Minimizing pharmacotherapy-related healthcare worker exposure to SARS-CoV-2

Am J Health-Syst Pharm. 2020;77:xxx-xxx

Brooke Barlow, Department of Pharmacy, University of Kentucky HealthCare, Lexington, KY

Ashley Barlow, Department of Pharmacy, University of Maryland Medical Center, Baltimore, MD

Melissa L. Thompson Bastin, Department of Pharmacy, University of Kentucky HealthCare, Lexington, KY

Karen Berger, Department of Pharmacy, New York-Presbyterian Hospital/Weill Cornell Medical Center, New York, NY

Deepali Dixit, Department of Pharmacy, Robert Wood Johnson University Hospital, New Brunswick, NJ, and Ernest Mario School of Pharmacy, Rutgers, the State University of New Jersey, Piscataway, NJ

Mojdeh S. Heavner, PharmD, BCPS, BCCCP, FCCM, Department of Pharmacy Practice and Science, University of Maryland School of Pharmacy, Baltimore, MD

Address correspondence to Dr. Heavner (mheavner@rx.umaryland.edu).

Twitter: @HeavnerPharmD

Keywords: coronavirus disease, coronavirus infections, exposure, healthcare worker, personal protective equipment, pharmacotherapy

The coronavirus disease 2019 (COVID-19) pandemic has led to a healthcare crisis as clinicians seek to provide care for growing numbers of critically ill patients while trying to prevent self-exposure. Protection against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) requires personal protective equipment (PPE); however, demand for PPE has often exceeded what existing supply chains are able to provide. The Centers for Disease Control and Prevention has recommended use of alternative respiratory PPE and reuse of N95 masks as strategies to optimize supply.[1] Compromising optimal PPE standards may lead to increased infection among healthcare workers. CDC's *Morbidity and Mortality Weekly Report* of April 9, 2020, suggested that approximately 1 in 5 cases of COVID-19 had occurred in healthcare personnel, and 55% of these individuals reported exposure in a healthcare setting.[2] To protect frontline providers combating COVID-19, a multipronged approach to minimize direct patient exposure and conserve PPE is necessary. In this article, we provide a medication-focused perspective on strategies to mitigate health system–related SARS-CoV-2 infection risk to medical workers. The strategies we discuss include the use of medication administration bundles, extended tubing sets, conservative therapeutic drug monitoring, and maximally concentrated continuous infusions.

Medication administration bundles. An average of 25 medication doses are prescribed to a single hospitalized patient per day. Only 25% of these doses are scheduled at standardized administration times, leaving the remaining doses to be staggered at random intervals.[3] Lack of awareness regarding timing of medications can lead to interruptions in workflow and unnecessary direct patient contact. Creating medication bundles aimed at standardizing medication administration times to align with routine patient encounters can alleviate nursing

staff task burden and healthcare worker exposure to SARS-CoV-2. This intervention should be personalized to each patient and requires collaboration with nursing personnel to coordinate medication administration with routine care activities such as turning the patient, vital sign assessments, and blood sampling for laboratory tests.

A collaborative care team approach should be taken to prioritize the prescribing of medications and formulations dosed at the lowest frequency (eg, once daily as opposed to multiple times a day). For example, patients with COVID-19 without evidence of acute kidney injury can be administered low-molecular-weight heparin 1 or 2 times a day for venous thromboembolism prophylaxis instead of unfractionated heparin 3 times a day. Medication lists should be reassessed daily to address polypharmacy and discontinue unnecessary medications or regimens; examples might include topical or oral chlorhexidine, vitamins, ophthalmic solutions, creams, sliding-scale insulin doses, and stress ulcer prophylaxis regimens that are no longer indicated. Routine electrolyte replacement and one-time doses of medications can be scheduled for the next planned entry into the patient room. Continuous infusions rather than scheduled doses may be considered, especially in patient care units that have implemented placement of infusion pumps outside of patient rooms. Examples can include infusing furosemide continuously rather than at 6- or 8-hour intervals and, for intubated patients, continuous infusion of sedatives rather than intermittent infusion of scheduled doses. In scenarios where continuous infusions are not possible or create more problems than they solve, intermittent dosing of medications administered via intravenous (i.v.) push (IVP) as opposed to intermittent infusion is another potential consideration; an example of this is IVP levetiracetam therapy. Some centers have considered transitioning from continuous infusions

of insulin to intermittent dosing, given the frequent blood sampling for glucose testing and dose titrations that are required with continuous insulin infusions. Standard approaches to antibiotic stewardship should of course be considered, and antibiotics should be discontinued if no longer indicated. When antibiotics are indicated, continuous infusion of certain antibiotics (eg, β-lactams, vancomycin) and preferential use of those with less frequent dosing requirements (eg, cefazolin instead of oxacillin) can be considered as a strategy to minimize healthcare worker virus exposures.

Extended tubing sets. Use of extended tubing sets to allow positioning of medication infusion pumps outside of patient rooms has been implemented in some centers as a PPE conservation strategy and to minimize healthcare worker exposure to SARS-CoV-2. Widespread use of this strategy has sometimes been limited by a shortage of extended tubing sets in the supply chain. If they are available, however, use of extended tubing sets reduces the frequency at which nurses must enter rooms for infusion management (eg, to increase or decrease drip rates, exchange infusion bags, and check alarms).

Although infusion via an extended tubing set is not a standard procedure, manufacturers and organizations have provided guidance to endorse best practices and mitigate safety concerns regarding implementation of extended tubing sets.[4] A central line is preferred for administration of i.v. infusions through extended tubing sets in order to ensure line patency. To optimize flow rates, infusion pump BD recommends use of 1 or 2 small-bore, extra-long extension sets to ensure device rate accuracy at specification (±5%).[4] Any efforts to reduce unnecessary resistance in the line, such as avoiding extraneous loops of pump tubing, keeping extension set additions as limited as possible, infusing through a large catheter, and

ensuring that all clamps and connections are open (when appropriate), should be employed to minimize high pressures in the i.v. line and prevent occlusions. Additional ways to improve rate accuracy include hanging the i.v. bag 20 inches above the pump, using a large-gauge catheter to decrease flow resistance, and priming the fluid through the extended tubing set prior to connecting to the patient in order to facilitate prompt medication delivery. If high flow rates are required, macrobore tubing may be considered, but the decision to use wider tubing should be balanced with drug supply considerations due to the high priming volume required.[4] Strategies to minimize fall hazards posed by extended tubing and power cords in the hallway should be implemented. Centers have created larger bag sizes or sent 2 bags of standard size for medication initiation to account for increased drug loss in the extended tubing and accommodate the higher fluid volume required to prime the extended tubing lines.

Modifying the standard frequency for changing tubing sets (eg, increasing the frequency to 24 hours for propofol infusions and 96 hours for infusions of other medications) has also been considered at some centers; this is particularly relevant given supply shortages of extension tubing. In patients with COVID-19 who are critically ill, use of emergency medications may be warranted, and any delay in medication delivery to the patient that might result from use of extended tubing should be considered when monitoring clinical response. Medication safety should be prioritized if extended tubing is employed, with consideration of adjusting the bedside barcode scanning protocol to require placement of barcodes on extended tubing sets to help prevent medication errors. Flushing the line post infusion is an important measure to ensure that a patient receives the full prescribed dose of medication.

Conservative therapeutic drug monitoring. Another key intervention to help ensure the safety of healthcare workers is minimizing prescribing of medications whose use requires therapeutic drug monitoring (TDM). Use of several antibiotics (eg, vancomycin, aminoglycosides), antiepileptics (eg, phenytoin, valproic acid) and anticoagulants (eg, unfractionated heparin, argatroban, bivalirudin) requires routine laboratory monitoring, increasing the need for direct patient contact to perform blood draws and infusion rate adjustments. Healthcare teams should have a collaborative discussion regarding transitioning appropriately selected patients from TDM-intensive medications to safe and effective alternatives, with therapy de-escalation when appropriate. For example, in a hospitalized patient with COVID-19 who is initiated on empiric broad-spectrum antibiotics, using linezolid as an alternative to vancomycin can eliminate the need for TDM. If vancomycin is deemed the most appropriate agent for empiric therapy, strategies for rapid de-escalation of therapy can include nasal screening for methicillin-resistant *Staphylococcus aureus*. As a laboratory stewardship strategy, vancomycin TDM can be restricted to patients who will require extended therapy or have rapidly changing renal function, and it can be avoided altogether in the empiric therapy setting. As always, a good policy is “think before you draw”; if the results of TDM will not change management decisions, blood sampling should be avoided. Inevitably, there may be instances when a TDM-requiring medication is warranted. In such circumstances, the simplest solution is to align blood draws with room entry for other required tasks at the bedside.

Maximally concentrated continuous infusions. Medication administration by continuous i.v. infusion may require frequent entry into a patient room for assessments, bag exchanges, infusion dose titrations, or alarms. Maximizing concentrations of i.v. infusions is a simple and effective intervention to decrease room entry by reducing the need for bag exchanges. This intervention can be of vital importance in the care of critically ill patients with COVID-19, as up to 11.5% will require intensive care unit admission to manage acute respiratory distress syndrome (ARDS)[1] and thus may need continuous infusions of sedatives, neuromuscular blockers, and vasopressors. Efforts to concentrate continuous infusions when possible should be balanced with safety considerations and the potential for medication waste when a drug is discontinued or the infusion rate is decreased significantly. Importantly, having multiple concentrations of an i.v. infusion available can pose a risk of medication safety events if infusion pump libraries are not updated accordingly and there is confusion about which concentration to select at the time of administration. As an alternative to use of maximally concentrated continuous infusions, if pumps remain inside patient rooms we recommend switching the administration route from i.v. infusion to IVP (ie, for neuromuscular blockers, antibiotics, and diuretics) or a step-down to oral medications (eg, from low-dose norepinephrine to midodrine, from low-dose i.v. fentanyl to oxycodone) when clinically appropriate. Concentrating infusions and using IVP administration may benefit patients with COVID-19–related ARDS by reducing net fluid balance.

Conclusion. SARS-CoV-2 is a highly contagious virus that has prompted escalating concerns of transmission to healthcare workers in the hospital setting. In order to minimize exposure risk, avoiding unnecessary contact with SARS-CoV-2–infected patients is critical. There are several opportunities to mitigate pharmacotherapy-related interruptions in workflow for healthcare professionals providing direct patient care to patients with COVID-19. Care teams, in coordination with the team pharmacist, should use a nimble approach to medication selection, use, and monitoring in this setting.

Disclosures

The authors have declared no potential conflicts of interest.

References

1. Centers for Disease Control and Prevention. Coronavirus (COVID-19). https://www.cdc.gov/coronavirus/2019-ncov/index.html. Accessed April 21, 2020.
2. Characteristics of health care personnel with COVID-19 – United States, February 12-April 9, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(15):477-481.
3. Jennings BM, Sandelowski M, Mark B. The nurse's medication day. *Qual Health Res*. 2011;21(10):1441-1451.
4. Becton, Dickinson and Company. COVID-19 clinical considerations: using extra-long extension sets with the BD Alaris Pump Module and Alaris Syringe Module. https://www.bd.com/documents/COVID-19/Clinical%20Considerations%20Long%20Extension%20Sets.pdf. Accessed April 14, 2020.