Third Time's a Charm

Optimizing Infusion Practices to Prevent Harm

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Get to know your presenters

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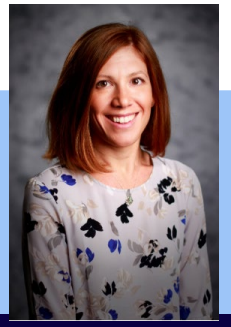
Dr. Olsen is the Clinical Program Director for Oncology at the Johns Hopkins Hospital and the Johns Hopkins Health System. She works work closely with JH oncology nurse leaders, oncology physician leaders, and directly with clinical staff to ensure best practice, and streamlined coordination of care throughout the Johns Hopkins Health System. Dr. Olsen serves as adjunct faculty for the Johns Hopkins School of Nursing and holds a Joint Faculty Appointment at the Johns Hopkins University and the Sidney Kimmel Comprehensive Cancer Center.

Dr. Olsen is the lead editor for the 3rd edition of the Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice (2023) and the Safe Handling of Hazardous Drugs 4th ed (2024). She is also the nurse co-chair of the ASCO/ONS Antineoplastic Administration Standards (2024). Dr. Olsen is the chair of the Johns Hopkins Health System Vascular Access and CLABSI Reduction Committee where she works with a team to harmonize patient care across 6 hospitals in the health system. Dr. Olsen has published and extensively presented on the topic of hazardous drug exposure risk for health care workers, antineoplastic administration, vascular access device insertion and maintenance, and CLABSI prevention.

AnnMarie Walton, PhD, MPH, RN, OCN, CHES, FAAN

Dr. Walton is an Associate Professor and the Dorothy L. Powell Term Chair of Nursing at the Duke University School of Nursing. Her program of research centers on understanding and minimizing occupational and environmental exposure to known carcinogens. Dr. Walton studies occupational exposure to antineoplastic drugs for healthcare workers and has been a policy advocate in this arena as well. Dr. Walton worked for 13 years in inpatient hematology/oncology in roles from Clinical Nurse I through Clinical Nurse IV and co-created the first nurse manager job share in the state of North Carolina.

Dr. Walton co-led the most recent writing of the Joint Position Statement on Safe Handling of Hazardous Drugs between the Oncology Nursing Society (ONS) and the Hematology/Oncology Pharmacy Association and has written and spoken extensively about safe handling of hazardous drugs. Dr. Walton wrote the safe handling chapter in the ONS Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice and is the co-editor of the 4th Edition of the ONS Safe Handling of Hazardous Drugs Book. Dr. Walton was honored as the 2016 Oncology Nursing Society Health Policy and Advocacy Award winner for her work on safe handling policies and a Breakthrough Leader in Nursing by the Future of Nursing Campaign for Action. She was inducted as a Fellow in the American Academy of Nursing in 2020.



Disclosure

The views and opinions expressed are solely our own and do not express the views or opinions of our employers or BD.

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Meeting space has been assigned to provide a Symposia supported by BD during the Oncology Nursing Society's (ONS) 50th Annual Congress, April 9 – April 13, 2025 in Denver, CO. The Oncology Nursing Society's assignment of meeting space does not imply product endorsement.

Objectives

1. Review the **state of science** on the adverse health effects associated with occupational exposure to hazardous drugs
2. Describe **newly published research** and guidelines regarding hazardous drugs
3. Discuss **strategies and outcomes** for ensuring the safe and accurate delivery of the prescribed drug doses
4. Explore **practical approaches and tools** to help your organization move towards optimization of safety both for patients and for the healthcare workforce

HD handling in the United States

For more than 50 years, healthcare workers (HCWs) have handled HDs that are known to be human carcinogens

8.5 million

HCWs potentially exposed to HDs[1]

Over 18 million cancer chemotherapy doses are administered annually in the US alone[2]

Pharmacy and nursing staff involved in preparing and administering are at highest risk

Other HCWs such as nursing assistive personnel, environmental services workers, and those in shipping and receiving have been under considered

1. NIOSH [2023]. Managing hazardous drug exposures: information for healthcare settings. By Hodson L, Ovesen J, Couch J, Hirst D, Lawson C, Lentz TJ, MacKenzie B, Mead K. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2023-130, https://doi.org/10.26616/NIOSHPUB2023130.

2. Weir HK, Thompson TD, Stewart SL, White MC. Cancer Incidence Projections in the United States Between 2015 and 2050. Prev Chronic Dis 2021;18:210006.

Adverse health effects of exposure[3-6]

Acute

- Headache
- Nausea/vomiting
- Ocular irritation
- Diarrhea

Short-term

- Hair loss or thinning
- Skin irritation and contact dermatitis
- Mouth and nasal sores

Long-term

- Risk of damage to organs and organ systems
- Risk to the ability to successfully conceive and give birth to healthy babies
- Risk of genotoxicity (including risk of cancer)

3. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.

4. Connor TH, Lawson CC, Polovich M, McDiarmid MA [2014]. Reproductive health risks associated with occupational exposures to antineoplastic drugs in health care settings. J Occup Environ Med 56(9):901–910.

5. NIOSH [2004]. NIOSH Alert: preventing occupational exposures to antineoplastic and other hazardous drugs in health care settings. By Burroughs GE, Connor TH, McDiarmid MA, Mead KR, Power LA, Reed LD, Coyle BJ, Hammond DR, Leone MM, Polovich M, Sharpnack DD. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-165, https://www.cdc.gov/niosh/docs/2004-165/.

6. NTP [2019]. NTP monograph on the systematic review of occupational exposure to cancer chemotherapy agents and adverse health outcomes. Monograph 5. Research Triangle Park, NC: National Toxicology Progra

Biomarkers of exposure

No recommendations for biologic monitoring currently exist

Routine urine testing is currently impractical

Blood has been used as a biomarker of exposure in pharmacists, pharmacy technicians, pharmacy cleaning personnel[7,8]

7. Béchet, V., Benoist, H., Beau, F., Divanon, F., Lagadu, S., Sichel, F. Saint-Lorant, G. (2022). Blood contamination of the pharmaceutical staff by irinotecan and its two major metabolites inside and outside a compounding unit. Journal of Oncology Pharmacy Practice, 28(4), 777–784. https://doi.org/10.1177/10781552211012059.
8. Benoist, H., Breuil, C., Le Neindre, B., Delépée, R., & Saint-Lorant, G. (2020). Does equipment change impact blood contamination with irinotecan and its two major metabolites in a centralized cytotoxic pharmacy unit? Journal of Oncology Pharmacy.

Biomarkers of effect

Chromosomal aberrations (CA) are associated with carcinogenesis

Increased micronuclei frequency (MNF) is associated with carcinogenesis

The **comet assay** is a test for DNA strand breaks and incomplete DNA repair using peripheral blood or buccal cells

Sister chromatid exchange are the exchange of products of DNA replication after exposure to DNA-damaging agents

9. Roussel, C., Witt, K.L., Shaw, P.B., & Connor, T.H. (2019). Meta-analysis of chromosomal aberrations as a biomarker of exposure in healthcare workers occupationally exposed to antineoplastic drugs. Mutation research—Reviews in Mutation Research, 781, 207–217. https://doi.org /10.1016/j.mrrev.2017.08.002.
10. McDiarmid, M.A., Oliver, M.S., Roth, T.S., Rogers, B., & Escalante, C. (2010). Chromosome 5 and 7 abnormalities in oncology personnel handling anticancer drugs. Journal of Occupational and Environmental Medicine, 52(10), 1028–1034. https://doi.org/10.1097/JOM .0b013e3181f73ae6.
11. McDiarmid, M.A., Rogers, B., & Oliver, M.S. (2014). Chromosomal effects of non-alkylating drug exposure in oncology personnel. Environmental and Molecular Mutagenesis, 55(4), 369–374. https://doi.org/10.1002 /em.21852.
12. Villarini, M., Gianfredi, V., Levorato, S., Vannini, S., Salvatori, T., & Moretti, M. (2016). Occupational exposure to cytostatic/antineoplastic drugs and cytogenetic damage measured using the lymphocyte cytokinesis-block micronucleus assay: A systematic review of the literature and meta-analysis. Mutation Research Reviews in Mutation Research, 770(Part A), 35–45. https://doi.org/10.1016/j.mrrev.2016.05.001.

Safe handling of HD recommendations

2004
NIOSH Safety Alert[13]

2016
OSHA HD Guidelines[14]

2018
ASHP Guidelines on Handling Hazardous Drugs[15]

2022
ONS HOPA Position Statement[16]

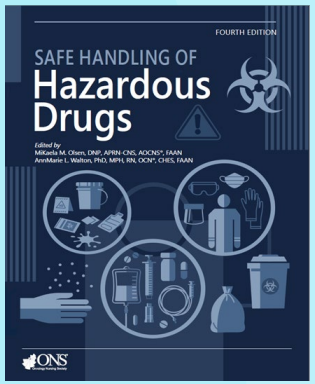
2022
USP <800> Standard–final chapter[17]

2023
NIOSH Managing HD Exposure[18]

2023
ONS Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice[19]

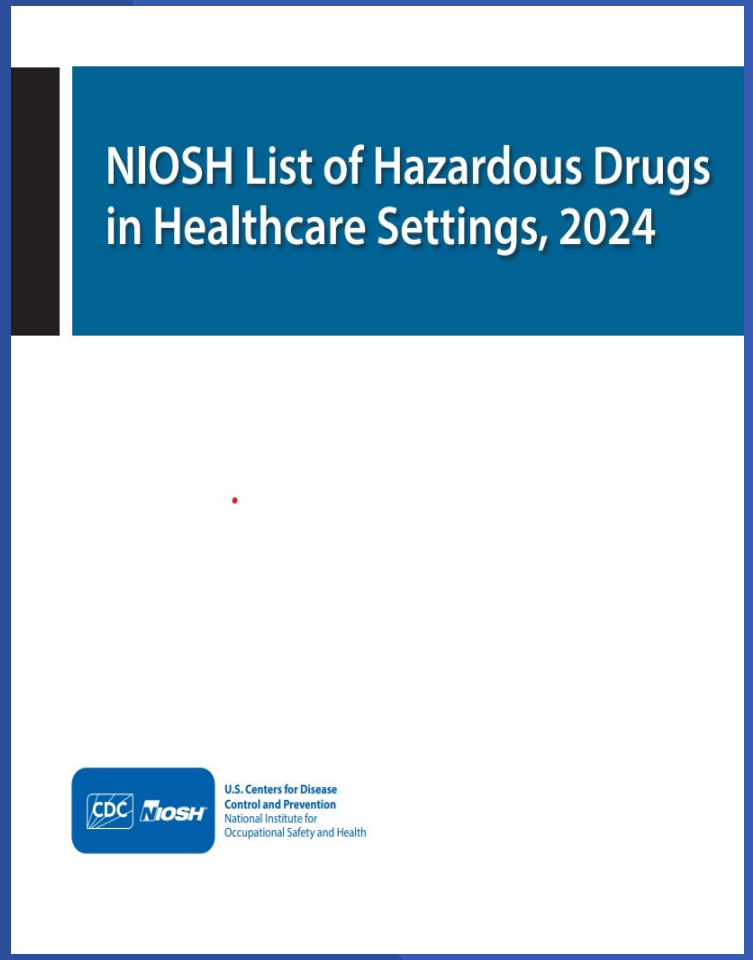
2024
ONS Safe Handling of Hazardous Drugs[20]

2024



13. The National Institute for Occupational Safety and Health (NIOSH) Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings pdf icon, September 2004.
14. Occupational Safety and Health Administration (OSHA). (2016). Safety and Health Program Management Guidelines.
15. ASHP guidelines on handling hazardous drugs. ASHP website. https://www.ashp.org/-/media/assets/policy-guidelines/docs/guidelines/handling-hazardous-drugs.ashx. Accessed April8, 2024.
16. Oncology Nursing Society & Hematology/Oncology Pharmacy Association. (2022). Ensuring healthcare worker safety when handling hazardous drugs: Joint position statement from the Oncology Nursing Society and the Hematology/Oncology Pharmacy Association. https://www.ons .org/make-difference/ons-center-advocacy-and-health-policy/position -statements/ensuring-healthcare.
17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings.
18. National Institute for Occupational Safety and Health. (2023b). Managing hazardous drug exposure: Information for healthcare settings. https:// www.cdc.gov/niosh/docs/2023-130.
19. Olsen, M, LeFebvre, K, Walker, S., Prechtel Dumphy, E. (2023). Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice 2nd ed in Press. Oncology Nursing Society, Pittsburgh, PA.
20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.

NIOSH List of Hazardous Drugs 2025



Two tables instead of three:

1. Table 1- MSHI in the package insert and/or classified by NTP as "known to be a human carcinogen" or IARC as group 1 or group 2- carcinogenic or probably carcinogenic. No longer limited to non-antineoplastic.
2. Table 2- Drugs that are hazardous by NIOSH definition but do not meet the above definition.

22. NIOSH [2024]. NIOSH list of hazardous drugs in healthcare settings, 2024. By Ovesen JL, Sammons D, Connor TH, MacKenzie BA, DeBord DG, Trout DB, O'Callaghan JP, Whittaker C. Cincinnati, OH: U.S. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2025-103 (Supersedes 2016-161), https://doi.org/10.26616/NIOSHPUB2025103

Standards for HD Safety: USP Chapter <800>[17]

What is required?[17]

Organizations must:

- Use CSTDs for administering antineoplastics
- Maintain list of hazardous drugs, with an annual update/review
- Provide PPE for all staff and ensure compliance
- Use CSTDs for administering antineoplastics
- Provide job-specific personnel education and training
- Decontaminate equipment and the work environment
- Prevent and manage antineoplastic spills

17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings

Engineering controls: highest level protection[17]

Machines or equipment

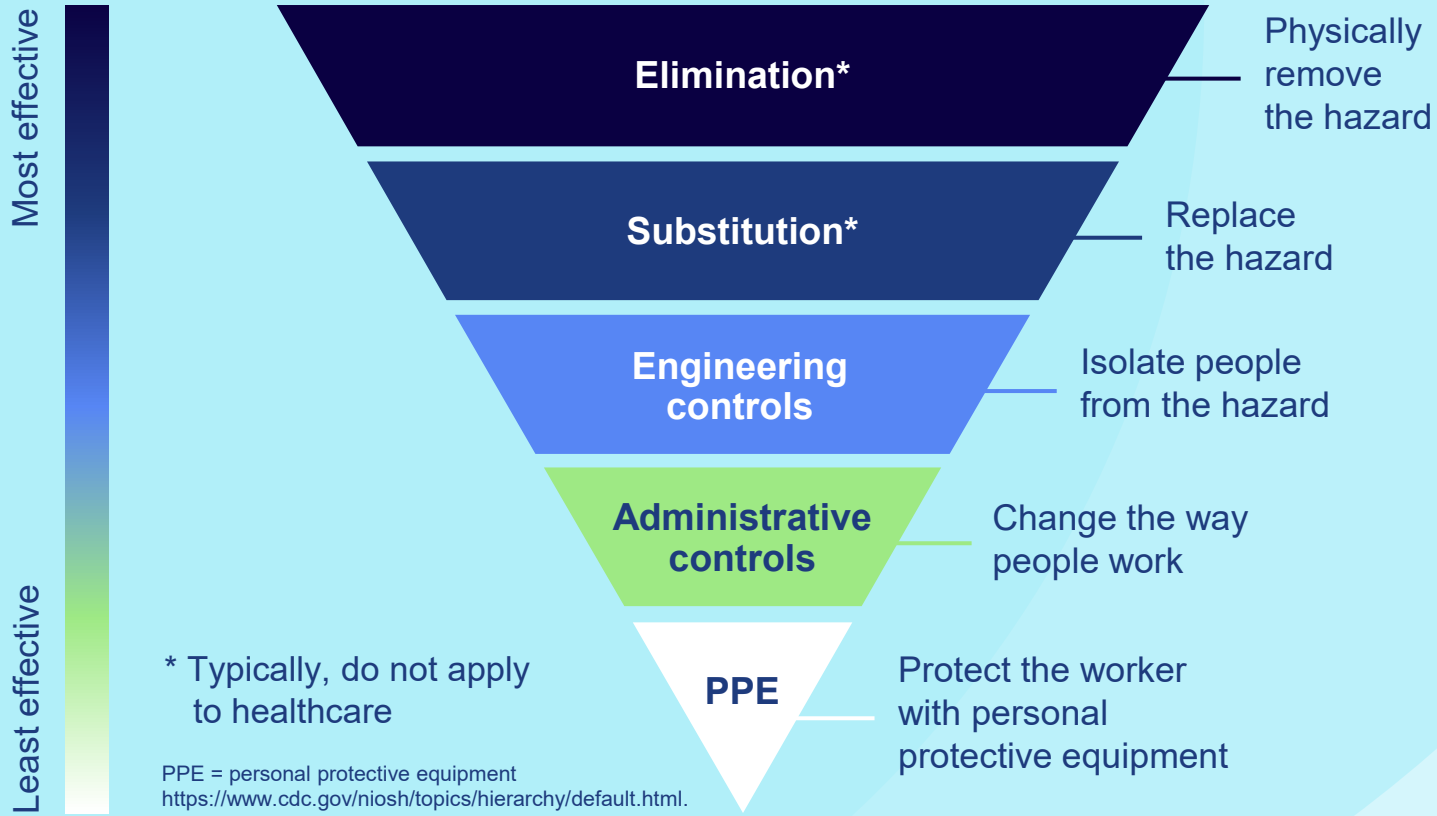
- Containment primary engineering control (C-PEC)
- Containment secondary engineering control (C-SEC)
- Supplemental engineering control—closed system drug transfer device (CSTD)

Advantages

- Containment of the hazard
- Independent of the worker

Hierarchy of controls

All recommendations follow these same principles



* Typically, do not apply to healthcare

PPE = personal protective equipment
https://www.cdc.gov/niosh/topics/hierarchy/default.html.

17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings..

Personal Protective Equipment (PPE)[17,19,20]

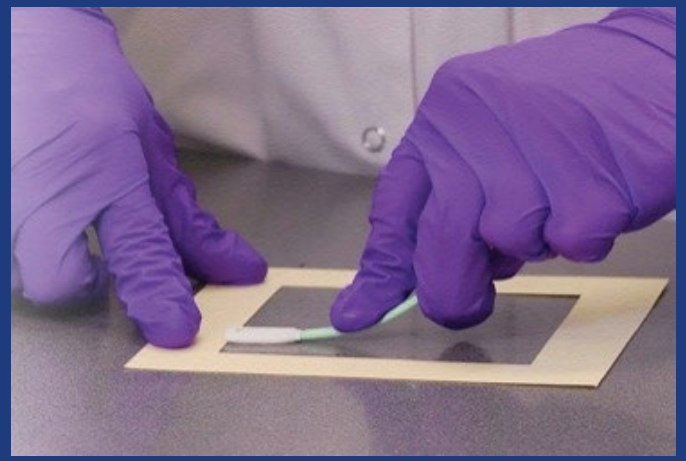
Gloves	• Wear **double gloves** for all handling activities, such as preparation, administration, and handling of contaminated waste (single pair of gloves for intact oral administration) • Disposable, powder-free gloves, tested for use with HDs • Inspect gloves for visible defects prior to use • Change gloves every 30 minutes or immediately if damaged or contaminated—DO NOT reuse gloves • Wash hands with soap and water after removing gloves • **Think of HDs like bugs and avoid touch contamination – remove outer gloves between activities (e.g. after hanging HD and before programming pump)**
Eye and face protection	• Combination of mask and face shield when possibility of spilling or splashing exists • An appropriate full-face piece, chemical cartridge-type respirator or **powered air-purifying respirator (PAPR)** should be worn when there are large spills or when there is known or suspected airborne exposure to vapors or gases.
Gowns	• **Choose the right gown for the right activity** • A gown tested for use with HDs must be used when cleaning up a spill or during activities in which spilling or splashing is possible. • Disposable gowns made of polyethylene-coated polypropylene or other laminate materials offer better protection than other materials or those not tested per the ASTM standard. • Gowns should be solid front with back closure, long sleeves, closed cuffs (elastic or knit). No seams or closures. • Cloth fabrics, including lab coats, **should not be used** • Inner glove under gown, outer glove over gown • Discard if visibly contaminated, after handling drug, and before leaving areas where drugs are handled • Gowns are for single use only—DO NOT reapply

17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings.
19. Olsen, M, LeFebvre, K, Walker, S., Prechtel Dumphy, E. (2023). Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice 2nd ed in Press. Oncology Nursing Society, Pittsburgh, PA.
20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.

Recommended standards[17, 21]

Environmental wipe sampling/ environmental quality control

- Baseline and every 6 months



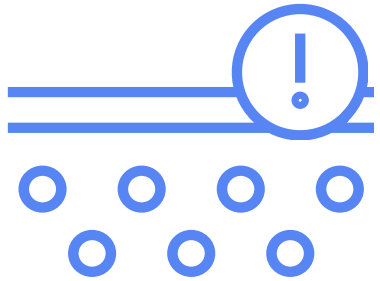
Medical surveillance for healthcare workers handling HDs

- Baseline health assessment
- Periodic health assessment
- Follow up for acute exposure
- Follow up for health changes

Recommended= “Should”

17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings.
21. https://www.pharmacypracticenews.com/Review-Articles/Article/07-20/Best-Practices-for-Monitoring-Hazardous-Drug-Surface-Contamination/58875

Environmental monitoring



It is widely understood that the majority of exposure for HCWs is dermal

- **There is no consensus on a “safe” or “acceptable” level of contamination**
  - USP <800> suggests action level above 1 ng/cm^2 for cyclophosphamide[17]
  - Others suggest action levels at the 75th or 90th percentile of the wipe sampling data distribution since a contamination level of zero is not possible
  - ALARA principle

- 31 studies published since 2013 were included in the 4th Edition of ONS Safe Handling of HDs demonstrating that **environmental contamination persists despite improvements in engineering controls and newer recommendations**[20]
- **Monitoring surface contamination** is important to **understand failure of current contamination methods** and where to focus efforts to **reduce opportunities for dermal exposure**[17,23]

17. U.S. Pharmacopeial Convention (USP). 2022 General chapter <800> hazardous drugs—handling in healthcare settings. www.uspnf.com/notices/gc-800-hazardous-drugs-handling-in-healthcare-settings.
20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.
23. Gabay, M., Johnson, P., Fanikos, J., Amerine, L., Kienle, P., Olsen, M., Moody, M.L. (2021). Report on 2020 Safe to Touch Consensus Conference on Hazardous Drug Surface Contamination. American Journal of Health-System Pharmacy, 78(17), 1568–1575. https://doi.org/10.1093 /ajhp/zxab134

Latest recommendations on where to sample in patient care areas[24]

Recommendations from the literature

Six locations for sampling have been recommended by Merger et al. (2014)[25]:

- Storage shelf or bin
- Counters where medication safety checks are performed
- Armrests of infusion chairs
- Counters or tables in patient rooms
- Counters in outpatient clinics
- Exterior surfaces of IV bags or syringes

Four locations for sampling have been recommended by Gabay et al. (2021)[23]:

- Infusion pumps
- Floors under infusion pumps
- HD disposal bins
- Bathroom used by patients or employees handling HDs

New recommendations

From this scoping review, the authors recommend adding the following locations for sampling:

- Doorknobs and handles
- Phones

The authors also recommend the following locations in bathrooms for sampling:

- Toilet seats
- Floors near toilets

24. Walton, A., Powell, M., Ledbetter, L., Bush, M. (in press). A Scoping Review of Surface Wipe Sampling for Antineoplastic Drug Contamination in Patient Care Areas. Journal of Occupational and Environmental Hygiene. https://doi.org/10.1080/15459624.2025.2471397
25. Merger, D., Tanguay, C., Langlois, E., Lefebvre, M., & Bussières, J.-F. (2014). Multicenter study of environmental contamination with antineoplastic drugs in 33 Canadian hospitals. International Archives of Occupational and Environmental Health, 87(3), 307–313. https://doi.org/10.1007/s00420-013-0862-0
23. Gabay, M., Johnson, P., Fanikos, J., Amerine, L., Kienle, P., Olsen, M., Moody, M.L. (2021). Report on 2020 Safe to Touch Consensus Conference on Hazardous Drug Surface Contamination. American Journal of Health-System Pharmacy, 78(17), 1568–1575. https://doi.org/10.1093 /ajhp/zxab134

Goals of safe HD administration and accurate drug delivery

- **Ensure five medication rights are followed**
- **Ensure safe handling of HD**
- **Minimize risk of infusion related reactions**

- **Choose a medication administration method that minimizes residual volume left behind in the tubing**
  - Administer the prescribed dose over the prescribed duration
  - Know drip chamber and tubing volumes
  - Account for overfill

Work smarter, not harder

Antineoplastic Therapy Administration Safety Standards for Adult and Pediatric Oncology: ASCO-ONS Standards 2024[26]

ASCO and ONS convened a **multidisciplinary Expert Panel** with representation of multiple organizations to **conduct literature reviews** and **add to the standards as needed.**

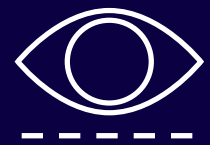
The evidence base was combined with the opinion of the ASCO-ONS Expert Panel to develop **antineoplastic safety standards and guidance.**

- Expanded to include all locations where antineoplastics are administered (e.g. Home, operating room, etc.)
- Includes cellular therapies
- New content related to social determinants of health, fertility preservation, and pregnancy avoidance.
- A fourth verification added to the standards
  - Prior to compounding
  - After compounding prior to administration
  - Prior to administration
  - In the presence of the patient at the bed or chair side

26. Siegel, R.D., LeFebvre, K.B., Temin, S., Evers, A., Barbarotta, L., Bowman, R., Chan, A., Dougherty, D.W., Ganio, M., Hunter, B., Klein, M., Miller, T.P., Mulvey, T.M., Ouzts, A., Polovich, M., Salazar- Abshire, M., Stenstrup, E.Z., Sydenstricker, C.M., Tsai, S., & Olsen, M.M. (in press). Antineoplastic therapy administration safety standards for adult and pediatric oncology: ASCO-ONS Standards. Journal of Clinical Oncology-Oncology Practice.

How is the HD dispensed?

- Consider double bagging the HD with a clean outer bag to reduce environmental contamination in the administration area
- Collaborate with compounding staff to ensure HD drug is dispensed in the correct IV tubing with filters attached and primed, if applicable



* If nursing is spiking and priming IV bag, it should be performed **below eye level**

HD bag dispensed without IV tubing

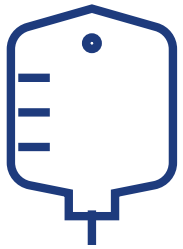
- CSTD spike must be attached to bag
- Never spike directly into the HD bag
- Prime with a non-HD solution
- For secondary infusions back prime using a CSTD from the primary solution
- Utilize filter if indicated and prime with a non-HD solution
- Use a CSTD at distal end

HD bag dispensed with IV tubing

- Know what the tubing is primed with before handling
- Use a CSTD at distal end
- Do not grab tubing or drip chamber and pull from the delivery bag
- Ensure tubing connections are tightened
- Ensure direct or dry spike is fully engaged in bag

20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.

Administer the prescribed dose over the prescribed duration[19,27]



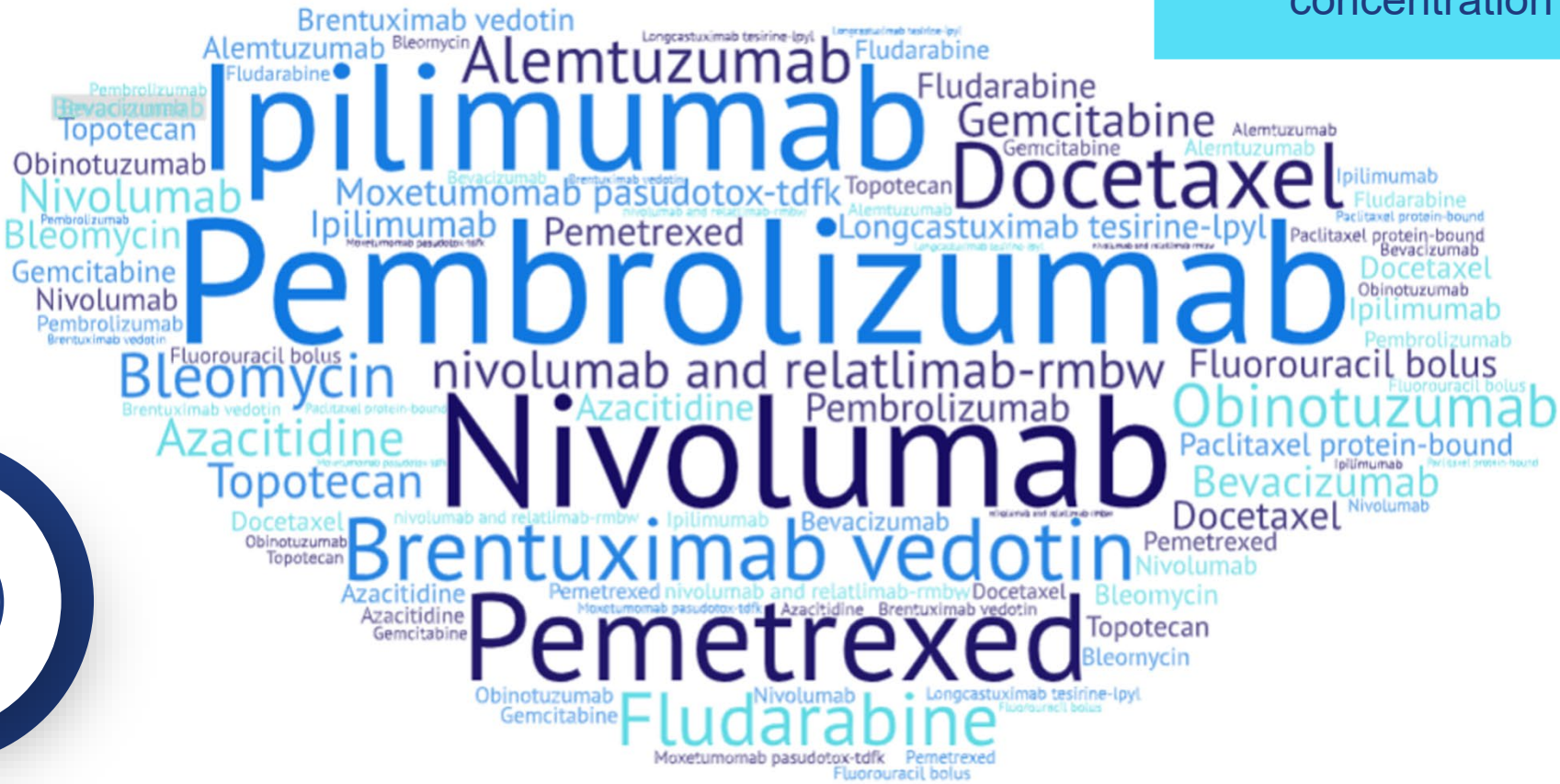
As much as
50% of the drug
can remain in the tubing post administration when using long macrobore primary administration set tubing and filters[25]

- Without adequate flushing of the bag and/or tubing, a clinically significant volume of the medication can remain in the tubing resulting in an under dose
- If the tubing is used for a subsequent medication or fluid administration, the residual volume left in the tubing could result in an inadvertent bolus of the medication
- Some filters contain up to 5 ml of priming volume

19. Olsen, M, LeFebvre, K, Walker, S., Prechtel Dumphy, E. (2023). Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice 2nd ed in Press. Oncology Nursing Society, Pittsburgh, PA.
27. ISMP Medication Safety Alert! ISMP, Hidden medication loss when using a primary administration set for small-volume intermittent infusions. 2020;25(24):1-4. https://www.ismp.org/resources/hidden-medication-loss-when-using-primary-administration-set-small-volume-intermittent

Examples of small volume HDs used for the treatment of cancer

- Per manufacturer guidelines regarding concentration



Overfill of IV bags
Must have a process in place for management

1 Overfill can leave clinically significant doses of medications in bags

- ONS- too quickly, too slowly or incomplete dose administration
  - Manufacturers bag volumes vary from actual volume
  - Volume added during compounding also increases overfill

2 The institution or practice should define a process to manage the overfill of IV bags

- To ensure accurate infusion rates and delivery of the entire medication dose, medication labeling, or institutional guidelines should provide the total volume to infuse on the label, including overfill and any additives
- Lack of a clear identification of the total volume in the bag can lead to administering the agent too fast, too slow, or incompletely

3 The pump may alarm before the bag is completed requiring time-consuming attempts to reprogram and administer the full dose (resulting in the drug running over the prescribed time)

4 Overestimating the total volume in the bag may result in air in IV tubing preventing the tubing from being used

Bag size	Overfill (mL)
50 mL	22
100 mL	24
250 mL	39
500 mL	59
1000 mL	74
Volume on label + overfill for tubing = Total volume for pump	

*used with permission MiKaela Olsen

19. Olsen, M, LeFebvre, K, Walker, S., Prechtel Dumphy, E. (2023). Chemotherapy and Immunotherapy Guidelines and Recommendations for Practice 2nd ed in Press. Oncology Nursing Society, Pittsburgh, PA.

Priming tubing with drug or a compatible non-drug solution[20]

- **Decision to prime tubing or not during compounding is an institutional or practice decision based on resources and workflows**
- **General principles**
  - **Ensure appropriate IV tubing is used for the drug (e.g. low sorbing, non-DEHP) and compatible solution**
  - Place CSTD at distal end of tubing when primed with HD
  - Priming outside of a biologic safety cabinet should only be done using a non-HD solution
  - Consider compatibility of CSTD used with needleless connector at patient side
  - Follow aseptic procedures during tubing priming
- **Circle priming is used in some practices care should be taken to ensure**
  - Use a CSTD to prevent leakage
  - Use aseptic technique
  - Perform all connections/disconnections below eye level
- **Research drugs**
  - Work with sponsors to ensure explicit instructions for administration and post drug flushing procedures
  - Ensure consistent use of HD handling guidelines with study drugs considered hazardous or if risk is unknown

20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024.

Minimize air in tubing issues[28]

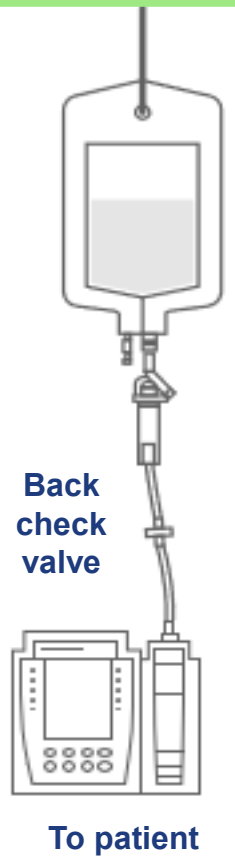
Be Proactive

- Correctly prime tubing per manufacturer guidelines
- Pre-connect filter prior to priming and prime per manufacturer guidelines-consider use of an IV set with integrated filters (per INS guidelines)
- Never remove endcap during priming
- Never prime over a trash can or sink
- Never prime with a hazardous drug
- Utilize antisiphon tubing for drugs that are associated with air bubbles
- Never remove air in line without using a CSTD and do not waste any of the patient's drug

28. Nickel, B., Gorski, L., Kleidon, T., et al, M. Infusion Therapy Standards of Practice, 9th ed. Infusion Nursing Society. 2024..

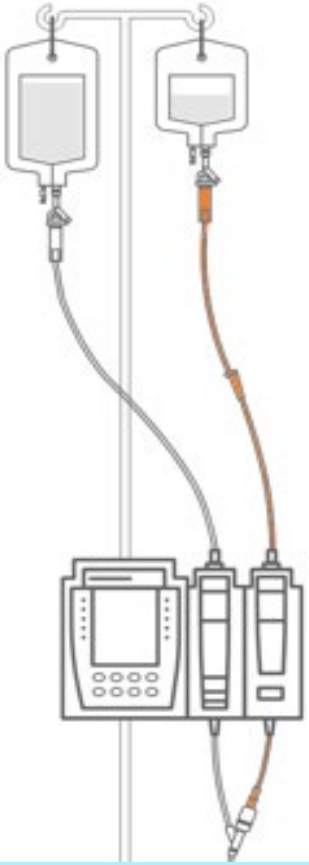
Ways to deliver intermittent infusions

Primary



Secondary set up

Short pump set up



Pump and tubing setup – primary tubing infusions[27]

Primary tubing set up (long-lining)

- Not recommended for small volume infusions because the remaining volume existing in the length of the primary tubing set may not be administered to the patient resulting in significant under dosing
- Recommended for drugs with high risk of infusion reactions so that the drug can be connected using a CSTD to the distal Y-site connection and stopped or disconnected quickly, in the event of a reaction
- Use a CSTD at the distal end of the tubing when HD tubing needs to be disconnected and reconnected for subsequent drugs
- Consider this; Primary sets have ~25 mLs priming volume and if run to air-in-line detector will have ~10-15 mLs drug remaining in line

INS 2024 - Identify medications that should be administered as uninterrupted primary infusions (e.g. risk for reaction)

27. ISMP Medication Safety Alert! ISMP, Hidden medication loss when using a primary administration set for small-volume intermittent infusions. 2020;25(24):1-4. https://www.ismp.org/resources/hidden-medication-loss-when-using-primary-administration-set-small-volume-intermittent

Administer the prescribed dose over the prescribed duration[27]

Frequently, drugs are **administered faster or slower** than the prescribed duration

INS, 2024[28] - Monitor flow-control devices during the administration of infusion therapy to ensure safe and accurate delivery of the prescribed infusion rate and volume

ONS chemo guidelines- administration chapter

Increased chair time in busy infusion clinics

Institutional experience

Delivery of clinical trial drugs may be compromised

Toxicities may be enhanced

Patient dissatisfaction

Policies must address include SOPs to ensure accurate delivery of medications and this must be consistent across the practice

27. ISMP Medication Safety Alert! ISMP, Hidden medication loss when using a primary administration set for small-volume intermittent infusions. 2020;25(24):1-4. https://www.ismp.org/resources/hidden-medication-loss-when-using-primary-administration-set-small-volume-intermittent
28. Nickel, B., Gorski, L., Kleidon, T., et al, M. Infusion Therapy Standards of Practice, 9th ed. Infusion Nursing Society. 2024.

Small volume medication infusions

A long primary infusion for small volume medications is **not recommended** because the remaining volume existing in the length of the primary tubing set may not be administered to the patient resulting in **significant under dosing.**

27. ISMP Medication Safety Alert! ISMP, Hidden medication loss when using a primary administration set for small-volume intermittent infusions. 2020;25(24):1-4. https://www.ismp.org/resources/hidden-medication-loss-when-using-primary-administration-set-small-volume-intermittent

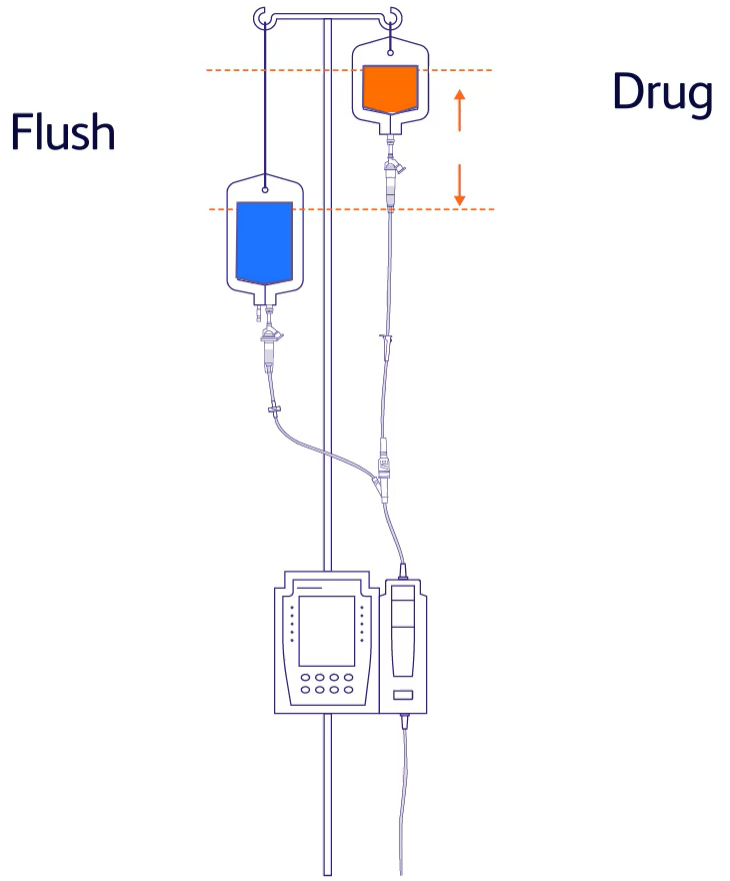
Pump and tubing setup – secondary tubing infusions[27]

Secondary (piggyback) tubing infusion set with a compatible primary infusion (carrier fluid)

Pros	Cons
◗ Can utilize back priming technique to ensure all drugs are administered from secondary bag and tubing and flush with primary line	◗ Delayed infusion caused by failing to open roller clamp on secondary infusion or failing to lower primary infusion bag
◗ Can administer multiple drugs as a secondary infusion using CSTDs	◗ **Sympathetic flow- need to ensure pump as well as primary bag differential heights are correct to eliminate/reduce sympathetic flow**
	◗ Risk of back flow into primary bag
	◗ **For high rates of infusion e.g. >300/hr sympathetic flow may not be avoidable – check with your pump manufacturer**

INS 2024[28] - Ensure accurate dose delivery, compatibility, and reduced risk for infection when administering secondary or piggybacked medication.

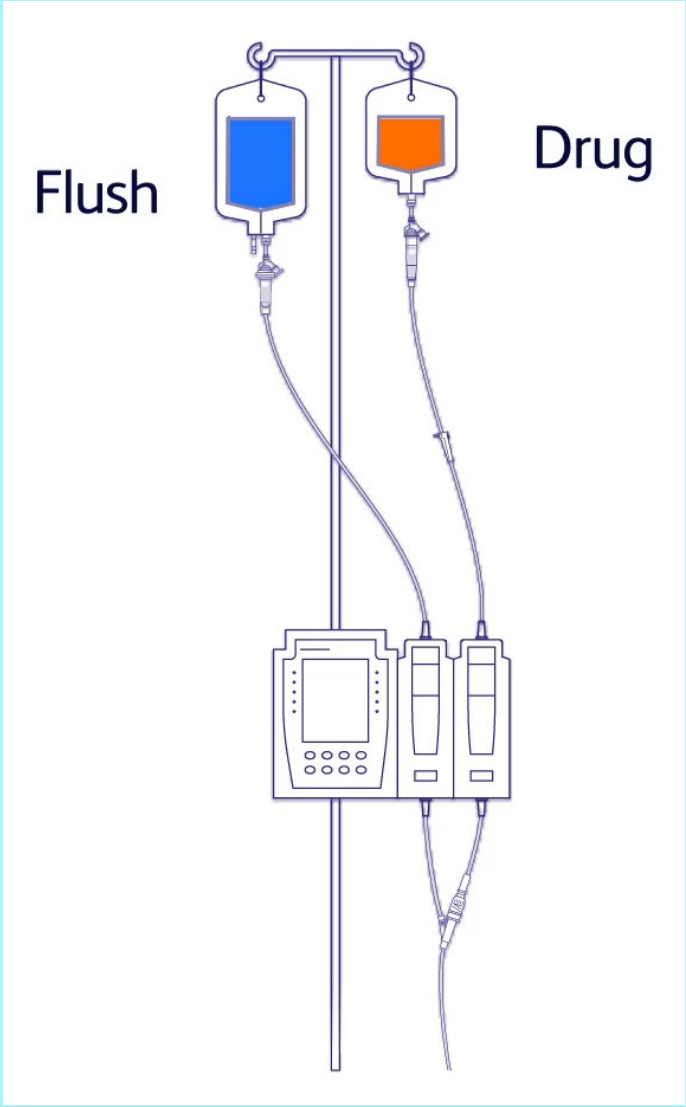
Secondary set up



27. ISMP Medication Safety Alert! ISMP, Hidden medication loss when using a primary administration set for small-volume intermittent infusions. 2020;25(24):1-4. https://www.ismp.org/resources/hidden-medication-loss-when-using-primary-administration-set-small-volume-intermittent
28. Nickel, B., Gorski, L., Kleidon, T., et al, M. Infusion Therapy Standards of Practice, 9th ed. Infusion Nursing Society. 2024..

Pump and tubing setup: short primary administration set

Short primary administration sets used with a primary infusion tubing **(carrier fluid)**



Pros

- Allows for programming of overfill to run drug dry to the air detector
- Significantly reduces the potential for residual volume remaining in the tubing
- Primary infusion can be used to flush between medications
- No back priming required
- Eliminates sympathetic flow
- Overfill of drugs in the bag and allowing the program of the pump to be over the amount of the bag so the alarm calls you back and the post flush can be started
- The Delay Options feature can be used to pre-program the start of the consecutive meds
- Eliminates errors related to unopened roller clamps, head-height differentials, and limitations in concurrent flow rates
- **Less than 1cc remains in tubing**

Pump and tubing setup: short primary administration set (cont'd)

Short primary administration sets used with a primary infusion tubing **(carrier fluid)**

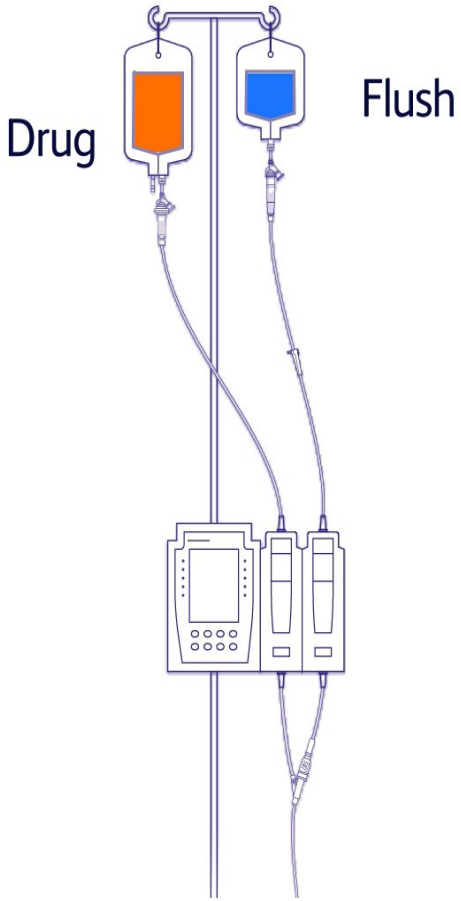
Pros

- Allows administrator to maintain a closed IV tubing system while using less CSTDs
- If multiple chemo drugs are needed, multiple short primary sets can be connected to a 5-port flush line
- A CSTD can be integrated for multi-drug HD regimens
- Less PPE for hook up and take down

Cons

- A multichannel pump may be required
- Tubing with multiple ports below the pump is required

Antineoplastics with high risk for infusion reactions or study drugs[29]



Example of nursing workflow– Reverse short Set

- Hang medication for intermittent infusion using a long primary infusion set on pump module/ channel A
- Hang flush line using a short set on pump module/ channel B
- When infusion is complete by running medication to air-in-line sensor, use flush line to flush the remaining = 14 mL of medication to the patient

Administer the medication through a long line

Medication runs dry to air chamber

Use a short set for flushing 14cc of flushing at the same rate will allow full delivery of the medication

Pros

Full delivery of medication, easy to administer and set up

Cons

Still requires a free flow rescue line to be nearby in case of a reaction. Use a CSTD at patient side and disconnect immediately for a reaction and add the rescue line with a CSTD on the end

29. Claraz P, Riff I, Vert C, Wolff E, Perriat S, Grand A, Cretu Y, Hennebelle I, Canonge JM, Puisset F. Assessment of efficacy of postinfusion tubing flushing in reducing risk of cytotoxic contamination. Am J Health Syst Pharm. 2020 Oct 30;77(22):1866-1873. doi: 10.1093/ajhp/zxaa357. PMID: 33124655..

Post administration strategies to ensure full dose is administered[20,29]

- **Flushing a primary infusion administration set**
  - Ensure tubing has not run dry
  - Using a flush syringe with CSTD attached add fluid to the bag through the dry or direct spike CSTD*
  - Add flush solution consistent with drip chamber and tubing volume to flush HD through end of tubing
  - Consider filter volume if added on to tubing
  - Consider use of a "reverse" short set for flushing

- **Flushing a secondary infusion (piggyback)**
  - Utilize a back priming technique to remove residual drug from secondary bag and tubing

- **Flushing does not eliminate HD from tubing completely – the tubing and all components of the administration set should be handled as hazardous waste**[27]

* When adding flush to the IV bag, perform **below eye level**

29. Claraz P, Riff I, Vert C, Wolff E, Perriat S, Grand A, Cretu Y, Hennebelle I, Canonge JM, Puisset F. Assessment of efficacy of postinfusion tubing flushing in reducing risk of cytotoxic contamination. Am J Health Syst Pharm. 2020 Oct 30;77(22):1866-1873
20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024

Post administration – disposal[20]

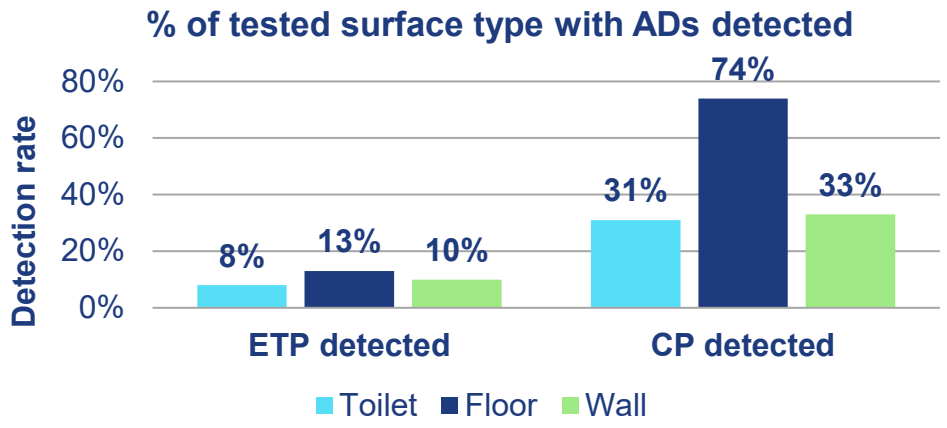
- Don PPE
- Do not remove CSTDs
- Keep tubing intact
- If the HD waste container is far away consider utilizing a sealable bag for HD waste
- Remove outer gloves before touching surfaces and opening doors
- If patient unable to tolerate HD follow institutional procedures for disposal of HD bulk waste
- Doff PPE- refer to **new** Donning and Doffing procedure from ONS

20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024

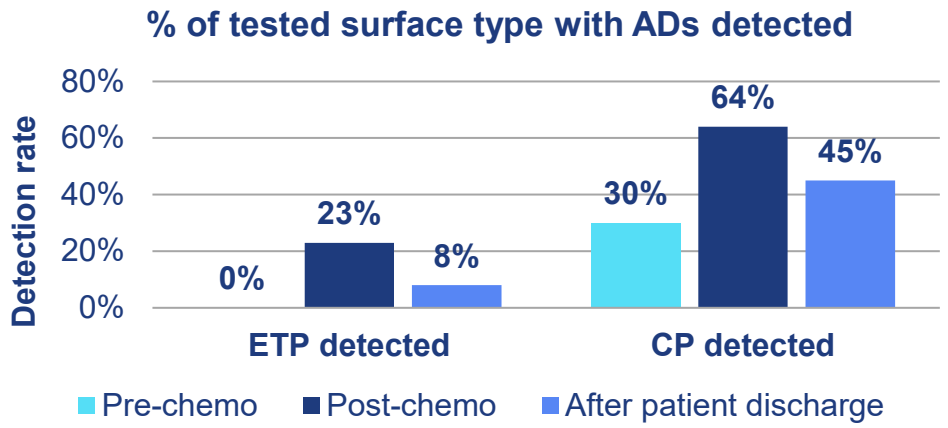
Post administration- excreta: Hot off the Press!

Surfaces in patient bathrooms in the adult blood and marrow transplant unit at Duke University Hospital were tested for contamination with 2 different ADs, Etoposide and Cyclophosphamide (ETP and CP), from 2021–2022. Surfaces were found to be contaminated, even prior to AD administration and after cleaning.[30]

Surfaces tested in patient's bathrooms

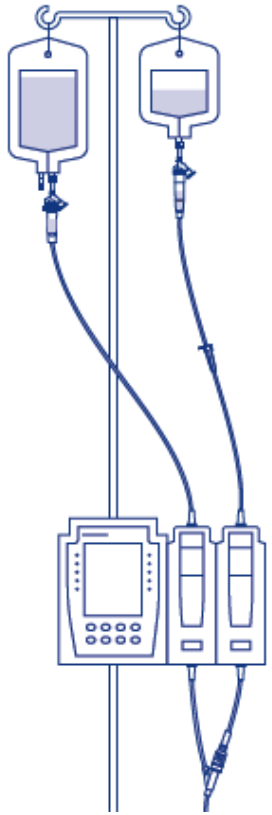


Timing of surface testing



30. Walton A, Bush M, Sung A, et al. Assessing etoposide and cyclophosphamide contamination and current cleaning practices in patient bathrooms. *Clinical Journal of Oncology Nursing*. 2025;29(2). doi:10.1188/25.cjon.e52-e59

Infusion metrics to assess success[20]



Chair time

Infusion data

- Start and stop times
- Pump data
  - Interruption alarms

Nursing satisfaction

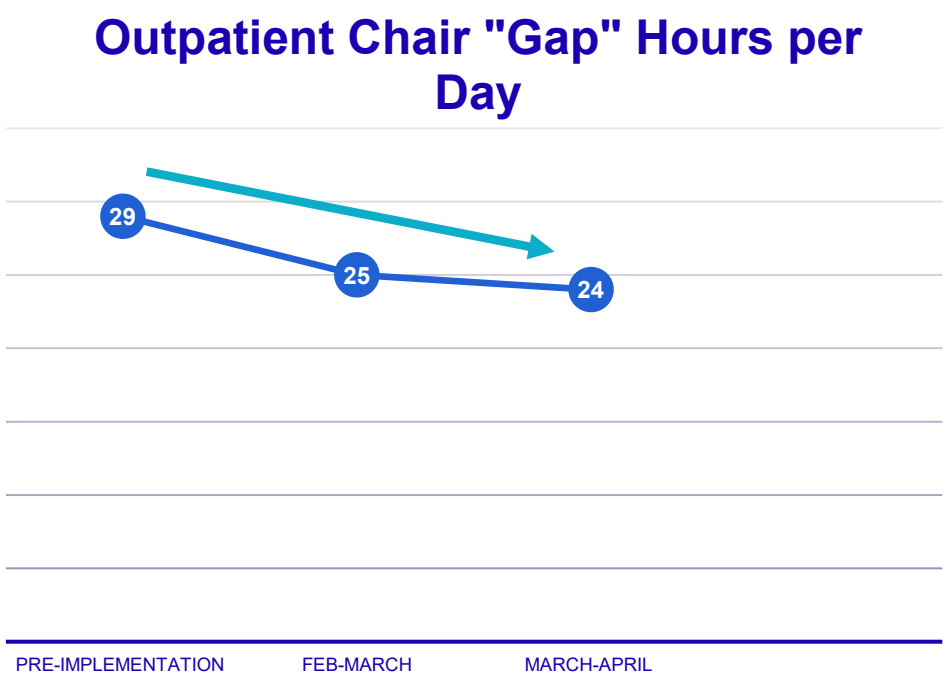
Current workflow

- Are we flushing the medication fully
  - Cost of lost medication
  - Cost of nursing burden
- Incident report/ Medication errors

Wipe studies

20. Olsen, M.M. & Walton, A.L. Safe Handling of Hazardous Drugs, 4th Edition, 2024

Post Implementation Data on Short Sets*



- Pre-implementation 29 gap hours or chair times that were not matching the schedule per day. Gap hours currently reduced to 24 hours per day two months post-implementation
- Ability to predict expected duration of appointments
- Pre-implementation the OP clinic ran late on average 7 out of 20 clinic days. Post-implementation the average is 4.5 days, and the data is trending down= Happy Staff, reduction in overtime
- Wait time on open chairs due to appointment time delay was 40 minutes post implementation reduced to 19 minutes= Happy patients

* Data generated by Johns Hopkins Medicine through IQ

Nursing practice changes that make a difference

- Standardize all HD handling workflows, including disposal and waste of HD and HD waste
- 100% compliance with PPE – understand proper use
- Utilize CSTDs for administration, when the dosage form allows
- Recognize the extent of surface contamination with HDs and the strategies for reduction

Evaluate your current practices and develop workflows that ensure HDs are contained, overfill is accounted for, and patients receive their full dose on time!

Advocate for accuracy of drug delivery

Our patients deserve to have every drop of their cancer medication!

Unless someone like you cares a whole awful lot, nothing is going to get better, it's not.

The Lorax
by Dr. Seuss

You can make a difference, and we are here to help!

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