

A photograph of two healthcare workers in a clinical setting. They are wearing blue surgical gowns, blue bouffant hairnets, and clear face shields. The worker in the foreground is also wearing a blue surgical mask. The background is slightly blurred, showing more of the clinical environment.

Healthcare Waste Management During COVID-19

**Mn
TAP**

The COVID-19 pandemic has led to increased use and disposal of personal protective equipment, sanitizer dispensers, and laboratory, testing and vaccine paraphernalia. To better understand the issue, MnTAP commissioned a survey of healthcare workers to verify whether information on managing healthcare waste had reached those on the front lines. The following waste reduction practices were identified:

- Use washable isolation gowns for patients and staff.
- Disinfect respirators and face shields for reuse.
- Decontaminate select “single-use” items for reuse.
- Manage disposable items as solid waste.
- Wash and reuse hand sanitizer containers.
- Manage testing and vaccine waste as solid and hazardous, rather than infectious waste.

Table of Contents

[Introduction](#)

[Waste reduction practices](#)

[Interviews](#)

[Discussion: Conserving resources and reducing waste](#)

[Personal protective equipment](#)

[Isolation gowns](#)

[Respirators](#)

[Face shields](#)

[Reprocessing Single Use Items](#)

[Alcohol-based hand rubs](#)

[Laboratory and testing waste](#)

[Vaccine waste](#)

Healthcare Waste Management During Covid-19

Excerpted from **Perspectives on Healthcare Waste Management During Covid-19**, developed by Catherine Zimmer, Zimmer Environmental Improvement, LLC for the Minnesota Technical Assistance Program

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Introduction

Cleaning, disinfecting and managing waste in healthcare facilities can be complicated in normal times. Layering on a pandemic with the SARS-CoV-2 pathogen has increased the complexity. Initially, due to the uncertainties associated with viral transmission and infectivity, single use items such as isolation gowns, masks and respirators were called for and disposed of as infectious waste. As the use of personal protective equipment (PPE) increased, so did the amount of waste in many facilities, particularly the waste associated with the care of COVID-19-positive patients. Other healthcare facilities treating COVID-19-positive patients reported no overall increase in solid waste volumes early in the pandemic, which may have been due to the shut-down of elective procedures and operating rooms.

It is important to make the appropriate determination of waste type to ensure it is properly managed and disposed to avoid exposure risk, environmental releases and excess cost. Improperly disposed hazardous waste, such as being managed as infectious waste, can lead to untreated chemicals from autoclave condensate being discharged to wastewater treatment which is not designed to manage chemicals and may lead to releases to the environment. Allowing solid waste streams to enter hazardous or infectious waste collection will increase disposal cost due to the high level of treatment required. Hazardous waste can cost dollars per pound as opposed to pennies per pound for solid waste.

Reliable sources of healthcare information posted best practices to assist healthcare providers in managing the materials and waste streams generated during the diagnosis, treatment and infection prevention activities associated with Covid-19. The original report—Perspectives on Healthcare Waste Management During Covid-19¹—from which this guidance is excerpted, used literature review of trusted sources, such as the Centers for Disease Control and Prevention (CDC), the Minnesota Department of Health (MDH), the Occupational Safety and Health Administration (OSHA), the World Health Organization (WHO), and respected journals as well as interviews with healthcare personnel working on the front line of the pandemic, to identify best practices for waste management and waste reduction in the healthcare sector during this pandemic and beyond.

Waste reduction practices

- Use washable isolation gowns for patients and staff.
- Disinfect respirators and face shields for reuse.
- Decontaminate select “single-use” items for reuse.
- Manage disposable items as solid waste.
- Wash and reuse hand sanitizer containers.
- Manage testing and vaccine waste as solid and hazardous, rather than infectious waste.

¹ Perspectives on Healthcare Waste Management During Covid-19, March 9, 2021.

<http://www.mntap.umn.edu/wp-content/uploads/simple-file-list/Healthcare/Perspectives-on-Healthcare-Waste-Management-During-Covid-19.pdf>

Interviews

Informational interviews were conducted with healthcare workers to verify whether information on managing healthcare waste during the Covid-19 pandemic had reached those on the front lines generating and managing healthcare waste streams. We attempted to interview environmental services, infection prevention, nursing and waste management staff from eight to ten healthcare systems to gain the perspective of practitioners in light of current recommendations. The immediacy of the pandemic and ongoing case surges limited availability of healthcare facility staff. Ten people representing a range of functions and services—frontline workers, waste management staff, and a rural county representative—were interviewed in the following facilities

- a large healthcare system with locations throughout Minnesota and Wisconsin
- a metro-based healthcare system and COVID-only facility
- Metro-area assisted living and long term care facilities
- a large clinical laboratory

The healthcare facility staff we spoke with were, for the most part, relying on effective processes already in place to address cleaning, disinfecting and waste management for SARS-CoV-2. Various strategies were identified and employed to manage shortages of critical supplies early in the pandemic.

Discussion: Conserving resources and reducing waste

Personal protective equipment

Isolation gowns

Initially, due to the many unknowns associated with SARS-CoV-2, a great deal of waste PPE was generated, disposed and managed as infectious waste, which is an intensive and expensive process. An article in Supply Chain Dive indicated, after gloves, isolation gowns made up the largest portion of PPE waste; eighty percent of isolation gowns used in US healthcare are disposable.² While CDC guidance eventually recommended isolation gown disposal as solid waste, supplies quickly ran low and healthcare facilities were forced to evaluate ways to maintain supplies through optimizing use and decontaminating PPE for reuse. Some facilities found reusable isolation gowns, previously rejected by infection prevention staff, to be a viable option.³ An American Journal of Infection Control (AJIC) study found reusable isolation gowns performed better than disposables, even after 75 washings.⁴

Respirators

To conserve respirators, two categories, “extended use” and “reuse,” have been suggested by the CDC.

Extended use suggests a properly fitted respirator may be worn over the course of a work day and maintain its filtering efficiency. Reuse suggests a respirator can be removed at the end of the work day, left to decontaminate and reused by the same person on a subsequent day.⁵ CDC recommends donning and doffing of respirators no more than five times as the fit and hence filtration may have appreciably diminished.⁶

Contact transmission of respiratory pathogens is the primary hazard of extended use and reuse. Using hand hygiene is important to minimize contamination and transmission during respirator donning and doffing procedures.⁷ Respirators should be discarded when visibly soiled, after an aerosol generating procedure, after contact with a patient co-infected with a contact isolation disease, or if the respirator becomes difficult to breathe through.⁸



² SupplyChainDive, Packaging, PPE and surgical supplies: How COVID-19 is pushing hospitals to reduce waste, <https://www.supplychaindive.com/news/packaging-ppe-surgical-supplies-covid-19-waste/593179/>, viewed 1/19/21.

³ Interview with sustainability coordinator, 12/20/2020.

⁴ *Am J Infect Control*. Disposable versus reusable medical gowns: A performance comparison, Oct 20 2020.

⁵ CDC, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html>, Mar 27, 2020. Viewed 2/16/2021.

⁶ Ibid.

⁷ CDC, Sequence for donning personal protective equipment PPE/Sequence for removing personal protective equipment, <https://www.cdc.gov/HAI/pdfs/ppe/ppeposter148.pdf>, viewed 11/16/2020.

⁸ CDC, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html>, Mar 27, 2020. Viewed 2/16/2021.

To minimize concerns regarding contact transmission of SARS-CoV-2, when reusing a respirator, decontamination procedures using already-available sterilization techniques with ethylene oxide and hydrogen peroxide were developed and studied.



An August 2020 Journal of the American Medical Association (JAMA) study indicated N95 respirators decontaminated with ethylene oxide or hydrogen peroxide had fitted filtration efficiencies (FFE) of >95%, which is the same FFE as an unused N95 respirator.⁹ The same study indicated the filtration efficiency remained after five sterilization cycles. The respirators in this study were not worn between sterilization cycles.¹⁰ Innovation around mask design and improved availability continues.¹¹

CDC advises decontamination and subsequent reuse of respirators should only be practiced where shortages exist.¹² CDC considers respirators one-time use products and states there are currently no manufacturer-authorized methods for decontamination. However, in the absence of manufacturer's recommendations, third parties, such as decontamination companies, safety organizations, or research laboratories, may also provide guidance or procedures on how to decontaminate respirators without impacting their performance.¹³ Manufacturers of N95 respirators may develop specific guidance regarding reuse of their product.¹⁴ N95 respirator reprocessing may become a viable means to reduce waste and costs, while protecting the wearer. Facilities wishing to incorporate respirators that can be decontaminated and reused into their long-term strategy should consider using reusable respirators such as elastomeric respirators or power air purifying respirators (PAPR).¹⁵

Face shields

Face shields are often worn by healthcare workers as protection from blood and body fluids.¹⁶ During the pandemic, face shields are worn to add another layer of protection from the virus.¹⁷ While

⁹ JAMA, Filtration Efficiency of Hospital Face Mask Alternatives Available for Use During the COVID-19 Pandemic, 2020;180(12):1607-1612, <https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2769443?applied=scweb>, viewed 1/19/21

¹⁰ Ibid., Emily Vavalle, chief author, email communication, 2/17/2021. Emily.Vavalle@unchealth.unc.edu

¹¹ Ford, FORD RAMPS UP #FINISHSTRONG INITIATIVE WITH MASK DELIVERIES TO HARD-HIT AREAS, SUPER BOWL LV ADS, NEW PPE DESIGNS, <https://media.ford.com/content/fordmedia/fna/us/en/news/2021/02/02/ford-ramps-up-finishstrong-initiative.html>, 2/2/2021, viewed 2/15/2021.

¹² CDC, Implementing Filtering Facepiece Respirator (FFR) Reuse, Including Reuse after Decontamination, When There Are Known Shortages of N95 Respirators, updated Oct. 19, 2020, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html>, viewed 2/16/2021.

¹³ Ibid.

¹⁴ CDC, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings, <https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html>, Mar 27, 2020. Viewed 2/16/2021

¹⁵ Ibid.

¹⁶ Cleveland Clinic, How to wear and clean a face shield, <https://health.clevelandclinic.org/how-to-wear-and-clean-a-face-shield/>, 8/25/2020. Viewed 1/8/2021.

¹⁷ Ibid.

broken or cracked face shields should be discarded, face shields can be cleaned for reuse. Although manufacturers may provide instructions; the CDC suggests using a mild soap and water to clean the shield, disinfect with alcohol, wipe with a clean cloth and fully dry.¹⁸ Hand hygiene should be practiced while cleaning the face shield, e.g. gloves and hand washing after the shield is cleaned. Staff in at least one facility interviewed were cleaning and reusing face shields.¹⁹

Reprocessing Single Use Items

Many other “single-use” items, such as compression sleeves, drill bits, and biopsy forceps, are safely reprocessed, that is, decontaminated for reuse, resulting in significant cost savings and waste reduction.^{20,21} The FDA has approved the reprocessing of single use devices as long as the reprocessing companies meet the same requirements that apply to the original approval.²²

Alcohol-based hand rubs

A key component of infection prevention is hand hygiene. When soap and water is not convenient or available, healthcare workers often rely on sanitizing alcohol-based hand rubs. In hospitals and clinics, alcohol hand rub is often available throughout the facility. However, for staff working off site or in long term care and assisted living facilities, they may carry personal sized hand rubs along with them. As supplies were low in the early days of the pandemic, two facilities interviewed used the dishwasher to wash personal sized bottles of sanitizer, which were then refilled from bulk containers for reuse.^{23,24}

Laboratory and testing waste

The widespread nature of the pandemic has led to millions of nasal swabs and/or saliva specimens being tested. These specimens may or may not contain the SARS-CoV-2 virus. Specimens can be tested a couple of different ways. The more complex and more accurate test is polymerase chain reaction (PCR); this test is performed in certified laboratories with highly trained staff. Antigen test kits which can provide a quick on-site preliminary indication of infection, are being used in a variety of settings, especially in long term care facilities.²⁵

Minnesota’s definition of “laboratory waste”, a subset of infectious waste, is defined, in part, as “discarded contaminated items used to inoculate, transfer, or otherwise manipulate cultures or stocks of agents that are infectious to humans and discarded live or attenuated vaccines that are

¹⁸ CDC, Strategies for Optimizing the Supply of Eye Protection, updated 12/20/2020, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/eye-protection.html>, viewed 2/18/2021.

¹⁹ Interview with occupational therapist, 1/14/2021.

²⁰ Premier Safety Institute, Safety Topics A-Z Reprocessing single use devices, <https://www.premiersafetyinstitute.org/safety-topics-az/reprocessing-single-use-devices/reprocessing-single-use-devices/#:~:text=T he%20practice%20of%20reprocessing%20single,the%20way%20for%20current%20activity>, viewed 2/17/2021.

²¹ FDA, Reprocessing of single-use devices, <http://wayback.archive-it.org/7993/20170111015341/http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/ReprocessingofSingle-UseDevices/default.htm>, viewed 2/17/2021.

²² Ibid.

²³ Interview with sustainability coordinator, 1/8/2021.

²⁴ Interview with occupational therapist, 1/14/2021.

²⁵ Care Providers, COVID Weekly Update, 12/17/2020.

infectious to humans.²⁶ The broader definition includes a list of body fluids that are also considered infectious waste when discarded; saliva and nasal mucus are not on the list. These fluids are also not typically bloody. Technically, in a literal read of the laboratory waste and body fluid definitions for infectious waste, nasal swabs, saliva specimens and antigen test kit cassettes do not fit Minnesota's definition of infectious waste. Positive controls, may or may not meet the infectious/laboratory waste definition and should be evaluated on a case by case basis.

The management of laboratory and testing wastes by healthcare facilities and laboratories varies widely. In interviews, several facilities stated they manage swabs²⁷ as infectious waste because they have the potential to be sharp, but saliva specimens as solid waste. Care Providers, a membership organization for long term care facilities, suggests managing antigen cassettes as infectious waste. MDH laboratories manage anything that has come in contact with a specimen as "biohazardous" (infectious) waste.²⁸

Other wastes are generated in the testing of specimens for SARS-CoV-2. These include chemicals and reagents used in the extraction of the virus and preparing the specimen for analysis. A review of safety data sheets for the elution reagent used in the antigen test Binax indicates it may be considered hazardous waste when disposed because it contains the dermally toxic chemical Proclin as an antimicrobial.²⁹ The extraction reagents used in PCR testing can contain ethanol, guanidinium thiocyanate and sodium perchlorate. These chemicals could be considered hazardous rather than infectious waste due to their flammability and reactivity. According to staff interviewed for this report, waste from PCR extractions was being managed as hazardous and the volumes of waste increased five to seven-fold during the pandemic.^{30,31,32}



The hazardous waste rules at both the state and federal level are complex. Federal rules in the Resource Conservation and Recovery Act (RCRA) identify any waste that exhibits the characteristics of ignitability, corrosivity, reactivity or toxicity, and/or contains chemicals on the F, K, P and U lists, be managed as hazardous, not infectious, waste. Minnesota adds a characteristic of lethality.³³ In some cases, for example vaccines that use a mercury-based preservative such as Thimerosal, any

²⁶ 2020 Minnesota Statutes, Chapter 116, Section 116.76, <https://www.revisor.mn.gov/statutes/cite/116.76>.

²⁷ Ibid., subp. 18, "Sharps" means: (1) discarded items that can induce subdermal inoculation of infectious agents, including needles, lancets, scalpel blades, pipettes, and other items derived from human or animal patient care, blood banks, laboratories, mortuaries, research facilities, and industrial operations; and (2) discarded glass or rigid plastic vials containing infectious agents.

²⁸ Email communication with MDH Safety Officer, various dates 12/2020-1/2021.

²⁹ Abbott, Safety Data Sheet, BinaxNOW™ Elution Solution, 9/23/2019.

³⁰ Interview with waste manager, 12/2/2020.

³¹ Email conversations with safety officer, 12/2020.

³² Interview with lab pack specialist, 12/9/2020.

³³ <http://www.mntap.umn.edu/industries/facility/healthcare/waste/hazardous/>

waste could be considered “dual” or both hazardous *and* infectious, requiring management under both sets of regulations.³⁴

It is important to make the appropriate determination of waste type to ensure it is properly managed and disposed of; improperly disposed of hazardous waste, such as being managed as infectious waste, can lead to untreated chemicals in autoclave condensate, which is then piped to a wastewater treatment plant that does not have the capacity to treat chemicals. This is also why sewerage chemical waste may be inappropriate. Wastewater treatment plants were not designed to treat chemicals which may lead to the chemicals passing through the wastewater plant into surface waters such as lakes and rivers. Hazardous waste, due to the high level of treatment required, is expensive to dispose of; hazardous waste can cost dollars per pound as opposed to pennies per pound for solid waste.

Vaccine waste

As of this writing, three vaccines have been developed and approved by the Food and Drug Administration (FDA) for use in the US to promote SARS-CoV-2 immunity: the two-dose vaccines from Pfizer-NBiotech and Moderna and the single-dose vaccine from Johnson & Johnson's.

Technically speaking, both the Moderna and Pfizer vaccines and any subsequent waste do not fit MPCAs definition of infectious waste. MPCA's definition, under “laboratory waste” states infectious waste is “discarded live or attenuated vaccines that are infectious to humans”. Because these vaccines do not contain live or attenuated virus but, rather, mRNA, which is not an infectious agent, vaccine waste, including the vials that are not “sharps,” are consistent with management as solid waste.

A summary of waste management and waste reduction options for the healthcare industry related to wastes generated from Covid-19 related activities is provided in Appendix 1.

³⁴ MnTAP offers detailed explanations of waste definitions and applicability to healthcare on its website at: <http://www.mntap.umn.edu/industries/facility/healthcare/waste/hazardous/#labwaste>

Appendix 1 - Waste Management And Reduction Opportunities³⁵

Item	Reuse Options	Extended Use	Guidance	Preferred Disposal	Notes
Patient Care Items					
Alcohol-Based Hand Rub	Clean Empty, Personal Size & Refill From Bulk Container			Non-Empty Containers As Hazardous Waste Empty Containers Recycle Or Solid Waste	Clean In Dishwasher
Disposable Covid Patient Care Isolation Gowns	N/A	Expired Gowns Can Be Used For Training	CDC ³⁶	Solid Waste	Ensure Gowns Are Appropriate For Tasks.
Face Shields	Clean & Disinfect		CDC ³⁷	Solid Waste	
Gloves	N/A		Minnesota ³⁸ Rules	Solid Waste	Unless Grossly Bloody, Dripping With Body Fluids>lw
Masks	Cloth For Lower Risk Personnel	N/A	CDC ³⁹	Launder Or Solid Waste	
N95 Respirators	Yes For Same Individual	Yes With Appropriate Hand Hygiene	CDC ⁴⁰	Solid Waste, Unless Used In Procedure With Aerosolization	Manufacturers Need To Develop Guidance For Re-Use.
Reusable Covid Patient Care Isolation Gowns	Wash As Per Manufacturer's Instructions		CDC ⁴¹	N/A	Ensure Gowns Are Ansi Level (1 Or 2) Appropriate For Tasks

³⁵ It should be noted that CDC's guidance for reuse of face shields and respirators is based on optimizing available supplies during the pandemic.

³⁶ CDC, Clinical Questions about COVID-19: Questions and Answers, Updated Dec.28, 2020, https://www.cdc.gov/coronavirus/2019-ncov/hcp/faq.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Finfection-control-faq.html#, viewed 12/31/20.

³⁷ CDC, Strategies for Optimizing the Supply of Eye Protection, updated 12/20/2020, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/eye-protection.html>, viewed 2/18/2021.

³⁸ 2020 Minnesota Statutes, Chapter 116, Section 116.76, <https://www.revisor.mn.gov/statutes/cite/116.76> .

³⁹ CDC, Use masks to slow the spread of COVID-19, <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html>, updated 2/10/2021, viewed 2/17/2021.

⁴⁰ CDC, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html>, Mar 27, 2020. Viewed 2/16/2021.

⁴¹ CDC, Strategies for optimizing supply of isolation gowns, updated Oct. 9, 2020, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/isolation-gowns.html>, viewed 12/22/20.

Item	Reuse Options	Extended Use	Guidance	Preferred Disposal	Notes
Covid Testing					
Specimen Collection Swabs	N/A		Minnesota Rules ⁴²	Solid Waste	May Be Considered A “Sharp”
Saliva Specimens	N/A		Minnesota Rules ⁴³	Solid Waste	Use Opaque Bag For Disposal To Alleviate Privacy Concerns
Covid Antigen Test Cassettes, Used	N/A		Minnesota Rules ⁴⁴	Solid Waste	
Covid Antigen Test Elution Reagent With Proclin, E.G. Abbott Binax	N/A		Minnesota Rules ⁴⁵ Abbott Guidance ⁴⁶	Hazardous Waste	Evaluate Case By Case Basis
Covid Antigen Test Positive Control	N/A		Minnesota Rules ⁴⁷ Abbott Guidance ⁴⁸	Solid Waste	Non-Infectious
Pcr Waste (Ethanol, Guanadinium Thiocyanate And Sodium Perchlorate)	N/A		Minnesota Rules ⁴⁹	Hazardous Waste	
Vaccines					
Moderna Mrna	N/A		Moderna Guidance ⁵⁰	Solid Waste ⁵¹	Vials Not Sharps Unless Broken
Pfizer-Nbiotech Mrna	N/A		Pfizer Guidance ⁵²	Solid Waste ⁵³	Vials Not Sharps Unless Broken

⁴² 2020 Minnesota Statutes, Chapter 116, Section 116.76, <https://www.revisor.mn.gov/statutes/cite/116.76> .

⁴³ Ibid.

⁴⁴ Ibid.

⁴⁵ MnTAP offers detailed explanations of waste definitions and applicability to healthcare on its website at:

<http://www.mntap.umn.edu/industries/facility/healthcare/waste/hazardous/#labwaste>

⁴⁶ Abbott, Safety Data Sheet, BinaxNOW™ Elution Solution, 9/23/2019.

⁴⁷ 2020 Minnesota Statutes, Chapter 116, Section 116.76, <https://www.revisor.mn.gov/statutes/cite/116.76> .

⁴⁸ Abbott, BinaxNOW, COVID-19 Ag card, 2020.

⁴⁹ MnTAP offers detailed explanations of waste definitions and applicability to healthcare on its website at:

<http://www.mntap.umn.edu/industries/facility/healthcare/waste/hazardous/#labwaste>

⁵⁰ Moderna, Fact sheet for recipients and caregivers, 12/20/2020, <https://www.fda.gov/media/144638/download>, viewed 2/15/2021.

⁵¹ Due to the potential or actual diversion of vaccine containers/labeling/packaging for illicit or counterfeit use, MDH and MPCA recommend all vaccine waste, including packaging be managed as infectious waste. Interim COVID-19 Vaccine Provider Guide, updated 9/2/2021, <https://www.health.state.mn.us/diseases/coronavirus/vaccine/guide.pdf>, viewed 9/23/2021.

⁵² Pfizer-NBiotech, Fact sheet for recipients and caregivers, Jan 2021, <https://www.fda.gov/media/144414/download>, viewed 2/15/2021.

⁵³ Due to the potential or actual diversion of vaccine containers/labeling/packaging for illicit or counterfeit use, MDH and MPCA recommend all vaccine waste, including packaging be managed as infectious waste. Interim COVID-19 Vaccine Provider Guide, updated 9/2/2021, <https://www.health.state.mn.us/diseases/coronavirus/vaccine/guide.pdf>, viewed 9/23/2021.