Infusion Journal
Volume 1, Number 2 | July / August 2022
InfusionJournal.com

About the cover:
According to the U.S. Census Bureau, the 65-and-older population grew by nearly 14 million individuals, 34.2%, from 2009 to 2019. Aging Baby Boomers—the majority of which prefer to age and receive health care at home—are driving increased use of home-based OPAT in adults 65+. New data shows that over 90% of older adults were successful in completing their home-based OPAT therapy and had a lower rate of ADRs while understanding the instructions related to performing home infusion tasks.

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From the Editor

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Editor-in-Chief, *Infusion Journal*

A great deal of medical research goes unpublished. In fact, a 2016 analysis of U.S. academic medical centers found that the proportion of clinical trials published within 24 months of study completion ranged from 10.8% to 40.3%.[1]

Not all findings are fit for publication, but these numbers still suggest a significant loss. Publishing research benefits science and its application to practice. It helps other researchers design their experiments. It is the culmination of the research process, and the research cycle is not complete without communicating its findings to the scientific community. Publishing biomedical research is essential because it helps enhance understanding of health, diseases, and their management, improving medical practice and benefiting patients. Unfortunately, research professionals report a lack of knowledge of research methodology and limited medical writing expertise as 2 barriers to formally writing and submitting a manuscript to a medical journal.

Fortunately, seeing the need for education and support for publishing research in infusion therapies, the National Home Infusion Foundation developed a comprehensive Research Training Certificate Program. The program's purpose is to support and educate independent researchers on performing studies with the potential to communicate their findings. The Research Training Certificate Program provides education on methods used to collect data and how to use tools to uncover new information and create a better understanding of the results. An entire section of the program details data collection, analysis, and interpretation. This is a solution to problem number one.

In addition, sharing and communicating the findings through publishing in a peer reviewed journal can seem like a monumental undertaking. The Research Training Certificate Program offers comprehensive guidance for writing the study reports and drafting the results, discussion, and conclusion sections. It covers how best to communicate the research, whether presenting a poster at a conference or publishing a manuscript in a journal.

Another common challenge is time. Knowing that it takes a series of dedicated blocks of time to design, conduct, and report out study findings, the Research Training Certificate Program focuses on efficient use of time. The program takes an independent researcher through the entire process, from determining the research topic, literature review, study rationale, methodology, and analysis. The final education session of the program is devoted to writing everything into a format that best communicates the research. Another problem is solved.

The reasons for independent medical research remaining unpublished vary. NHIF encourages independent research and supports researchers studying the effects of infusion therapies. The Research Training Certificate Program, available free to members on NHIA University, provides education and training on performing scientific research, particularly studies with the potential to communicate research in home and alternate site infusion. It closes a gap in training and education empowering researchers to become authors.

1. Chen R, Desai N, Ross J, Zhang W, Chau C, et al. Publication and reporting of clinical trial results: cross sectional analysis across academic medical centers. *BMJ* 2016;352:i637.

Patient-Reported Outcomes for Understanding of Instructions and Success Rates in the 65+ Age Group Receiving Home-Based Outpatient Parenteral Antimicrobial Therapy (OPAT)

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ABSTRACT

Background

Patients in the 65+ age group and those receiving outpatient parenteral antimicrobial therapy (OPAT) in the home setting are increasing. There is a void in research that investigates OPAT satisfaction and outcomes in the 65+ age group. To better serve the home infusion needs of this population, an investigation of the patient's OPAT success rate and understanding of home infusion instructions is needed. The purpose of this study is to determine if differences exist between OPAT patients aged 18-64 and 65+ in their understanding of home infusion instructions and their therapy success rate.

Methodology

Study data was obtained from the National Home Infusion Foundation (NHIF) database, including data from the NHIF-validated patient satisfaction survey and status at discharge benchmarking project. Five questions about the patient's understanding of instructions are part of the satisfaction survey. Status at discharge data was used to determine OPAT success since therapy completed, unplanned hospitalizations, and adverse drug reaction (ADR) data were collected. Data analysis included determining if a significant difference ($p = \leq .05$) exists between the 18-64 and 65+ age groups.

Results

Forty-five home infusion providers submitted 3,262 OPAT patient satisfaction surveys, while 15 submitted 4,360 OPAT status at discharge patient cases to the NHIF database. The composite score for the 5 Yes/No questions that assessed the patient's understanding of instructions was 98.45%. The only significant difference detected by the Fisher's Exact Test between the 2 age groups was the response to the question about the patients' understanding of how to wash their hands. "Therapy completed" status at discharge from home infusion accounted for 90.11% of the OPAT 65+ year old patients. The rate of ADRs in the 65+ patient population was 0.25%, while the 18-64 age group rate was higher at 0.42%. Conversely, the unplanned hospitalization rate was higher in the 65+ age group (4.79%) than in the 18-64 age group (3.28%). The results of the Chi-Square analysis indicate a significant difference (p=.027) between the 2 age groups and status at discharge.

Discussion

The patient-reported data collected by NHIF reveals a significant difference (p=.009) between the 18-64 age group and older adult (65+) in their understanding of how to wash their hands with the 18-64 age group having a better understanding of the task. When calculated as a composite score, 98.45% of older adults report understanding the instructions provided on how to wash their hands, store medications, care for the IV catheter, administer the IV therapy, and use the equipment.

Significant differences exist (p=.027) in the status at discharge between adults 65+ and those 18-64. Older adults are less likely to have an ADR but are more likely to be discharged from home infusion due to an unplanned hospitalization. This difference can be attributed to the higher clinical acuity and co-morbidities associated with increased age. Even so, 90.11% of the patients age 65+ successfully completed OPAT therapy.

Conclusions

An aging population in the U.S. is driving increased use of home-based OPAT in adults 65+. This study confirms that most older adults understand the instructions related to performing home infusion tasks. While over 90% of older adults in this study were successful in completing their home-based OPAT therapy and had a lower rate of ADRs, there was a significant difference in patients 65+ when compared to patients 18-64 years of age in the reasons for discontinuing home-based OPAT, including higher rates of unplanned hospitalization.

Keywords: Home infusion, outpatient parenteral antimicrobial therapy (OPAT), 65+, patient instructions, adverse drug reaction (ADR), therapy complete, unplanned hospitalization

Background

One of the fastest growing age groups in the United States is 65 years and older.[1] This age group grew by over one-third (34.2% or 13,787,044) during the past decade, and by 3.2% (1,688,924) from 2018 to 2019.[1] It is surmised that the U.S. will experience further growth in this age group for many decades due to the baby boom cohort that began turning 65 years old in 2011.[2] With age comes a decline in health status with 22.2% of this age group who are non-institutionalized in fair or poor health.[3]

Of the Americans 50 and older, 76% prefer to remain at home as they age, and when health issues arise, most patients prefer to recover at home compared to receiving care in a facility setting.[4] Infectious disease physicians report that home is the most common site of care for outpatient parenteral antimicrobial therapy (OPAT) in the U.S. followed by skilled nursing facilities.[5] No studies have been conducted to discern how decisions are made when selecting the site of care for OPAT for older adults. Most patients are referred for OPAT after a brief hospitalization. Factors that influence site of care decisions are presumed to be financial support from the insurance payer, ability to manage the therapy at home (i.e., ability to self-administer medications, having a safe home environment and a capable informal caregiver), concomitant need for physical rehabilitation, and patient preference.

Despite the lack of a comprehensive benefit for home-based OPAT under the Medicare program, the percentage of home-based OPAT patients that comprise the 65+ age group has grown from 23% in 2010 to 30% in 2020.[6] The National Home Infusion Foundation (NHIF) speculates that increasing enrollment in Medicare Advantage is a primary driver of this trend as these plans are more likely to offer a home infusion benefit.

As documented, a growing number of patients in the 65+ age group receive OPAT in the home setting. A literature review shows a void in research that investigates OPAT satisfaction and outcomes in the 65+ age group. To better serve the home infusion needs of this population, there is a need to investigate the OPAT 65+ age group's success rates and satisfaction with their home infusion experience. Given that the patient's home infusion success is often related to their understanding of instructions, this study investigates patient-reported outcomes pertaining to how well they understood instructions for performing critical home infusion-related tasks. The purpose of this study is to determine if differences exist among levels of understanding of home infusion instructions, and success rates in the OPAT 65+ age group when compared to the 18–64-year-olds. The information gained from this study will assist in better understanding and serving the 65+ age group.

Methodology

The NHIF administers national data collection and benchmarking programs to assess patient satisfaction, hospital readmission rates, and patient status at the end of home infusion therapy.[7] These programs are based on a need to monitor the home infusion patient experience and outcomes. Home infusion provider locations participate in these programs voluntarily by submitting their patient data quarterly using a formatted data entry Excel® file and participant guide. Additionally, provider locations must use the standardized definitions associated with each program. Provider confidentiality is maintained, and all patient data is de-identified before entry into the formatted data entry file. For this reason, the study protocol was exempt from institutional review board (IRB) review. The data used in this investigation was derived from the 2021 patient satisfaction surveys and status at home infusion discharge data submitted to NHIF. Status at discharge data was used to determine OPAT success because therapy completed, unplanned hospitalizations, and adverse drug reactions (ADRs) are all standard variables used in the medical arena to measure patient success.[8]

Patient Satisfaction

In 2018, using Delphi methodology, home infusion patient satisfaction survey questions and response options were written by the NHIF using a 15-member home infusion expert panel to validate and establish consensus for the questions. Test-retest method of assessment for reliability was also implemented (r=0.90). The final survey includes 12 questions with 22 data points.[9] Five of the survey data points pertain to the patient's understanding of instructions and used a Yes/No/NA response option. Data from these questions were used in this study.

FIGURE 1
Status at Discharge Variables and Definitions

Discharge Variable	Definition
Therapy complete	Applies when a physician discontinues the home infusion therapy because the patient has achieved sufficient clinical improvement and/or met the goals in the plan of care.
Patient expired	Patient expired (unrelated to the infusion therapy)
Unplanned hospitalization	When a patient requires an unplanned, inpatient admission to an acute care facility for any reason.
Change in home infusion eligibility	Includes, but is not limited to unsafe home environment, no available caregiver, affordability, patient choice, unable to comply with treatment.
Insufficient response/ complication	Applies when the patient stops treatment due to an exacerbation of disease or non-response to therapy.
Adverse drug reaction (ADR)	An undesirable response, other than a known side effect, that compromises efficacy and causes toxicity.
Access device related	When 1 of the following results in discontinuation of therapy: migration, dislodgement, occlusion, phlebitis, skin integrity impairment, infection, damage, breakage, or thrombosis.
Change infusion provider	When the patient changes their infusion provider for any reason.
Other	All reasons that cannot be otherwise classified.

Providers participating in this data program were required to use the NHIF validated patient satisfaction survey instrument and validate their sample populations, ensuring that survey data was only collected for a defined population of patients who received infused therapies at home. Patients represented in this study were either: 1) discharged patients who were active to the home infusion provider for 7 or more days and received at least 1 infusion treatment at home, or 2) active home infusion patients who had been on service for at least 6 months.

Patient Status at Discharge from Home Infusion Therapy

A research team comprised of professionals with experience in home infusion nursing, pharmacy, and administration was established. After reviewing the literature and discussion, the research team determined 9 "status at discharge" variables and definitions that would be used to describe the reason for discontinuing home infusion services (Figure 1).

Analysis

Since this study focuses on comparing OPAT patients in the 65+ age group with patients in the 18-64 group, data from patients under 18 years of age and those representing other therapy types was deleted from the study data sets before analysis, as shown in Figures 2 and 3.

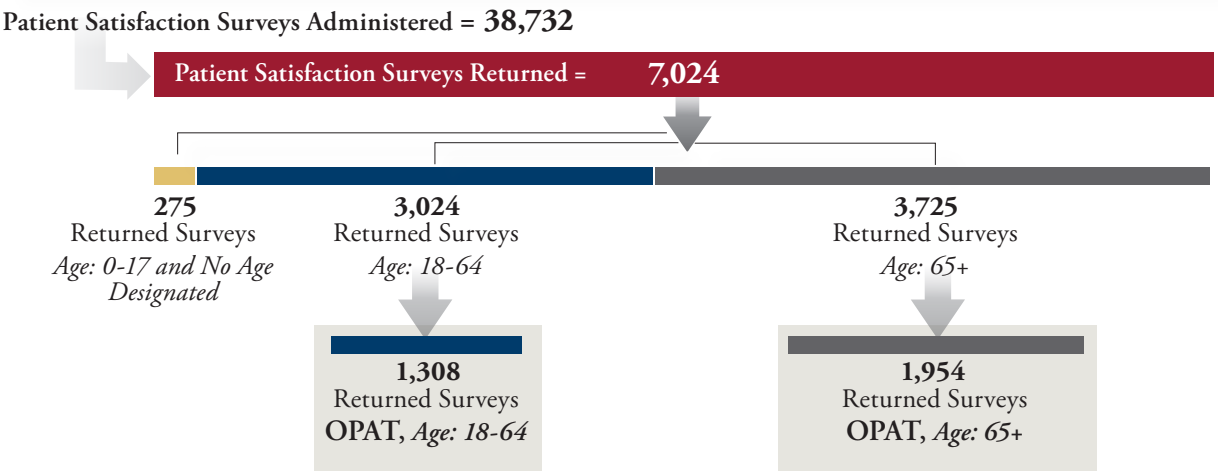
Patient Satisfaction Survey

The frequency and percentage of patients who selected each response option were determined for questions about the patient's understanding of instructions. Fisher's Exact Test was conducted to determine if a significant difference existed between the 2 age groups and the responses to the survey questions.

Status at Discharge

The percentage of 18-64 and 65+ OPAT patients discharged for the following reasons was calculated: therapy completed, unplanned hospitalization, ADR, access device related, and other, which included

FIGURE 2
Patient Satisfaction Survey OPAT Sample



patient expired, change in home infusion eligibility, insufficient response/complication, and change infusion provider. Using Chi-Square analysis, the 18-64 and 65+ age group data were compared to determine if there was a significant difference. Frequency and percent were also determined for each discharge reason.

Results

Patient Satisfaction

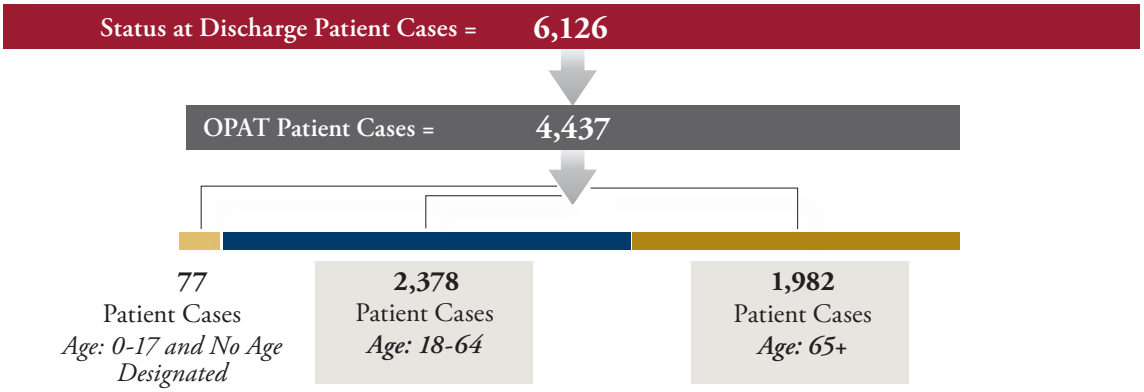
In 2021, the 45 home infusion providers administered 38,732 patient satisfaction surveys with 7,024 returned for a return rate of 18.13%. Of the surveys, 3,725 were from patients 65 or older, of which 1,954 were from OPAT patients. OPAT patients 18-64 years of age had 1,308 surveys returned. As shown in Figure 2, the 1,308 surveys from the 18-64 age group and the 1,954 surveys from the 65+ OPAT patients were used for the patient experience (satisfaction) portion of this study which also included questions about the patient's understanding of instructions.

Of the 65+ OPAT patient cases, the mean patient age was 74.84 (SD=6.89), with the oldest being 98 years old. Males represented 60.63% of the population, while females were 39.37%. For the 18-64 age group, the mean age was 53.98 (SD=9.97) years, with males and females representing 55.86% and 44.14%, respectively.

TABLE 1
Age Group Comparison of Response to Patient Understanding of Instructions

Survey Question	18-64 Age Group (n=1,308)		65+ Age Group (n=1,954)		Fisher's Exact Test
	Yes%	No%	Yes%	No%	
I understood the instructions provided for how to wash my hands.	99.43	0.57	98.46	1.54	*p=.009*
I understood the instructions provided for how to give home infusion medication(s).	99.29	0.71	98.78	1.22	*p=.116*
I understood the instructions provided for how to care for the IV catheter.	98.54	1.46	98.20	1.80	*p=.293*
I understood the instructions provided for how to store the home infusion medication(s).	99.38	0.62	99.31	0.69	*p=.506*
I understood the instructions provided for how to use the home infusion pump.	98.31	1.69	97.52	2.48	*p=.203*
Composite Score for "Understanding Instructions"	98.99	1.01	98.45	1.55	

FIGURE 3
Status at Discharge OPAT Patient Sample



The 5 patient satisfaction survey questions that assessed the patient's understanding of home infusion instructions are shown in Table 1. The Fisher's Exact Test revealed a significant difference in the patient responses between the 2 age groups in 1 patient "understanding of instructions" question, "I understood the instructions for how to wash my hands." The results suggest that patients in the 18–64 age group better understood the hand washing instructions than the 65+ patients.

Status at Discharge

Sixteen home infusion providers submitted 6,126 patient cases to NHIF for the status at discharge from home infusion therapy project. Of these cases, 4,437 were OPAT patients. Of the OPAT patients, 1,982 were in the 65+ age group, and 2,378 were in the 18-64 group, as shown in Figure 3.

The mean patient age for the 65+ age group was 75.07 (SD=7.47), with the oldest patient being 101 years of age. "Therapy completed" status at the time of discharge from a home infusion service accounted for 90.11% of the OPAT 65+-year-old patients, followed by "unplanned hospitalization" (4.79%). Table 2 provides a comprehensive breakdown of the status at discharge for the 18-64 and 65+ study cases. The rate of ADRs as a reason for discontinuation of home-based OPAT in the 65+ patient population was 0.25%, while the 18-64 age group rate was higher at 0.42%. Conversely, the unplanned hospitalization rate was higher in the 65+ age group (4.79%) than

TABLE 2
Patient Status at Discharge by Age Group

		Age Group		
		18-64	65+	Total
Therapy completed	Count	2,194	1,786	3,980
	% within Age Group	92.26	90.11	91.28
Unplanned hospitalization	Count	78	95	173
	% within Age Group	3.28	4.79	3.97
ADR	Count	10	5	15
	% within Age Group	0.42	0.25	0.34
Access device related	Count	15	9	24
	% within Age Group	0.63	0.45	0.55
Other	Count	81	87	168
	% within Age Group	3.41	4.39	3.85
Total	Count	2,378	1,982	4,360
	% within Age Group	100.00	100.00	100.00

There is a significant difference (p=.027) between the age groups and status for discharge.

in the 18-64 age group (3.28%). The results of the Chi-Square analysis indicate a significant difference (p=.027) between the 2 groups and status at discharge from home infusion therapy.

Discussion

The home-based OPAT process is methodical and follows a standard of care, resulting in a high success rate. The process begins with assessing the patient's eligibility and setting expectations for home-based therapy. These steps often precede hospital discharge and primarily involve the physician and personnel responsible for facilitating the transition of care from hospital to home. Hospital and home infusion staff can be involved in this process; however actual procedures vary and depend on the companies involved.

Nurses are an integral part of the home-based OPAT process, with one of their goals to teach the patient how to self-administer the IV medications. The purpose of the initial nursing visit is to assess the patient and home environment; provide instruction on medication storage, equipment use, and self-administration; and teach patients how to care and aseptically maintain the patency of the IV catheter. The number of nursing visits required to reach patient/caregiver independence with self-administration of medications varies and depends on individual patient acuity and the complexity of the administration method. Follow-up nursing visits are performed (usually weekly) to assess the patient's progress, draw labs, and perform sterile dressing changes for the IV catheter. Between nursing visits, a series of actions will usually involve the patient visiting the prescriber, the home infusion pharmacist reviewing lab results, and communicating with the nurse, patient, and caregivers. These actions assist in evaluating whether the goals of therapy are being met. Based on assessments and lab results, pharmacists will propose interventions to the prescriber to modify the plan of care when necessary. Protocols for managing home-based OPAT vary across practice settings, and the level of communication and coordination fluctuates based on physician preferences. Assessing patient understanding of home infusion tasks and instructions is a means of evaluating the teaching methods and the effectiveness of the transition of care process.

The patient-reported data reveals a significant difference (p=.009) between the 18-64 age group and older adults (65+) in their understanding of how to wash their hands with the 18-64 age group having a better understanding of the task. However, when calculated as a composite score, 98.45% of older adults (mean age 74.84, SD=6.89) served by 45 pharmacy-based home infusion providers report understanding the instructions provided on how to wash their hands, store medications, care for the IV catheter, administer the IV therapy, and use the equipment. Based on these findings, the existing methods and collaborative approach by physicians and hospital discharge and home infusion personnel for identifying eligible patients for home-based OPAT appear to be effective in selecting and referring patients capable of managing home-based OPAT.

Significant differences exist (p=.027) in the status at discharge from home infusion services between adults over age 65 and adults between the ages of 18-64. Older adults (mean age 75.07, SD=7.47) are less likely to have an ADR. Still, they are more likely than younger adult patients to be discharged from home infusion services due to an unplanned hospitalization (4.79% vs. 3.28%) or for other reasons such as insufficient response, change in eligibility, or expiring while on service. This difference is attributed primarily to the higher clinical acuity and potential for co-morbidities associated with increased age. Even so, 90.11% of the 1,982 home-based OPAT patients age 65+ in this study successfully completed OPAT therapy according to prescriber orders and exhibited the desired amount of clinical improvement at the time of discontinuation of therapy.

Limitations

Home-based antimicrobial therapy is one of several types of home infusion therapies. This study focused on home-based OPAT patients; thus, the study results should only be generalized to this therapy type. Even though the NHIF patient satisfaction survey used in this investigation is a valid and reliable instrument, there are limitations to survey methodology. First, due to a response rate of 18.13%, there is the possibility of non-response error. Specifically, it is unknown if the respondent's results would be similar to those of the non-respondents. Furthermore, respondents may not be 100% truthful with their answers for various reasons. Survey methodology is the most used method to measure patient satisfaction and collected patient-reported outcomes. The data used for the status at discharge section of

this study included 4,360 patient cases. However, the data was from only 15 unique provider locations. The generalizability of the data might be questioned even though the sample size is adequate.

Conclusions

An aging population in the U.S. is driving increased utilization of home-based OPAT in adults 65 years of age and older. This study confirms that most older adults understand the instructions related to performing home infusion tasks. While over 90% of older adults in this study were successful in completing their home-based OPAT therapy and had a lower rate of ADRs, there was a significant difference in adults over age 65 when compared to patients 18-64 years of age in the reasons for discontinuing home-based OPAT, including higher rates of unplanned hospitalization.

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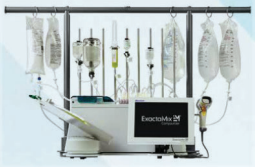

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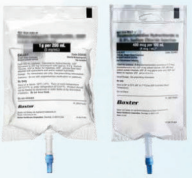

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US-00-220009 v1.0 01/2022

An Investigational Study on the Use of a Sporicidal Disinfectant to Decontaminate Hazardous Drug Residues on IV Bags

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This project was funded by Contec, Inc.

ABSTRACT

Introduction

It is best practice to wipe down surfaces of supplies such as intravenous (IV) bags and vials packaged in cardboard boxes with a disinfectant before bringing the supplies into classified areas of a clean room. Effective decontamination of hazardous drug residues on containers such as IV bags may reduce the risk of occupational exposure. It is critical to understand the risk of penetration of any potential disinfecting or decontaminating agent into the IV bags.

Methods

The ability of 4 types of IV bags to resist penetration by an EPA-registered sporicidal disinfectant based on peracetic acid and hydrogen peroxide (PAA/HP) was determined by 2 methods: A standard method used to measure barrier properties of gowns and gloves in a closed-loop system and analysis for trace levels of hydrogen peroxide in the IV fluids after immersion of the bags in a solution of the disinfectant. The 4 IV container materials studied were polyvinyl chloride, ethylene vinyl acetate, polypropylene, and ethylene propylene copolymer. The reduction of residues from 3 antineoplastic drugs on the outside of 1 type of IV bag was assessed after wiping the surface of the bags once with the disinfectant followed by isopropyl alcohol utilizing a commercially-available wipe sampling product.

Results

No migration (<5 ppm) of the PAA/HP disinfectant through the 4 types of IV bags was detected through 8 hours of exposure in a closed-loop system. No hydrogen peroxide (<31 ppb) was detected in the IV fluids after immersing the bags for 1 hour in the disinfectant. Dried residues from 3 antineoplastic drugs were reduced by at least 99.97% after wiping the surface of IV bags with the sporicidal disinfectant and then isopropyl alcohol.

Conclusion

Using a PAA/HP sporicidal solution to disinfect and decontaminate IV bags does not result in penetration or leaching of the PAA/HP into the bags, even after prolonged contact. Results also indicate that a single pass with PAA/HP-saturated wipes, followed by isopropyl alcohol, can effectively reduce common hazardous drug residues from the outside surface of IV bags.

Keywords: IV bags, sporicidal, disinfectant, decontamination, hazardous drugs

Introduction

Containers for compounded sterile preparations (e.g., IV bags, syringes, elastomeric pumps) are subject to intense quality control by manufacturers, including sterility validations for the absence of foreign matter or substances. However, once they are received into health care organizations, the responsibility to maintain their integrity and hygiene during compounding and administration shifts to pharmacy and nursing personnel.

PeridoxRTU® Sporicidal Disinfectant Cleaner (PAA/HP) is a sporicidal, fungicidal, and bactericidal 1-step disinfectant registered with the Environmental Protection Agency. The product is commonly used to disinfect surfaces in compounding pharmacies and clean rooms. Additionally, some facilities that compound hazardous drugs (HDs) use a wiping or mopping protocol with chemical agents such as PAA/HP to decontaminate surfaces that may harbor HD residues. Results of previous studies using PAA/HP with wipes or mop pads on surfaces such as stainless steel, plastic, and vinyl have demonstrated reductions exceeding 99.99% of several marker HDs.[1] However, decontamination of residual HDs by wiping final compounded sterile preparation (CSP) containers with PAA/HP has not been studied previously.

IV bags often are composed of multiple layers of polymers, including polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), polypropylene (PP), polyethylene, or a combination of these polymers. The goal for design and construction of bags is to maximize puncture resistance and maintain sterility while ensuring the materials are safe to contact the IV fluids for a prolonged duration.[2] Design features also include the use of materials that can be sterilized while minimizing the cost and complexity of manufacturing. The bags may be supplied empty or prefilled with different IV fluids. Most, but not all, IV bags also are sealed inside an outer bag called an overwrap. The overwrap reduces fluid loss from the IV bag due to osmosis, and further protects the bag and its contents from physical damage or contamination during shipping.

Many facility standard operating procedures (SOPs) require that all supplies be wiped to decrease microbial bioburden before entering the buffer room or crossing the segregated compounding area (SCA) perimeter line. Additionally, compounding pharmacies also wipe final hazardous drug CSP doses after compounding HDs to remove potentially hazardous drug residue. This wiping step can reduce the risk of spreading HD residue outside the negative compounding spaces during transport and exposure during administration. Although HD residue on the outside of IV bags and other containers has been examined in several previous studies, the risk level is unclear.[3-10] Regardless, IV bags used for HDs are handled in several steps through compounding, transportation, and administration. Strategies for breaking the chain of transmission of these drug residues to reduce occupational exposure can use many of the same methods employed for decreasing transmission of microbial contamination in health care settings. Thus, it is desirable to explore if a simple protocol such as wiping the bag with a readily available chemical agent can effectively decontaminate HD residues without posing a risk to the fluids inside the bag.

Methods

Although the polymers used in personal protective equipment (PPE) like gloves or gowns may differ from those used in IV bags, a method used to understand penetration resistance for PPE can be applied to IV bags. The most common protocol for testing the chemical resistance of plastics and textiles is ASTM F-739 "Standard Test Method for Permeation of Liquids and Gases Through Protective Clothing Materials Under Conditions of Continuous Contact."[11] This method describes most of the experimental design and details needed to test any type of flat material for resistance to different chemical agents, including disinfectants and HDs. As described below, this standard method was adopted to test the penetration resistance of 4 container materials used for IV bags (Table 1) to prolonged exposure to PAA/HP.

The studies were conducted at the Akron Rubber Development Lab, a laboratory that specializes in

TABLE 1 | Container Material of IV Bags in ASTM F-739 Test Protocol to Determine Penetration Resistance

Container material	Brand (manufacturer)	Diluent	Container volume	Catalog reference
Polyvinyl chloride	Viaflex® (Baxter)[12]	NS[a]	1,000 mL	2B1324X
Propylene ethylene copolymer	Excel™ (B. Braun)[13]	NS[a]	1,000 mL	L8000
Polypropylene	E^3™ (B. Braun)[14]	NS[a]	1,000 mL	E8000
Ethylene vinyl acetate	Pinnacle™ CP0500(B. Braun)[15]	None	500 mL	2112347

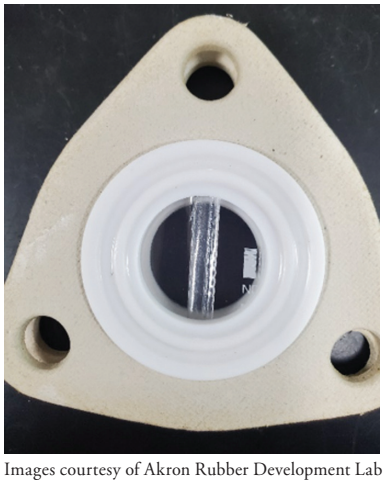
[a]NS: Sodium chloride 0.9% solution

testing the penetration resistance of PPE. IV bags were removed from the overwrap, if present, and emptied of fluid. An initial study measured penetration resistance of 3 randomly selected areas (5 cm^2) of the 4 types of IV bags, some of which may have included the seams. A second study consisted of single samples (5 cm^2) that focused on the seams of each bag (Figure 1A). In each case, the outer face of the IV bag was positioned within the exposure test chamber (Figure 1B) to contact the solution of PAA/HP.

Over 8 hours, a fresh solution of PAA/HP was recirculated across the surface of the IV bags through a closed-loop system. A blank solution of distilled water was recirculated on the other side of the IV bag sample. It was measured continuously with UV-Vis absorption spectrometry to detect penetration of the PAA/HP solution through the sample. The minimum detection level was 5 parts-per-million (ppm) of PAA/HP solution.

The penetration resistance of IV bags after immersion in a solution of PAA/HP also was determined with a different procedure. This colorimetric assay uses spectrophotometry to measure trace levels of hydrogen peroxide after reaction with a mixture of ferric iron with xylenol orange (PeroxiDetect™ Kit, Sigma-Aldrich). In Europe, several studies have utilized this sensitive assay for peroxides to assess if vapor-phase peracetic acid or hydrogen peroxide can penetrate IV bags during disinfection of isolators and devices used to reconstitute HDs.[16-17] This test included samples of IV bags like those listed in Table 1. The Baxter Viaflex® bags used in this study were smaller (250 mL; REF 2B1322) than the bags used in the penetration studies using ASTM Method F-739. The Pinnacle™ EVA bags were prefilled with 500 mL sterile water before the test. The exposure method involved immersing triplicate bags in a solution of PAA/HP up to, but not covering, the septa. After

FIGURE 1A
Sample Holder with a Sample of IV Bag Containing a Seam Before Placing into the Test Chamber



Images courtesy of Akron Rubber Development Lab

FIGURE 1B
Exposure Test Chamber

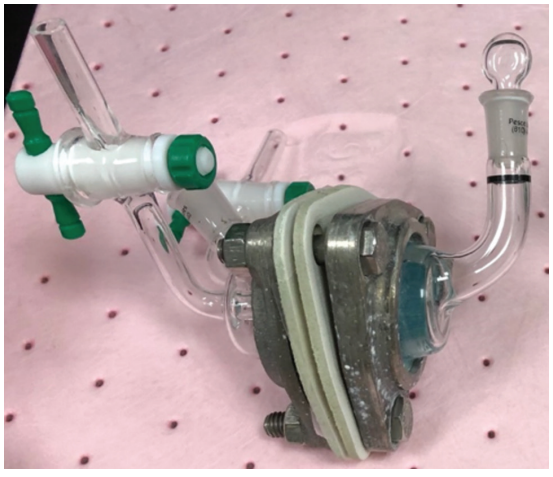


TABLE 2 | Hazardous Drug Dilution for Surface Application and Decontamination Testing of IV Bags

Drug	Diluent	Concentration/ reconstituted	Dilution for test and Control (1/10 dilution)	Amount applied to container surface[a]
Cyclophosphamide	Sodium chloride 0.9%	20 mg/mL	2.0 mg/mL	0.0500 mg
Methotrexate	Sodium chloride 0.9%	25 mg/mL	2.5 mg/mL	0.0625 mg
5-Fluorouracil	Sterile Water for Injection	50 mg/mL	5.0 mg/mL	0.1250 mg

[a]Protocol: 0.025 mL in 4 droplets of approximately 6.25 microliters each, applied across a 7.6 cm by 10.2 cm (3-inch by 4-inch) area on the container surface.

immersing the bags for 1 hour at room temperature, the IV solutions inside the bags were assessed for levels of hydrogen peroxide using the test kit.

An additional study was performed to determine the decontamination of HD residues from the outside of IV bags using wipers wetted with the PAA/HP solution. The outer surface, 7.6 cm x 10.2 cm (3 inches x 4 inches area) of 2 sets of triplicate PVC bags were intentionally contaminated with dilutions of 3 different HDs using a 1 mL syringe/needle as described in Table 2.

Drug solutions were allowed to dry on the outside surface of the bag for 30 minutes inside the containment primary engineering control (CPEC). One set of triplicate samples was used as controls to determine recovery efficiency of the sampling process. The other set of triplicate samples was used to measure the efficacy of decontamination. The decontamination procedure involved wiping each contaminated bag using a single pass with a sterile quarter-folded 9 inch x 9 inch polyester-cellulose wipe saturated with PAA/HP. After 3 minutes, each bag was wiped with a sterile quarter-folded 9 inch x 11 inch polypropylene wipe pre-saturated with sterile 70% isopropyl alcohol/30% water (sIPA). After drying, the area of contamination on each of the 6 bags was sampled using the swabbing technique prescribed in a commercial HD sampling kit.[18]

Results

As shown in Table 3, the results of testing using ASTM F-739 on 4 types of polymeric films used in IV bags indicated no penetration or leaching (< 5 ppm) of PAA/HP solution through 8 hours of exposure in either study 1 (3 different areas, some may have contained seams) or study 2 (single samples that included bag seams).

The resistance of the IV bags to penetration from the PAA/HP solution was further substantiated by

TABLE 3 | Penetration of PAA/HP through Container Material of IV Bag over an 8-Hour (480 min.) Exposure Using a Procedure Based on ASTM Test Method F-739

Container material	Average breakthrough detection time (minutes)
Polyvinyl chloride	>480
Propylene ethylene copolymer	>480
Polypropylene	>480
Ethylene vinyl acetate	>480

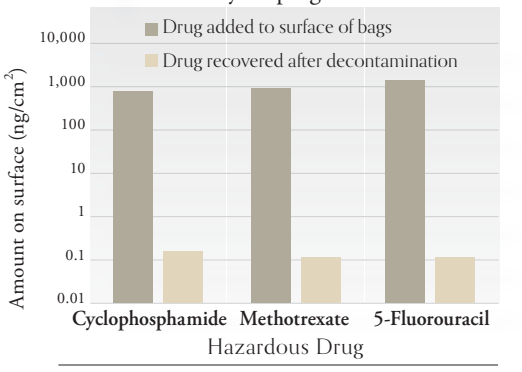
the results of testing using a commercially available assay for trace levels of hydrogen peroxide. As shown in Table 4, after soaking the 4 types of IV bags in the PAA/HP solution for 1 hour, the average concentrations of hydrogen peroxide recovered from the fluids inside the bags were below the minimum detection level of the method (<0.9 nanomoles/mL or 31 ppb). Although all the levels were below the minimum test threshold, the sodium chloride 0.9% from the 250 mL bags composed of PVC contained the highest concentration of peroxide of all the bag types. However, it was impossible to determine whether the increased levels were due to bag composition or to the smaller volume of the PVC bags.

TABLE 4 | Concentration of Hydrogen Peroxide Measured in IV Bag Diluents after 1 Hour of Immersion in PPA/HP Solution using a Colorimetric Assay[a]

Container Material	Container Volume	Mean Concentration of Hydrogen Peroxide[b] (SD)
Polyvinyl chloride	250 mL	26 (13)
Propylene ethylene copolymer	1,000 mL	20 (15)
Polypropylene	1,000 mL	10 (5)
Ethylene vinyl acetate	500 mL	9 (1)

[a]The minimum detection level of the method is <31 ppb.
[b]Measured in parts-per-billion (ppb)

FIGURE 2 Reduction of Hazardous Drug Residues on the Outside of PVC IV Bags after Wiping with PAA/HP Solution Followed by Wiping with sIPA[a]



[a]The corresponding percent reductions were 99.97% (cyclophosphamide), >99.98% (methotrexate) and >99.99% (5-fluorouracil).

Decontamination of 3 common hazardous drugs was accomplished by wiping the bags once with the PAA/HP solution, waiting 3 minutes, then wiping the bags with sIPA (Figure 2). The average recovery efficiency of the HDs from the control bags (no wiping with PAA/HP) using the commercial HD sampling kit was approximately 78% (data not shown). With the test IV bags, a single pass of PAA/HP on quarter-folded wipes, followed by wiping with sIPA, reduced the average level of drugs by at least 99.97%. With all but 1 replicate with cyclophosphamide, no residual HDs (<10 ng per 7.6 cm x 10.2 cm area (3 inches by 4 inches) were detected after the decontamination protocol. The minimum detection level in these tests was 0.13 ng/cm^2.

Discussion

Results of this study indicate minimal risk of penetration of an EPA-registered disinfectant based on peracetic acid and hydrogen peroxide through several common types of IV bags. Studies to measure the potential penetration of the PAA/HP solution into IV bags were performed under extreme conditions where the bags (including seams) were exposed to the PAA/HP solution over an 8-hour period. Results of additional studies that measured levels of hydrogen peroxide concentrations in the IV solutions after immersion for 1 hour also represent a worst-case scenario. Even if bags are wiped repeatedly, whether to disinfect, or to remove HD residues, the total duration of exposure would only be a few minutes. These results indicate that wiping IV bags with the PAA/HP solution poses minimal risk to the fluids inside the bags or the overall integrity of commonly used container closure devices.

Previous studies have examined the migration or leaching of disinfectant solutions into IV bags that might occur during vapor-phase sterilization processes.[16,17,19-21] Interestingly, the active ingredients used for these sterilization processes are the same actives used in the PAA/HP solution: peracetic acid and hydrogen peroxide. However, the sterilization processes use 10-100 times higher concentrations of these 2 chemicals and for a much longer duration of exposure when compared with a simple surface application of PAA/HP. Some of these previous results revealed differences in the amount of migration into IV bags depending on the type of polymeric film used in the bags.[16,20] Although the levels of trace hydrogen peroxide measured in this study were all below the stated sensitivity of the test kit, it is interesting to note that the levels of hydrogen peroxide detected inside PVC bags were higher than with other types of IV bags. Although penetration through the overwrap was not tested here, results of previous studies by other researchers indicated no detectable migration into IV bags if they were exposed to the sterilization process while still contained in the overwrap.[16,17,19-21]

As mentioned above, considering that PAA/HP would be in contact with the IV bags only for a few minutes to accomplish disinfection of microbes or decontamination of HD residues, it appears the risk of leaching of PAA/HP into the IV bags is extremely low. In cases where the outer packaging (overwrap) is disinfected with PAA/HP, the risk of IV fluid contamination from PAA/HP would be even lower since the PAA/HP is not directly contacting the IV fluid bag at that time. If wiping the IV bags themselves (instead of the overwrap), it is recommended to wipe with sIPA at some point after PAA/HP to remove any visible dried residues that might cause concerns from nurses or patients.

While the results described above demonstrate the penetration resistance of IV bags to PAA/HP, further discussion and studies elucidate the suitability of PAA/HP to both disinfect microorganisms and decontaminate hazardous drug residues on the external container surface of the IV bags. Most facility SOPs for bringing supplies into the negative pressure buffer room or beyond the perimeter line of the SCA require wiping materials with a disinfectant to decrease microbial bioburden on the surfaces

of supplies. This practice is based on the guidance in both the current and recent revisions of USP <797> Pharmaceutical Compounding – Sterile Preparations and the recognition that cardboard and paper packaging often can harbor significant levels of bacterial and fungal spores. The revisions of USP <797> published in 2019 and 2021 (but not yet finalized) clarify that EPA-registered disinfecting agents must be allowed to dwell, with the surface remaining wet, for the contact time. The PAA/HP solution is registered with the EPA to disinfect various surfaces, including the same type of polymeric films used in IV bags. As shown on the EPA master label, the contact times for the PAA/HP disinfectant range from 1 to 2 minutes for fungi and vegetative bacteria and 3 minutes for bacterial endospores.[24]

Regarding decontamination of hazardous drug residues on IV bags containing HD CSPs, the results of this study indicate that a wiping protocol utilizing PAA/HP with appropriate textiles, followed by wiping with sIPA, is a viable option to reduce the risk of HD migration. Numerous guidance documents from the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the American Society of Health-System Pharmacists (ASHP), and others mention IV bags as a potential source of occupational exposure to HDs. As described above, several published studies have examined the occurrence of HD residues found on the surfaces of IV bags (also called infusion or intravenous containers in the literature). While a recent large study conducted in 8 Dutch hospital pharmacies found no detectable contamination of 5-Fluorouracil on the outside of IV bags, several other studies have recovered substantial levels of HDs from the outside of IV bags.[3,4-10] The occurrence of HD contamination likely depends on variables like compounding technique, the use of robotics and closed-system transfer devices (CSTDs), the level of contamination on the outside of vials provided from manufacturers, and the robustness and frequency of decontamination, cleaning, and disinfection procedures. Since many of these factors are challenging to control and may be both variable and highly operator-dependent, it may be a best practice to wipe the outside of the final HD CSPs before they are removed from the CPEC and packaged for transport. The current study did not consider other types of containers used for HD CSPs, such as plastic syringes and elastomeric pumps. However, these containers are composed of similar polymers as many IV bags. Future studies should investigate the resistance to penetration and impact of HD decontamination of these containers using the PAA/HP solution.

Conclusion

The surfaces of supplies such as IV bags should be disinfected to reduce the transfer of viable microorganisms into classified areas of compounding clean rooms. For sterile compounding of hazardous drugs, decontamination of potential drug residues on the external surfaces of final CSP containers can reduce the risk of occupational exposure during transport and administration. Results of this study indicate that a 1-step sporicidal disinfectant and cleaner based on peracetic acid and hydrogen peroxide can effectively reduce hazardous drug residues on the container surfaces of IV bags without posing a risk that the disinfectant ingredients penetrate through the bags.

Disclosures

Mark Wiencek and Lauren Pernot are employees of Contec, Inc.

Michael Bedenbaugh is a consultant on retainer with Contec, Inc

Kate Douglass is a consultant on retainer with Contec, Inc.

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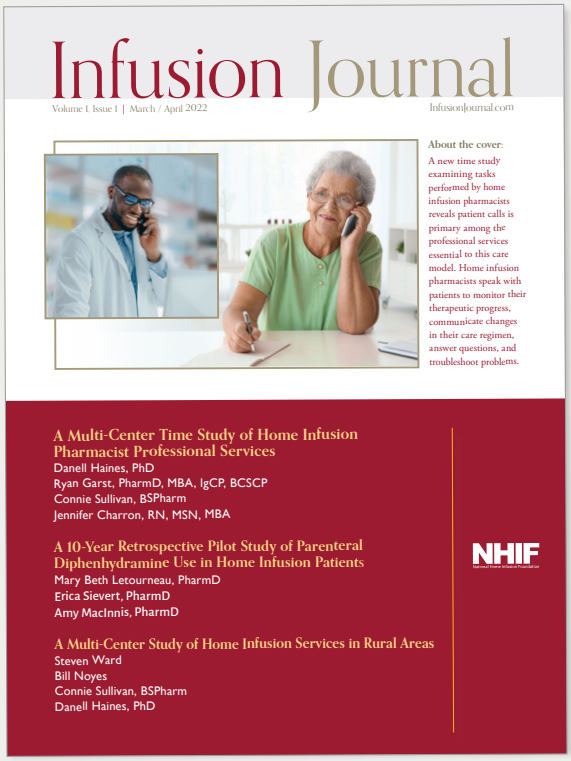

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A Retrospective Cohort Study of Vancomycin Dose Reductions Among Home Infusion Patients Post-Hospitalization

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ABSTRACT

Background
Patients treated with intravenous (IV) vancomycin in the hospital often require outpatient parenteral antimicrobial therapy (OPAT) after discharge for the continuation of therapy. Despite vigilant monitoring, nephrotoxicity is a common adverse drug event associated with vancomycin in the home infusion setting.

Methods
This multi-center retrospective cohort study included adult patients from the North Central United States receiving trough-based IV vancomycin dosing for osteomyelitis between April 1, 2021, and June 30, 2021. The primary objective was to determine the percentage of patients requiring vancomycin dose reductions upon transition from an inpatient setting to home infusion services. Secondary outcomes evaluated the incidence of acute kidney injury (AKI) and rehospitalization rates due to AKI.

Results
A total of 94 patients were included and evaluated for dose reductions of vancomycin. Of these, 47 (50%) patients required dose reductions throughout therapy, with 24 (51%) reductions occurring within the first 7 days post-hospitalization. Nine (9.5%) patients developed AKI from vancomycin within 2-7 days post-hospitalization, and 4 (4.3%) patients required readmission due to AKI.

Conclusions
Most patients in this study required vancomycin dose reductions within the first 7 days post-hospitalization, indicating the importance of careful monitoring upon transition to home infusion services. Patients receiving vancomycin dose reductions before hospital discharge did not experience AKI or rehospitalization. Empiric vancomycin dose modifications may be reasonable with proper clinical judgment but should be monitored closely to ensure therapeutic drug levels and patient safety.

Keywords: Home infusion, vancomycin, outpatient parenteral antimicrobial therapy, therapeutic drug monitoring, nephrotoxicity, MRSA

Background
Vancomycin is a glycopeptide antibiotic with bactericidal activity commonly used to treat gram-positive infections, including methicillin-resistant *Staphylococcus aureus* (MRSA).[1] Intravenous (IV) vancomycin requires extensive clinical monitoring in both community and health care settings to maintain efficacy and limit toxicity. Parenteral antibiotics are often used to treat severe infections and can be administered in the home setting with proper patient education.[2] However, a significant concern of vancomycin use is the incidence of nephrotoxicity.

Until recently, therapeutic drug monitoring (TDM) for vancomycin has been centered on maintaining trough concentrations between 15 and 20 mg/L for severe MRSA infections.[3] Although trough monitoring has been heavily integrated into clinical practice over the years, current data correlates the risk of acute kidney injury and supratherapeutic vancomycin trough levels.[3-4] Published literature regarding the incidence of vancomycin-induced AKI is more established in acute care settings. In a meta-analysis by van Hal and colleagues, vancomycin-associated AKI varied from 5 to 43%. Most episodes of AKI developed between 4 and 17 days after initiation of vancomycin therapy.[4]

Upon hospital discharge, patients often require home infusion services to continue therapy. Hydration status between the acute care and home settings may

impact drug metabolism and clearance, posing a risk to patient safety after hospital discharge. Vancomycin clearance is dependent on the glomerular filtration of the kidneys; therefore, renal dysfunction slows the excretion of vancomycin and is usually a reversible process.[1] Home infusion pharmacists perform clinical monitoring and provide therapeutic recommendations based on renal function and vancomycin serum concentrations to ensure patient safety.

Currently, no published literature addresses the incidence of vancomycin-induced nephrotoxicity in this setting. The primary objective of this study was to determine the percentage of patients requiring vancomycin dose reductions upon transition from the inpatient setting to home infusion services, as well as throughout therapy in the home setting. Dose reductions were noted on days 0, 1-7, 8-14, and >14 based on clinical judgment and laboratory values, such as serum creatinine and vancomycin trough levels. Secondary outcomes evaluated the incidence of AKI and rates of rehospitalization due to AKI. Results of this study may indicate whether an empiric dose reduction before starting home infusion services would prevent the incidence of vancomycin-induced nephrotoxicity following hospitalization.

Methods

This multi-center retrospective cohort study included patients from the North Central United States. Patients 18 years and older who received trough-based IV vancomycin dosing for osteomyelitis between April 1, 2021, and June 30, 2021, were evaluated for inclusion. This population was selected to target vancomycin trough levels between 15 to 20 mg/L, as these levels correlate with vancomycin-induced AKI.[3-4] Patients were excluded if vancomycin was initiated in the outpatient setting, received vancomycin dosing based on Area Under the Curve/Minimum Inhibitory Concentration (AUC/MIC), or concomitant use of piperacillin-tazobactam.

Patient electronic health records were retrospectively reviewed for hospital discharge orders, laboratory results, home infusion-related assessments, and interventions. For the primary outcome analysis, vancomycin dosing regimens and corresponding trough values were analyzed throughout therapy to determine the need for dose reductions or extended intervals between doses. Electronic health record review also determined the number of patients developing AKI and those requiring hospital readmission due to AKI. Based on Kidney Disease: Improving Global Outcomes (KDIGO) guidelines, AKI was defined as an increase in serum creatinine of ≥0.3 mg/dL within 48 hours or 1.5 times increase from baseline within the last seven days.[5] For this study, baseline renal function was based on hospital discharge laboratory values.

The research involved secondary data analysis where the data set was deidentified before analysis and recorded in a manner where the resulting data contained no information that could be linked directly or indirectly to the identity of the patients. This study was determined as exempt from IRB review.

Results

A total of 141 patients were screened for study enrollment. Of these, 94 patients met inclusion criteria. Forty-four patients were excluded because vancomycin was initiated in the outpatient setting rather than continuing therapy post-hospitalization. Two patients were excluded due to concomitant use of piperacillin-tazobactam and 1 patient who received AUC-based dosing. Included patients were majority male (73.4%) and had an average age of 63.37 years (SD=15.51). Patient ages ranged from 22-97 years old.

Patients who met inclusion criteria were observed for the primary and secondary endpoints. 47 (50%) patients required dose reductions throughout therapy. Most vancomycin dose reductions occurred within 7 days post-hospitalization, with 24 (51%) total reductions occurring during this period. The age range of the 47 patients with dose reductions was 40 to 84 years old. Eight (17%) patients had empiric dose reductions on day 0 before starting home infusion services. Of note, 3 regimens were empirically modified to longer dosing intervals (e.g., from every 18 to every 24 hours) by home infusion pharmacists based on clinical judgment for ease of administration and increased adherence in the home setting. Inpatient pharmacists performed the other 5 interventions for dose reductions on day 0

TABLE 1 | Baseline Characteristics of Study Participants and Study Outcomes (n=94)

Baseline Characteristics	
Age, years*	63.4 (22-97)
Gender, male	69 (73.4)
Primary Outcome	
Total Dose Reductions	47 (50)
Day 0	8 (17)
Day 1-7	16 (34)
Day 8-14	13 (27.7)
Day >14	10 (21.3)
Secondary Outcomes	
Patients with SCr Increase	46 (49)
Average with SCr Increase†	0.26 (24.2)
AKI	9 (9.5)
Hospital Readmission	4 (4.3)

Data are n(%), unless stated otherwise. *Mean (range). †SCr in mg/dL (average % increase from baseline).

FIGURE 1 | Percentage of Patients Requiring Dose Reductions Post-Hospitalization (n=47)

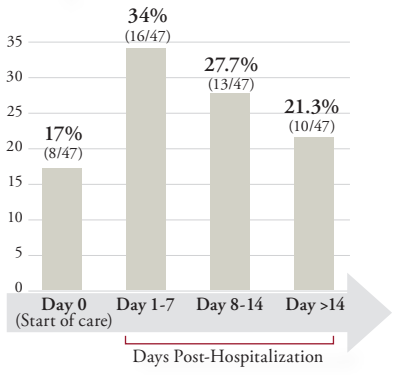
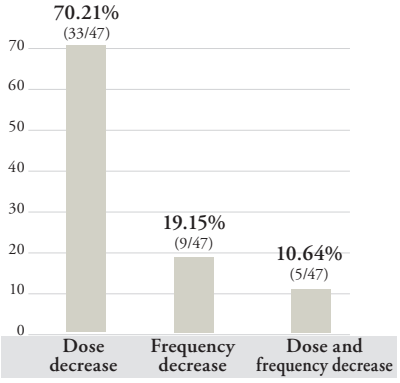


FIGURE 2 | Percentage of Patients Receiving Vancomycin Dose and Frequency Reductions (n=47)



before hospital discharge. An additional 13 (27.7%) regimens were dose reduced on days 8-14 and 10 (21.3%) regimens on days >14. The primary outcome results are summarized in Table 1 and Figure 1. Figure 2 demonstrates how vancomycin reductions occurred by dose, frequency, or both.

Overall, 46 (49%) patients experienced an increase in serum creatinine on therapy, with an average increase of 0.26 mg/dL (SD=0.27) from baseline. A total of 9 (9.5%) patients developed AKI from vancomycin within 2-7 days post-hospitalization. These patients were between 40 and 85 years old. Three of the 9 patients developed AKI within 48 hours upon transitioning to home infusion services. Four (4.3%) patients required hospital readmission due to AKI. None of the patients with vancomycin dose reductions on day 0, before home infusion services, experienced AKI or rehospitalization due to AKI. Vancomycin dose increases occurred in 2 patients with subtherapeutic and therapeutic trough levels despite worsening renal function. In one case, the patient developed a notable AKI within 48 hours of transitioning to home infusion services, followed by a dose increase. Secondary outcome results can be seen in Table 1.

Discussion

Upon transition to the home infusion setting, empiric dose reductions of vancomycin are based on clinical judgment and feasibility of home administration. Before hospital discharge, inpatient pharmacists are involved with vancomycin dosing essentially based on renal function and TDM. After discharge, patients are further evaluated by home infusion pharmacists for appropriateness of the vancomycin indication and dosing regimen.

For severe MRSA infections, current guidelines recommend AUC/MIC monitoring to improve patient safety and reduce rates of nephrotoxicity. One approach to accomplish AUC-based therapy involves using Bayesian dose-optimizing software, which requires minimal pharmacokinetic (PK) sampling.[3] Alternatively, multiple serum concentrations are collected to calculate AUC using analytic PK equations.[6] Despite increased utilization of AUC/MIC-based vancomycin dosing for severe MRSA infections, this monitoring strategy has not been widely adapted in the home infusion setting. Due to the cost limitations of acquiring Bayesian software, trough monitoring is still commonly used in the home infusion setting.

Throughout vancomycin therapy, 50% of patients in this study required dose reductions, most occurring within 7 days post-hospitalization. Patients are at an increased risk of dehydration, leading to AKI immediately post-hospitalization.[7] The cessation of IV hydration and increased ambulation causing fluid mobilization may contribute to hydration status following hospitalization. Compared to the inpatient setting, these factors contributing to dehydration in the home may alter renal function, thus changing the predicted vancomycin PK. Upon transition to home infusion services, patients receiving vancomycin dose reductions on day 0 did not experience AKI or rehospitalization during therapy. This finding suggests empirically reducing vancomycin doses post-hospitalization for continuation with home infusion services may improve patient safety regarding nephrotoxicity while sustaining efficacy. A concern with empiric vancomycin dose reductions is the potential for suboptimal trough levels leading to antimicrobial resistance. With known MRSA infection, it is essential to maintain levels within the therapeutic range.

Of the patients who experienced nephrotoxicity, the most common time for dose reductions was between days 8 and 14. In this population, the delay in dose reductions was often due to therapeutic vancomycin trough levels in the setting of serum creatinine values trending upward. In one case, the vancomycin dose was increased due to subtherapeutic trough values in worsening renal function. This led to drug accumulation and nephrotoxicity, reinforcing the importance of various factors influencing vancomycin pharmacokinetics.

Limited literature is available on vancomycin-induced nephrotoxicity in the home infusion setting. Limitations of this study include the retrospective study design and the small sample size. In addition, a comprehensive past medical history is not always available when providing outpatient parenteral antimicrobial therapy (OPAT) after hospital discharge. It was unknown whether patients were predisposed to nephrotoxicity due to a history of chronic kidney disease (CKD) or CKD related to diabetes. More extensive studies expanding to different regions of the United States, as well as the inclusion of other severe MRSA infections requiring prolonged treatment courses, such as bacteremia, endocarditis, and meningitis, may be beneficial.

Conclusion

Half of the study population required dose reductions within the first week of home infusion services. Patients may experience a shift in fluid status post-hospitalization, causing dehydration and altered renal function. Empirically reducing vancomycin regimens may correlate with a decreased incidence of AKI as patients transition from the hospital to home infusion services to continue therapy. Patients who received dose reductions on day 0, before starting home infusion services did not experience nephrotoxicity or hospital readmission due to AKI.

Practitioners should continue closely monitoring all vancomycin dose modifications to ensure optimal therapeutic drug levels and maximize patient safety. As clinical evidence continues to evolve, the implementation of AUC/MIC-based vancomycin dosing rather than trough-based dosing alone will enhance patient safety regarding the incidence of AKI.[3,6] Further research with larger sample sizes is needed to confirm the results of this study.

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This publication is a product of the National Home Infusion Foundation and is published by the National Home Infusion Association, 1600 Duke Street, Suite #410, Alexandria, Virginia 22314.

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US-00-220010 v1.0 01/2022