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BRIEF REPORT

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Adaptations in vascular access procedures as an initiative to protect healthcare workers throughout the COVID-19 pandemic

Anna Hackett BS | Celia Wells PhD, RN | Rohit Gupta MD | Roopa Kohli-Seth MD

Icahn School of Medicine at Mount Sinai, New York, New York, USA

Correspondence
Anna Hackett, Institute of Critical Care Medicine, One Gustave L Levy Place, Box 1264, New York, NY 10029, USA.
Email: anna.hackett@mountsinai.org

Abstract

COVID-19 has led to procedural changes in vascular access services to protect healthcare workers and patients from further spread of the virus. Operational changes made by the vascular access service at a healthcare system in New York City during the first wave of the COVID-19 (SARS-CoV-2) pandemic included a team-based approach as well as consideration for types of lines placed to address the increase in patient volume while providing safety to healthcare workers and conserving personal protective equipment. The study consists of two samples of adult inpatients admitted to Mount Sinai Hospital in New York City in need of vascular access. Chi-square tests of independence were used to analyze trends in data. By the fourth wave, usage of shorter lifespan ultrasound-guided peripheral intravenous lines increased significantly and the use of longer lasting intravenous catheters decreased significantly between the first and fourth waves of COVID-19. This paper aims to show that with greater knowledge about proper personal protective equipment and mindful resource use, hospitals are able to become more comfortable and efficient while providing increasingly frequent vascular access services in the current and future pandemics.

KEYWORDS
COVID-19, health personnel, vascular access

Key points

- A team-based approach in an emergent situation helped keep healthcare workers safe and provided optimal patient care during the initial months adapting to the COVID-19 pandemic.
- Using longer lifespan peripheral intravenous lines like extended-dwell peripheral intravenous lines in the first wave of the pandemic limited the frequency with which lines needed placement in admitted patients, reducing the possibility of spreading the COVID-19 virus when proper personal protective equipment guidelines were still being discussed.
- By the fourth wave, greater comfort with personal protective equipment usage and limiting spread as well as greater staff availability allowed shorter lifespan lines to be placed more frequently by nurses.

1 | INTRODUCTION

The global COVID-19 pandemic required hospitals around the world to rapidly adapt their typical patient care practices and capacity to meet the exhaustive numbers and acuity of patients. Challenges for healthcare systems include the need to protect healthcare workers (HCWs) from occupational exposure to the disease. Personal protective equipment (PPE) is essential in the protection and spread of the COVID-19 virus as SARS-CoV-2 is transmitted through respiratory droplets and close contact (Park, 2020). At the beginning of the pandemic, there was much discussion as to what the proper and most protective forms of PPE were (Hussain et al., 2020; Min et al., 2021). This uncertainty, although unavoidable, likely created a delayed response time to patient care, as more time was needed between patients to assure proper PPE and safety protocols could be followed by HCWs. As of January 3, 2022, hospital guidelines in New York City for PPE when caring for COVID-19 positive patients or persons under investigation were updated in accordance with the World Health Organization, Centers for Disease Control and Prevention (CDC), and New York State Department of Health recommendations and is defined as use of an N95-respirator, gown, gloves, and eye protection (World Health Organization, 2020).

The first wave of COVID-19 in the United States began in March 2020. During this time, New York City was the epicenter of the pandemic in the United States (Centers for Disease Control and Prevention COVID-19 Response Team, 2020). Although the prepandemic consult process for requesting access remained the same, the vascular access service at an urban quaternary care hospital shifted from its traditional one-person insertion teams to two-person insertion teams (Zhang et al., 2021). The two-person insertion team allowed one nurse to enter a COVID-19 isolation room to evaluate the patient's vasculature and provide access. The second nurse served as a resource outside the patient's room. This process alleviated staff concerns of self-contamination as the resource nurse would observe the nurse inserter remove their PPE equipment and help maintain compliance to PPE guidelines.

Beyond assuring PPE compliance for one another, the vascular access service is responsible for insertion of vascular access devices (VAD) including central venous catheters, permanent (tunneled) catheters and ports, and peripheral intravenous (IV) catheters such as midline catheters, extended dwell peripheral intravenous catheters (EDPIVs), and ultrasound-guided peripheral intravenous catheters (USGPIVs). The process begins with providers placing requests for vascular access through the electronic medical record system. Requests include information about the patient's diagnosis, treatment therapy, and duration of treatment. This information, based on the Michigan Appropriateness Guide for Intravenous Catheters guidelines (Chopra et al., 2015), is processed by an algorithm and informs the team about the appropriate line to place. During the COVID-19 pandemic, the lifespan of these lines as well as the implication and feasibility of frequent line changes became considerations for HCW safety and exposure.

Having clear PPE recommendations, patient care guidelines, supportive leadership, and experience with a global pandemic has led to changes in practice that facilitate efficient vascular access services without risking the safety of HCWs. With this in mind, understanding differences in lines used between the first and fourth waves of COVID-19 is of interest. This paper compares data and processes from March–April 2020, during the first wave, and from December 2021–January 2022, during the fourth wave experienced in New York City. More specifically, the numbers and type of peripheral vascular access devices used during these two waves are considered.

TABLE 1 Lines placed in the first wave

March and April 2020			
Line type	**Total**	**% of all lines**	**% of all peripheral lines**
USGPIV	663	50.6	60.5
Midline	248	18.9	22.6
EDPIV	184	14.0	16.8
Total	1095		

Abbreviations: EDPIV, extended dwell peripheral intravenous catheters; USGPIV, ultrasound-guided peripheral intravenous catheters.

TABLE 2 Lines placed in the fourth wave

December 2021 and January 2022			
Line type	**Total**	**% of all lines**	**% of all peripheral lines**
USGPIV	1067	66.8	80.8
Midline	185	11.6	14.0
ED PIV	69	4.3	5.2
Total	1321		

Abbreviations: EDPIV, extended dwell peripheral intravenous catheters; USGPIV, ultrasound-guided peripheral intravenous catheters.

2 | METHODS

The study population consists of two samples of adult inpatients admitted to Mount Sinai Hospital in New York City in need of vascular access, a total of 2907 patients. The sample from the first wave of COVID-19 in New York City comes from non-intensive care unit patients receiving vascular access services between March and April 2020 (see Table 1). The sample from the fourth wave comes from non-intensive care unit patients receiving vascular access services between December 2021 and January 2022 (see Table 2). The type of lines placed were recorded, with specific focus on peripheral lines including USGPIVs, EDPIVs, and midline catheters. For quality assurance purposes, the vascular access services team maintains a database of all their consults and VAD placements so this study does not require institutional review board approval as only type of line placed and when the line was placed were analyzed. The associated raw data, which is stored on a RedCap database, can be shared upon individual request. Chi-square tests of independence were used to analyze trends in this data.

3 | RESULTS

Four sets of chi-square analysis were run on Excel to analyze the data using a total of 2907 patients. The four categories compared (1) total counts of lines placed across all lines placed in the hospital (including central and tunneled lines), (2) total counts of lines placed across only the peripheral lines placed in the hospital, (3) proportions of each type of peripheral line across all lines placed in the hospital, and (4) proportions of each type of peripheral line across only peripheral lines placed in the hospital.

When comparing total counts of lines placed across only peripheral lines between 2020 and 2022, a significant change was seen for each line – USGPIV: X^2 (1, $N = 2416$) = 120.4443, $p < 0.00001$, midline: X^2 (1, $N = 2416$) = 30.4102, $p < 0.00001$, and EDPIV: X^2 (1, $N = 2416$) = 85.6405, $p < 0.00001$. This level of significance remained when comparing lines placed to all lines placed in the hospital including central and tunneled lines ($N = 2907$, $p < 0.00001$). When analyzing the proportional changes of lines places within the three types of peripheral lines, the most significant change was seen with the 20% increase of USGPIVs [X^2 (1, $N = 2416$) = 9.7135, $p = 0.0018$], followed by the 11.6% decrease in EDPIVs [X^2 (1, $N = 2416$) = 7.3544, $p < 0.01$], and finally an insignificant 8.6% decrease in midline catheters [X^2 (1, $N = 2416$), $p = 0.1012$]. When analyzing the proportional changes of peripheral lines placed across all lines, the only significant change was the 9.7% decrease in EDPIVs [X^2 (1, $N = 2907$) = 6.105, $p < 0.05$].

4 | DISCUSSION

Securing stable vascular access is a key component of providing medical care to hospitalized patients. Vascular access modalities vary from temporary peripheral intravenous cannulas that can be used for a few days to longer lifespan extended dwell catheters that can be used for several weeks. Devices also vary based on their infusion rate capacities, medication compatibility, and maintenance requirements. Decisions regarding which specific vascular access will be used are complex and are determined by multiple factors including insertion process intricacy, need for specialized equipment and training, cost of insertion, specific medical needs of the patient, and hospital-specific protocols regarding infusion and device use (MacRae et al., 2016).

A significant decrease in the use of longer lifespan peripheral vascular access devices was noted (midline catheters: 4-week insertion lifespan, extended dwell catheters: 4-week insertion lifespan) from 39.4% to 19.2% between a sample from the first wave (March–April 2020) when compared to a sample from the fourth wave (December 2021–January 2022). Over the same time period, the use of USGPIV) 3-day insertion lifespan) significantly increased from 60.5% to 80.8%.

The first wave of COVID-19 was different from the fourth wave in that the number of patients admitted to our hospital with COVID-19 pneumonia was higher and represented a higher percentage of all hospitalized patients. Additionally, the severity of illness rates of mortality and morbidity were greater with the first wave as compared to the fourth wave. This meant greater restrictions on patient transport, higher risk of infection transmission, and prolonged need for medication infusion. Finally staffing resources, therapeutic modalities, vaccine availability, and surge capacity were underdeveloped at the time of the first wave compared to the fourth wave.

There appears to be several reasons for the shifting trend in the use of peripheral IV device usage between these two time periods. During the first wave, limited clinical experience was available regarding the transmission risks of COVID-19 (Park, 2020). In this setting, protecting staff from iatrogenic spread of the virus was of high priority (CDC, 2020). By selecting IV devices with a longer lifespan, time spent at the bedside by the vascular access staff was reduced. This decreased the risk for potential exposure because lines needed to be switched less frequently. This also reduced the strain on the availability of PPE, which would have been used more frequently. By the onset of the fourth wave, staffing resources, PPE availability, environmental protection protocols, and proportion of non-COVID patients in the hospital had increased.

Another reason for the greater use of longer duration IV access was the restriction in transporting patients with COVID-19 to specialized vascular insertion locations that are traditionally used to insert central venous catheters. Given this limitation, in addition to the lower number of trained staff available for independent bedside insertion of central venous catheter, peripheral access device usage was prioritized wherever appropriate. Where central venous access could not be substituted, central lines were placed at the patient's bedside by the central vascular access service. Transportation restrictions linked to the predominance of patients with COVID pneumonia appears to have improved by the time of the fourth wave where the number of central catheters insertion increased from 9.6% to 12.9% of all consults. Additionally, another reason for the selection of longer duration IV access was that it allowed insertion of catheters that could provide two channels for infusion of medications as opposed to a single infusion channel USGPIV, which meant fewer insertions and fewer replacement procedures at the bedside.

There are several limitations to our study. The time intervals that are being evaluated include patients with differing COVID and non-COVID populations. These have an influence on the choice of IV access being used. Greater number of elective procedures and services were available during the fourth wave as compared to the first wave, which can also influence the choice of IV access. With growing experience in managing patients with COVID-19, healthcare facilities and healthcare staff have grown more comfortable in providing care and specialized services to these patients. The efficient selection of different devices and development of robust and safe insertion protocols allowed healthcare professionals to adapt to the evolving vascular access needs of our patient population while limiting healthcare provider exposure. When confronting future emergent infectious diseases, healthcare providers should consider the implications catheter selection and catheter lifespans have for healthcare exposure risks.

AUTHOR CONTRIBUTIONS

Study design: Anna Hackett, Celia Wells, Rohit Gupta. Data collection: Celia Wells. Data analysis: Anna Hackett. Manuscript writing: Anna Hackett, Celia Wells, Rohit Gupta, Roopa Kohli-Seth.

DATA AVAILABILITY STATEMENT

Data can be made available upon specific request to the study team.

ORCID

Anna Hackett https://orcid.org/0000-0001-8844-0171

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