Infusing Safety: Comparing Oncology Infusion Outcomes at Home Infusion Services vs. Hospital-Based Outpatient Infusion Centers

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ABSTRACT

Background
Oncology infusions are a cornerstone of cancer treatment, often administered in hospital-based outpatient departments (HOPDs) due to the controlled environment they offer. However, with the rise of patient-centered care and cost reduction efforts, home infusion services are an increasingly viable alternative for oncology treatments, though some professional groups have concerns about safety. To address these concerns, this study compares safety outcomes of oncology infusions administered through home infusion (HI) to those administered in HOPDs.

Methods
This retrospective study analyzed data from adult oncology patients who received infusion therapies between January 2020 and December 2023 through HI or HOPDs within a single health system. Primary outcomes included infusion-related reactions (IRRs), all-cause acute care visits within 48-hours, and respiratory infection (influenza, COVID-19, RSV) rates within 14-days following infusions. Chi-square tests compared patient characteristics and infusion outcomes by site of care.

Results
There were 3,084 patients (38,052 infusions) treated in HOPDs and 145 patients (1,242 infusions) treated through HI; 93 (3.0%) patients were treated at both sites. Patients receiving HI were younger (Under 50 years: HI: 36 (69.2%) vs. HOPD: 486 (16.2%), $p < 0.0001$) and more likely to be female (HI: 34 (65.4%) vs. HOPD: 1,723 (57.4%), $p = 0.049$). Rates of IRRs and acute care utilization were similar following infusions at both sites of care (IRRs: HI: 0.16% vs. HOPD: 0.19%, $p = 0.81$; Acute care visits: HI: 1.4% vs. HOPD: 1.2%, $p = 0.47$). There were fewer respiratory infections reported following HIs compared to HOPD infusions (HI: 0 (0.0%) vs. HOPD: 144 (0.38%), $p = 0.029$).

Conclusion
These findings indicate that oncology infusions occurring within HI result in safety outcomes comparable to HOPDs; further, there were fewer respiratory infections, which can be life-threatening among oncology patients, following HI. Home infusion has the potential to enhance patient-centered care and maintain high safety standards, while also providing comfortable, convenient therapy for patients. This knowledge may aid oncologists in making informed and personalized decisions with their patients regarding site of care and resource allocation.

Keywords: home infusion, oncology, chemotherapy, safety, adverse events, infusion therapy

Abbreviations
- CRI, Catheter-related infection
- ED, Emergency department
- HI, Home infusion
- HOPD, hospital-based outpatient
- IRR, Infusion-related reaction

INTRODUCTION

In the United States, about half of men and a third of women will be diagnosed with cancer during their lifetimes.[1] These results are staggering, as approximately 2 million new cancer cases and 610,000 cancer deaths are projected in 2024, alone.[2] Encouragingly, however, the overall cancer mortality rate has dropped 33% since 1991, averting over 4 million deaths, due to improvements in prevention and early cancer detection, as well as advancements in cancer treatments.[2,3] Oncology infusions are foundational to many treatment regimens and involve chemotherapy, immunotherapy, or targeted therapy.[2,4] These require meticulous attention to safety protocols to mitigate the risk of adverse events. Hospital outpatient departments (HOPDs) have been the primary setting for administering these infusion therapies, offering a controlled environment that facilitates comprehensive treatment monitoring, prompt interventions, and the ability to escalate care swiftly due to the proximity of emergency resources.[5]

However, the landscape of health care delivery is shifting, driven by multiple factors including patient-centered care initiatives, cost reduction efforts, and technological advancements.[6] The home health care market has been growing rapidly, with a projected compound annual growth rate of ~8% between 2024 and 2030.[7] An estimated 3.2 million patients receive home infusion services in the United States each year, and there are an increasing number of health plans that cover these services.[8-10] This shift towards home-based care aims to enhance the patient experience by improving access to care through providing treatment in the comfort and convenience of patients' homes, potentially improving medication adherence and overall quality of life.[8,9,11]

Home infusion services can offer significant cost savings compared to hospital-based care, which is relevant in the context of rising costs of health care.[12] Further, since infusion centers are challenged with resource constraints, home infusion services can fill the gap for health systems and their patients to provide necessary treatments.[5,8,9,13,14] The transition to home infusion services for oncology patients is promising, but raises important questions about safety. HOPDs have traditionally managed oncology infusions, as the controlled environment may offer advantages in the risks associated with infusion therapies. Home infusion, despite its benefits, has unique challenges in ensuring the same level of safety.[8,11] Key concerns include the management of adverse events, such as catheter-related infections (CRIs), infusion-related reactions (IRRs), and the ability to respond effectively to complications that may arise during or shortly after the infusion process.[2,4] Understanding how the safety outcomes associated with home infusion services compare to HOPDs is essential for optimizing patient care and health care resource utilization. This study evaluates safety outcomes by site of care within the landscape of oncology infusions. Further, since immunocompromised patients, such as those receiving oncology infusions, have a significantly higher risk of severe complications from respiratory infections, this study evaluates respiratory infection rates following infusions to examine if there are differences by site of infusion care.[15]

METHODS

Study Setting and Design

This retrospective study was conducted within a large, Midwestern health system that employs clinicians skilled in more than 100 specialties across 142 locations who serve over 2.1 million patients annually. The pharmacy services oversee the health system's 26 retail pharmacies, a large, national URAC-accredited specialty pharmacy, 11 HOPDs (4 standalone and 7 supported by acute care hospitals, including world-class cancer infusion centers), and a home infusion service which is licensed in 13 states, among other services.

This study examined patients treated within the health system's home infusion (HI) and hospital-based outpatient infusion centers (HOPDs). HI administered oncology infusions in patients' residences by trained health care professionals equipped with necessary medical supplies and telehealth support. HOPDs operated within hospital facilities, providing a controlled environment with immediate access to emergency resources. Data were available within the electronic health records: CPR+ (WellSky; Overland Park, KS) which contained data on HI-administered infusions and patient care, and Epic (Epic Systems; Verona, WI) which contained data on HOPD-administered infusions, and other patient and clinical information from health system utilization. This study was approved by the health system's Institutional Review Board.

Study Population and Oncology Infusions of Interest

The study population consisted of adult oncology patients (aged 18-years and older) who received infusion therapies between January 1, 2020 and

December 31, 2023 from HI and 8 HOPD locations. Patients were eligible if they received infusions for at least 1 of the following medications: Adriamycin/Doxil (doxorubicin, doxorubicin liposomal), Avastin/Mvasi/Zirabev (bevacizumab and biosimilars), Bavencio (avelumab), cytarabine, DTIC (dacarbazine), Dacogen (decitabine), Darzalex (IV; daratumumab), Darzalex Faspro (SQ; daratumumab and hyaluronidase), Gemzar (gemcitabine), Herceptin/Kanjinti/Trazimera/Herceptin Hylecta (trastuzumab and biosimilars, trastuzumab and hyaluronidase), Ifex with/without Mesnex (ifosfamide with/without mesna), Imfinzi (durvalumab), Navelbine (vinorelbine), Velcade (bortezomib), and Vidaza (azacytidine) at either site of care; these medications were chosen due to the overlapping use at both sites of care. Patients were excluded if they were on a drug as part of a clinical trial.

Variables of Interest

The primary predictor of interest was site of care. Infusions were considered based on the site of care (HOPD or HI) of their occurrence. Occasionally, infusions were started in the HOPD and then care was transferred to HI; in these instances, the infusions were considered to be HI infusions since the majority of the care was within HI.

The primary outcomes of interest were safety outcomes related to the oncology infusion therapies.

Emergency department (ED) and hospital admissions were considered if they occurred within 48-hours post-infusion for any cause. Since ED and hospital admissions were uncommon, a joint metric of acute care visits was assessed if either of these admission types occurred following infusion.

Late infusions were considered among home infusion patients only based on data availability and were defined as infusions occurring more than 5 days following an expected infusion. Late infusion reasons included insurance/financial, infection, lost to follow up, treatment failure/disease progression or oncology infusion discontinued, care coordination (scheduling, labs, etc.), admission, planned care (surgery, vaccine, childbirth delivery), and others.

Adverse events considered were infusion-related reactions (IRRs) and catheter-related infections (CRIs). Data for IRRs are collected as standard of care in both HI and HOPDs in CPR+ and Epic, respectively. The dose at which an IRR occurred was categorized as either occurring on the first or a subsequent infusion of a medication. Data for CRIs were collected through chart review for HI infusions but were unavailable for HOPD infusions. Severity of adverse events were graded based on the Common Terminology Criteria for Adverse Events, as Mild (Grade 1), Moderate (Grade 2), Severe (Grade 3), Life-threatening (Grade 4), or Death (Grade 5).[16]

Lastly, respiratory infection rates were considered based on *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) coding of health system visits occurring within 14- days post-infusion. ICD-10-CM codes included were: COVID-19 (U07.1), respiratory syncytial virus (J12.1, J20.5, J21.0), and influenza (J09, J10, J11).

Secondary variables include patient demographic information (i.e. age, sex, interpreter status, ethnicity, and race) and clinical information (i.e. cancer type(s) and medication(s)). Further, a medication switch during the study period was determined to exist if a patient had a new medication infused across the study period, not on the same date as the first medication(s).

Data Analysis

Characteristics were compared at the patient-level by site of care (HI, HOPD, or both for patients who had received care from both sites). Chi-squared tests compared distributions of variables across site of care. Safety outcomes (ED or inpatient admission, IRR, post-infusion respiratory infection) were compared both at the patient-level and at the infusion-level by site of care using chi-squared tests. CRIs and late infusions were unable to be compared across sites of care because data were unavailable for infusions occurring in HOPDs; thus, the incidences of CRIs late infusions were reported for HI only. Significance was set *a priori* at $\alpha = 0.05$. SAS, version 9.4 (SAS Institute Inc.; Cary, NC) was utilized for analyses.

RESULTS

There were 3,146 adult patients who received a total of 39,294 oncology infusions after inclusion criteria were employed. Out of these, 3,084 (98.0%) patients received 38,052 (96.8%) infusions in HOPDs, and 145 (4.6%) patients received 1,242 (3.2%) infusions through HI. Notably, 93 (3.0%) patients received infusions within both sites of care. The majority of patients in the sample were female (n = 1,800, 57.2%), >65-years-old (n = 1,646, 52.3%), and White (n = 2,724, 86.6%).

Table 1 shows demographics and characteristics of the study population based on the site of care where infusions were received. Patients receiving care through HI were generally younger than patients treated within HOPDs, with 36 (69.23%) patients being <50 years-old treated by HI-only compared to 486 (16.19%) patients by HOPD-only (p <.0001). Females comprised a larger majority of HI-only patients compared to HOPD-only patients (n = 34, 65.38% vs. n = 1,723, 57.41%; p = 0.049). Further, there was a statistically significantly larger proportion of Hispanic or Latinx patients treated within the HI-only group compared to HOPD-only (n = 3, 5.77% vs. n = 41, 1.37%, p = 0.0056). Patients treated within both sites of care had a greater number of infusions during the time period, with a median of 24 (IQR: 10-44), compared to HI-only (median: 4.5, IQR: 2-6) and HOPD-only patients (median: 6, IQR: 4-14; p <.0001).

Common Cancer Types and Infusion Medications

The most common cancer type treated in both HI and HOPDs was malignant neoplasms of lymphoid, hematopoietic, and related tissue, as shown in Table 2. Among HI-only patients, 42.3% of had this cancer type, while 28.7% of patients in HOPDs had the same cancer type. The most infused medication in HI was Ifex with/without Mesnex (ifosfamide with/without mesna), (16.6%), whereas

TABLE 1 | Demographics and Characteristics of Patients by Site of Care

		Infusion Center n (%)	Home Infusion n (%)	Both Services n (%)	Total n (%)	p-value
Total Patients		3,001 (95.39)	52 (1.65)	93 (2.96)	3,146 (100.00)	
Age Group	18-29 years old	46 (1.53)	15 (28.85)	3 (3.23)	64 (2.03)	
	30-49 years old	440 (14.66)	21 (40.38)	25 (26.88)	486 (15.45)	
	50-64 years old	884 (29.46)	15 (28.85)	51 (54.84)	950 (30.20)	
	65-74 years old	935 (31.16)	1 (1.92)	12 (12.90)	948 (30.13)	
	75+ years old	696 (23.19)	0 (0.00)	2 (2.15)	698 (22.19)	<.0001
Sex	Female	1,723 (57.41)	34 (65.38)	43 (46.24)	1,800 (57.22)	
	Male	1,278 (42.59)	18 (34.62)	50 (53.76)	1,346 (42.78)	0.049
Interpreter Needed	No	2,891 (96.33)	48 (92.31)	86 (92.47)	3,025 (96.15)	
	Yes	110 (3.67)	4 (7.69)	7 (7.53)	121 (3.85)	0.056
Ethnicity	Hispanic or Latinx	41 (1.37)	3 (5.77)	4 (4.30)	48 (1.53)	
	Not Hispanic or Latinx	2,216 (73.84)	37 (71.15)	74 (79.57)	2,327 (73.97)	
	Unknown	744 (24.79)	12 (23.08)	15 (16.13)	771 (24.51)	0.0056
Race	American Indian or Alaska Native	14 (0.47)	0 (0.00)	0 (0.00)	14 (0.45)	
	Asian	112 (3.73)	4 (7.69)	4 (4.30)	120 (3.81)	
	Black	182 (6.06)	2 (3.85)	10 (10.75)	194 (6.17)	
	White	2,608 (86.90)	43 (82.69)	73 (78.49)	2,724 (86.59)	
	Other/Unknown	85 (2.83)	3 (5.77)	6 (6.45)	94 (2.99)	0.12
		Median (IQR)				
Infusions during time period		6 (4, 14)	4.5 (2, 6)	24 (10, 44)	6 (4, 15)	<.0001
Any medication switch during time period	Yes	244 (8.13)	7 (13.46)	28 (30.11)	279 (8.87)	<.0001

TABLE 2 | Top 5 Most Common Cancer Types Treated Among Patients by Site of Care

HOPD-only n = 3,001 patients		HI-only n = 52 patients		Both SOC n = 93 patients	
Type	n (%)	Type	n (%)	Type	n (%)
Malignant neoplasms of lymphoid, hematopoietic and related tissue	860 (28.66)	Malignant neoplasms of lymphoid, hematopoietic and related tissue	22 (42.31)	Malignant neoplasms of mesothelial and soft tissue	43 (46.24)
Malignant neoplasms of digestive organs	666 (22.19)	Benign neoplasms, except benign neuroendocrine tumors	15 (28.85)	Malignant neoplasms of lymphoid, hematopoietic and related tissue	25 (26.88)
Malignant neoplasms of breast	593 (19.76)	Malignant neoplasms of mesothelial and soft tissue	15 (28.85)	Neoplasms of uncertain behavior, polycythemia vera and myelodysplastic syndromes	13 (13.98)
Neoplasms of uncertain behavior, polycythemia vera and myelodysplastic syndromes	459 (15.29)	Malignant neoplasms of bone and articular cartilage	12 (23.08)	Malignant neoplasms of bone and articular cartilage	12 (12.90)
Benign neoplasms, except benign neuroendocrine tumors	407 (13.56)	Neoplasms of unspecified behavior	6 (11.54)	Malignant neoplasms of eye, brain and other parts of central nervous system	12 (12.90)

in the HOPDs it was Avastin/Mvasi/Zirabev (bevacizumab and biosimilars; 17.6%), as shown in Figure 1.

Table 3 indicates rates of safety outcomes by the site of care where a patient was treated. Patients had similar distributions of ED admission, hospitalization, or utilizing any acute care service within 48-hours following infusion based on the site of care ($p > 0.05$ for all comparisons). More specifically, 212 (6.74%) patients required ED admission, and 206 (6.55%) patients were hospitalized following infusions. The incidence of patient-

FIGURE 1 | Distribution of Most Infused Medications by Site of Care

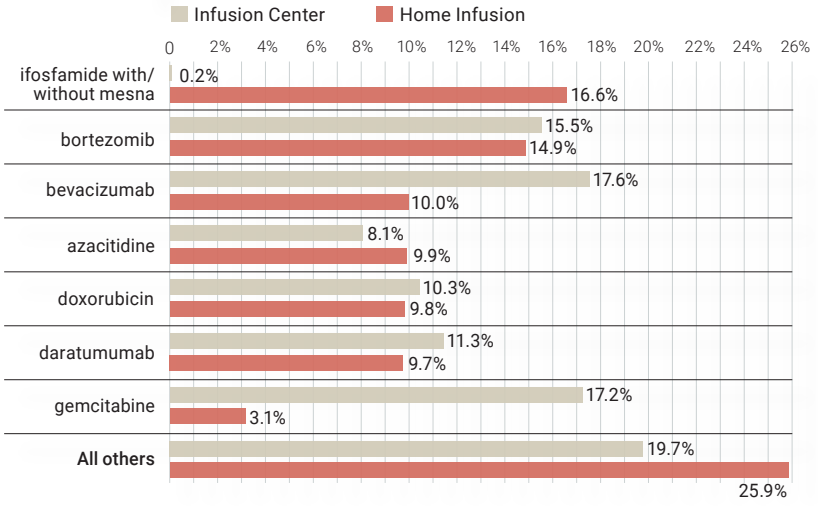

TABLE 3 | Patient-Level Safety Outcomes by Infusion Site of Care

	Infusion Center n (%)	Home Infusion n (%)	Both Services n (%)	Total n (%)	*p*-value
Total Patients	3,001 (95.39)	52 (1.65)	93 (2.96)	3,146 (100.00)	
ED admission within 48 hours of infusion	201 (6.70)	4 (7.69)	7 (7.53)	212 (6.74)	0.92
Hospitalization within 48 hours of infusion	191 (6.36)	4 (7.69)	11 (11.83)	206 (6.55)	0.10
Any acute care within 48 hours of infusion	360 (12.00)	7 (13.46)	16 (17.20)	383 (12.17)	0.31
Respiratory infection within 2 weeks of infusion	111 (3.70)	0 (0.00)	3 (3.23)	114 (3.62)	0.36
Infusion-related reaction (IRR)	56 (1.87)	0 (0.00)	10 (10.75)	66 (2.10)	<.0001

level respiratory infection was also similar across sites of care (p = 0.36), with 114 (3.62%) of patients being diagnosed with COVID-19, respiratory syncytial virus, or influenza within 14-days of their infusion. However, rates of IRRs differed significantly by site of care, with 10 (10.75%) of patients treated across both sites of care having a reported IRR compared to 56 (1.87%) of HOPD-only patients and 0 (0.0%) of HI-only patients (p <.0001).

Of 39,294 infusions during the study period, 38,052 (96.8%) occurred within HOPDs and 1,242 (3.2%) occurred within HI. Table 4 indicates safety outcomes by site of care at the infusion-level. Notably, rates of acute care visits within 48 hours of an oncology infusion were similar across sites of care (HOPD: n = 464, 1.2% vs. HI: n = 18. 1.5%; p = 0.47). However, respiratory infections reported within 2 weeks following infusion differed by site of care, with 0 (0.0%) occurring following HI care and 144 (0.4%) following infusions at HOPDs (p = 0.03).

Table 5 indicates further information on IRRs across sites of care. There were 75 total documented IRRs resulting in a rate of 191 IRRs per 100,000 infusions. Rates were similar across sites of care, with a rate of 192 per 100,000 infusions in HOPDs and 161 per 100,000 infusions in HI (p = 0.81). Of the 73 IRRs occurring

TABLE 4 | Infusion-Level Safety Outcomes Following Infusion by Site of Care

	Infusion Center n = 38,052	Home Infusion n = 1,242	Total n = 39,254	*p*-value
Infusion-Related Reaction (IRR)	73 (0.19%)	2 (0.16%)	75 (0.19%)	0.81
ED admission within 48 hours of infusion	234 (0.61%)	8 (0.64%)	242 (0.62%)	0.89
Hospitalization within 48 hours of infusion	239 (0.63%)	10 (0.81%)	249 (0.63%)	0.44
Any acute care within 48 hours of infusion	464 (1.22%)	18 (1.45%)	482 (1.23%)	0.47
Respiratory infection within 2 weeks of infusion	144 (0.38%)	0 (0.00%)	144 (0.37%)	0.029

TABLE 5 | IRR Grading and Additional Information by Site of Care

Infusion Center	Home Infusion
Total Infusions: **38,052**	Total Infusions: **1,242**
IRR 73 (0.19% of infusions) **Incidence rate:** 192 per 100,000 infusions	**IRR** 2 (0.16% of infusions) **Incidence rate:** 161 per 100,000 infusions
IRR Grading • Grade 1: 1 (1.37%) • Grade 2: 48 (65.75%) • Grade 3: 24 (32.88%)	**IRR Grading** • Grade 3: 2 (100%)
Dose of occurrence First Dose: **56** • Rate: 147 per 100,000 infusions Subsequent Dose: **17** • Rate: 45 per 100,000 infusions	**Dose of occurrence** First Dose: **0** • Rate: 0 per 100,000 infusions Subsequent Dose: **2** • Rate: 161 per 100,000 infusions
Medications associated with IRRs: Adriamycin/doxorubicin: 43 (58.90%) Avastin/bevacizumab: 2 (2.74%) Bavencio/avelumab: 1 (1.37%) Darzalex Faspro/daratumumab: 19 (26.03%) Gemzar/gemcitabine: 1 (1.37%) Herceptin/trastuzumab: 7 (9.59%)	**Medications associated with IRRs:** Darzalex Faspro/daratumumab: 1 (50%) Vidaza/azacytidine: 1 (50%)

TABLE 6

CRIs and Late Infusions Among HI Infusions

Total Infusions: 1,242
CRIs
Number (%) of CRIs 2 (0.16% of infusions)
CRI Grading • Grade 3: 2 (100.0%)
Therapy resulting in CRIs • Adriamycin/doxorubicin, including Doxil/doxorubicin liposomal: 1 (50.0%) • Cytarabine: 1 (50.0%)
Late Infusions
Number of late infusions 43 (3.46%)
Reasons for late infusions • Infection: 11 (25.58%) • Planned care (surgery, vaccine, delivery): 11 (25.58%) • Care coordination (scheduling, labs, etc.): 7 (16.28%) • Hospital admission: 6 (13.95%) • Insurance or financial: 1 (2.33%) • Other: 7 (16.28%)

within HOPDs, most (n = 48, 65.75%) were moderate (Grade 2), and 24 (32.89%) were severe (Grade 3). Most (n = 56, 76.7%) of the IRRs in the HOPDs occurred at the first infusion dose, and a majority (n = 43, 58.90%) occurred with adriamycin/doxorubicin infusions. There were only 2 IRRs in HI. Both were severe (Grade 3), and both occurred in subsequent dose infusions.

Table 6 indicates information on CRIs and late infusions occurring within HI. CRIs were uncommon, with only 2 CRIs reported among 1,242 infusions (0.16%) and both were severe (Grade 3). Further, there were 43 (3.46%) late infusions among all HI infusions reported during the study period. Most were late due to infection (n = 11, 25.58%) or planned care such as surgery, vaccine, or childbirth delivery (n = 11, 25.58%).

DISCUSSION

This study indicated that oncology infusions administered within HI may have a comparable safety profile to those administered within HOPDs. These results have important implications for patient care, payor contracting, and health system utilization, especially during conditions where HOPDs lack the space and staffing to accommodate the surge in patients who necessitate infusion care.[13] Home infusion services may then provide a safe, convenient, and comfortable repose for patients to receive more personalized oncology infusion care.[8,11] Further, home infusion services can work jointly with HOPDs to provide care for patients, such as collecting blood prior to an infusion, providing dressing changes, or disconnecting home chemotherapy pumps so patients may avoid hospital admission for extended chemotherapy infusions.[17,18]

It is well-recognized by groups such as the American Cancer Society, that home care for the management of cancer, including receiving therapies from HI services, is important to promote via research, collaboration, and development.[19] Additionally, generally speaking, patient views of home infusion are positive, with reports of high patient satisfaction and confidence in care, better physical and mental well-being, and less disruption in lifestyle compared to HOPDs.[20,21] Many commercial payors also recognize the benefits of providing infusion in the home, even for riskier therapies.[8,9,22] Despite this, certain specialty organizations, such as the Community Oncology Alliance and the American Society of Clinical Oncology, affirmed their reservations about home therapy for oncology infusions in 2020 due to concerns about quality and safety, though the American Society of Clinical Oncology has since updated their position to affirm that home therapy may be an option for some patients.[23-25] They further recommend more independent and unbiased research to evaluate home infusion safety, with messaging that patient safety should take precedence over purely financially-driven decisions.

The current analysis indicates that a health system-based HI service provides a similar safety profile to HOPDs, with rates of ED and inpatient visits following infusions, and IRR rates that are similar across sites of care. While it should be noted that rates of IRRs were higher at the patient-level among individuals who were treated across both sites of care (i.e. HI and HOPDs), this was likely due to IRRs occurring during initial doses of oncology medications at HOPDs, and, once medications were optimized, the patient was able to receive home infusion care without any follow-up issues. This may suggest that home infusion services are appropriate for cancer patients, especially as they are infusing maintenance doses of their medications.

The rate of IRRs can be quite high in oncology-related infusions, especially on initial doses.[26,27] Some studies have published the incidence of IRRs ranging up to 15% for Grade 3-4 IRRs.[27] A more recent single-site study of IRRs within an outpatient oncology clinic noted an overall rate of 0.53%, with about half being Grade 2 or higher.[28] However, the incidence hinges on specific therapy, cancer type, and administration practices.[27] Regardless, these previously reported rates are higher than the incidence rates found in the current analysis, which noted an overall rate of 0.19% (191 per 100,000 infusions).

While IRR incidence differences between the current study and previous literature could potentially be due to reporting differences or variations in medications being evaluated, they may be due to differing care practices within the studied institution; for example, the institution's home infusion service line has protocols that create efficient collaboration with on-site colleagues to prevent medication errors, help nurses identify IRRs faster, connect patients to providers when they have follow-up questions, and allow an immediate return to the patient's home for lab draws or line care when needed. It should be emphasized that the incidence of IRRs for infusions occurring in the home were similar to those occurring in HOPDs in the current study (0.16% vs. 0.19%, respectively), with only 2 IRRs reported among 1,242 home oncology infusions. Thus, even within the home infusion setting, incidence of IRRs is notably lower than previously published literature, which further demonstrates the safety practices within the institution's HI service line.

While many studies focus on rates of IRRs regarding infusion safety, this study also followed all-cause acute care utilization post-infusion to denote either very serious complications or delayed IRRs. It was noted that there was no statistically significant difference between post-infusion acute care utilization within 48-hours among HOPDs and HI, with an overall rate of 1.23%.

These results conflict with previous literature of biologic infusions indicating that those occurring at home had slightly higher odds of acute care utilization than did facility-based infusions; though the conflict may arise due to institutional protocols or the different medications being compared.[29] Further, the current results are contrary to the concerns cited by professional organizations regarding home infusion having inadequate safety protocols or not having enough clinicians readily available to care for patients.[23,25] If this were the case, it would be expected that infusions in the home would result in greater proportions of acute care visits compared to those within infusion centers. In practice, HI provides one-on-one care, while infusion centers employ 1 nurse for multiple patients; thus, home infusion nurses may, in fact, identify IRRs sooner than they would be identified in the infusion center, and take action to reduce their acuity more quickly and avoid unnecessary acute care visits. Additionally, patients and HI nurses have 24/7 access to support if questions arise during or after the home care visit. Further, to increase safety, the use of technology is pertinent, especially within the home setting; for example, video chat services have been known to result in fewer medication errors than standard care.[30] Ultimately, it is agreed upon that many oncology regimens can be safely administered within the home, which is suggested by the results of the current study.[18]

Finally, it should be mentioned that the patient population within the current study who received oncology infusions within HI had broadly different sociodemographic characteristics than those receiving care in HOPDs. This study noted that patients were younger, more likely to be female, and more likely to be Hispanic or Latinx when treated within HI compared to HOPDs. Other studies have also noted sociodemographic differences across infusion site of care.[31] These differences may correlate with the prevalence of different cancer types and medications infused at each site of care, and may also be related to upstream care characteristics such as oncologist preferences and payor-related information. For example, Medicare currently only has coverage for fragments of HI services for oncology medications through Part B, and any coverage under Part D leaves the patient with potentially unaffordable out-of-pocket costs.[10] Whereas many commercial and medical assistance plans allow access to this important service.[8,9,32]

Social determinants of health are strongly correlated with health outcomes and transportation, itself, is a primary barrier to health care access, thus, ensuring patients have sufficient access to home infusion therapy through payor contracting is an important step toward health equity in the United States.[33,34] Access to HI care is also especially important among patients with high-acuity conditions, such as cancers, as the current study noted lower rates of respiratory infections following infusions among patients who received HI care compared to HOPD care. Since oncology patients are often immunocompromised, respiratory infections

are common and can cause morbidity and mortality.[15] Thus, HI care may be of the utmost importance for oncology patients to ensure safe, personalized, convenient, and comfortable access to medication therapies, lab draws, and dressing changes.[8,9,11,17]

Limitations of the current study include commonly noted characteristics of retrospective studies of electronic medical record information such as potential reporting discrepancies.[35] In particular, while both HI and HOPDs had standardized methods to capture IRRs, they were slightly different due to differing information capture systems, and HOPDs did not have a method of capturing CRIs at all. Similarly, outcomes of acute care utilization would only be noted if patients received care within 1 of the health system's 9 EDs or 12 hospitals, thus would not capture these if they occurred outside of the health system. However, oncologists recommend that their patients receive care, especially acute care, within the health care system because they can efficiently collaborate to provide the nuanced specialty care required of these highly complex patients through shared medical record, hospital privileges, and closeknit communication with other care team members. Thus, acute care utilization should be well-captured.

CONCLUSION

This study demonstrates that oncology infusions administered through home infusion services have safety outcomes comparable to those provided in hospital-based outpatient infusion centers. Despite differences in patient demographics and cancer types, the rates of adverse events, hospitalizations, and infections were similar between the 2 settings. Since safety is a concern regarding oncology therapies, this understanding enables health care providers and their patients to make informed and personalized decisions regarding the appropriate site of care for treatment, especially as HOPDs are reaching capacity.[13,23,25] This study's results may allow providers to optimize resource allocation and enhance the quality of care delivered through balancing a patient's individual needs and preferences. As health care continues to evolve towards more patient-centered models, home infusion services represent a safe, convenient, and valuable option for delivering high-quality oncology care.

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