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ISMP Institute for Safe Medication Practices
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Acute Care ISMP Medication Safety Alert!®

Educating the Healthcare Community About Safe Medication Practices

Respiratory therapists play a critical role in medication safety

Problem: Respiratory care is vital for patients in respiratory distress or experiencing shortness of breath. Treatment delays may reduce the effectiveness of medications and lead to clinical deterioration, and omission of treatment may adversely affect a patient's respiratory health, safety, and outcome.[1] Respiratory therapists (RTs) are licensed professionals whose role in pulmonary medicine is identifying lung and breathing disorders; assisting with creating treatment plans; and preventing acute or chronic dysfunction of the cardiopulmonary system.[2,3] They have expert knowledge of cardiopulmonary physiology and pathophysiology.[2] While nurses administer most other medications in hospitals, RT administration of respiratory medications is a notable exception.

Respiratory medications represent a unique modality of treatment (e.g., inhalers, nebulizer solutions) that are often administered by RTs using various devices (e.g., spacer, nebulizer machine). Errors related to respiratory treatment include omission or missed treatments, wrong drug, wrong formulation, wrong dose, wrong route, wrong patient, documentation errors (e.g., failing to document the reason for holding or omitting treatments), equipment errors, and drug order communication errors.[1,4] Contributing factors include inadequate RT staffing, RTs not alerted when a prescriber changes an order in the electronic health record (EHR), look-alike packaging, inaccurate retrieval of medications from an automated dispensing cabinet (ADC) via override, failure to use barcode scanning for medication administration, and confusion regarding the route of administration.[1,4] RTs have also identified patient refusal as a common cause of missed respiratory treatments.[1] The following are examples of respiratory treatment medication errors that have been reported to ISMP.

Errors Reported to ISMP

*An RT discovered packages of budesonide inhalation suspension (0.5 mg/2 mL) in the ADC pocket designated for racepinephrine inhalation solution 2.25%. Both products, by Nephron, come in the same package size with a red, white, and blue layout (**Figure 1**). These were gathered together for stock replenishment, but the process in this hospital was for the pharmacy technician to scan only one individual product barcode when loading and refilling multiple doses of the same medication in the ADC.*

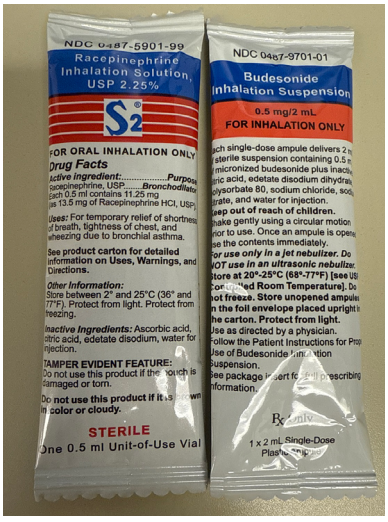

Figure 1. Racepinephrine inhalation (left) and budesonide inhalation (right) packages by Nephron look similar.

*A prescriber ordered 20% acetylcysteine solution via nebulizer and aceta**ZOLAMIDE** to be given intravenously (IV) to a patient. The nurse obtained the products from the medication room and administered both IV. The Hospira acetylcysteine label states "NOT FOR INJECTION" at the top and "For Inhalation (Mucolytic Agent) or Oral Administration (Acetaminophen Antidote)" in small font below the drug name, but is available in a vial that resembles an injectable product (**Figure 2**, page 2). Although the RTs were responsible for administering inhaled acetylcysteine at this facility, when the nurse scanned the barcode on the acetylcysteine vial, she did not receive a warning since the patient had an order in the EHR.*

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Never dilute medication in a syringe labeled as a saline flush. A physician ordered chemotherapy for a pediatric oncology patient in an outpatient infusion center. To mitigate the risk of chemotherapy-induced nausea and vomiting, the prescriber ordered doses of oral ondansetron and intravenous (IV) diphenhydr**AMINE**, along with as needed (PRN) doses of IV prochlorperazine. The nurse diluted the diphenhydr**AMINE** and prochlorperazine in separate manufacturer-prefilled 10 mL saline (0.9% sodium chloride) flush syringes and labeled them with the drug names. The nurse administered the diluted diphenhydr**AMINE** IV using an infusion pump and set aside the diluted prochlorperazine syringe in case it was needed.

Before her break, the nurse communicated the antiemetic plan to another nurse during handoff. Upon returning, the nurse found that a different nurse had taken over.

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Survey on Implementation of Targeted Best Practices

ISMP is conducting a short survey to get a sense of the current level of implementation of the ***Targeted Medication Safety Best Practices for Hospitals***. We would greatly appreciate your participation in this survey. Click here to start the survey.

Please complete this online survey by **June 5, 2025**. For a detailed description and exact wording of the *Best Practices*, click here to download a copy. ISMP plans to present the results of this survey during the American Society of Health-System Pharmacists (ASHP) Midyear Clinical Meeting and Exhibition in December 2025. The findings will also be described when introducing the new ***Targeted Medication Safety Best Practices for Hospitals*** early in 2026.

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*Due to a shortage of individually packaged 3% and 7% sodium chloride nebulizer solutions, a pharmacy purchased alternative products made by PharmaCaribe. The solutions are packaged in nearly identical clear plastic respules with embossed drug labeling (**Figure 3**), making it difficult for practitioners to read. The hospital reported an increase in mix-ups with these solutions. The 3% product is used to treat pediatric patients with bronchitis, while the 7% product is indicated for patients with cystic fibrosis. While the outer carton has a barcode, the individual respules do not, so the pharmacy had to create and add a barcode before dispensing.*

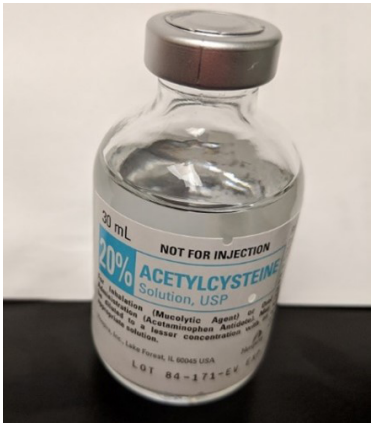

Figure 2. The Hospira 20% acetylcysteine solution label states "NOT FOR INJECTION," but is packaged in a vial that resembles those used for parenteral injections. Below the drug name it states, "For Inhalation (Mucolytic Agent) or Oral Administration (Acetaminophen Antidote)."

*A nurse requested that the pharmacy send a replacement **ANORO ELLIPTA** (umeclidinium bromide/vilanterol) inhaler for a patient. After reviewing the medication administration record (MAR) and dispensing record, the pharmacist discovered they had previously dispensed an institutional (7-dose) inhaler and determined that the patient had been receiving doses from an empty one for 2 weeks. The nurse was not familiar with the device and noted that, unlike other inhalers, the dose counter changed to a solid color when it became empty instead of displaying "0," so it was not obvious that it was empty. The inhaler still clicked when the "dose" was ready, even though there were no more doses available.*

Figure 3. Sodium chloride solution 3% (left) and 7% (right), by PharmaCaribe, are packaged in nearly identical clear plastic respules with difficult-to-read embossed drug labeling.

Role of RTs on the Care Team

RTs play a critical role in reducing the risk of these medication errors. RTs monitor the patient's response to respiratory medications, identify adverse reactions, assess allergies, assist in selecting drug delivery devices (e.g., inhalers, nebulizers), and educate patients on proper administration techniques. On medication safety committees, RTs collaborate with prescribers, nurses, and pharmacists to create standard respiratory therapy protocols, complete risk assessments before adding respiratory medications to the formulary, review adverse events related to respiratory medications, and monitor barcode scanning compliance.

For more than a decade, organizations (e.g., Pennsylvania Patient Safety Authority, American Association for Respiratory Care) have promoted protocols for respiratory therapy clinical interventions.[1,5] When RTs are allowed to operate under evidence-based protocols, studies have shown reduced variations in practice between practitioners, enhanced clinical outcomes, fewer medication errors, and reduced costs.[5-7]

Errors in the proper technique of using an inhaler may result in uncontrolled asthma, chronic obstructive pulmonary disease (COPD) exacerbation, poor respiratory clinical assessment scores, and increased healthcare utilization.[8-10] One systematic review showed that inhalation errors were associated with worse disease outcomes in patients with asthma and COPD.[10] However, a reduction in inhaler technique errors over time led to improved patient outcomes. In addition to inaccurate inhaler technique among patients, another systematic review of 55 studies involving 6,304 practitioners found that only 15.5% of practitioners demonstrated proficiency with proper

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The first nurse could not find the syringe containing prochlorperazine, but its label was on the floor. The covering nurse told the first nurse that the prescriber had ordered another antiemetic, aprepitant, which she administered. However, she used the syringe containing prochlorperazine to flush the line after administering the aprepitant, thinking it was normal saline. No patient harm was reported. During the event investigation, it was noted that nurses at this clinic were encouraged to dilute/reconstitute medications in manufacturer-prefilled saline flush syringes due to the nationwide fluid shortages.

This is not the first time ISMP received a report of this type of error. The ISMP ***Safe Practice Guidelines for Adult IV Push Medications***, discourages diluting or reconstituting medications by drawing up the contents into commercially available, prefilled flush syringes that could be mistaken as normal saline. The US Food and Drug Administration (FDA) regulates commercially available prefilled syringes of saline and heparin as devices, not as medications. These devices have been approved for the flushing of vascular access devices but have NOT been approved for reconstituting or diluting medications to be subsequently administered IV push. Organizations should NOT encourage this practice, even during shortages. Notify nurses of this risk and ensure policies and practices align with our guidelines.

More mix-ups with rifamycin antibiotics. Recently, we learned about another mix-up between **XIFAXAN** (rif**AXIM**in) and rif**AMP**in. A hepatologist consulted on a patient and recommended rif**AXIM**in 550 mg PO twice daily for hepatic encephalopathy. However, the transplant prescriber ordered rif**AMP**in 550 mg PO twice daily. Rif**AMP**in is used to prevent and treat tuberculosis and other bacterial infections. A dose range checking alert fired indicating the rif**AMP**in dose exceeded the recommended daily dose of 600 mg. Thinking that this was the correct medication and dose that the hepatologist recommended, the prescriber overrode the warning and documented "patient to be monitored." During order verification, the pharmacist received the same alert and also

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inhaler technique.[11] As experts in this area, RTs can play a pivotal role in providing education to staff and patients to ensure proper inhaler technique is used.

Use of a Protocol

In 2024, a team of RT leaders at UCHealth, a 14-hospital health system in Colorado, collaborated with prescribers and pharmacists to create evidence-based protocols that include guidelines for the ordering and administration of respiratory medications, lung expansion assessments, and airway clearance therapies. Prescribers can initiate protocols by entering an order for an RT consultation or when an acute treatment (i.e., albuterol) is needed.

Under the protocol, the RT assesses the patient's respiratory status in six defined areas: pulmonary history, breath sounds, respiratory pattern, cough, speech, and oxygen status to generate an acuity score in the EHR. When added together, the total score determines the intensity of therapy, selection of medication therapy, and frequency of dosing. To place the indicated medication order, the RT navigates to the protocol, selects the appropriate acuity score range, and the recommended medication order automatically populates in the EHR. Each scoring range includes an option for nebulized bronchodilator therapy and a metered-dose inhaler (MDI).

For example, a patient with an acuity score of 8 is considered low intensity. Once the RT navigates to the protocol and selects the score range, they are given the option to select albuterol 2.5 mg nebulized twice daily or albuterol MDI 2 puffs inhaled twice daily. An order for albuterol every 4 hours as needed for shortness of breath is also populated based on the scoring category. The RT may then select and place the appropriate orders directly from the protocol. The medication and dosing frequency are consistent based on the acuity score, but the RT selects the delivery system (i.e., nebulizer versus MDI) based on clinical assessment or patient preference. The frequency of re-evaluation of the patient's therapy is also based on the acuity score. For the previous example of a patient with an acuity score of 8, the RT will reassess in 24 hours and adjust therapy as indicated.

This protocol excludes pediatric patients, medications prescribed for a short duration (i.e., 12 hours or less, one-time orders), and maintenance therapy (i.e., corticosteroids, long-acting beta-agonists). Once the protocol is initiated, the EHR sends automated updates to the prescriber to keep them apprised of their patient's respiratory status and treatment.

Safe Practice Recommendations: RTs play a critical role in medication safety, and organizations should leverage their expertise. Consider the following recommendations to help prevent respiratory medication-related events.

Include RTs on interdisciplinary medication-related committees. Invite RTs to pharmacy and therapeutics (P&T) and medication safety committee meetings. Routine attendance as a committee member is best; however, if not possible (e.g., smaller hospitals, limited staffing), assign an RT to attend as a subject matter expert when needed. Routinely incorporate RTs in the review of close calls and adverse events related to respiratory medications. When considering a new respiratory medication for formulary addition or practice changes during shortages, collaborate with RTs in risk assessments.

Create policies and protocols. Meet with stakeholders (e.g., prescribers, RTs, pharmacists, nurses) to develop policies with assessment tools and evidence-based treatment protocols that allow RTs to evaluate patients and optimize care ordered by prescribers. Protocols should be written in an algorithmic form and include guideline instructions with interventions the RT can implement as the patient's medical condition dictates. Determine conditions that require notification of the prescriber when respiratory treatments are held or if an adverse event or lack

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overrode it, documenting the same rationale as the prescriber. The pharmacist did not review the patient's medical record or contact the prescriber to confirm the indication or rationale for a higher than normal rif**AMP**in dose. Since rif**AMP**in was only available in 150 mg and 300 mg capsules, the pharmacist selected a pharmacy-compounded oral liquid to provide the patient with the prescribed 550 mg dose. The patient received two doses before another pharmacist identified the error. No patient harm occurred.

This is not the first time a mix-up has been reported between these two rifamycin antibiotics. We first alerted the healthcare community about possible confusion between this name pair in June 2005. However, these are not the only drugs in the rifamycin class of drugs that can be confused due to name similarity. Mix-ups are possible between the following: rif**AMP**in, rif**AXIM**in, rifabutin, and rifapentine.

In fact, just recently, a hospital pharmacist reported two different outpatient pharmacies inadvertently dispensed rif**AMP**in instead of rifapentine to patients. In both cases, the outpatient pharmacists were unfamiliar with rifapentine, had not dispensed it before, and did not have the product in the pharmacy. The hospital pharmacist who reported these mix-ups was concerned that practitioners may not be aware of the *Updated Guidelines on the Treatment of Drug-Susceptible and Drug-Resistant TB* that recommend rifapentine as an initial tuberculosis treatment option, which has a longer half-life and can lower a patient's pill burden compared to rif**AMP**in.

Organizations should maximize clinical decision support by building and updating protocols and order sets that include the drug's indication, proper dose based on indication, and dose range checking. Orders should automatically link to the appropriate formulation. If a practitioner receives an alert that the prescribed dose exceeds the maximum dose, they should investigate and clarify before proceeding. Do not trust that an order is appropriate solely because it was ordered or recommended by a specialist. Pharmacists should clarify orders in which the prescribed

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of efficacy is suspected. Routinely gather feedback from RTs and prescribers and adjust policies and protocols as needed. *To learn more about how UCHealth implemented evidence-based RT protocols, please register to attend our May 2025 Medication Safety Officers Society (MSOS) member briefing.*

Conduct a proactive safety analysis. When the organization receives a new respiratory medication product, pharmacy and respiratory therapy should conduct a review to identify potential risks with the product's design, including look-alike labeling and packaging concerns with other products in use. When the review team recognizes potential risks, consider purchasing the product (or one product of a problematic pair) from a different manufacturer. Store similar-looking products separately.

Ensure products have barcodes. Procure nebulized solution products whose unit doses are individually barcoded by the manufacturer. Otherwise, the pharmacy should create a flag label that incorporates the appropriate barcode and attach it to the part of the container that does not come in contact with the medication. Consider applying a patient-specific barcode to inhalers so that before administration the RT/nurse can scan the patient's wristband, the patient-specific barcode on the drug container (to ensure correct patient's inhaler), and the manufacturer's barcode on the inhaler (to ensure correct medication). For additional information, review our December 14, 2023 article, *ISMP 26th Annual Cheers Awards: Hitting the Safety High Notes*, which discusses how one organization implemented a three-scan method for a similar process with insulin pens.

Maximize barcode scanning. Use barcode scanning when receiving, dispensing, filling the ADC, and prior to administration of respiratory medications. Monitor barcode scanning compliance by user and medication. Gather feedback from RTs about barriers to scanning (e.g., RT's access to scanners, barcodes that are difficult to scan) and resolve any issues.

Minimize ADC overrides. Educate RTs about safe practices when removing medications from ADCs; outside of an emergency, do not allow nebulized medications to be removed from an ADC via override. Evaluate and share override compliance data with RT leaders to highlight positive practices and address concerns. Carefully review product labels after removing the medication from the ADC or medication room (e.g., inhaler stored in a patient cassette/bin/drawer), when removing nebulized solutions from the outer package, and before scanning the barcode prior to administration. Always review the patient's allergies prior to administration.

Integrate RTs in the clinical care team. Incorporate RTs in interdisciplinary patient rounds to discuss patient care and discharge disposition and to help coordinate care in a timely manner. Include RTs on medical emergency response teams (e.g., code blue, rapid response).

Communicate orders. Establish a reliable system for communicating new, modified, and discontinued orders for respiratory medications to RTs. Evaluate the system before use, monitor its reliability, and investigate all failed communication of orders to determine opportunities for improvement. In situations where either a nurse or RT may administer a respiratory medication, create a clear communication plan to avoid an extra or missed dose.

Enhance documentation. Document all respiratory administrations in the EHR. Document the reason for holding treatments or omitting any respiratory medication. Record ventilator parameters and alarm changes. Ensure all changes, along with the rationale, are communicated among the entire healthcare team caring for the patient.

Ensure sufficient staffing. Evaluate RT staffing patterns to ensure coverage is adequate to provide all necessary respiratory treatments. Establish a realistic and reliable backup plan for emergency coverage that is well coordinated and communicated with nursing staff. Routinely

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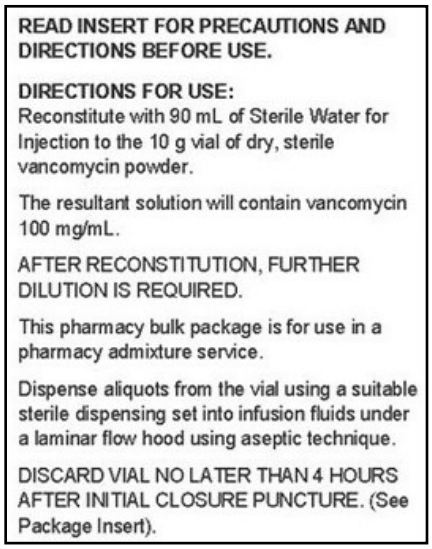
drug does not match the usual indication or dose. Educate practitioners about the various dosing parameters and indications for all rifamycins. Store these products separately and use barcode scanning when receiving, dispensing, and prior to administration.

Changes to Hikma's vancomycin reconstitution instructions. A concerned pharmacist reported that they were unaware of recent changes in the prescribing information for Hikma's vancomycin 10 g pharmacy bulk package product (National Drug Code [NDC] 0143-9164-01). The carton and prescribing information previously stated to reconstitute the vial with 90 mL of sterile water for injection to result in a concentration of 100 mg/mL (**Figure 1**). The pharmacist identified that Hikma had updated the reconstitution instructions to now state that it should be reconstituted with 94 mL of sterile water (**Figure 2**, page 5), but this was not explicitly communicated to customers.



READ INSERT FOR PRECAUTIONS AND DIRECTIONS BEFORE USE.

DIRECTIONS FOR USE:
Reconstitute with 90 mL of Sterile Water for Injection to the 10 g vial of dry, sterile vancomycin powder.

The resultant solution will contain vancomycin 100 mg/mL.

AFTER RECONSTITUTION, FURTHER DILUTION IS REQUIRED.

This pharmacy bulk package is for use in a pharmacy admixture service.

Dispense aliquots from the vial using a suitable sterile dispensing set into infusion fluids under a laminar flow hood using aseptic technique.

DISCARD VIAL NO LATER THAN 4 HOURS AFTER INITIAL CLOSURE PUNCTURE. (See Package Insert).

Figure 1. The Hikma vancomycin 10 g pharmacy bulk package carton previously stated to reconstitute with 90 mL of Sterile Water for Injection.

A second hospital reported a similar concern. The pharmacy had built instructions into the intravenous workflow management system (IVWMS) to reconstitute with 90 mL, and was also unaware of the updated instructions. They were concerned that they had been preparing the medication incorrectly for several months.

We reached out to Hikma, who confirmed that this labeling change was made in

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monitor and evaluate reasons for missed respiratory treatments. Plan for shift partners who can help relieve duties between RTs during peak work hours. Designate a shift charge RT who is responsible for reassigning patient care needs when RTs are unable to complete their duties.

Educate staff and patients. Implement RT-led initiatives to spearhead patient and staff education on proper inhaler device techniques and nebulizer administration. To minimize the number of refused treatments, RTs should clearly explain treatments to the patient, listen to and respect their concerns, and consider various modes of delivery to make treatments easier for the patient. Engage patients in their treatment plan (e.g., asthma action plan), and ensure they understand the indication, dosing frequency, and side effects of the medication. Education should include a review of disease state, inhaler technique, and the differences between rescue (e.g., beta-2 agonist) and controller (e.g., inhaled corticosteroid) inhalers, along with using the teach-back method for how to use the associated devices (e.g., spacer, nebulizer machine).

Perform walkarounds. Designate an RT leader to regularly engage staff and perform safety walkarounds. Inform staff about the purpose of the walkaround by describing the process and encouraging them to raise quality and safety issues. Follow up with staff to provide feedback about actions that are planned or have been implemented based on their input. For additional information about walkarounds, refer to our July 11, 2024 article, *Cultivate Discussions in a Psychologically Safe Workplace—Part I*.

Report errors. Emphasize to RTs that the organization values a culture of safety and encourages medication error reporting and sharing lessons learned. Consider implementing a good catch program to acknowledge RTs who exemplify values in safety. This is a way for leaders to recognize colleagues who speak up for patient safety and to encourage a safe learning culture.

We thank Kevin M. McQueen, MHA, RRT, RRT-ACCS, CPPS, FAARC, from UCHealth Memorial Hospital in Colorado Springs, CO for sharing how the health system operationalized an RT-led protocol as well as helping to write this article.

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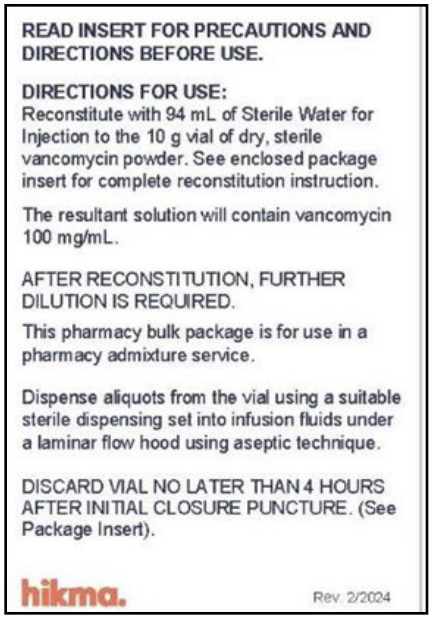
August 2024 to ensure practitioners could obtain 100 mL of drug from the vial. When manufacturers make changes to packaging, labeling, and/or prescribing information, this should be explicitly communicated to customers. Organizations that purchase this product should review IVWMS instructions and master formulation records to ensure they reflect the updated reconstitution volume of 94 mL. Notify pharmacy staff of this change, as they may be accustomed to reconstituting with 90 mL. Consider completing an annual review of prescribing information for formulary medications to screen for potential changes such as this.


READ INSERT FOR PRECAUTIONS AND DIRECTIONS BEFORE USE.

DIRECTIONS FOR USE:
Reconstitute with 94 mL of Sterile Water for Injection to the 10 g vial of dry, sterile vancomycin powder. See enclosed package insert for complete reconstitution instruction.

The resultant solution will contain vancomycin 100 mg/mL.

AFTER RECONSTITUTION, FURTHER DILUTION IS REQUIRED.

This pharmacy bulk package is for use in a pharmacy admixture service.

Dispense aliquots from the vial using a suitable sterile dispensing set into infusion fluids under a laminar flow hood using aseptic technique.

DISCARD VIAL NO LATER THAN 4 HOURS AFTER INITIAL CLOSURE PUNCTURE. (See Package Insert).

hikma.

Rev. 2/2024

Figure 2. The Hikma vancomycin 10 g pharmacy bulk package carton now states to reconstitute with 94 mL of Sterile Water for Injection.

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