski, J. (2020). Impact of patient-engaged video surveillance on nursing workforce safety: Patient aggression/violence. *Journal of Nursing Care Quality, 35*(3), 213-219. https://doi.org/10.1097/ncq.0000000000000450

Spetz, J. (2020, March 31). There are not nearly enough nurses to handle the surge of coronavirus patients: Here's how to close the gap quickly. *Health Affairs*. https://www.healthaffairs.org/do/10.1377/hblog20200327.714037/full/

Stam, H. J., Stucki, G., & Bickenbach, J. (2020). Covid-19 and post intensive care syndrome: A call for action. *Journal of Rehabilitation Medicine, 52*(4), jrm00044. https://doi.org/10.2340/16501977-2677

Tsay, S.F., Kao, C.C., Wang, H.H., & Lin, C.C. (2020). Nursing's response to COVID-10: Lessons learned from SARS in Taiwan. *International Journal of Nursing Studies, 108*, 103587. https://doi.org/10.1016/j.ijnurstu.2020.103587

Tzeng, H.M., Grandy, G.A., & Yin, C.Y. (2013). Staff response time to call lights and unit-acquired pressure ulcer rates in adult inpatient acute care units. *Contemporary Nurse, 45*(2),182-187.

U.S. Department of Health & Human Services. (2012). *Guidance regarding methods for de-identification of protected health information in accordance with the Health Insurance Portality and Accountability Act (HIPAA) Privacy Rule.* https://www.hhs.gov/sites/default/files/ocr/privacy/hipaa/understanding/coveredentities/De-identification/hhs_deid_guidance.pdf

Votruba, L., Graham, B., Wisinski, J., & Syed, A. (2016). Video monitoring to reduce ralls and patient companion costs for adult inpatients. *Nursing Economic$, 34*(4), 185-189.

Whitelaw, S., Mamas, M.A., Topol, E., & Van Spall, H.G. (2020). Applications of digital technology in COVID-19 pandemic planning and response. *The Lancet*, *2*(8). E435-E440. https://doi.org/10.1016/S2589-7500(20)30142-4

Quigley, P.A., Votruba, L.J., & Kaminski, J.M. (2021). Registered nurses, patient-engaged video surveillance, and COVID-19 patient outcomes. *MEDSURG Nursing, 30*(2), 89-96. Used with permission of the publisher, Jannetti Publications, Inc., msjrnl@ajj.com, www.medsurgnursing.net