A Pilot Study of Ocrelizumab Infusion Reaction Rates Among Multiple Sclerosis Patients Treated in a Hospital and 2 Outpatient Sites of Care

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ABSTRACT

Objectives

Economic data on site of care optimization is well-established, yet limited data exist on the safety of administering ocrelizumab in home infusion settings. Ocrelizumab is administered for the treatment of multiple sclerosis and carries a warning for the risk of infusion-related reactions (IRRs) during administration. The study objective was to measure the incidence and severity of infusion-related reactions in patients receiving ocrelizumab administered in both hospital-based and outpatient sites of care.

Methods

This was a retrospective study of patients who received ocrelizumab infusions for multiple sclerosis between March 2017 and September 2019. Patient and infusion characteristics were compared by infusion setting using appropriate nonparametric tests and z-tests.

Results

There were 85 patients with 230 ocrelizumab infusions. Patients were similar demographically. Outpatient sites of care had a higher proportion of maintenance infusions than hospital-based sites of care (outpatient: 81.1%, hospital: 43.0%, p=0.0001). There were 25 IRRs reported, a majority of these in the hospital setting (92.0%), with encounter rates similar across infusion settings (outpatient: 5.4%, hospital: 11.9%; p=0.24).

Conclusion

This study demonstrated similar incidence, severity, and management of ocrelizumab IRRs regardless of infusion setting. Although limited by the small sample size, safety results endorse clinical support for administering ocrelizumab in outpatient sites of care. Patient access to ocrelizumab infusions in their home or ambulatory infusion suite may improve adherence to the medication therapy and improve disease outcomes.

Keywords: *infused specialty medication, home infusion, infusion site of care (SOC), safety outcomes, infusion-related reaction (IRR)*

Key Points:

- Site of care optimization as a utilization management strategy encourages the use of lower-cost, convenient care settings, however, data on real-word utilization and clinical outcomes is limited.
- This retrospective pilot study demonstrated that infusion-related reactions from ocrelizumab are infrequent and mild.
- Current data supports the safe and cost-effective administration of ocrelizumab in an outpatient, ambulatory, or home infusion setting.

Background

Since 2010, the number of specialty medications available in the United States, including infusion medications, has grown exponentially, which has driven infusion site of care (SOC) optimization programs focusing on therapeutic areas such as autoimmune, inflammatory, and oncology disease states.[1] SOC optimization aims to reduce the total cost of care and promote positive clinical outcomes for patients receiving infused or injected therapies, including specialty medications and biologics.[2-4] Home infusion allows for administration of intravenous, subcutaneous, and injectable medications by patients or skilled nurses in an individual's home. Home infusion has emerged as an ideal setting for SOC programs due to increased patient accessibility and convenience of care as well as reduced exposure to infectious agents. The majority (85%) of commercial health plans direct patients toward home infusions.[5-7] Additionally, home infusion offers considerably less expensive care; for example, the estimated cost per claim for infliximab and ustekinumab, commonly utilized inflammatory specialty infused medications, are considerably less when administered through home infusion compared to a hospital-based infusion center (infliximab: $6,692 vs. $11,081; ustekinumab: $15,564 vs. $31,385, respectively).[1]

Multiple sclerosis and autoimmune diseases have been a large focus of SOC programs.[6] Multiple sclerosis has been estimated to affect nearly 1 million American adults and has several high-cost, Food and Drug Administration (FDA)-approved injectables and infused disease modifying therapies (DMTs) available, making it a great candidate for SOC programs.[8] FDA-approved infused medications include Lemtrada® (alemtuzumab), Tysabri® (natalizumab), and Ocrevus® (ocrelizumab). Alemtuzumab and natalizumab have required Risk Evaluation Mitigation Strategy (REMS) programs.[9] Ocrelizumab, a CD20-directed monoclonal antibody, has become a widely used DMT for treating relapsing and primary progressive forms of multiple sclerosis since its FDA approval in 2017.[10] Ocrelizumab offers convenient twice-yearly dosing and demonstrated lower rates of clinical disease progression in clinical trials.[10-13] However, ocrelizumab infusions have been noted to carry a high risk of infusion-related reactions (IRR), which range from minor issues like pruritis and fever to severe reactions like tachycardia and bronchospasms. In clinical trials, the incidence of IRRs for ocrelizumab was 34-40%, with the highest incidence occurring during the first infusion; additionally, 58-70% of patients developed at least one infection related to the infusion, such as respiratory tract, skin, or herpes infections.[13]

Previous literature has evaluated infliximab, a highly utilized biologic therapy with indications for several inflammatory disease states that carries a possible risk of IRRs.[14] In a retrospective chart review of patients who received infliximab infusion in community clinics, severe infusion reaction events were rare, the majority being mild-moderate reactions and none requiring hospital admissions.[15] Similarly, a retrospective chart review of Crohn's disease and ulcerative colitis patients who received infliximab demonstrated that IRRs were adequately managed in a community setting without provider intervention.[16] Another large population of specialty infusion medications includes enzyme replacement therapy. Enzyme replacement therapy has been shown to be infused safely in the home.[17] A study in Australia has similarly demonstrated no clinically significant difference in safety and effectiveness of natalizumab infusions in the clinic versus home infusions in patients with multiple sclerosis.[18] By examining ocrelizumab infusions and infusion reaction rates, this study adds to the limited body of evidence that supports specialty medication administration through home infusion.

More recently, several health care systems across the United States have established programs to administer ocrelizumab either at an ambulatory infusion suite or in the patient's home.[19] Although the cost-effectiveness of transitioning patients to home infusion is well-established, there is limited research on the safety of administering ocrelizumab infusions in the patient home.[14-18,20,21] This pilot study collected data on administration of ocrelizumab in a hospital-based site of care and outpatient sites of care. Hospital-based sites of care are within the hospital setting. Outpatient infusions are administered in the patient home or ambulatory infusion suite. Ocrelizumab infusions were categorized by initial infusion and maintenance dose administration and then measured by rates and characteristics of IRRs. The research will support the growing interest in SOC programs for specialty infusions and engage the needs of multiple sclerosis patients prescribed ocrelizumab.

Methods

Study Setting and Population. This was a retrospective cohort study of adult patients presenting to a large, Midwestern health system with both hospital-based infusion sites of care and outpatient infusion sites of care. For this study, the hospital-based infusions were administered by a nurse and included physician oversight and immediate access to emergency services. The outpatient infusions were administered by a nurse in an ambulatory infusion suite or patient home. Inclusion criteria for patients included those who received at least one dose of ocrelizumab for multiple sclerosis between March 2017, when ocrelizumab was FDA-approved, and September 2019. Patients were excluded if they were concurrently using other DMTs in addition to ocrelizumab. This study was approved by the health system's Institutional Review Board (IRB).

Infusion procedures. Institutional protocol for ocrelizumab administration and management of IRRs were the same across infusion settings. Patients received oral acetaminophen, IV or oral diphenhydramine, and IV or oral steroid premedication as ordered prior to each infusion. Initial infusions were administered over 2.5 hours and maintenance infusions were administered over 3.5 hours per manufacturer-recommended rate titration steps and all patients were monitored for 1 hour post-infusion.[10]

Data collection: Eligible patients were identified through the electronic medical record; a manual chart review was completed to document patient demographics and characteristics on infusion encounters. The chart review was conducted by a single pharmacist trained in the health system's electronic medical record systems. Data collection was maintained securely within the health system.

Variables of interest. A predictor of interest was the setting in which patients received ocrelizumab infusions (hospital or outpatient). Patients who switched infusion settings had encounters included only at their most recent infusion setting.

The primary outcome was adverse events occurring during infusion and included IRRs, severity of reaction, reaction management strategy, and new or recurrent infections occurring due to ocrelizumab therapy. Reaction severity was assessed using Common Terminology Criteria for Adverse Events (CTCAE) version 5.0, which standardizes and defines the severity of IRRs as Mild (Grade 1), Moderate (Grade 2), Severe (Grade 3), Life-threatening (Grade 4), and Death (Grade 5).[22] Other variables assessed with respect to infusion setting included patient demographics such as age, gender, and race, and clinical information such as type of multiple sclerosis (relapsing or primary progressive), treatment history including prior DMTs and reason for the switch to ocrelizumab, infusion duration, and total infusion visit time.

Data analysis: Data were summarized using traditional methods, including the expression of categorical data by frequency and percent; continuous variables were assessed for normality using the Kolmogorov–Smirnov test and then summarized using median and interquartile range (IQR) after deemed non-normally distributed. Data were compared by infusion setting using appropriate nonparametric statistical tests, which included chi-squared, and Fisher's exact tests for categorical data and Mann-Whitney U tests for continuous data. Z-tests compared proportions of IRRs occurring across infusion settings. We estimated the odds of an IRR and associated 95% confidence intervals (CIs) with respect to site of care and infusion dose using logistic regression. The significance level was set *a priori* as α=0.05.

Results

Patient characteristics. There were 85 patients with 230 ocrelizumab infusions who met the study criteria. Patient baseline demographics and clinical characteristics by care setting are outlined in Table 1. Patients were largely similar across infusion setting by demographic and clinical characteristics. Study patients were predominantly male (n=48, 56.5%), white race (n=75, 88.2%), with a median age of 47 years (IQR: 38- 55). Within this population, 24 (28.2%) patients were treated through outpatient infusion sites of care, and 61 (71.8%) patients were treated in hospital-based infusion sites of care. Of outpatient infusions, nearly all (n=23, 95.8%) occurred in the ambulatory infusion suite. One patient received infusions in their home. Additionally,

TABLE 1 | Characteristics of Patients Treated with Ocrelizumab Infusions, March 17 through September 2019

		Total population, n=85	Outpatient Infusion Site(s), n=24 (28.24%)	Hospital-based Infusion Site(s), n=61 (71.76%)	*p* value
Age, years; Median (IQR)		47 (38, 55)	48.5 (37.5, 52.5)	47 (38. 55)	0.70
Race/Ethnicity	**White**	75 (88.24)	24 (100.00)	51 (83.61)	0.11
	Black	9 (10.59)	0 (0.00)	9 (14.75)	
	Hispanic	1 (1.18)	0 (0.00)	1 (1.64)	
Sex	**Male**	48 (56.47)	12 (50.00)	36 (59.02)	0.45
	Female	37 (43.53)	12 (50.00)	25 (40.98)	
Diagnosis	**Primary progressive MS**	32 (37.65)	8 (33.33)	24 (39.34)	0.61
	Relapse remitting MS	53 (62.35)	16 (66.67)	37 (60.66)	
Previous DMTs	**Interferon Beta**	41 (48.24)	11 (45.83)	30 (49.18)	0.78
	Glatiramer acetate	35 (41.18)	10 (41.67)	25 (40.98)	0.95
	Other DMTs	35 (41.18)	11 (45.83)	24 (39.34)	0.58
	None/Unknown	12 (14.12)	4 (16.67)	8 (13.11)	0.67
Reason for switch to ocrelizumab among patients with previous DMTs	**Disease progression**	46 (63.01)	12 (60.00)	34 (64.15)	0.18
	Side effects	17 (23.29)	3 (15.00)	14 (26.42)	
	Other (noncompliance, insurance, etc.)	10 (13.70)	5 (25.00)	5 (9.43)	
Number of infusions during study period; median (IQR)		2 (2, 4)	1 (1, 2)	3 (2, 4)	<0.001

IQR = Interquartile range; DMT = Disease modifying therapy

of the outpatient infusions, 13 (54.2%) transitioned from a hospital-based infusion SOC specifically due to SOC utilization management strategies by their health plans.

Many patients (n=41, 48.2%) had previously been treated with interferon beta or glatiramer acetate (n=35, 41.2%) for their multiple sclerosis. Among patients who had used DMTs previously, the primary reasons for switching to ocrelizumab infusion therapy included disease progression (n=46, 63.0%) or intolerable side effects of previous therapies (n=17, 14.1%). Hospital-based infusion patients underwent a greater number of infusions during the study period (median: 3, IQR: 2-4)) compared to the outpatient infusion group (median: 1, IQR: 1-3; $p<0.001$).

Infusion characteristics. There were 230 ocrelizumab infusions during the study period, including 37 (16.1%) outpatient infusions and 193 (83.9%) hospital-based infusions. Maintenance doses of ocrelizumab occurred more often in the outpatient sites of care compared to hospital-based infusions (n=30, 81.1% vs. n=83,43.0%, respectively; $p=0.0001$).

Infusion and total visit times were similar by infusion setting and dose type. Median total visit time for initial infusions was 4 (IQR: 3.75-4) hours

TABLE 2 | Description of Infusion Encounters for Ocrelizumab Across 85 Patients, March 2017 through September 2019.

		Total encounters, n=230	Outpatient Infusion Site(s), n=24 (28.24%)	Hospital-based Infusion Site(s), n=61 (71.76%)	*p* value
Dose timing	**Initial Day 1**	60 (26.09)	4 (10.81)	56 (29.02)	0.0001
	Initial Day 15	57 (24.78)	3 (8.11)	54 (27.98)	
	Maintenance	113 (49.13)	30 (81.08)	83 (43.01)	
Infusion time (hours), Initial doses; Median (IQR)		3 (2.75, 3)	3 (2.5, 3)	3 (2.75, 3)	0.31
Total visit time (hours), initial doses; Median (IQR)		4 (3.75, 4)	3.75 (3.5, 4)	4 (3.75, 4)	0.10
Infusion time (hours), maintenance doses; Median (IQR)		3.5 (3.5, 3.75)	3.5 (3.5, 4)	3.5 (3.5, 3.75)	0.55
Total visit time (hours), maintenance doses; Median (IQR)		4.5 (4.5, 5)	4.5 (4.5, 5)	4.5 (4.5, 4.75)	0.88
Any IRR	**Yes**	25 (10.87)	2 (5.41)	23 (11.92)	0.24
Timing of IRR	**Acute**	22 (88.00)	2 (100.00)	20 (86.96)	0.61
	Delayed	3 (12.00)	0 (0.00)	3 (13.04)	
	Initial Dose	17 (73.91)	1 (50.00)	16 (76.19)	0.42
	Maintenance Dose	6 (26.09)	1 (50.00)	5 (23.81)	
Severity of reaction	**Mild**	10 (31.82)	2 (100.00)	8 (25.00)	0.20
	Moderate	14 (63.64)	0 (0.00)	14 (70.00)	
	Severe	1 (4.55)	0 (0.00)	1 (5.00)	
Post-infusion Infection	**Yes**	9 (3.91)	0 (0.00)	9 (4.66)	0.18

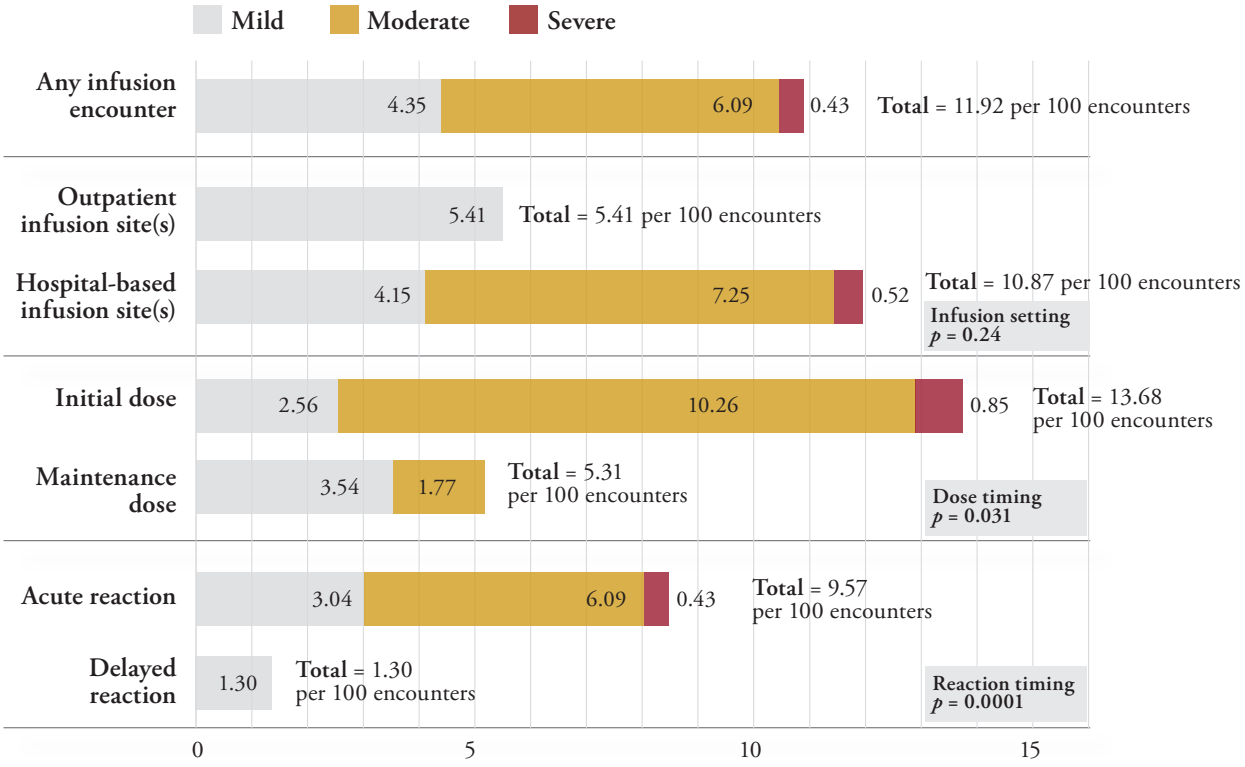
IQR = Interquartile range; IRR = Infusion-related reaction

and for maintenance infusions was 4.5 (IQR: 4.5-5) hours. Comparisons of encounter characteristics by infusion site are available in Table 2.

Infusion-related reactions (IRRs)

There were 25 IRRs noted among 20 patients during the study period; 22 IRRs (88.0%) were acute and occurred during the observation time following the infusion and 3 (12.0%) were delayed and occurred ≥24 hours after infusion administration. Only 2 IRRs occurred among outpatient infusions and both were acute and mild. Nearly two-thirds of IRRs were moderate (n=14, 63.6%), with 10 (31.8%) being mild and only 1 (4.6%) being severe. The 3 delayed IRRs were all mild and consisted of symptoms such as aches, rash, and nausea. The rate of IRRs per encounter was 5.4 per 100 encounters for outpatient infusions and 11.9 per 100 encounters for hospital-based infusion encounters (p=0.24). Most (72.7%) IRRs occurred during initial infusions, at a rate of 13.68 per 100 encounters compared to 5.31 maintenance dose IRRs per 100 encounters (p=0.031). Moderate severity IRRs had physician consult and the single severe IRR resulted in emergency medical attention. Figure 1 indicates the breakdown of IRRs by severity and dose administration. Based on regression models depicted in Table 3, site of infusion was not significantly associated with IRR when controlled for timing of dose (initial versus maintenance). In fact, initial infusion doses were 3 times more likely to result in an IRR independent of infusion site when compared to maintenance doses (Model 1). Adjusting for both infusion site and timing

FIGURE 1 | Incidence of Ocrelizumab Infusion Reactions per 100 Infusion Encounters



of dose, initial dose was still 2.8 times more likely to result in an IRR compared to maintenance dose (Model 2). Reviewing only the initial (Model 3) and maintenance (Model 4) doses, infusion site, again, was not significantly associated with risk of IRR.

Infections

No intravenous line infections were reported at any site of care (hospital or outpatient), though 7 patients treated across 10 hospital-based infusion encounters reported viral or bacterial agents causing chronic or acute infection. These infections included upper respiratory tract, pneumonia, herpes simplex, and urinary tract infections. Recurrent infection was noted in 3 patients; multiple infections were noted in 2 patients. No infections were documented for outpatient infusions.

TABLE 3 | Regression Models Examining Effect of Site of Care on IRR with Respect to Initial and Maintenance Ocrelizumab Infusions

	Model 1	Model 2	Model 3	Model 4
	All infusions, univariate	All infusions, adjusted	Initial Dose	Maintenance dose
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Hospital-based infusion site(s)	reference	reference	reference	reference
Outpatient infusion site(s)	0.47 (0.11, 2.09)	0.71 (0.15, 3.35)	0.98 (0.11, 8.68)	0.54 (0.06, 4.80)
Maintenance dose	reference	reference		
Initial dose	3.03 (1.15, 8.00)	2.84 (1.04, 7.75)		

Discussion

Home infusion therapy is well-established and accepted by health care providers as safe and clinically equivalent to hospital based infusions, with approximately 829,000 patients receiving 1.24 million home infusion therapies annually, of which >15% are specialty medications.[7] The current pilot study evaluated the safety profile of ocrelizumab infusions in multiple sclerosis patients and found similar rates of adverse reactions and infections within outpatient sites of care and hospital-based infusions, supporting the outpatient settings for infusion therapy for treatment of multiple sclerosis. The home may be an ideal choice for patients seeking more personalized and convenient medication administration and for payors looking to decrease costs while increasing value to their patients.

The landscape of home infusion indicates equal or superior patient and clinical outcomes compared to hospital-based infusion. Specifically, a systematic review of 13 studies evaluated the utility of home infusion versus clinic-based infusion as a mechanism to affect the triple aim of better health, better health outcomes, and lower costs, and demonstrated that home infusion patients on anti-infective medications were no more likely to experience adverse drug events or side effects, had equal or better clinical outcomes including lower rates of hospitalizations.[21] The review also noted higher quality of life for patients and significantly lower costs within home infusion compared to infusions within medical settings. However, the review predominantly included patients with anti-infective infusions. Specialty medications and biologic infusion therapy outcomes were not evaluated. Similar to the review, however, our study was able to demonstrate that patients receiving ocrelizumab outpatient infusions were not at added risk for adverse reactions and have comparable safety outcomes. Although it could not be evaluated in this pilot study, it is likely that outcomes with regard to cost savings and increased access to specialty therapies are more pronounced in this study given the inherent high cost of ocrelizumab, which has a list price of $68,000/year[23] and reduced costs for providing home infusion services, in general.[3] To date, limited evidence exists examining the safety of administering specialty infusions through home infusion. Our study provides added support to current literature by evaluating home infusion utility through the lens of specialty infusions and demonstrated that infusing ocrelizumab in outpatient site is comparable to hospital-based infusion centers. Outpatient infusion does not result in higher rates of IRR.

In our study, reported IRRs for ocrelizumab were similar in all infusion settings, and reactions that occurred during outpatient infusions were managed by skilled nurses without direct provider intervention. Our study reported 9% of infusions resulting in an IRR. The incidence of IRRs noted in this pilot study is lower than reported in the clinical trials. In clinical trials, the incidence of IRR for patients on ocrelizumab was 34.3% and 39.9%, respectively.[10-13] In clinical trials, the incidence was highest with the first dose and decreased with each subsequent dosing, which is reflective of this study population and 80% of reactions occurring with the initial dose. Regression models on study data also demonstrate that initial doses are more likely to result in an IRR compared to maintenance doses regardless of infusion site, which further supports site of care optimization for maintenance doses through use of outpatient sites of care.

Limitations of this study include the small and homogenous patient population overall and a single patient in the home infusion setting. Provider office is also a common outpatient site of care for specialty therapies but was not an infusion site included in this study. While this pilot study involved robust data collection techniques, larger, multicenter studies of ocrelizumab and other specialty infusion therapies are important to further evaluate their safety profiles in the home setting across more diverse population groups. Further, home infusion services in this health system use an electronic medical record (EMR) separate from the institution's EMR, thus, infections may have been tracked inconsistently across infusion settings. As such, the chart review for these patients also examined clinic visit records surrounding the infusion date to examine the presence of infections when documentation was available. Outcomes were collected by unblinded nurses delivering infusions at both sites of care.

Conclusion

This pilot study is a key step in understanding the safety of administering biologic specialty therapies through home infusion, specifically for patients with multiple sclerosis. This study demonstrated that ocrelizumab can be administered with a low rate of IRRs in the hospital

or outpatient sites of care. Compared to hospital-based infusions, ocrelizumab had similar risk of adverse effects including IRRs and infections when administered in outpatient sites of care. Notably, the overall observed incidence of IRRs within the study population was lower than what has previously been documented in clinical trials. Data support administration of ocrelizumab outside a hospital-based infusion site. Additional research on SOC programs will not only advance clinical insight for home infusion clinicians but also improve accessibility and quality of care to immunocompromised patients who may benefit from receiving infusions in an ambulatory infusion suite or in the comfort of their own home.

Disclosures

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References

1. Magellan Rx Management. Employer market insights report, 1st edition. 2018. Available at: https://www1.magellanrx.com/publications/employer-market-insights-report Accessed April 1, 2020.
2. United Health Care. Provider Administered Drugs, Site of Care Review Guidelines, Effective April 1, 2019.
3. Counce J. Home Infusion's Expanding Role in Optimizing Site of Care. *Infusion Magazine*. May/June 2019.
4. Johnson R, Freeman EN. Addressing Costs and Continuity of Care through Innovative Solutions for Infused Therapies: A Collaborative Experience with Infliximab. Am Health Drug Benefits. 2011;4(1):39-46.
5. Magellan Rx Management. Employer market insights report, 2nd edition. 2019. Available at: https://www1.magellanrx.com/documents/2019/05/2019-mrx-employer-market-insights-report.pdf/ Accessed April 1, 2020.
6. DIMENSIONS. Specialty Management Solutions. Issue Brief: Site-of-Care Optimization. 2015. Janssen Biotec, Inc. and Avalere Health.
7. Phase I:2010 NHIA Provider Survey Comprehensive Aggregate Analysis Report. National Home Infusion Association, 2011.
8. The prevalence of MS in the United States A population-based estimate using health claims data Mitchell T. Wallin, et al. LaRocca Neurology Mar 2019, 92 (10) e1029-e1040; DOI: 10.1212/WNL.
9. National Multiple Sclerosis Society. Treating MS. Available at: https://www.nationalmssociety.org/Treating-MS/Medications. Accessed May 1, 2022.
10. OCREVUS® intravenous injection, ocrelizumab intravenous injection. Genentech Inc (per FDA), South San Francisco, CA, 2018.
11. Hauser SL, Bar-Or A, Comi G, et al. Ocrelizumab versus interferon beta-1a in relapsing multiple sclerosis. *N Engl J Med.* 2016;376(3):221-234.
12. Montalban X, Hauser SL, Kappos L, et al. Ocrelizumab versus placebo in primary progressive multiple sclerosis. *N Engl J Med*.2017;376(3):209-220
13. Mayer L, Kappos L, Racke MK, Rammohan K, Traboulsee A, Hauser SL, Julian L, Köndgen H, Li C, Napieralski J, Zheng H, Wolinsky JS. Ocrelizumab infusion experience in patients with relapsing and primary progressive multiple sclerosis: Results from the phase 3 randomized OPERA I, OPERA II, and ORATORIO studies. *Mult Scler Relat Disord.* 2019 May;30:236-243.
14. REMICADE® intravenous injection, infliximab intravenous injection. Janssen Biotech Inc (per FDA), Horsham, PA, 2018.
15. Ducharme J, Pelletier C, Zacharias R. The safety of infliximab infusions in the community setting. *Can J Gastroenterol.* 2010 May;24(5):307-11.
16. Checkley LA, Kristofek L, Kile S, Bolgar W. Incidence and Management of Infusion Reactions to Infliximab in an Alternate Care Setting. *Dig Dis Sci.* 2019;64(3):855–862.
17. Elstein D, Burrow TA, Charrow J, Giraldo P, Mehta A, Pastores GM, Lee HM, Mellgard B, Zimran A. Home infusion of intravenous velaglucerase alfa: Experience from pooled clinical studies in 104 patients with type 1 Gaucher disease. *Mol Genet Metab.* 2017 Jan - Feb;120(1-2):111-115.
18. Schultz TJ, Thomas A, Georgiou P, et al. Home infusions of natalizumab for people with multiple sclerosis: a pilot randomised crossover trial. *Ann Clin Transl Neurol.* 2021;8(8):1610-1621. doi:10.1002/acn3.51410
19. Ocrevus. Genentech's Philosophy on Site-of-Care and Home Infusion. Available at: https://www.ocrevus-hcp.com/content/dam/gene/ocrevus-hcp/pdfs/ocrevus-site-of-care-philosophy.pdf Accessed May 1, 2022.
20. Patient Safety and Site of Service for Biologics. ACR postition statement available at: https://www.rheumatology.org/Portals/0/Files/Biologics-Patient-Safety-and-site-of-Service.pdf Accessed April 1, 2020.
21. Polinski JM, Kowal MK, Gagnon M, Brennan TA, Shrank WH. Home infusion: Safe,clinically effective, patient preferred, and cost saving. *Healthc (Amst).* 2017. Mar;5(1-2):68-80.
22. Common Terminology Criteria for Adverse Events (CTCAE) Version 5.0. Published November 27, 2021. US Department of Health and Human Services. Available at: https://ctep.cancer.gov/protocoldevelopment/electronic_applications/docs/ctcae_v5_quick_reference_5x7.pdf
23. Ocrelizumab: Drug Information. UpToDate. Retrieved May 1, 2022, from https://www.uptodate.com/contents/ocrelizumab-drug-information/print?search=ocrevus&source=panel_search_result&selectedTitle=1~19&usage_type=panel&kp_tab=drug_general&display_rank=1