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**Full title of manuscript (maximum of 20 words):**

**Biologic sex inequality in rheumatology wait times during the COVID-19 pandemic**

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**Statement of ethics and consent:**

Full ethics approval has been provided by the University of Alberta Health Ethics Board (Pro00124125).

**Abstract:**

**Objective:** To examine the effect of biologic sex on wait-times to first rheumatology appointment in a central triage system before and during the COVID-19 pandemic.

**Methods:** De-identified data of all referred patients between November 2019 and June 2022 were extracted from the electronic medical record. Variables including time from referral to first appointment, biologic sex, referral period, urgency status, age, and geographic location were collected and analyzed.

**Results:** 12,817 referrals were identified. Wait-times increased by 24.3 days in the peri-COVID time period ( $p < 0.001$ ). In the pre-COVID time period, there was no significant difference in wait-times by biologic sex or age. Triage urgency was a predictor of wait time with semi-urgent referrals seen 8.94 days (95% CI -15.90 to -1.99) sooner than routine referrals and urgent referrals seen 25.42 days (95% CI -50.36 to -0.47) sooner than routine referrals. In the peri-COVID time period, there was a significant difference in wait time by biologic sex with women waiting on average 10.03 days (95% CI 6.98 to 13.09) longer than men ( $p < 0.001$ ). Older patients had shorter wait times than younger patients, with a difference of -4.64 days for every 10-year increase in age (95% CI -5.5, to -3.8). Triage urgency continued to be a predictor of wait time.

**Conclusion:** Women and younger patients appear to have been impacted by wait time increases during the COVID-19 pandemic. This finding should be further investigated to determine its pervasiveness across other specialties and to better understand the underlying cause of this finding.

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Arthritis and other rheumatic diseases are common reasons for presentation to primary care. Nearly 60 million Americans (CDC), or 1 in 4, have a form of arthritis, with similar data in Canada where over 6 million have arthritis (1,2). With fewer than 400 full time clinical equivalent rheumatologists in Canada, or less than 1 rheumatologist per 100,000 population (3), timely access to rheumatology care is challenging. Some centres in Canada report wait-times upwards of 1 year from time of referral (4,5), further compounded by delays in patient presentation and referral. However, timely referral is paramount for optimal treatment, as evidence demonstrates early initiation of DMARDs for inflammatory arthritis leads to better disease control and prevents disease progression (6).

To that end, central triage systems have been designed to prioritize incoming rheumatology referrals that would most benefit from early assessment. The central triage system at the University of Alberta in Edmonton, Canada has been previously reported as a system that has a robust system to correctly assign referral urgency in a simple cost effective manner (7).

The COVID-19 pandemic has had a significant impact on the healthcare system. In rheumatology, much of the focus has been on the effects of immunosuppression on COVID-19 outcomes and treatments in established patients with autoimmune inflammatory rheumatic diseases (8,9). What remains less clear is the impact the pandemic has had on initial access to care for rheumatology services and if this impact has affected men and women equally. Here, we conduct a retrospective cohort study examining the effect of biologic sex on wait time to first rheumatology appointment in a group practice that employs a central triage system.

### Methods:

As previously described (7), the Division of Rheumatology at the University of Alberta established a central triage system in 2009. Twelve rheumatologists participated during the study period. As a brief summary, each week, one rheumatologist reviews and triages all incoming patient referrals. Triage is based on the referral letter and information provided, although a rheumatologist may choose to look up investigation

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results to supplement their triage decision. There is no standardized evaluation or scoring system used. The triage rheumatologist will assign a pre-assessment diagnosis and urgency status.

Urgency status is assigned based on the pre-assessment diagnosis and need for early access to care.

Urgency is categorized as urgent, semi-urgent or routine, with ideal target wait times of less than 7 days, 6 weeks and no target, respectively. Urgent consults are often those with organ threatening disease and facilitated through direct physician-to-physician communication. Semi-urgent consults are those with a suspicion for an inflammatory process such as inflammatory arthritis and inflammatory connective tissue diseases. Routine consults are those that are for non-inflammatory conditions such as osteoarthritis or soft tissue ailments. Once urgency is assigned, a central triage administrative clerk contacts the patients consecutively for an appointment with the rheumatologist in the group who best meets the urgency target window.

#### *Study Design*

In November 2019, the central triage system moved from eClinician, an EPIC based outpatient electronic medical record, to ConnectCare, an updated EPIC based comprehensive universal electronic medical record. ConnectCare allows for specific reporting of patient referral wait-times and patient characteristics. We extracted de-identified data of all referred patients between November 2019 and June 2022. Patient-level variables collected included: time from referral to first appointment, biologic sex, referral period (pre-COVID prior to March 2020 or peri-COVID from March 1, 2020 forward), urgency status, age, and geographic location, identified using postal code data as urban (within the Greater Edmonton Metropolitan area) or rural (outside the Greater Edmonton Metropolitan area).

#### *Statistical Analysis*

Baseline characteristics were compared between men and women using one-way analysis of variance (ANOVA) for continuous variables, and chi-square tests of independence for categorical variables. Crude

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analysis using univariable linear regression was performed to examine the differences in wait times by biologic sex, age, region and referral period. Within group and pairwise comparisons for categorical exposures (triage level) were done using one-way ANOVA analysis of variance with Bonferroni corrected p-values. Multivariable linear regression was performed adjusting for biologic sex, age, region and triage level, stratified by referral period. Effect modification was tested using interaction terms for sex\*triage level, age\*triage level, region\*triage level and sex\*region during the peri-covid period. Stratified analysis is presented for significant interaction terms. Statistical analysis was completed with STATA/BE 17.0.

The University of Alberta Medical Ethics Board approved this project (Pro00124125).

Results:

12,817 referrals were identified with a referral and first appointment scheduled between November 2019 and June 2022. 1,736 referrals (13.54%) were received during the pre-COVID time period and the remainder were received during the peri-COVID time period. The majority of referrals were women (N=8548 vs men N=4269). Women were older than men (51.7 vs 54.0,  $p<0.001$ ) and were more likely to be assigned a lower triage level ( $P<0.001$ ) (Table1). There was no difference in geographic location or referral period between men and women. Approximately 42% of patients who were referred lived in the Greater Edmonton Metropolitan area.

Wait times increased by 24.3 days on average in the peri-COVID time period (pre-COVID 64.6 days vs peri-COVID 88.9 days,  $p<0.001$ ). The unadjusted difference in wait times between men and women was 11.73 days (men 77.72 days vs women 89.45 days,  $p<0.001$ ) (Table 2). Other variables associated with increased wait time included younger age (-4.40 days per 10-year increase in age) and lower triage level (routine 97.74 days, semi-urgent 73.46 days, urgent 16.57 days,  $p<0.001$ ). Geographical region was not significantly associated with wait time. In the pre-COVID time period, once adjusted for age, region and triage level, there

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was no significant difference in wait time by biologic sex (difference 2.30 days, 95% CI -5.05 to 9.64) or age (0.02 days per 10-year increase in age, 95% CI -2.06 to 2.01). Triage level was a significant predictor of wait time with semi-urgent referrals seen 8.94 days (95% CI -15.90, -1.99) sooner than routine referrals and urgent referrals seen 25.42 days (95% CI -50.36 to -0.47) sooner than routine referrals.

In the peri-COVID time period, once adjusted for age, region and triage level, there was a significant difference in wait time by biologic sex with women waiting on average 10.03 days (95% CI 6.98 to 13.09) longer than men ( $p<0.001$ ) (Table 3A). Older patients had significantly shorter wait times than younger patients, with a difference of -4.64 days for every 10-year increase in age (95% CI -5.49 to -3.78). Triage level continued to be a significant predictor of wait time with semi-urgent referrals seen 26.30 days (95% CI -29.22, -23.37) sooner than routine referrals and urgent referrals seen 86.48 days (95% CI -97.01, -75.94) sooner than routine referrals. Geographical location had no association with wait time in both time periods.

The interaction terms sex\*triage level and age\*triage level were significant in the adjusted linear regression model ( $p=0.002$ ,  $p=0.001$ , respectively), but the interaction terms sex\*region and region\*triage level were not significant ( $p>0.05$ ). As there was effect modification seen with triage level for the association between sex and age and wait times during the peri-COVID time period, stratified analyses are presented for these predictors in Table 3B. Females waited on average 14.15 days (95% CI 9.19 to 19.10) longer than males for routine referrals and 6.32 days (95% CI 2.90 to 9.75) longer for semi-urgent referrals. Patients waited on average 5.90 days and 3.48 days less for every 10 years increase in age for routine and semi-urgent referrals, respectively. There were no significant differences in wait times by sex or age for urgent referrals ( $p>0.05$ ).

## Discussion:

This study demonstrates that wait times for new rheumatology referrals have increased significantly more for women than men during the COVID-19 pandemic. While increased wait times due to the COVID-19

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pandemic have previously been reported (10,11,12), the inequality of this adverse effect on women more than men has not.

In the central triage system, patients are offered appointments consecutively based on their urgency status alone, regardless of their personal characteristics. Therefore, from a central triage perspective, age and biologic sex should not impact time from referral to first appointment. Further, this difference in wait time by biologic sex was not seen prior to the COVID-19 pandemic. While this study does not examine the cause of this discrepancy, multiple studies suggest the COVID19 pandemic has impacted women and men differently. Specifically, women appear to have been more impacted by loss of employment or less hours of employment compared to men, while women parents appear to have taken on more of the burden of childcare during the pandemic, as lockdowns led to children completing school online from home, requiring home supervision (13,14). These differences may impact the ability for women to accept more timely appointments.

Similarly, once adjusted for covariates, older age was not associated with shorter wait time prior to the COVID-19 pandemic. However, during the COVID-19 pandemic, patients waited on average 4.6 days less per 10-year increase in age. While there is no explanatory literature around this finding, younger patients, like women, may have been disproportionately impacted by childcare issues during the pandemic, preventing them from accepting a timely appointment.

It was reassuring to see geographic location did not impact wait times, particularly as previous studies have demonstrated higher rates of inflammatory arthritis in rural areas of Alberta compared to metro centres (15). However, it is possible a more granular examination of data beyond a simple urban and rural divide used here may have demonstrated different results.

One limitation of this study is that the pre-COVID time window is relatively short due to the change in electronic medical record at the centre in November 2019. While this may impact our power to detect differences between groups in the pre-COVID time period, there were no other changes in our triage

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process. In this study we dichotomized the time period of referral into pre-COVID and peri-COVID. However, we recognize the peri-COVID period is more complex, with multiple waves of increased COVID19 infections and varying degrees of public health restrictions, requiring a detailed review of the infection rates and health restrictions over the triage period, which was outside the scope of this study. Thus the effects shown for the peri-COVID period may not be consistent through this time period and may benefit from further study in the future.

Women and younger patients appear to have been especially impacted by wait time increases during the COVID-19 pandemic. This finding should be further investigated not only in other rheumatology centres, but in the healthcare system in general as this inequality may be pervasive across specialties. Most importantly, studies need to be done to understand root causes of this disparity in biologic sex and age so that interventions can be implemented to repair it. Further, as the COVID-19 pandemic evolves, it will be important to continue to monitor inequalities in access to care.

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Accepted Article

Table 1. Rheumatology Central Triage Referral Characteristics

	<b>Men</b>	<b>Women</b>	<b>p-value</b>
	<b>N=4,269</b>	<b>N=8,548</b>	
Age, years (SD)	54.0 (16.9)	51.7 (16.8)	<0.001
Region			0.459
City	1818 (42.59%)	3699 (43.27%)	
Outside city	2451	4849	
Triage level			<0.001
Routine	2,197 (51.46%)	4,927 (57.64%)	
Semi-urgent	1,973 (46.22%)	3,478 (40.69%)	
Urgent	99 (2.32%)	143 (1.67%)	
Referral period			0.061
Pre-COVID	544 (12.74%)	1192 (13.94%)	
Peri-COVID	3725 (87.27%)	7356 (86.06%)	

Table 2. Crude predictors of wait time to first appointment

	Wait time, days (95% CI)	p-value
Gender		<0.001
Men	77.72 (75.34 - 80.09)	
Women	89.45 (86.63 - 92.44)	
Age	-4.40 days per 10 year increase in age (-5.21 to -3.58)	<0.001
Region		0.117
City	84.35 (81.57 - 87.12)	
Outside city	86.56 (84.74 - 88.39)	
Triage level		<0.001
Routine	97.74 (95.92 - 99.57)	
Semi-urgent	73.46 (70.73 - 76.20)	
Urgent	16.57 (6.72 - 26.41)	
Referral period		<0.001
Pre-COVID	64.65 (60.93 - 68.36)	
Peri-COVID	88.88 (84.89 - 92.87)	

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Table 3. Difference in wait time to first appointment stratified by (A) referral period and (B) urgency status, adjusted linear regression model

	Wait time difference, days (95% CI)	
	Pre-COVID Referral Period N=1,736 (13.50%)	Peri-COVID Referral Period, N=11,081 (86.50%)
<b>3A*</b>		
Sex		
Male (reference)		
Female	2.30 (-5.05 to 9.64) p=0.540	10.03 (6.98 to 13.09) p<0.001
Age (days per 10 year increase in age)	-0.02 (-2.06 to 2.01) p=0.982	-4.64 (-5.49 to -3.78) p<0.001
Region		
Outside city (reference)		
City	-5.56 (-12.44 to 1.31) p=0.113	-2.77 (-5.67 to 0.14) p=0.062
Triage level		
Routine (reference)		
Semi-urgent	-8.94 (-15.90 to -1.99) P=0.012	-26.30 (-29.22 to -23.37) p<0.001
Urgent	-25.42 (-50.36 to -0.47) P=0.046	-86.48 (-97.01 to -75.94) p<0.001

<b>3B**</b>	<b>Routine</b>	<b>Semi-urgent</b>	<b>Urgent</b>
Sex			
Male (reference)			
Female	14.15 (9.19 to 19.10) p<0.001	6.32 (2.90 to 9.75) p<0.001	-5.09 (-10.42 to 0.24) p=0.061
Age (days per 10 year increase in age)	-5.90 (-7.27 to -4.52) p<0.001	-3.48 (-4.45 to - 2.51) p<0.001	0.41 (-1.12 to 1.95) p=0.596

\*adjusted for sex, age, region and triage level

\*\*adjusted for sex, age, region, restricted to peri-covid referral period