



# Nurses' Perceptions of Infusion Therapy During the COVID-19 Pandemic

Susan H. Weaver, PhD, RN, CRNI<sup>®</sup>, NEA-BC • Marlene M. Steinheiser, PhD, RN, CRNI<sup>®</sup> • Miriam McNicholas, DNP, RN, CNL, NEA-BC • Deborah Prinzo, MSN, RN, MEDSURG-BC • Bridget Wertz, DNP, RN, NE-BC, NP-BC, CCRN

## ABSTRACT

During the COVID-19 pandemic, nurses were faced with challenges when caring for patients, safely administering intravenous (IV) medications and solutions, and protecting themselves from the virus. To address these challenges, nurses moved infusion pumps outside of intensive care unit (ICU) rooms of patients with COVID-19 to minimize their exposure to the virus, conserve personal protective equipment, and efficiently administer IV medications and solutions. The purpose of this qualitative descriptive study was to explore and describe nurses' perception of managing infusion pumps outside the ICU rooms of patients with COVID-19 at 6 acute care hospitals. Eight interviews were conducted with ICU nurse managers, assistant nurse managers, clinical nurses, and vascular access team staff. From the interviews, the overarching theme was "figure out a way," with the subtheme "no clear-cut policy." Additional themes were: (1) limiting nurses' exposure, (2) increased risk for infection and error, (3) teamwork, and (4) roller coaster of emotions. The findings from this study revealed that, during this unprecedented pandemic, nurses were innovative and figured out a way to care for patients who were critically ill with COVID-19. Understanding this experience provides insight into creating policies and procedures to guide patient care in future pandemics or emergency care.

**Key words:** coronavirus, COVID-19, infusion pump, nursing, pandemic, qualitative descriptive

**Author Affiliations:** Hackensack Meridian Health, Ann May Center for Nursing, Neptune, New Jersey (Dr Weaver); Infusion Nurses Society, Norwood, Massachusetts (Dr Steinheiser); Hackensack Meridian Health, Neptune, New Jersey (Dr McNicholas); Hackensack Meridian Health, Old Bridge Medical Center, Old Bridge, New Jersey (Ms Prinzo); Hackensack Meridian Health, Hackensack University Medical Center, Hackensack, New Jersey (Dr Wertz).

**Susan H. Weaver, PhD, RN, CRNI<sup>®</sup>, NEA-BC,** is a nurse scientist at the Ann May Center for Nursing at Hackensack Meridian Health. She has experience as an intensive care unit nurse, nurse educator, operations manager, and evening administrative supervisor. Dr Weaver received a BS in nursing from Penn State University, a Master's degree in nursing administration from Seton Hall University, and a PhD in nursing from Rutgers, the State University of New Jersey. Her research focus is on the nursing workforce, particularly administrative supervisors and clinical nurses who work the night shift, and improving outcomes. As 2021-2022 Infusion Nurses Society (INS) President, her presidential theme was "ReSEARCH Your Passion," and she particularly enjoys conducting qualitative research because she believes it is important to hear the perspective of participants. **Marlene M. Steinheiser, PhD, RN, CRNI<sup>®</sup>,** is the INS Director of Clinical Education. In her role, she directs the development of educational programs and resources for INS and develops strategic alliances with other organizations. A nurse for more than 35 years, Dr Steinheiser has experience in acute care, home infusion, long-term care, regulatory affairs, and academia. She received her diploma in nursing from Cleveland Metropolitan General Hospital School of Nursing and her BSN and MSN from the University of Akron. Dr Steinheiser earned her

PhD in nursing at the University of Arizona, conducting qualitative research focusing on compassion fatigue among nurses working in skilled nursing facilities. She has published numerous articles on the topics of compassion fatigue, as well as infusion therapy. **Miriam McNicholas, DNP, RN, CNL, NEA-BC,** is the Hackensack Meridian Health Director of Professional Practice and Clinical Policy and serves as adjunct faculty at the Hackensack Meridian Georgian Court University, School of Nursing. She received her BS in nursing from Bloomfield College, her Master's in Clinical Nurse Leadership from the College of New Jersey, and her Doctorate of Nursing Practice from Monmouth University. Dr. McNicholas has experience in nursing administration, nursing education, program management, and quality and outcomes. Clinically Dr McNicholas's experience encompasses critical care, operating room, and medical-surgical telemetry. During the COVID-19 pandemic surges, her primary responsibility was researching and writing protocols for the care of patients with COVID-19. **Deborah Prinzo, MSN, RN, MEDSURG-BC,** is a nurse leader of the inpatient vascular access and outpatient infusion departments at Old Bridge Medical Center at Hackensack Meridian Health. Deborah has 32 years of nursing experience and is currently the chair of the vascular access device committee for Hackensack Meridian Health network, focusing on best practice in infusion nursing and harmonizing policies and procedures across the network sites. Deborah received a BS in nursing from Kean University and a Master's in nursing administration from Kean University. Deborah presented "Is a Picture Worth 1,000 Rads" at the INS 2019 meeting in Baltimore and is passionate about infusion nursing. Deborah is interested in pursuing additional research opportunities in the future. **Bridget Wertz, DNP, RN, NE-BC, NP-BC, CCRN,** is the Hackensack Meridian Hackensack University

The unprecedented COVID-19 pandemic presented multiple challenges for nurses in providing safe, quality care to the surge of critically ill patients with COVID-19. Early in the pandemic, nurses adopted an innovative practice of moving the infusion pumps outside the intensive care unit (ICU) rooms of patients with COVID-19 to decrease their exposure to this new infectious disease. As the pandemic unfolded, the Society of Critical Care Medicine (SCCM) supported this innovation, recommending maintaining infusion pumps outside the rooms of patients who were positive for COVID-19 to minimize nurses' exposure.<sup>1</sup> There is a gap in the literature on this innovative practice, particularly regarding the impact on patients when intravenous (IV) tubing is extended to enable the management of infusion pumps outside of the patient rooms. The purpose of this study was to explore and describe nurses' perceptions of managing infusion pumps outside the ICU rooms of patients who were COVID-19 positive at 6 acute care hospitals.

## REVIEW OF THE LITERATURE

The most severe pandemic in recent history was the Influenza Pandemic of 1918, which had three waves of illness, and an estimated one billion people were infected. In December 2019 a novel coronavirus, SARS-CoV-2, was identified as the causative agent of an outbreak of viral pneumonia in Wuhan, Hubei, China. On January 20, 2020, the first case of the 2019 novel coronavirus (COVID-19) was announced in the United States.<sup>2</sup> On March 11, 2020, the World Health Organization declared the outbreak a pandemic,<sup>2</sup> and on March 13, 2020, US President Donald Trump declared a national emergency. As COVID-19 began to spread throughout the northeastern United States, acute care hospitals quickly changed to caring primarily for patients with COVID-19 or persons under investigation (PUI). The COVID-19 pandemic had multiple waves of illness, with the first wave in the northeast starting on March 11, 2020, and continuing until May 31, 2020. As of June 25, 2022, 86 787 443 people in the United States have been infected with COVID-19, and there have been 1 011 013 deaths.<sup>3</sup>

As the pandemic unfolded, the SCCM and American Society of Healthcare Engineering recognized that having infusion pumps in hallways outside the rooms of patients who were positive for COVID-19 or PUI would minimize nurses' exposure to this disease and conserve personal protective equipment (PPE).<sup>1,4</sup> The SCCM advised to mini-

mize the use of extension sets and provided recommendations such as, "Label each intravenous (IV) line inside and outside the room with different colors for each unique line; suspend IV tubing inside the room to prevent damage from radiograph machines or ultrasound machines running over tubing; and extra precaution is necessary to avoid accidentally dislodging tubing from the patient's IV access or concomitantly dislodging the IV access."<sup>1(p14)</sup> The SCCM also suggested, "Secure IV tubing to the floor out of the path of care equipment, especially radiograph machines, so that IV lines remain free flowing and are not damaged."<sup>1(p25)</sup> When the crisis diminishes, the SCCM recommended installing conduits so IV tubing does not have to be on the floor.<sup>1</sup>

During pandemics, the literature identifies the role of the nurse in clinical management, prevention, and surveillance, but prior to the COVID-19 pandemic there was no information on managing an infusion pump outside a patient's room. For instance, when caring for patients with the Ebola virus, it was noted that central vascular access devices (CVADs) were placed to ensure that patients had reliable vascular access to administer fluids and obtain blood specimens.<sup>5</sup> Some descriptions of experiences with managing infusion pumps outside the room during the current COVID-19 pandemic can be found in the literature. Cheruku et al described extending IV tubing to outside the room using "three 5-foot microbore tubing segments in a series,"<sup>6(p3)</sup> which allowed for administration of medications and obtaining blood specimens. Another organization described the challenge of keeping infusion pumps outside the room during the COVID-19 pandemic, including increasing the amount of time for a medication bolus to reach the patient and the need to have a nurse at the pumps outside the room when others were caring for the patient inside the room.<sup>7</sup> Yet a detailed description of nurses' perception and description of managing infusion pumps outside the ICU rooms of patients who were COVID-19 positive is lacking.

During the COVID-19 pandemic the extension of IV tubing so the infusion pump could be managed outside the ICU room was contrary to the Infusion Nurses Society (INS) established *Infusion Therapy Standards of Practice* (the *Standards*). In March 2020, at the onset of the pandemic, the *Standards* indicated that add-on devices, such as multiple extension sets, should be limited due to the "increased risk for contamination from manipulation and the risk for accidental disconnections and misconnections."<sup>8(p5126)</sup> The current *Standards* further specified, "Limit the use of add-on devices whenever possible to

was supporting the clinical team for the implementation of the updated and evolving practice guidelines to care for patients with COVID-19.

**Conflicts:** None to declare.

**Corresponding Author:** Susan H. Weaver, PhD, RN, CRNI<sup>®</sup>, NEA-BC, Hackensack Meridian Health, Ann May Center for Nursing, 2020 Sixth Avenue, Neptune, NJ 07753 (Susan.Weaver@hmhn.org).

DOI: 10.1097/NAN.0000000000000497

*Medical Center Co-Magnet Program Director. She has experience as a step down and critical care nurse, education specialist responsible for teaching critical care orientation, and project manager for the organization's Magnet designation. Dr Wertz received her BS in nursing and Master's in Nursing Education from Rutgers University, as well as her Doctorate of Nursing Practice from Monmouth University. Dr Wertz has experience in nursing administration, nursing education, and program management. In March of 2020, during the COVID-19 surge at Hackensack Meridian Hackensack University Medical Center, her primary responsibility*

decrease excessive manipulations, accidental disconnections or misconnections, and risk of contamination and subsequent infection. Add-on devices may cause challenges with drug delivery and increase costs.”<sup>9(p5107)</sup> Thus, it is important in this study to investigate how the IV tubing was extended and managed outside of the patient’s room so as to identify best practices for future pandemics, epidemics, or illness outbreaks. The purpose of this study was to investigate the nurses’ perception and description of how infusion pumps were set up and managed outside the ICU rooms of patients who were COVID-19 positive at 6 acute care hospitals.

## METHODS

A qualitative descriptive study was conducted to explore and describe nurses’ perceptions of delivering IV therapies and managing infusion pumps outside ICU rooms and how vascular access devices were maintained, including the securement and length of the IV tubing at 6 acute care hospitals during COVID-19 pandemic. Institutional review board (IRB) approval was obtained from the health care system IRB.

### Research Procedures

Purposive sampling was used to recruit ICU nurse managers, assistant nurse managers, clinical nurses, and vascular

access team staff from different hospitals to participate in this study.<sup>10</sup> Emails were sent inviting them to participate in an interview at their hospital. In-person interviews were held at varied dates and times in locations chosen by the participants.

At the beginning of each interview, the researchers explained the research study, had the participant read the Information Sheet for Participation in Research, and allowed time to ask questions. Participation in the interview served as their consent for participating in this research study and for recording the interview. A semistructured interview discussion guide, developed by the researchers, was utilized to facilitate discussion (See Table 1). The interviews commenced with asking participants their position title and role during the COVID-19 pandemic and then to describe and discuss how patients received infusion therapy outside their room. All interviews were audio recorded, utilizing a digital recorder. Descriptive field notes were written after each interview. The interviews continued until data saturation was reached.

### Sample and Setting

Eight interviews were conducted at 6 acute care hospitals, part of a large health care system, in the northeast region of the United States. The hospitals were nonprofit medical centers (67%) and academic medical centers (33%), with staff sizes ranging from 152 to 781 beds.

**TABLE 1**

## Interview Guide

1. Tell me your position title and your role during the COVID-19 pandemic.
2. During COVID-19, please describe and discuss how patients received infusion therapy outside their room:
  - a. Describe the unit such as an ICU or a unit that became an ICU, number of beds, private or semi-private rooms.
  - b. For placement of the infusion pumps outside the room:
    - Describe when the decision was made.
    - Describe how the decision was made.
  - c. Describe in detail the procedure for placing the pump outside the room (step by step how the extension tubing was connected to the patient, then placed out the door) the intravenous tubing length, number of tubing segments, and type of tubings such as MRI tubing or extension sets.
  - d. Describe in detail how the intravenous tubing was labeled.
  - e. Describe in detail how the intravenous tubing was secured.
  - f. What was the average number of infusions per patient?
  - g. Explain how you identified what pump belonged to which patient.
  - h. Explain how you identified the patient when titrating/administering IV medications.
  - i. Discuss who was responsible for CVAD dressing/cap changes.
  - j. Discuss who was responsible for the CHG baths.
  - k. Talk about how the pump was managed outside the patient room on patients who were prone and/or intubated.
  - l. Discuss if you noticed any difference in the rate of flow and the expected volume emptying of the IV bag.
  - m. Discuss how managing infusion therapy outside the room evolved over time.
  - n. Discuss the advantages managing infusion therapy outside the room.
  - o. Discuss the disadvantages managing infusion therapy outside the room.
  - p. Describe any near misses or errors.
  - q. Tell me how you felt about managing infusion therapy outside the room.
3. Conclusion:
  - a. Can you give me an example of an especially challenging time you had with managing patients’ intravenous infusion therapy during COVID-19?
  - b. Can you give me an example of an especially satisfying or rewarding time you had with managing patients’ intravenous infusion therapy during COVID-19?
  - c. Is there anything else you would like to tell me regarding managing patients’ intravenous infusion therapy during COVID-19?

Abbreviations: CHG, chlorhexidine gluconate; CVAD, central vascular access device; ICU, intensive care unit; IV, intravenous; MRI, magnetic resonance imaging.

Four of the hospitals had American Nurses Credentialing Center Magnet® designation, and 2 of the hospitals had vascular access teams. The interviews were held between March and July 2021 and lasted an average of 46 minutes. Sampling continued until saturation occurred, as evidenced by no new concepts or themes emerging.<sup>10</sup> In qualitative research, the smaller sample size is less important than the degree of saturation that emerges (no new information coming forth), and the goal is not to generalize the findings but rather to understand the experience or phenomenon.<sup>10</sup>

Specific demographic data of the participants were not collected, but the interviews were held with ICU assistant nurse managers, ICU managers, clinical nurses, and members of 2 vascular access teams.

## DATA ANALYSIS

The interview transcripts were thematically analyzed for participants' perception and description of how the infusion pumps were maintained outside the ICU rooms of patients who were COVID-19 positive at 6 acute care hospitals during the COVID-19 pandemic. The audio recordings, which were digitally recorded, were transcribed verbatim by paid transcriptionists and were checked for accuracy by a research team member. Transcripts and descriptive field notes were then read, reread, and coded individually by each researcher, beginning with the first interview and continuing throughout the rest of the study. In conducting the thematic analysis, the researchers used an iterative, constant comparative method to identify codes and themes.<sup>11-12</sup>

The coprincipal investigators, who are certified in infusion therapy, and 2 other members of the research team conducted the interviews. During each interview, 2 members of the research team were present. All members of the research team participated in the data analysis, along with a qualitative subject matter expert who was certified in infusion therapy.

The researchers first reviewed the data separately, creating codes and categories. Members of the research team used Google Sheets (Google, Mountain View, CA) and Microsoft Excel (Microsoft Corporation, Redmond, WA) for documenting quotations from the transcripts with the corresponding page numbers, categories, and codes. The research team held frequent meetings to compare the data for common codes, categories, and themes and to reach consensus. When analyzing the data, contrast tables were drawn, and mapping was done to systematically display common patterns and themes.<sup>11</sup>

To enhance the validity of this research, trustworthiness was established with reflexivity, thick description, and respondent validation (member checks).<sup>13-14</sup> Thick description with in-depth details was used when writing the descriptive field notes after each interview. Reading and reflecting were utilized to thoroughly analyze the data

from the interviews, and field notes. The data were read, reread, contemplated, analyzed, and discussed by the research team to uncover and draw conclusions based on the deeper, not the superficial, meanings.

For credibility by using respondent validation, member checks were used in which a summary of the findings were sent to 6 participants. Five participants responded indicating that the synopsis was accurate and they agreed with the themes. One participant felt that the increase risk for error when administering medications was not accurate because they utilize a second registered nurse for verification. The research team rereviewed the transcripts and found the transcripts supported the theme of increased risk for infection and error. Credibility was also established by presenting the participants' perspectives clearly and with use of some direct quotes.<sup>15-18</sup>

## RESULTS

The nurses working at these 6 acute care hospitals were in the epicenter of the pandemic and cared for more than 13 000 patients with COVID-19 during the first wave of the pandemic. The ICU nurses were caring for critically ill patients with COVID-19 who were intubated on ventilators and receiving multiple infusion medications through various types of CVADs. Participants described predominately utilizing nontunneled CVADs with placements in the internal jugular, subclavian, and femoral veins and even some peripheral vascular access devices (VADs). The 2 hospitals with vascular access teams placed a great number of peripherally inserted central catheters (PICCs) during the pandemic. One vascular access nurse explained they inserted 70 to 80 PICCs monthly pre-COVID and, "during COVID we were doing like 130 [monthly]...and almost all, all of the COVID patients had triple lumen PICCs." However, the participants at hospitals without vascular access teams said PICCs were not used as commonly because they did not have enough lumens for the multiple medications they were administering.

On March 16, 2020, nurses at one of the academic medical centers involved in the study were the first at this health care system to move the infusion pumps outside the ICU rooms of patients with COVID-19. These ICU patients had at least 8 medications infusing, and as described by a participant, there was "a spiderweb of tubing" to the pumps outside of the room (Figures 1 and 2). Participants explained that they learned about moving the infusion pumps outside the ICU room from social media. A participant stated that the idea came from the ICU nurses who "saw on social media that other hospitals in the state were using various techniques to get the pumps out of the room." A participant further explained that moving the pumps outside the rooms demonstrates how important it is to listen to the voice of the nurse and empower them to provide the best patient care.



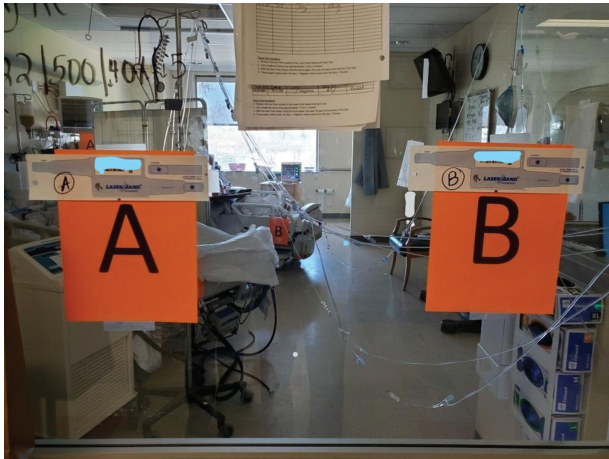


Figure 1 Patient identification labels outside semi-private room.

From the interviews the overarching theme was “figure out a way” with “no clear-cut policy” as the subtheme (Table 2). The additional themes were (1) limiting nurses’ exposure, (2) increased risk for infection and error, (3) teamwork, and (4) roller coaster of emotions.

### Figure Out a Way

*Figure out a way* describes how the nurses worked together to decide on how to run the tubing from the IV catheter to the pump outside the room, how to extend the IV tubing and how much tubing to use, how to secure the IV tubing, and how to insert a PICC without bringing the PICC cart into the room of patients with COVID-19. Depending on the design of each hospital ICU, decisions were made on whether to run the tubing between the

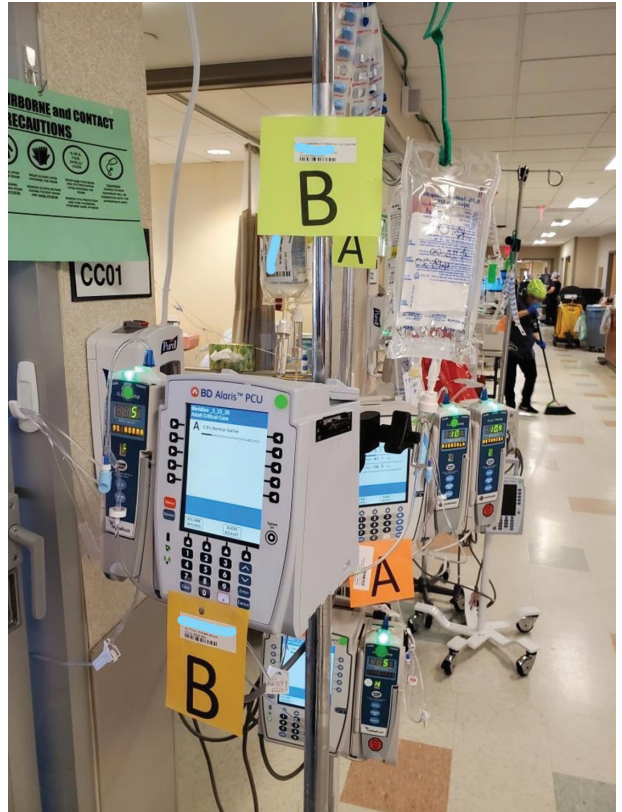


Figure 2 IV pumps labeled outside semi-private patient room.

doors or to have holes drilled through the walls to run the IV tubing into the room. A participant explained how they decided to manage the tubing to the pumps outside the room:

TABLE 2

## Themes, Subtheme, and Supporting Quotes

| Theme                                  | Subtheme            | Quotes  |
|--|---------------------|---|
| Figure out a way                       |                     | “...depended on which tubing we were using...So, we could use their chairs and we could use the bedside table...we would literally just push it across into the hole from the wall so, it never hit the floor, it was always above, and it was always kinda like stabilized...There was no tension on any of it, there was plenty of room. I want to say some of the tubing was like 45 inches, some of it was like 116 inches, so it kinda varied you know it was kinda the soup of the day. Whichever... Storeroom brought up to us is kinda like what we had...” (8) |
|  | No clear-cut policy | “No, we kinda just thought on our feet figuring out the best way to do things” (4).<br>“And we had to adjust the way that we would give our medicine and our IV infusions based off of what we would learn and every new experience” (5).   |
| Limiting nurses’ exposure              |                     | “...having them outside the room with the isolation because if we just needed to replenish a drip or change the rate we didn’t have to gown up and put on all the PPE just to do that...and also less exposure” (7).  |
| Increased risk for infection and error |                     | “...because now you have more tubing. More hands on the pumps, so higher chance of CLABSI... confusing other patients. Because if you have two patients, you have 2 pumps outside. If you’re in a hurry, and there’s eight drips hanging, you don’t even know which, you know which button to press first. So, med variances I would say.” (4)  |
| Teamwork                               |                     | “I’d say that was the major advantage that you could hear it beeping and you could help each other out by changing bags...” (5)   |
| Roller coaster of emotions             |                     | “I think the whole thing was challenging. From start to finish I think the whole thing was challenging.”  |

Abbreviations: CLABSI, central line-associated bloodstream infection; IV, intravenous; PPE, personal protective equipment.

We'll figure out a way. Because they're worried about the door not closing all the way with the tubing in the way and interfering with the negative pressure. So, we said let's just do what we're doing, it's working. Negative pressures are all good in the rooms. Maintenance comes around and checks. If we have an issue then we'll start drilling holes, but it's a little excessive right now. So, we made it work.

The length of tubing and number of extension sets needed from the patient to the infusion pump varied based on the layout of the ICU rooms and the types of tubing that were available. For smaller patient rooms, only 1 extension set was needed with the primary tubing; however, other patient rooms needed 3 or 4 coiled extension sets with the primary tubing. Furthermore, when the pumps were initially moved outside the room, tubing choices were based on trial and error as explained by a participant:

We started off initially using the very narrow diameter MRI [magnetic resonance imaging] tubing . . . I think initially we had connected 3 tubings to reach the patient and then once we were able to find and refine our tubing choices, we ended with the 254-inch beautiful bore no issues at all. So, it was really an evolution over time.

Another challenge with moving the pumps in the ICU hallways outside the patient rooms was, "We just don't have the plugs in the hallway," explained a participant, so extension cords had to be used until more outlets could be installed. Working in "uncharted territory, participants were innovative not only in utilizing whatever tubing was available at their hospital but in securing the tubing to keep it off the floor."

We set up hook systems outside the room and inside the room, for the drooping. Because of course the extension tubing that you're using is really uncharted territory. We would use anything that they would let us use. We started off initially using the very narrow diameter MRI tubing. Now the challenge with that was that propofol does not go through it very well.

The vascular access team nurses also had to figure out a way to insert PICCs on patients with COVID-19. Due to the isolation, the nurses could no longer bring the PICC cart into the room when inserting the catheter. So the PICC cart was left outside the room and only essential items were brought into the room. Nurses at one hospital compiled the essential items for inserting the PICC into a bag, which was brought into the room. A participant explained that another challenge was no pen or paper in the room to document the measurements: "Every PICC has to be cut and that nurse had to be good about remembering what the measurements were cause you, you couldn't write it down, so that was challenging too."

There was *no clear-cut policy* or evidence-based practice on how to manage the infusion pumps outside the room. The organization had well-established medication administration and patient identification (ID) policies and procedures, which were adhered to by the nurses. However, there were no policies on administering IV push

medications, boluses, or how to identify patients with the infusion pumps outside the rooms. Some of the participants stated IV push medications could only be given in the room, whereas others gave the IV push, "at the pump, outside the room." A participant explained how they adapted and administered medication boluses:

There was no clear-cut policy as to give it out here or give it in there...So, some of them would go in the room and if there was another nurse available, which most times there wasn't another nurse available for them, they would stay in the room and someone else would just hand them the boluses as needed. But, for the most part it was easier and safer to give it outside of the room and then just bolus the drip in, you know, saline or something along those lines. Because you're not gonna use a flush, flushes no, not gonna get anywhere near that patient. So, we just figured you know what, if we just run this at 999 it'll get to the patient a lot quicker.

For patient identification, most participants explained that, in addition to the patient having the ID band on their wrist, another ID band was outside the room, typically on the patient's pump. A participant further explained their process for patient identification:

A patient's name band on the pump. And so, the pole, if we had 2 poles for 1 patient, because it was you know, six, seven, channels that we needed, we would have the ID bands on both. And every 12 hours at change of shift they would have to do a 2-person ID with the pump and the patients' wrist.

In October 2020, participants explained that the system-wide Critical Care Committee established criteria for which patients could have their infusion pumps outside the room. The patients had to be in the ICU, COVID-19 positive or PUI, and have a CVAD with a titratable medication.

### Limiting Nurses' Exposure

According to the participants, the primary advantage of having the infusion pumps outside the room was limiting nurses' exposure to patients with COVID-19. In caring for these critically ill patients with a new highly contagious disease, a participant explained that nurses cannot just run into the room to increase the medication rate or hang a new bag. She stated, "Even though that IVs running out inside, you have to take time to protect yourself." The nurses had to properly don their PPE, which takes time, and having the pumps outside the room greatly decreased the frequency with which nurses had to enter the room.

Limiting nurses' exposure also resulted in conserving PPE, because with the pumps outside the room nurses did not need to enter the room as often to respond to a pump alarm or change the infusion bag. When asked about why the infusion pumps were moved outside the room, a participant explained: "To limit the exposure. Because our pumps beep, you have drips that need to be changed every few hours...So, we decided to move the pumps from in the room to outside the rooms...so now we're not wasting PPE, gown up, glove, go in the room."

## Increased Risk for Infection and Error

When asked about the disadvantages, some participants struggled to identify any disadvantages. One participant stated: “I don’t know that there were any disadvantages to be honest with you. I mean I think the whole thing was advantageous really. I mean it was safer for the patients.” However, all other participants listed their concerns: increased risk for central line-associated bloodstream infections (CLABSI), increased chance of errors, challenge in communicating with others when inside the room, tubing being too long leaving medication in the tubing, increased difficulty in monitoring the IV insertion site and assessing for infiltration, congested ICU hallway with infusion pumps, and concern that the catheter, particularly the PICC, would be accidentally removed due to others tripping on the tubing.

“The biggest disadvantage was the increased risk of infection,” said one participant. There was so much tubing and multiple extension tubings added together to accommodate the distance between the patient and the pump outside the room. Anywhere from 1 to 4 extension tubings had to be utilized, and lengths of the extension tubing varied greatly, ranging from 20 to 254 inches. Supply chain interruptions contributed to no guarantee that IV tubings would be available to change the tubings every 96 hours or as required. Additionally, when the infusion pumps were first moved outside the room, the IV tubings were initially placed on the floor at some hospitals. A participant explained that, although in the very beginning the tubing was on the floor, “We did not feel it was best practice to do that because it just wasn’t sanitary to keep them on the floor.” The participants then became innovative in using hooks, clips, chairs, bedside tables, or even the ventilator to drape the tubing and keep it off the floor. The managers indicated that there was a spike in CLABSI in their units.

Although having the pumps outside the room allowed nurses to help each other with changing the infusion bag or responding to a pump alarm, it was also seen as a disadvantage because nurses felt there was an increased chance for error, such as with colleagues programming the wrong pump, just silencing the alarm, or administering the incorrect bolus medication. A participant explained: “a beeping alarm, someone’s gonna touch it...instead of just seeing what the issue is, they may just walk by press continue and keep walking. You don’t know what’s going on, you don’t know if the nurse stopped it for a reason.”

With the infusion pumps outside the rooms, communication was a challenge when the nurse was caring for a patient inside the room. If these critically ill patients needed an extra bolus of medication, nurses had to yell for help or knock on the window and rely on another nurse to correctly adjust the pump for them because, “I can’t bolus them from inside.” Nurses would explain through a crack in the door what they needed. A participant further explained this challenge, “I have to yell to somebody outside where you know, if you’re looking out the window, there’s nobody

there. So, then I’m opening my door I’m dirtying my pump by bolusing my patient.”

## Teamwork

The patients in the ICUs with COVID-19 required much nursing care because they were typically sedated, on a ventilator, and/or receiving 4 or more continuous infusion medications. A participant explained that having the pumps outside the room was a gift to help nurses manage these acutely ill patients. Another participant further explained this teamwork:

I hear a pump beeping...and I can look, what’s wrong, ask the nurse can I do it for you? If they’re in the room, you can have somebody outside the room helping you. Can you give them a bolus, can you do this, can you hang that bag, I have one there, let me know when it’s up. Like, it was all hands on deck with the pumps being outside because everybody was aware of what was going on with their patients.

Participants explained that an advantage to having the pumps outside the room was better time management because they or their colleagues could easily help each other with changing the infusion bag or titrating the infusion. A participant stated: “...having three very high acuity patients at once, it was easier to have it outside the room just for, you could quickly change and adjust the rate as needed while you’re checking all your patients at the same time.” It was also easier for all nurses to hear and respond to pump alarms, because when the pumps were inside the room, it was sometimes difficult to discern from which room the alarm was coming.

## Roller Coaster of Emotions

Although the questions in the interviews related to infusion therapy during the pandemic, the emotional toll and fear experienced and expressed by participants emerged in the conversations and cannot be ignored. During the interviews, the participants shared how caring for patients with COVID-19 impacted them emotionally. As the number of patients suspected of or diagnosed with COVID-19 increased, participants described a range of emotions: “I think it was a lot of like a roller coaster of emotions, and it was, it was difficult.”

Notably, several participants described feeling fearful and scared, “I think that we were so overwhelmed being like—we literally went from having like one COVID patient to like having like an entire unit full. So, we were overwhelmed to say the least. With emotions, with not knowing, fear.” Fear was related to being exposed to COVID-19, needing to care for a great number of critically ill patients, and a lack of experience in pandemic patient care. Participants expressed stress and fear when alone caring for patients with COVID-19, and, as one participant stated, “If you’ve ever, I don’t know if you’ve ever been in one of those rooms but it’s eerily quiet when you’re the only one in the room. And it’s scary and you know, it’s just you and these two patients who are on life support and there’s



just, all you hear are the ventilators, and you know, it's like eerie and it's like you're here by yourself and if something happens it's on you, you're the only person in the room."

Participants also described their sadness as they cared for some patients with COVID-19 for a very long time and then watched them die, told families that they could not be with their loved ones, were told COVID wouldn't impact younger people yet saw patients in their thirties being admitted and dying, and dealt with increasing and frequent deaths.

From start to finish, I think the whole thing was challenging. We had a lot of patients that family members just didn't get it, didn't want to get it, didn't care to get it, or just didn't understand. It was sad, it was really sad watching it because you just knew that these patients, they came to you, and they were gonna die.

Participants expressed grief and heartbreak as they were the only person in the room while a patient expired.

No nurse, I can say, I would never let a patient die by themselves so we put our lives in jeopardy because we were constantly in the rooms if they were dying, we were holding their hands because no one else could be with them. Having to watch these family members sob on FaceTime or, you know, not be able to see their loved one as they were dying is brutal. I mean, you were watching little kids, on FaceTime, watching their grandmother take their last breath. I mean, it was heart-wrenching you know.

Their work took a toll on the participants as they provided care for patients with COVID-19. In the beginning, little was known about COVID-19, which created anxiety and frustration. It was described as "really just everyone including the patients and the nurses were just trying to survive." Having direct knowledge of the impact that COVID-19 had upon patients and families, participants were challenged as described: "And you know, the frustrating portion was the people that said well it doesn't exist, you know?" There was a sense of reluctance, "I mean it was just, it was brutal, it was brutal. I don't ever want to live through that again, I'll be honest with you."

Although participants expressed fear, sadness, and frustration, they also noted elements of compassion satisfaction while spending time with patients, assisting patients with simple things like handing them the phone or providing basic care. A participant explained that, when inserting a PICC, she spends a significant amount of time in the room, which provides an opportunity to talk with the patient. She described this experience as a chance to "hear how they're doing and provide comfort and maybe you know, what else do you need...things like that I think that was kinda rewarding. And just, kinda like providing comfort to people." Participants described the emotional challenges experienced during this time but also expressed satisfaction in their work inserting VADs, in some cases for nearly all the patients with COVID-19, administering multiple IV medications, and creating an environment which reduced their risk of exposure.

## DISCUSSION

The findings from this study revealed that, during this unprecedented COVID-19 pandemic, nurses were innovative and figured out a way to care for patients who were critically ill with COVID-19. In the early days of the pandemic, ICU nurses had to make decisions on how to best care for their patients, along with protecting themselves from this contagious disease. They knew the organization's policy and procedures were to limit add-on devices; however, moving the pumps outside the patient rooms was the only way to minimize their exposure and bundle their care.

Nurses recognized that moving the pumps outside the room increased the risk for CLABSIs and errors, so they were innovative in striving to prevent CLABSIs and errors. When the SCCM suggested IV tubing be secured to the floor, nurses recognized that this recommendation was contrary to basic nursing practice because not only is the floor considered dirty but securing something onto the floor is a hazard for tripping or falling.<sup>1</sup> Nurses created ways to drape the tubing and keep it off the floor. As noted by our participants and reported by others, there was an increase in CLABSIs during the COVID-19 surges.<sup>19</sup> In the next phase of our research, we are examining the incidence of CLABSI in patients who were COVID-19 positive with the infusion pump managed outside the room.

The emotional well-being of nurses was impacted in caring for COVID-19 patients during the pandemic. There was uncertainty about how to best care for patients and the lack of policies, with specific concerns about monitoring the vascular access sites when pumps were outside the room, uneasiness about communication when inside the patients' rooms, fear of contracting COVID-19, and sadness as a result of watching patients die, particularly without loved ones nearby. Participants described their range of emotions, including fear, anxiety, sadness, and frustration, but also described teamwork and compassion satisfaction in their daily work. Clinical implications from this study suggest ways to address pandemic nursing well-being. Just as important as developing clinical policies and procedures, a plan to address the emotional well-being of nurses during crisis or pandemic events should be considered. Vital to developing a plan to address nurse well-being is collaboration among staff nurses, managers, and leaders and plans to continually assess to improve interventions.<sup>20</sup>

## RECOMMENDATIONS

These findings can guide nurses in managing infusion pumps outside the patient rooms in future emergencies, illness outbreaks, epidemics, and pandemics. Our primary recommendation is to develop policies and procedures for managing infusion pumps outside the room. The policy should establish criteria for patients, along with reassessment criteria, to have their infusion pumps outside the



room. The procedures should specify the process for the rights of medication administration, especially patient identification, bolus dose administration, type, length, and volume of tubings for extension, as well as how to secure the IV tubing. As the practice of extending the pumps outside the room does not align with the *Standards*, additional research is needed to identify best practices and the impact of this practice on patient outcomes.

Considering that the design and floor plan of each ICU is unique and the rooms are different, it would be beneficial to designate which patient rooms are best to have the infusion pumps outside. Rooms should be selected that require the least extension tubing and can support the equipment outside of the room. Collaboration should occur with engineering and facilities departments to ensure that the designated rooms have electrical outlets outside the room and conduits for the tubing.

We strongly recommend that vascular access team nurses and nurses at the bedside are allowed and encouraged to be innovative in caring for patients. In the absence or limitations of a vascular access team, organizations should consider designating and training vascular access champions who can provide optimal delivery of infusion services. Nurses understand their duty to provide optimal care to patients and prevent infections, so supporting their innovation can foster teamwork and improve outcomes. In addition to nurses' innovation, technology should be optimized to design smart infusion pumps with automation.

Although command centers were created at each of the 6 hospitals, along with a systemwide centralized staffing command center, there was no mechanism to share clinical information or innovation between hospitals.<sup>21</sup> Establishing a 24-hour clinical command center to share and discuss clinical issues, such as how to secure the IV tubing with the infusion pumps outside the room, would provide a mechanism to foster best practices.

The ANA Code of Ethics<sup>22</sup> specifies that nurses not only have a duty to care for patients but also have the same duty to care for self. A plan to address the emotional toll of pandemic nursing could include some of the following interventions: Stress First Aid (SFA), daily rounding by behavioral health specialists to offer support, implementation of a Code Lavender program, and peer-to-peer support including the use of a lavender kit or creation of a Watson room.<sup>23</sup> SFA is a structured program, with options for addressing stress, aimed to reduce one's reactions that can become long-lasting.<sup>24</sup> SFA can be used for self-care and to improve the well-being of coworkers. A Code Lavender program consists usually of a team of individuals from spiritual care and other supportive services such as music therapy, ethics committee members, employee assistance, and individuals from the wellness department. After a stressful event, a Code Lavender program can provide a dedicated physical presence, debriefing, team support, and other complementary therapies. Peer-to-peer support can include the use of a lavender kit which might consist of gifting a piece

of chocolate or lavender to a coworker to show support during a stressful time. Named in honor of Jean Watson, nursing theorist, a Watson room can be created to provide a space for self-care. As a dedicated relaxation space, a Watson room can be supplied with comfortable seating, dim lighting, coloring books, music, meditation, and/or other stress reducing practices. An effective plan to address nurses' well-being should not only include team collaboration but also implementation plans with education for all health care staff and leaders.

## LIMITATIONS

A limitation of this qualitative study was that the participants were a voluntary sample of nurses who worked at acute care hospitals, part of a large health care system, in the northeast region of the United States; their perceptions may not reflect the perceptions of nurses in other parts of the state or country. It is important to note that the perspective of these nurses who were working in these hospitals in the northeast region is particularly valuable because they were at the epicenter of the pandemic in March of 2020.

## CONCLUSIONS

Prior to the COVID-19 pandemic, the nursing profession was faced with generational workforce concerns, changing patient care delivery systems, increased patient acuity with patients requiring complex care, and staffing shortages. Then new challenges were created by the COVID-19 pandemic, many of which have never been faced by nurses. Florence Nightingale's words, "the more experience we gain the more progress we can make," were never more evident than in the innovation and resilience demonstrated by nurses during the pandemic.<sup>25(p761)</sup>

Challenged with a virus that was little known, nurses were placed in situations where they drew on principles of infusion therapy, patient safety, and creativity to meet the complex infusion needs of patients with COVID-19. The thematic outcomes from this study demonstrate how the lack of policy to guide practice was felt to impact patient safety by increasing the risk for errors and infection and how supply shortages affected the care that nurses were able to provide. At the same time, these challenges opened the door for innovation and collaboration to devise ways to provide care under these circumstances.

The emotional and mental burden left by COVID-19 will continue to be seen in all nursing research addressing COVID-19, no matter the topic. Through this study we learned that the reward felt by nurses can serve as a balance to the extreme physical and emotional fatigue experienced during this pandemic and that we should be prepared to leverage this moving forward.

The findings in this study contribute to the body of knowledge regarding care of patients with COVID-19 receiving infusion therapy and address the gap in evidence that is available to provide guidance and insight into policies and procedures to guide patient care and nurse well-being in future pandemics or catastrophic emergency care

## REFERENCES

- Halpern NA, Kaplan LJ, Rausen M, Yang JJ. Configuring ICUs in the COVID-19 era. *Society of Critical Care Medicine*. 2020. Accessed May 26, 2022. <https://www.sccm.org/getattachment/03130f42-5350-4456-be9f-b9407194938d/Configuring-ICUs-in-the-COVID-19-Era-A-Collection>
- Centers for Disease Control and Prevention. CDC Museum COVID-19 timeline. 2022. Accessed May 26, 2022. <https://www.cdc.gov/museum/timeline/covid19.html#:~:text=January%2020%2C%202020,January%2018%20in%20Washington%20state>
- Centers for Disease Control and Prevention. COVID data tracker. Accessed May 25, 2022. [https://covid.cdc.gov/covid-data-tracker/#trends\\_dailydeaths](https://covid.cdc.gov/covid-data-tracker/#trends_dailydeaths)
- American Society for Health Care Engineering. Innovative IV pump placement. 2020. Accessed May 26, 2022. <https://www.ashe.org/innovative-iv-pump-placement>
- Webster S. Tackling Ebola in Africa: a warning to the world. *Emerg Nurse*. 2015;23(6):18-22.
- Cheruku S, Dave S, Goff K, et al. Cardiopulmonary resuscitation in intensive care unit patients with coronavirus disease 2019. *J Cardiothorac Vasc Anesth*. 2020;34(10):2595-2603. doi:10.1053/j.jvca.2020.06.008
- Griffin KM, Karas MG, Ivascu NS, Lief L. Hospital preparedness for COVID-19: a practical guide from a critical care perspective. *Am J Respir Crit Care Med*. 2020;201(11):1337-1344. doi:10.1164/rccm.202004-1037CP
- Gorski L, Hadaway L, Hagle ME, McGoldrick M, Orr M, Doellman D. Infusion therapy standards of practice. *J Infus Nurs*. 2016;39(suppl 1):S1-S159.
- Gorski LA, Hadaway L, Hagle ME, et al. Infusion therapy standards of practice. *J Infus Nurs*. 2021;44 (suppl 1):s1-s224.
- Sandelowski M. Whatever happened to qualitative description? *Res Nurs Health*. 2000;23(4):334-340. doi:10.1002/1098-240X(200008)23:4<334::AID-NUR9>3.0.CO;2-G
- Graneheim U, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Ed Today*. 2004;24(2):105-112. doi:10.1016/j.nedt.2003.10.001
- Sandelowski M. What's in a name? Qualitative description revisited. *Res Nurs Health*. 2010;33(1):77-84. doi:10.1002/nur.20362
- Morse JM. Critical analysis of strategies for determining rigor in qualitative inquiry. *Qual Health Res*. 2015;25(9):1212-1222. doi:10.1177/1049732315588501
- Squires A, Dorsen C. Qualitative research in nursing and health professions regulation. *J Nurs Reg*. 2018;9(3):15-26. doi:10.1016/S2155-8256(18)30150-9
- Fleming V, Gaidys U, Robb Y. Hermeneutic research in nursing: developing a Gadamerian-based research approach. *Nurs Inquiry*. 2003;10(2):113-120.
- Krefting L. Rigor in qualitative research; the assessment of trustworthiness. *Am J Occup Ther*. 1991;45(3):214-222.
- Lincoln Y, Guba E. *Naturalistic inquiry*. Sage: 1985; 289-331.
- Sandelowski M. The problem of rigor in qualitative research. *Adv Nurs Sci*. 1986;8(3):27-37.
- Baker MA, Sands KE, Huang SS, et al. The impact of Coronavirus disease 2019 (COVID-19) on healthcare-associated infections. *Clin Infect Dis*. 2022;74(10):1748-1754. doi:10.1093/cid/ciab688
- Boyle DA, Steinheiser MM. Emotional hazards of nurses' work: a macro perspective for change and a micro framework for intervention planning. *J Infusion Nurs*. 2021;44(2):78-93. doi:10.1097/NAN.0000000000000419
- McNicholas M, Marcus-Aiyeku U, Brodrick T, et al. Not alone: one network's approach to pandemic nurse staffing. *Nurs Manage*. 2021;52(10):24-30. doi:10.1097/01.NUMA.0000792020.48900.45
- American Nurses Association (ANA). *Code of Ethics for Nurses with Interpretive Statements*. American Nurses Association; 2015.
- Stone RSB. Code Lavender: a tool for staff support. *Nursing (Jenkintown, Pa)*. 2018;48(4):15-17. doi:10.1097/01.NURSE.0000531022.93707.08
- National Center for PTSD. Stress first aid for health care workers. Accessed May 26, 2022. [https://www.ptsd.va.gov/professional/treat/type/stress\\_first\\_aid.asp](https://www.ptsd.va.gov/professional/treat/type/stress_first_aid.asp)
- McDonald L, ed. *The Collected Works of Florence Nightingale*. Wilfird Laurier University Press; 2009.