"Therapy With Biologic Agents After Diagnosis of Solid Malignancies: Results From the Corrona Registry"

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Disclosure: This study was sponsored by Corrona, LLC and the analysis was funded by Amgen. Only Corrona has access to the study data and Corrona statisticians completed all of the analysis; all authors contributed to the interpretation of the results. Corrona, LLC has been supported through contracted subscriptions in the last 2 years by AbbVie, Amgen, Boehringer Ingelheim, Bristol-Myers Squibb, Crescendo, Eli Lilly and Company, Genentech, Gilead, GSK, Horizon Pharma USA, Janssen, Momenta Pharmaceuticals, Novartis, Pfizer Inc, Roche, Sun-Merck, UCB and Valeant.

N. Accortt and D. Collier are employed by Amgen Inc. and own Amgen Inc. stock. J. Schenfeld is a contractor for DOCS, Global and has received salary support from Amgen Inc. S. Rebello and M. Liu are employed by Corrona, LLC. D. Pappas is employed by Corrona, is affiliated with Columbia, and is an instructor at Novartis. Y. Li has no conflicts of interest to declare.

Running footline: Biologic Therapy after Cancer

Keywords: Rheumatoid arthritis, malignancy, biologics.

Word count: Abstract: 248/250, Manuscript: 2099/3500

Figures: 2

Tables: 3

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Abstract (248/250 words)

Introduction: Recently issued guidelines suggest rheumatoid arthritis (RA) patients with previously treated solid malignancy may be treated as patients without such history. The recommendation is based on limited evidence and rheumatologists and patients are frequently hesitant to start or continue biologic therapy. The objective of this study was to describe biologic utilization in real-world RA patients following a malignancy diagnosis.

Methods: RA patients enrolled in Corrona diagnosed with solid malignancy with at least 1 follow-up visit within 12 months after diagnosis were included in this analysis. The proportion of patients continuing or initiating biologic/targeted synthetic disease-modifying antirheumatic drug (bDMARD/tsDMARD) after diagnosis was estimated. Median time to initiation of biologic/tsDMARD after diagnosis was calculated using the Kaplan-Meier method and proportion initiating biologic treatment in 6-month time intervals was estimated using the life-table method.

Results: 880 patients met inclusion criteria with 2,585 person-years total follow-up time post-diagnosis. 367 of 880 patients (41.7%) were treated with biologics/tsDMARDs within 12 months preceding malignancy, of which 270 (30.7%) were on such agents at first post-diagnosis visit. 44 (5%) switched biologic agents within 36 months and an additional 90 patients (10.2%) started a biologic. The majority of biologic/tsDMARD initiations during follow-up were a TNF inhibitor (TNFi) (53.5%).

Conclusion**:** In real-world practice, nearly one-third of RA patients with a cancer diagnosis were treated with systemic therapy in the immediate visit after malignancy diagnosis and a considerable percentage of malignancy survivors initiated biologic therapy within 3 years. The majority of biologic/tsDMARD initiations post- malignancy diagnosis was a TNFi.

Introduction

Recently issued guidelines suggest that rheumatoid arthritis (RA) patients with previously treated solid malignancy may be treated as patients without such history[1]. However, rheumatologists and patients are frequently hesitant to continue or start biologic disease-modifying antirheumatic drug (bDMARD) therapy after a cancer diagnosis. Treating physicians may be concerned that biologic agents may interfere with the immune response to cancer and increase the risk for new malignancies or recurrence of previously diagnosed malignancies. The aforementioned concerns are fueled by the fact that biologic agents have been linked with an increased risk for skin cancers – albeit not for solid tumors or lymphoproliferative malignancies[2] . In addition, early clinical trial signals suggesting a potential increase of risk for malignancies in patients treated with TNF inhibitors may have established a fear regarding the effect of biologic agents on tumorigenesis, despite the fact that a multitude of observational data have not verified an increased risk for carcinogenesis[3-11]. Furthermore, physicians are concerned that the safety of biologic therapy use after diagnosis of cancer has not been clearly established, specifically in terms of prognosis, progression, and relapse[3] although the limited available evidence so far shows that recurrence of malignancy is not increased in patients treated with biologic agents[3,11].

Compared to the general population patients with RA have a higher risk of malignancy, specifically lymphoma and lung cancer[12]. Thus, treating RA patients with a concurrent malignancy is not rare and the need to take care of cancer patients with active joint disease necessitating aggressive therapy with biologics frequently occurs in the daily practice. Lower disease activity would allow such patients to have better quality of life and improved functionality during cancer therapy. Furthermore, aggressive therapy of RA would prevent joint damage which would allow a return to normal life after cancer therapy. The goal of the present study was to describe the real-world bDMARD and targeted synthetic (ts) DMARD utilization in RA patients following a solid malignancy diagnosis.

Methods

Patient Population

The Corrona registry is an independent, prospective, observational cohort of patients with RA recruited at 169 private and academic practice sites across 40 states in the United States; additional details have been published previously[13-16]. As of April 1, 2017, data on 45,722 patients with RA had been collected. This translates to information on 343,798 patient visits and 155,779 patient-years of follow-up observation time. The mean duration of patient follow-up is 4.3 years (standard deviation 3.4) and median 3.5 years. The Corrona registry was established in accordance with the Declaration of Helsinki. All participating investigators were required to obtain full board approval for conducting non-interventional research involving human subjects. Sponsor approval and continuing review was obtained through a central

Institutional Review Board (IRB) (New England Independent Review Board, NEIRB No. 120160610). For academic investigative sites that did not receive a waiver to use the central IRB, full board approval was obtained from the respective governing IRBs and documentation of approval was submitted to Corrona prior to initiating any study procedures. All registry patients were required to provide written informed consent and authorization prior to participating.

Study Population

This analysis included RA patients enrolled in the Corrona registry between March 1, 2002 and March 31, 2016. Eligible patients were required to have a new onset of solid malignancy during follow-up in the registry and at least one follow-up visit within twelve months of malignancy diagnosis. The index date was defined as the first Corrona visit after the diagnosis of a malignancy. Patients with a history of any previous solid cancer or a diagnosis of hematologic cancers (such as lymphoma, leukemia, or multiple myeloma) were excluded from the analysis. Patients with non-melanoma skin cancers (squamous and basal cell skin carcinomas) diagnosed after enrollment to the registry were not included in the analysis and were not counted as part of the malignancies reported in this work. Follow-up time was counted from the index date until the last follow-up visit in Corrona or until the initiation of the first bDMARD or tsDMARD following the malignancy diagnosis. bDMARDs included tumor necrosis factor inhibitor (TNFi) medications adalimumab, certolizumab pegol, etanercept, golimumab, and infliximab and non-TNFi medications abatacept, anakinra, rituximab, and tocilizumab. tsDMARDs included tofacitinib citrate.

Measures and data collection

Data are collected from both patients and their treating rheumatologists, who gather information on disease duration, prognosis, disease severity and activity, medical comorbidities- including malignancies, use of medications including biologics, csDMARDs, and prednisone, and adverse events. Follow-up assessments are requested at least as often as every 6 months and completed during routine clinical encounters.

Study outcomes

Clinical characteristics were evaluated as of the index date. The primary outcome was the proportion of patients continuing or initiating bDMARDs or tsDMARD after a solid malignancy diagnosis.

Statistical Analysis

The proportion of patients initiating a bDMARD or tsDMARD after diagnosis was estimated. Median time to the first initiation of a bDMARD/tsDMARD after diagnosis was calculated using the Kaplan-Meier method. The proportion of patients initiating bDMARD treatment in 6-month time intervals was estimated using the life-table method.

Results

Of 42,619 RA patients historically enrolled in Corrona at the time of this analysis, 934 patients had an incident solid malignancy after registry enrollment, of which 880 patients had at least 1 follow-up visit within 12 months after diagnosis, constituting the final analysis cohort. There were 763 patients who had an incident non-melanoma skin cancer (NMSC) during follow-up and were not included in this analysis. The mean (SD) time from the visit preceding the diagnosis of malignancy to the first visit after the malignancy diagnosis was 8.4 (7.5) months. Total follow-up time for the study population after the index visit was 2,585.6 person-years. Demographic and clinical characteristics at the first registry visit following malignancy diagnosis (index visit) are shown in Table 1. Patients were mostly females (67%), had a mean RA disease duration prior to malignancy diagnosis of 14.1 years, and a mean age of 66.6 years. Baseline mean Clinical Disease Activity Index (CDAI) at index date was 11.2 with 38% of patients being in moderate or high disease activity. The most frequent cancer types were breast cancer (21%) and melanoma skin cancer (9%)..

As seen in Table 2, 367 (41.7%) patients were on a biologic agent prior to the diagnosis of malignancy. As seen in Table 3, at the first registry visit following a diagnosis of malignancy (index visit) 270 (30.7%) of 880 patients were treated with a biologic agent or tsDMARD – the majority of which (79.2%) were on a TNF inhibitor. Out of the 270 patients, 187 (69.3%) were on the same biologic/tsDMARD as they were immediately prior to malignancy diagnosis. Table 3 displays the numbers of biologic initiations, switches and discontinuations over the first 3 years of follow up. At the end of the 3 year period 350 patients remained in follow-up in the registry. Of those lost to follow-up before three years, an exit from the registry visit has been recorded for 240 patients; 63 exited the registry due to death. As shown in table 3, a decreasing percentage of patients were treated with a biologic or tsDMARD during this follow up period; 34.7% of the patient cohort at the end of 6 month interval, 25.1% at the end of 24 month interval and 19.1% at the end of the 36 month interval.

During this 36 months of follow-up, 90 patients initiated a biologic. This translates to 14.8% (90/610) of the total number of patients not on a biologic at index visit. 275 of the 350 with at least 3 years of follow-up did not start a biologic within three years of malignancy diagnosis. In addition, there were 44 biologic switches among the 270 patients on a biologic at index visit (16.3%) during the 3 year follow-up period. Among the 270 patients on a biologic at index visit 50 patients (18.5%) stopped their biologic agent during the first 3 years of follow-up.

Patients who remained on the initial biologic had relatively better control of disease activity (mean CDAI=8.5) while those who switched or started a new biologic had higher levels of disease activity (CDAI 15.2 and 18.3 respectively).

The Kaplan Meier curve for the time to initiation of a new biologic after the diagnosis of malignancy is shown in Figure 1. Based on the IQR, 25% of the patient cohort started a biologic by the 36th month. The median time to initiation of the first bDMARD/tsDMARD after the diagnosis of a malignancy was 114.8 months, approximately 10 years.

There were a total of 170 (19.3%) biologic and tsDMARD initiations that occurred during the entire follow-up. The majority (53.5%) were TNFis (Figure 2). Of the 58 who remained on their initial bDMARD during three years of follow-up 86% were on TNFis. (Figure 2).

We also evaluated the 134 biologic/ tsDMARDs initiations occurring during the first 36 months of follow up based on the history of biologic exposure up to the moment of the index visit. As shown in table 4 patients with a history of biologic exposure prior to malignancy diagnosis were more likely to start a biologic in the 36 months following index visit.

Discussion

There is relative uncertainty regarding the management of biologic therapy in patients with RA who are diagnosed with a solid malignancy. However, clinicians are frequently faced with a patient who has recently been diagnosed with a cancer and has active disease which necessitates therapy with biologics. Given that several cancers may be curable nowadays, aggressive therapy of joint disease may ensure a functional life after cancer without joint damage and disability. In addition, mobility and intact functionality without joint pain or damage is important for patients even during therapy for cancer, regardless of the cancer prognosis. This is a challenging position for both physicians and patients because of the still lingering fears that biologics may increase the chance for a malignancy recurrence or may interfere with the effectiveness of chemotherapy or radiation treatment or may hamper the healing process of frequently extensive surgeries needed for the therapy of cancer. Such fears are not supported by the available evidence [2,8-10,16] . This is probably the reason why recent guidelines indicate that if a patient within 5 years from a solid malignancy diagnosis needs a biologic then the biologic therapy may be started[18]; even with noting, data supporting such a decision are limited.

This study aimed to describe what happens in real world practice using a large cohort of RA patients diagnosed with solid malignancies. The study did not aim to provide guidance as to how to manage patients diagnosed with a cancer nor investigate how patients respond to biologic therapy after diagnosis of cancer but only to describe how treating rheumatologists across the United States handle biologic therapies after a diagnosis of cancer.

In real-world practice, nearly one-third of RA patients were on therapy with bDMARD and tsDMARD therapies in the first visit (approximately 6 months) after diagnosis of a solid malignancy. Up to 5% of patients still in follow-up were starting a biologic in every 6 month interval of follow up. The majority of bDMARD/tsDMARD initiations was with a TNFi medication.

We showed that people with a history of biologic exposure were more likely to be treated with a biologic after malignancy diagnosis. This most likely reflect a more active disease that necessitated the initiation/ continuation of a biologic agent

The strength of this study is that the registry allowed us to detect a relatively large number of solid malignancies for the “average” patient treated in both academic and private rheumatology practices. A limitation of the study lies with the fact that we were not able to ascertain the status of the percentage of patients lost in follow up; the most likely explanation of this percentage of lost to follow up patients is death due to malignancy or no return to the rheumatologist while the patients were receiving therapy for their malignancy. Corrona has started to collect personal identifying information (PII) in recent years but these were not available in the early phases of the registry. Thus, linkage to other databases was not possible in order to determine how many of the patients diagnosed with malignancy and lost to follow-up died. Based on the data collected at the practices participating in Corrona approximately 25% of the patients reported in this analysis as lost to follow-up were confirmed to have died- the living status of the rest of the patients remains unknown at the moment.

Our results may not be generalizable to hematological cancers that were excluded from this analysis. We also excluded NMSC because, in general, they are not considered life threatening. Furthermore the severity of cancer was not considered and all solid malignancies were included in this analysis regardless of stage or histology aggressiveness. Thus, it cannot be commented whether biologics were initiated or continued in less aggressive malignancies. As the malignancy diagnosis for patients occurred between registry visits, there is a potential for misclassification of therapy and any changes that were made due to the diagnosis before the index visit. Corrona was not collecting information for temporary interruptions of biologics/tsDMARDs until recently. For the data presented in this analysis, possible temporary interruptions of therapy between the malignancy diagnosis and the index visit will not have been captured. Finally, patients with high disease activity were not separated from those in low disease activity in this research in order to further specifically investigate the management of patients in need for augmentation of therapy.

This study provides the first description of a large RA cohort with solid malignancies and how rheumatologists treat these patients. Based on these results, it appears that rheumatologists are comfortable either continuing or initiating biologic therapy (primarily TNFi) in this select group of RA

patients. Further study is needed to determine the long term outcome (survival, recurrence of malignancy but also damage of joints) of patients with cancer treated with biologics as well as how biologics may interfere with antineoplastic therapy and healing after oncologic surgeries.

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Figure 1: Kaplan-Meier curve for month (95%) CI from diagnosis of cancer to the initiation of the biologic in Corrona*

*Number at risk is represented at 10 month intervals

Figure 2: Initiations of biologics/tsDMARDS during follow-up and the patients remaining on initial therapy during follow-up

Table 1. Patient Demographic and Clinical Characteristics at index visit/baseline[1]

		Incident Malignancy N=880
Gender N		878
Female	n (%)	592 (67.4)
Age	**N**	878
Mean (SD), Median [IQR]		66.6 (10.5), 67 [59,74]
Duration of RA	**N**	878
Mean (SD), Median [IQR]		14.1 (10.7), 11 [6,20]
Race	**N**	864
White	n (%)	792 (91.7)
African-American	n (%)	47 (5.4)
Asian	n (%)	9 (1)
Other	n (%)	16 (1.9)
Education	**N**	844
College or above	**n (%)**	471 (55.8)
Smoking status	**N**	878
Never smoker	n (%)	395 (45)
Previous smoker	n (%)	349 (39.7)
Current smoker	n (%)	134 (15.3)
Weight (lbs)	**N**	880
Mean (SD), Median (IQR)		172.7 (41.4), 170 [145,195]
BMI	**N**	877
Underweight	n (%)	21 (2.4)
Normal weight	n (%)	268 (30.6)
Overweight	n (%)	312 (35.6)
Obese	n (%)	276 (31.5)
Work Status	**N**	859
Full Time	n (%)	174 (20.3)
Part Time	n (%)	64 (7.5)
At home	n (%)	73 (8.5)
Student	n (%)	9 (1)
Disabled	n (%)	111 (12.9)
Retired	n (%)	428 (49.8)
Insurance	**N**	862
None	n (%)	3 (0.3)
Private	n (%)	581 (67.4)
Medicaid	n (%)	43 (5)
Medicare	n (%)	464 (53.8)
RF/CCP status	**N**	602
Positive	n (%)	468 (77.7)

		Incident Malignancy N=880
Comorbid Conditions	**N**	880
Hx of CVD	n (%)	68 (7.7)
Hx of Serious Infection	n (%)	75 (8.5)
Solid cancer type	**N**	880
Breast cancer	n (%)	190 (21.6)
Lung cancer	n (%)	78 (8.9)
Skin melanoma cancer	n (%)	83 (9.4)
Prostate cancer	n (%)	61 (6.9)
Uterus and ovary cancer	n (%)	36 (4.1)
Colon cancer	n (%)	33 (3.8)
Bladder cancer	n (%)	20 (2.3)
Thyroid cancer	n (%)	17 (1.9)
Other cancer	n (%)	362 (41.1)
CDAI	**N**	858
Mean (SD), Median [IQR]		11.2 (12.1), 8 [3,16]
CDAI Categories	**N**	858
Remission	n (%)	218 (25.4)
Low	n (%)	311 (36.2)
Moderate	n (%)	197 (23.0)
High	n (%)	132 (15.4)
Year period of cancer diagnosis	**N**	880
2002-2006	n (%)	124 (14.1)
2007-2012	n (%)	491 (55.8)
2013-2016	n (%)	265 (30.1)

[1] The index date is the first Corrona visit following a malignancy diagnosis, or the enrollment visit for those with a history of malignancy prior to enrollment. Variable reported at index date, unless otherwise noted.

[2] Treatment reported at the visit prior to cancer diagnosis. Out of 880 patients, 734 patients had a visit within 12 months before the index date. The mean (SD) months from index date to the visit prior to cancer (solid tumor only) diagnosis is 8.4 (7.5).

Table 2 Medication Treatment prior to Index Visit

	Incident Malignancy N=880
Treatment Reported at Visit Prior to Index visit Cancer Diagnosis[2] N	880
On a biologic	367(41.7)
TNFi n (%)	286 (32.6)
non-TNFi n (%)	76 (8.5)
tsDMARD n (%)	5 (0.6)
Not on biologic/tsDMARD n (%)	513 (58.3)
Prior to index visit history of number of csDMARD N	880
Mean (SD), Median [IQR]	1.1 (1.2), 1 [0,2]
Prior to index visit history of TNFi use N	880
0 prior TNFi n (%)	374 (42.5)
1 prior TNFi n (%)	341 (38.8)
2+ prior TNFi n (%)	165 (18.8)
Prior to index visit history of non-TNFi use N	880
0 prior non-TNFi n (%)	746 (84.8)
1 prior non-TNFi n (%)	94 (10.7)
2+ prior non-TNFi n (%)	40 (4.5)
Prior to index visit history of tsDMARD (tofacitinib) use N	880
0 prior tsDMARD n (%)	872 (99.1)
1 prior tsDMARD n (%)	8 (0.9)
Prior to index visit history of Biologic/tsDMARD Use N	880
0 prior biologic/tsDMARD n (%)	352 (40)
1 prior biologic/tsDMARD n (%)	311 (35.3)
2 prior biologic/tsDMARD n (%)	121 (13.8)
3+ biologic/tsDMARD n (%)	96 (10.9)
Current Treatment Reported at Index visit N	880
On a biologic /tsDMARD n	270
TNFi n (%)	197 (22.4)
non-TNFi n (%)	69 (7.8)
tsDMARD n (%)	4 (0.5)
Not on biologic/tsDMARD n (%)	610 (69.3)
Current Prednisone Use at Index Visit N	160
Dose< 5mg n (%)	42 (26.3)
5<= dose <=10mg n (%)	103 (64.4)
Dose>10mg n (%)	15 (9.4)

Table 3 Clinical Characteristics in 6-Month Intervals After Diagnosis of Solid Malignancy

		Intervals during follow-up						
	Overall cohort at 36 months N=880	**Index Visit**	**6 months**	**12 months**	**18 months**	**24 months**	**30 months**	**36 months**
Number of patients remaining in follow-up: N_0		**880**	**660**	**576**	**511**	**451**	**397**	**350**
Patients on a biologic/tsDMARD during follow-up: n_0 (%)	67 (7.6%)	270 (30.7%)	229 (34.7%)	172 (29.9%)	147 (28.8%)	113 (25.1%)	85 (21.4%)	67 (19.1%)
on TNFi: n (%)	53 (6.0%)	197 (73.0%)	166 (72.5%)	126 (73.3%)	118 (80.3%)	86 (76.1%)	72 (84.7%)	53 (79.1%)
on nonTNFi: n (%)	14 (1.6%)	69 (25.6%)	59 (25.8%)	44 (25.6%)	28 (19.0%)	26 (23.0%)	13 (15.3%)	14 (20.9%)
on tsDMARD: n (%)	0 (0.0%)	4 (1.5%)	4 (1.7%)	2 (1.2%)	1 (0.7%)	1 (0.9%)	0 (0.0%)	0 (0.0%)
Patients on a biologic/tsDMARD at Index Visit (or at the beginning of each 6 month interval)*	**270**	270	270*	190*	144*	119*	93*	75*
Patients persistent on the biologic/tsDMARD: n (%)	58 (21.5%)		190 (70.4%)	144 (75.8%)	119 (82.6%)	93 (78.2%)	75 (80.6%)	58 (77.3%)
on TNFi: n (%)	50 (18.5%)		140 (71.1%)	114 (81.4%)	99 (86.8%)	78 (78.8%)	65 (83.3%)	50 (76.9%)
CDAI**: n			153	91	69	65	51	40
Mean(SD)			8.5 (9.9)	6.4 (7.3)	7.4 (7.5)	9.7 (11.5)	9.7 (9.3)	8 (8.8)
Remission/Low: n (%)			113 (73.9%)	76 (83.5%)	52 (75.4%)	44 (67.7%)	35 (68.6%)	29 (72.5%)
Patients who switched to another biologic/tsDMARD: (%)	44 (16.3%)		10 (3.7%)	6 (2.3%)	10 (4.9%)	9 (5.2%)	5 (3.4%)	4 (3.4%)
CDAI**: n			10	6	10	9	5	4
Mean(SD)			15.2 (9.1)	23.9 (16.2)	12.2 (11.8)	14.8 (18)	14.2 (4.7)	20.5 (17.1)
Remission/Low: n (%)			4 (40%)	1 (16.7%)	6 (60%)	5 (55.6%)	1 (20%)	1 (25%)
Patients who discontinued all biologic/tsDMARD use: n (%)	50 (18.5%)		13 (4.8%)	17 (8%)	9 (5.4%)	5 (3.5%)	3 (2.5%)	3 (3%)
Discontinuation of a TNFi: n (%)	29 (10.5%)		11 (4.1%)	5 (2.2%)	5 (2.6%)	4 (2.3%)	1 (0.7%)	3 (2.6%)
CDAI**: n			12	17	8	5	3	3
Mean(SD)			10.8 (11.2)	11.7 (12.6)	13 (8.4)	5.5 (7.9)	6.9 (8.1)	11.2 (14.1)
Remission/Low: n (%)			7 (58.3%)	12 (70.6%)	5 (62.5%)	4 (80%)	2 (66.7%)	2 (66.7%)
Patients Not on a Biologic/tsDMARD at Index Visit	**610**	610	610	407	327	265	215	177
Patients initiating a biologic/tsDMARD after Index Visit*: n (%)	90 (14.8%)		29 (4.8%)	22 (5.4%)	18 (5.5%)	11 (4.2%)	5 (2.3%)	5 (2.8%)
TNFi: n (%)	57 (9.3%)		21 (3.4%)	10 (2.4%)	14 (4.3%)	5 (1.9%)	4 (1.9%)	3 (1.7%)
CDAI**: n			29	20	19	9	5	6
Mean(SD)			18.3 (12.9)	16.5 (14.2)	17.2 (15.6)	13.2 (10.3)	19.8 (12.3)	7.4 (11.6)
Remission/Low: n (%)			9 (31%)	9 (45%)	8 (42.1%)	3 (33.3%)	1 (20%)	5 (83.3%)

*The number reported for each interval correspond to the beginning of the interval. The summation of the numbers of patients with changes during each interval (Patients persistent on the biologic/tsDMARD + Patients who switched to another biologic/tsDMARD+Patients who discontinued all biologics/tsDMARDs) does not equal the number at the beginning of each interval because it does not take into account lost to follow-up or deaths Such patients may have contributed to changes reported during each interval before they died or were lost to follow-up.

**CDAI is reported at the visit closest to the end of the time interval.

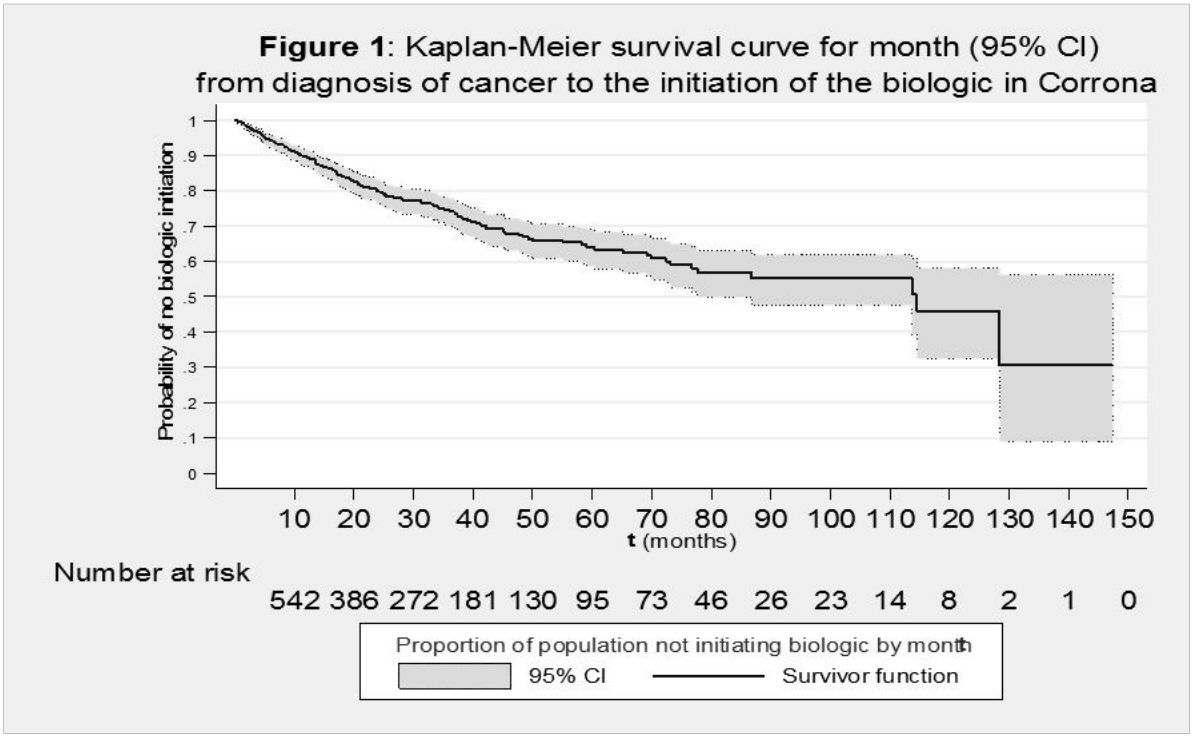
Table 4

Treatment history at index visit and initiation of biologics during the 36 months after cancer diagnosis

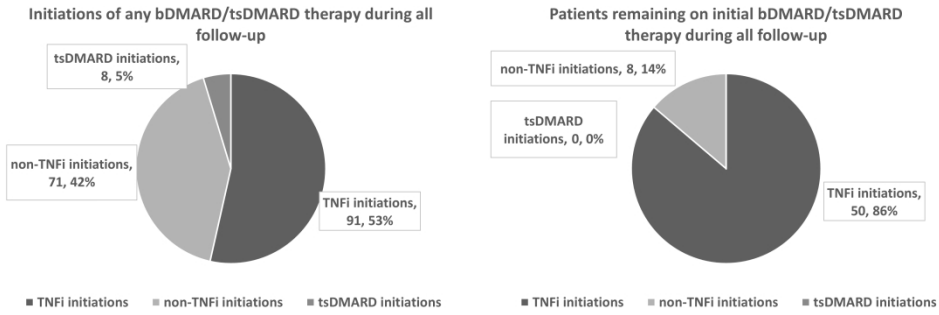
	Not on biologic at index visit and no history of prior biologic use	**Not on a biologic at index visit but with history of prior biologic therapy**	**On a biologic at index visit**
N (%)*	347 (39.4%)	263 (29.9%)	270 (30.7%)
Number and Proportion of patients starting a biologic by 36 months post index	25 (7.2%)	65 (24.7%)	44 (16.3%)

*8 patients did not have a registry visit prior to cancer diagnosis

Figures



*Number at risk is represented at 10 month intervals



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