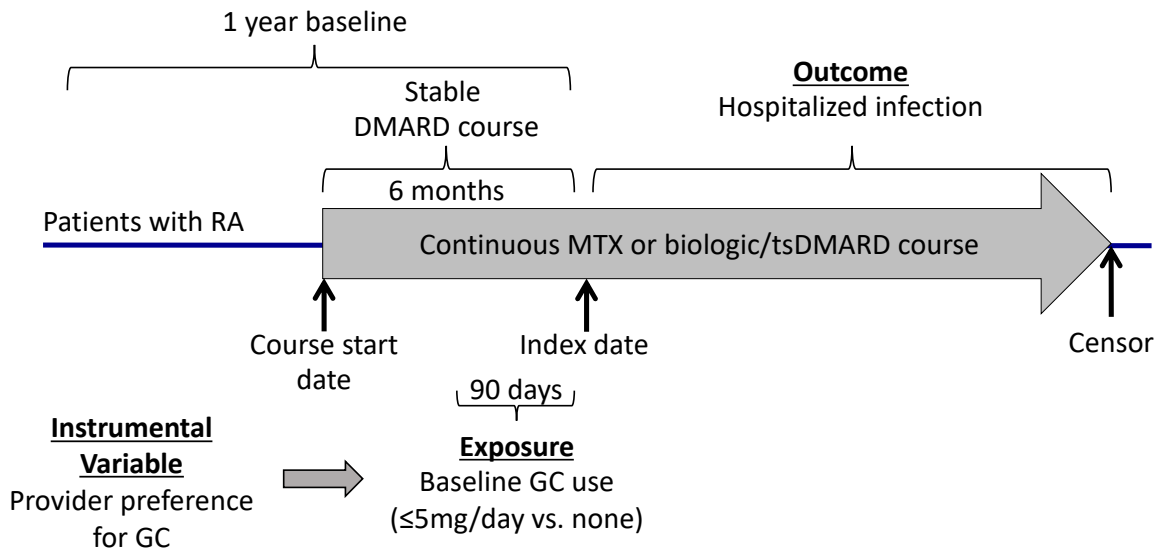


eFigure 1



eTable 1: Codes and Definitions

Codes for inclusion criteria		
Diagnosis	ICD-9 diagnosis code	Definition
RA	714.x	2 physician diagnoses at least 7 days apart + DMARD prescription/infusion
Codes for exclusion criteria		
Diagnosis	ICD-9 diagnosis code	Definition
Inflammatory bowel disease	555.x, 556.x	1 physician diagnosis
Psoriatic Arthritis	696.0	1 physician diagnosis
Ankylosing spondylitis	720.0	1 physician diagnosis
Systemic lupus erythematosus	710.0	1 physician diagnosis
HIV	042.xx, V08	1 physician diagnosis
Malignancy	140.x-172.x, 174.x-195.x, 200.x-208.x	1 physician diagnosis
Outcomes		
Outcome	ICD-9 diagnosis code	Definition
Hospitalized infection any diagnosis code	See Appendix Table 2	Diagnosis code in any position of discharge diagnoses from an acute care hospitalization
Hospitalized infection principal diagnosis code	See Appendix Table 2	Diagnosis code in the primary position of discharge diagnoses from an acute care hospitalization
Diagnosis codes and definitions for select covariates (codes for all covariates available upon request)		
Diagnosis	ICD-9 diagnosis code	Definition
Diabetes mellitus	249.x, 250.0-250.9, 357.2, 362.0x, 366.41	1 inpatient or 2 outpatient diagnosis codes
Obesity	278.00, 278.01, V8530, V8531, V8532, V8533, V8534, V8535, V8536, V8537, V8538, V8539, V854, V8541, V8542, V8543, V8544, V8545	1 diagnosis code
Chronic obstructive pulmonary disease	491.0, 491.1, 491.8, 491.9, 492.0, 492.8, 491.20, 491.21, 491.22, 494.0, 494.1, 496	1 inpatient or 2 outpatient diagnosis codes
Asthma	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92	1 inpatient or 2 outpatient diagnosis codes
Extra-articular Rheumatoid Arthritis	RA lung disease (714.81), RA carditis (714.2), inflammatory eye disease (364.0, 364.1, 364.3), Felty's syndrome (714.1)	1 diagnosis code

eTable 2: Full list of ICD-9 codes to define hospitalized infection

032.83, 095.2, 539.01, 539.81, 540.0, 540.1, 540.9, 541, 562.01, 562.03, 562.11, 562.13, 567.0, 567.1, 567.2, 567.21, 567.22, 567.23, 567.29, 567.38, 567.39, 567.8, 567.81, 567.82, 567.89, 567.9, 569.5, 590.2, 039.0, 039.1, 039.2, 039.3, 039.4, 039.8, 039.9, 022.1, 022.8, 022.9, 117.3, 484.6, 020.2, 022.3, 026.0, 026.1, 026.9, 036.2, 036.3, 038.0, 038.1, 038.10, 038.11, 038.12, 038.19, 038.2, 038.3, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9, 790.7, 116.0, 087.0, 087.1, 087.9, 088.81, 088.82, 324.0, 324.1, 324.9, 023.0, 023.1, 023.2, 023.3, 023.8, 023.9, 112.3, 112.5, 112.82, 112.83, 112.84, 112.85, 078.3, 088.0, 117.2, 046.1, 046.11, 046.19, 114.0, 114.1, 114.2, 114.3, 114.4, 114.5, 114.9, 051.01, 117.5, 996.6, 996.60, 996.61, 996.62, 996.63, 996.64, 996.66, 996.67, 996.68, 996.69, 999.33, 036.1, 046.2, 049.8, 049.9, 054.3, 055.0, 056.01, 058.21, 058.29, 062.0, 062.1, 062.2, 062.3, 062.4, 062.5, 062.8, 062.9, 063.0, 063.1, 063.2, 063.8, 063.9, 064, 066.40, 066.41, 066.42, 066.49, 071, 072.2, 094.81, 323.0, 323.01, 323.02, 323.1, 323.2, 323.4, 323.41, 323.42, 323.61, 484.7, 036.42, 074.22, 093.20, 093.21, 093.22, 093.23, 093.24, 098.84, 112.81, 421.0, 421.1, 421.9, 422.92, 360.00, 360.01, 360.02, 360.03, 360.04, 120.0, 120.1, 120.2, 120.3, 120.9, 121.0, 121.1, 121.2, 121.3, 121.4, 121.5, 121.6, 121.8, 121.9, 122.0, 122.1, 122.2, 122.3, 122.4, 122.5, 122.6, 122.7, 122.8, 122.9, 123.0, 123.1, 123.2, 123.3, 123.4, 123.5, 123.6, 123.8, 123.9, 124, 125.0, 125.1, 125.2, 125.3, 125.4, 125.5, 125.6, 125.7, 125.9, 126.0, 126.1, 126.2, 126.3, 126.8, 126.9, 127.0, 127.1, 127.2, 127.3, 127.4, 127.5, 127.6, 127.7, 127.8, 127.9, 128.0, 128.1, 128.8, 128.9, 129, 133.9, 134.0, 136.21, 001.0, 001.1, 001.9, 002.0, 002.1, 002.2, 002.3, 002.9, 003.0, 003.1, 003.20, 003.21, 003.22, 003.23, 003.24, 003.29, 003.8, 003.9, 004.0, 004.1, 004.2, 004.3, 004.8, 004.9, 005.0, 005.1, 005.2, 005.3, 005.4, 005.8, 005.81, 005.89, 005.9, 006.2, 006.8, 007.0, 007.1, 007.3, 007.4, 007.5, 008.0, 008.00, 008.01, 008.02, 008.03, 008.04, 008.09, 008.1, 008.2, 008.3, 008.41, 008.42, 008.43, 008.44, 008.45, 008.46, 008.47, 008.49, 008.5, 008.6, 008.61, 008.62, 008.63, 008.64, 008.65, 008.66, 008.67, 008.69, 008.8, 009.0, 009.1, 009.2, 009.3, 022.2, 041.41, 041.42, 041.43, 041.49, 006.3, 054.10, 054.11, 054.12, 054.13, 054.19, 054.2, 054.6, 054.71, 054.73, 054.74, 054.79, 054.8, 054.9, 115.00, 115.01, 115.03, 115.04, 115.05, 115.09, 115.10, 115.11, 115.13, 115.14, 115.15, 115.19, 115.90, 115.91, 115.93, 115.94, 115.95, 115.99, 054.40, 054.41, 054.42, 054.43, 054.44, 054.49, 054.72, 066.0, 997.69, 032.81, 077.1, 077.2, 077.3, 077.4, 077.8, 090.3, 117.6, 117.7, 117.8, 117.9, 118, 027.8, 027.9, 030.0, 030.1, 030.2, 030.3, 030.8, 030.9, 100.0, 100.81, 100.89, 100.9, 085.0, 085.1, 085.2, 085.3, 085.4, 085.5, 085.9, 027.0, 084.0, 084.1, 084.2, 084.3, 084.4, 084.5, 084.6, 084.7, 084.8, 084.9, 055.71, 006.5, 036.0, 047.0, 047.1, 047.8, 047.9, 049.0, 049.1, 091.81, 094.2, 098.82, 320.0, 320.1, 320.2, 320.3, 320.7, 320.8, 320.81, 320.82, 320.89, 320.9, 036.43, 074.20, 074.23, 422.0, 422.90, 006.0, 006.9, 024, 025, 027.2, 032.82, 036.40, 036.81, 036.89, 036.9, 037, 040.2, 041.0, 041.00, 041.01, 041.02, 041.03, 041.04, 041.05, 041.09, 041.1, 041.10, 041.11, 041.12, 041.19, 041.2, 041.3, 041.4, 041.5, 041.6, 041.7, 041.8, 041.81, 041.82, 041.83, 041.84, 041.85, 041.89, 041.9, 054.0, 055.79, 055.8, 055.9, 056.00, 056.09, 056.79, 056.8, 056.9, 057.0, 057.8, 057.9, 058.10, 058.11, 058.12, 058.81, 058.82, 058.89, 059.00, 059.01, 059.09, 059.10, 060.1, 060.9, 061, 065.0, 065.1, 065.2, 065.3, 065.4, 065.8, 065.9, 066.1, 066.3, 066.4, 066.8, 066.9, 072.0, 072.3, 072.72, 072.79, 072.8, 072.9, 073.7, 073.8, 073.9, 074.0, 074.1, 074.3, 074.8, 075, 078.4, 078.5, 078.7, 079.0, 079.1, 079.2, 079.3, 079.51, 079.52, 079.8, 088.8, 101, 104.9, 321.0, 321.1, 321.2, 321.3, 321.8, 360.12, 360.13, 360.19, 363.00, 372.00, 372.01, 372.03, 372.04, 375.01, 375.02, 375.31, 375.32, 375.33, 376.11, 376.13, 482.4, 995.91, 995.92, 998.5, 998.59, 031.0, 031.1, 031.2, 031.8, 031.9, 364.03, 364.05, 370.55, 376.03, 730.00, 730.01, 730.02, 730.03, 730.04, 730.05, 730.06, 730.07, 730.08, 730.09, 730.10, 730.11, 730.12, 730.13, 730.14, 730.15, 730.16, 730.17, 730.18, 730.19, 730.20, 730.21, 730.22, 730.23, 730.24, 730.25, 730.26, 730.27, 730.28, 730.29, 730.80, 730.81, 730.82, 730.83, 730.84, 730.85, 730.86, 730.87, 730.88, 730.89, 730.90, 730.91, 730.92, 730.93, 730.94, 730.95, 730.96, 730.97, 730.98, 730.99, 036.41, 074.21, 020.0, 020.1, 020.3, 020.4, 020.5, 020.8, 020.9, 136.3, 079.6, 079.81, 079.82, 079.83, 480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482.0, 482.1, 482.2, 482.3, 482.30, 482.31, 482.32, 482.39, 482.40, 482.41, 482.42, 482.49, 482.8, 482.81, 482.82, 482.83, 482.84, 482.89, 482.9, 483, 483.0, 483.1, 483.8, 484.3, 484.5, 484.8, 485, 486, 487.0, 487.1, 487.8, 488.01, 488.02, 488.09, 488.1, 488.11, 488.12, 488.19, 488.81, 488.82, 488.89, 494.1, 513.0, 997.31, 997.32, 006.4, 046.3, 098.12, 098.32, 590.00, 590.01, 590.10, 590.11, 590.3, 590.80, 590.81, 590.9, 595.0, 599.0, 996.65, 083.0, 080, 081.0, 081.1, 081.2, 081.9, 082.0, 082.1, 082.2, 082.3, 082.40, 082.41, 082.49, 082.8, 082.9, 083.1, 083.2, 083.8, 083.9, 036.82, 056.71, 098.50, 098.51, 098.52, 098.53, 098.59, 711.00, 711.01, 711.02, 711.03, 711.04, 711.05, 711.06, 711.07, 711.08, 711.09, 711.90, 711.91, 711.92, 711.93, 711.94, 711.95, 711.96, 711.97, 711.98, 711.99, 519.01, 530.86, 536.41, 596.81, 006.6, 022.0, 027.1, 032.85, 035, 040.0, 040.1, 040.3, 040.42, 040.81, 040.82, 040.89, 376.01, 569.61, 597.0, 597.80, 597.89, 680.0, 680.1, 680.2, 680.3, 680.4, 680.5, 680.6, 680.7, 680.8, 680.9, 681.00, 681.01, 681.02, 681.10, 681.11, 681.9, 682.0, 682.1, 682.2, 682.3, 682.4, 682.5, 682.6, 682.7, 682.8, 682.9, 683, 684, 685.0, 686.8, 686.9, 785.4, 997.62, 998.51, 117.1, 091.0, 091.1, 091.2, 091.3, 091.4, 091.50, 091.51, 091.52, 091.61, 091.62, 091.69, 091.7, 091.82, 091.89, 091.9, 092.0, 092.9, 093.0, 093.1, 093.81, 093.82, 093.89, 093.9, 094.0, 094.1, 094.3, 094.82, 094.83, 094.84, 094.85, 094.86, 094.87, 094.89, 094.9, 095.0, 095.1, 095.3, 095.4, 095.5, 095.6, 095.7, 095.8,

095.9, 096, 097.0, 097.1, 097.9, 098.0, 098.10, 098.11, 098.13, 098.14, 098.15, 098.16, 098.17, 098.19, 098.2, 098.30, 098.31, 098.33, 098.34, 098.35, 098.36, 098.37, 098.39, 098.40, 098.41, 098.42, 098.43, 098.49, 098.6, 098.7, 098.81, 098.83, 098.85, 098.86, 098.89, 099.0, 099.1, 099.2, 099.4, 099.40, 099.41, 099.49, 099.50, 099.51, 099.52, 099.53, 099.54, 099.55, 099.56, 099.59, 099.8, 099.9, 130.0, 130.3, 130.4, 130.5, 130.7, 130.8, 130.9, 086.0, 086.1, 086.2, 086.3, 086.4, 086.5, 086.9, 010.00, 010.01, 010.02, 010.03, 010.04, 010.05, 010.06, 010.10, 010.11, 010.12, 010.13, 010.14, 010.15, 010.16, 010.80, 010.81, 010.82, 010.83, 010.84, 010.85, 010.86, 010.90, 010.91, 010.92, 010.93, 010.94, 010.95, 010.96, 011.00, 011.01, 011.02, 011.03, 011.04, 011.05, 011.06, 011.10, 011.11, 011.12, 011.13, 011.14, 011.15, 011.16, 011.20, 011.21, 011.22, 011.23, 011.24, 011.25, 011.26, 011.30, 011.31, 011.32, 011.33, 011.34, 011.35, 011.36, 011.40, 011.41, 011.42, 011.43, 011.44, 011.45, 011.46, 011.50, 011.51, 011.52, 011.53, 011.54, 011.55, 011.56, 011.60, 011.61, 011.62, 011.63, 011.64, 011.65, 011.66, 011.70, 011.71, 011.72, 011.73, 011.74, 011.75, 011.76, 011.80, 011.81, 011.82, 011.83, 011.84, 011.85, 011.86, 011.90, 011.91, 011.92, 011.93, 011.94, 011.95, 011.96, 012.00, 012.01, 012.02, 012.03, 012.04, 012.05, 012.06, 012.10, 012.11, 012.12, 012.13, 012.14, 012.15, 012.16, 012.20, 012.21, 012.22, 012.23, 012.24, 012.25, 012.26, 012.30, 012.31, 012.32, 012.33, 012.34, 012.35, 012.36, 012.80, 012.81, 012.82, 012.83, 012.84, 012.85, 012.86, 013.00, 013.01, 013.02, 013.03, 013.04, 013.05, 013.06, 013.10, 013.11, 013.12, 013.13, 013.14, 013.15, 013.16, 013.20, 013.21, 013.22, 013.23, 013.24, 013.25, 013.26, 013.30, 013.31, 013.32, 013.33, 013.34, 013.35, 013.36, 013.40, 013.41, 013.42, 013.43, 013.44, 013.45, 013.46, 013.50, 013.51, 013.52, 013.53, 013.54, 013.55, 013.56, 013.60, 013.61, 013.62, 013.63, 013.64, 013.65, 013.66, 013.80, 013.81, 013.82, 013.83, 013.84, 013.85, 013.86, 013.90, 013.91, 013.92, 013.93, 013.94, 013.95, 013.96, 014.00, 014.01, 014.02, 014.03, 014.04, 014.05, 014.06, 014.80, 014.81, 014.82, 014.83, 014.84, 014.85, 014.86, 015.00, 015.01, 015.02, 015.03, 015.04, 015.05, 015.06, 015.10, 015.11, 015.12, 015.13, 015.14, 015.15, 015.16, 015.20, 015.21, 015.22, 015.23, 015.24, 015.25, 015.26, 015.50, 015.51, 015.52, 015.53, 015.54, 015.55, 015.56, 015.60, 015.61, 015.62, 015.63, 015.64, 015.65, 015.66, 015.70, 015.71, 015.72, 015.73, 015.74, 015.75, 015.76, 015.80, 015.81, 015.82, 015.83, 015.84, 015.85, 015.86, 015.90, 015.91, 015.92, 015.93, 015.94, 015.95, 015.96, 016.00, 016.01, 016.02, 016.03, 016.04, 016.05, 016.06, 016.10, 016.11, 016.12, 016.13, 016.14, 016.15, 016.16, 016.20, 016.21, 016.22, 016.23, 016.24, 016.25, 016.26, 016.30, 016.31, 016.32, 016.33, 016.34, 016.35, 016.36, 016.40, 016.41, 016.42, 016.43, 016.44, 016.45, 016.46, 016.50, 016.51, 016.52, 016.53, 016.54, 016.55, 016.56, 016.60, 016.61, 016.62, 016.63, 016.64, 016.65, 016.66, 016.70, 016.71, 016.72, 016.73, 016.74, 016.75, 016.76, 016.90, 016.91, 016.92, 016.93, 016.94, 016.95, 016.96, 017.00, 017.01, 017.02, 017.03, 017.04, 017.05, 017.06, 017.10, 017.11, 017.12, 017.13, 017.14, 017.15, 017.16, 017.20, 017.21, 017.22, 017.23, 017.24, 017.25, 017.26, 017.30, 017.31, 017.32, 017.33, 017.34, 017.35, 017.36, 017.40, 017.41, 017.42, 017.43, 017.44, 017.45, 017.46, 017.50, 017.51, 017.52, 017.53, 017.54, 017.55, 017.56, 017.60, 017.61, 017.62, 017.63, 017.64, 017.65, 017.66, 017.70, 017.71, 017.72, 017.73, 017.74, 017.75, 017.76, 017.80, 017.81, 017.82, 017.83, 017.84, 017.85, 017.86, 017.90, 017.91, 017.92, 017.93, 017.94, 017.95, 017.96, 018.00, 018.01, 018.02, 018.03, 018.04, 018.05, 018.06, 018.80, 018.81, 018.82, 018.83, 018.84, 018.85, 018.86, 018.90, 018.91, 018.92, 018.93, 018.94, 018.95, 018.96, 647.3, 647.30, 647.31, 647.32, 647.33, 647.34, 021.0, 021.1, 021.2, 021.3, 021.8, 021.9, 032.1, 032.2, 032.3, 033.0, 033.1, 033.8, 033.9, 034.0, 034.1, 460, 461.0, 461.1, 461.2, 461.3, 461.8, 461.9, 462, 463, 464.0, 464.00, 464.01, 464.10, 464.11, 464.20, 464.21, 464.30, 464.31, 464.4, 464.50, 464.51, 465.0, 465.8, 465.9, 466.0, 466.1, 466.11, 466.19, 475, 072.71, 790.8, 053.0, 053.10, 053.11, 053.12, 053.13, 053.14, 053.19, 053.20, 053.21, 053.22, 053.29, 053.71, 053.79, 053.8, 053.9

Appendix Methods

Defining the instrumental variable

To define the instrumental variable (IV), a large cohort of patients with rheumatoid arthritis (RA) who were new or prevalent users of disease-modifying anti-rheumatic drugs (DMARDs) was used to estimate and evaluate different definitions of each rheumatologist's "provider preference for glucocorticoids" based on how frequently each provider's patients were treated with glucocorticoids relative to other providers. We defined the IV in this larger cohort (as opposed to the smaller cohort on stable DMARD therapy in which the IV was applied) to ensure that each provider saw enough qualifying patients to accurately determine the provider's preference for glucocorticoids. In each calendar year, we identified patients with ≥ 2 diagnoses for RA (714.x) ≥ 7 days apart who either 1) filled a prescription or received an infusion of a biologic or janus kinase inhibitor (JAKi) or 2) filled a prescription for methotrexate and received no biologics or JAKi during that year. We excluded patients with diagnoses of psoriatic arthritis, ankylosing spondylitis, inflammatory bowel disease, or systemic lupus erythematosus during that calendar year and required that patients have ≥ 180 days of available follow up after the first DMARD prescription or infusion. Patients could contribute observations to each qualifying calendar year.

We assessed four pre-specified definitions of glucocorticoid use based on filled prescriptions of oral prednisone, prednisolone, or methylprednisolone: a) filling any glucocorticoid prescription within 90 days of the first biologic/JAKi prescription or infusion or first methotrexate prescription of the year (for patients not receiving biologics or JAKi) for both new and prevalent users, b) filling ≥ 30 day supply of glucocorticoids within 90 days of the first

biologic/JAKi prescription or infusion or methotrexate prescription of the year, c) filling any glucocorticoid prescription 91-180 days after the first biologic/JAKi prescription or infusion or methotrexate prescription of the year, or d) filling ≥ 30 day supply of glucocorticoids 91-180 days after the first biologic/JAKi prescription or infusion or methotrexate prescription of the year.

For each patient, we identified the treating rheumatologist using the National Provider Index (NPI) number from the most recent rheumatology outpatient visit (Medicare provider type 66) which occurred prior to the first biologic/JAKi or methotrexate prescription of the year and included an RA diagnosis. We then defined each individual rheumatologist's preference for glucocorticoids for any year in which they treated at least 10 qualifying RA patients in that year (to enable stable preference estimates).

Two different pre-specified definitions of provider preference were created. First, provider preference for glucocorticoids was defined as the proportion of a provider's patients receiving glucocorticoids within each calendar year. Then, to account for differences in case mix, an observed/expected measure of provider preference was created. To do this, a logistic regression model was created with glucocorticoid use as the outcome and covariates including age; sex; race; calendar year; type of DMARD; receipt of a new biologic/JAKi, methotrexate, or other csDMARD in the preceding 3 months (capturing new versus prevalent use); Charlson comorbidity score and each individual component comorbidity from the preceding year (including COPD). The coefficients from this model were then used to calculate the predicted probability of glucocorticoid use for each patient based on this patient's characteristics. The number of a provider's patients expected to receive glucocorticoids was the sum of the

predicted probabilities of glucocorticoid use for each of the provider's patients in each calendar year. The observed/expected measure of provider preference was the actual (observed) number of the provider's patients receiving glucocorticoids in each calendar year divided by the expected number. This process was repeated for each of the four glucocorticoid definitions resulting in 8 different potential instrumental variable measures of provider preference for glucocorticoids.

For each patient in the smaller, analytic cohort (patients with RA on stable DMARD therapy), the provider preference for glucocorticoids for a patient's rheumatologist was obtained from the larger cohort after subtracting out the contribution of the patient of interest to ensure patients were not contributing to their own provider preference measure and to avoid overfitting.

To select an instrumental variable, we assessed univariate associations between each of the eight potential instrumental variables (as continuous measures) and glucocorticoid use at baseline in our cohort of patients on stable DMARD therapy using ANOVA, comparing F-statistics and r^2 values. The best performing instrumental variable was an observed/expected measure of provider preference with glucocorticoid use defined as ≥ 30 days of glucocorticoids within 90 days of the first biologic/JAKi or methotrexate prescription of the calendar year (see Appendix Table 3), and this was selected as the instrumental variable for subsequent analysis.

eTable 3: Performance of different potential instrumental variable definitions

Candidate instrumental variable measure definition		R ²	F
Provider preference method	Glucocorticoid exposure definition ^a		
Proportion of provider's patients receiving glucocorticoids	Any GC Rx within 90 days	.0268	4497.04
	Any GC Rx at 91-180 days	.0244	4098.62
	≥30 days of GC within 90 days	.0275	4620.64
	≥30 days of GC at 91-180 days	.0270	4531.60
Observed/Expected number of provider's patients receiving glucocorticoids	Any GC Rx within 90 days	.0278	4675.27
	Any GC Rx at 91-180 days	.0254	4258.25
	≥30 days of GC within 90 days	.0284	4779.02
	≥30 days of GC at 91-180 days	.0274	4609.03

Results from separate univariate ANOVA models with glucocorticoid use in the analytic cohort as the dependent variable and the candidate instrumental variable measure as the independent variable. Gray cells show the definition chosen as the instrumental variable for subsequent analysis.

^aThe time-frame for glucocorticoid exposure was either 1-90 days or 91-180 days after the first methotrexate or biologic/janus kinase inhibitor prescription or infusion of the year, regardless of whether patients were new or prevalent users.

GC = glucocorticoid

eTable 4: Full cohort characteristics by exposure level or by instrumental variable status

	Comparisons by Exposure			Comparisons by Instrumental Variable		
	No Glucocorticoids N = 102,143	Glucocorticoids ≤5mg/day N = 61,460	SMD	Low IV N = 81,802	High IV N = 81,801	SMD
Demographics/Year						
Age						
<40	2,453 (2.4%)	1,186 (1.9%)	-0.032	1,856 (2.3%)	1,783 (2.2%)	-0.006
40-45	2,102 (2.1%)	1,113 (1.8%)	-0.018	1,563 (1.9%)	1,652 (2.0%)	0.008
45-50	3,484 (3.4%)	1,998 (3.3%)	-0.009	2,654 (3.2%)	2,828 (3.5%)	0.012
50-55	5,499 (5.4%)	3,076 (5.0%)	-0.017	4,203 (5.1%)	4,372 (5.3%)	0.009
55-60	6,925 (6.8%)	4,031 (6.6%)	-0.009	5,494 (6.7%)	5,462 (6.7%)	-0.002
60-65	7,754 (7.6%)	4,610 (7.5%)	-0.003	6,152 (7.5%)	6,212 (7.6%)	0.003
65-70	23,014 (22.5%)	12,864 (20.9%)	-0.039	17,807 (21.8%)	18,071 (22.1%)	0.008
70-75	21,598 (21.1%)	13,155 (21.4%)	0.006	17,382 (21.2%)	17,371 (21.2%)	0.000
75-80	15,126 (14.8%)	9,735 (15.8%)	0.029	12,497 (15.3%)	12,364 (15.1%)	-0.005
80-85	9,204 (9.0%)	6,185 (10.1%)	0.036	7,824 (9.6%)	7,565 (9.2%)	-0.011
≥85	4,984 (4.9%)	3,507 (5.7%)	0.037	4,370 (5.3%)	4,121 (5.0%)	-0.014
Female	83,599 (81.8%)	49,896 (81.2%)	-0.017	66,754 (81.6%)	66,741 (81.6%)	0.000
Race						
White	73,289 (71.8%)	44,852 (73.0%)	0.027	58,293 (71.3%)	59,848 (73.2%)	0.042
Black	9,489 (9.3%)	6,058 (9.9%)	0.019	7,548 (9.2%)	7,999 (9.8%)	0.019
Hispanic	9,442 (9.2%)	5,310 (8.6%)	-0.021	8,280 (10.1%)	6,472 (7.9%)	-0.077
Other/ Unknown	9,923 (9.7%)	5,240 (8.5%)	-0.041	7,681 (9.4%)	7,482 (9.1%)	-0.008
Year						
2007	7,174 (7.0%)	4,213 (6.9%)	-0.007	5,658 (6.9%)	5,729 (7.0%)	0.003
2008	9,744 (9.5%)	6,253 (10.2%)	0.021	7,766 (9.5%)	8,231 (10.1%)	0.019
2009	10,404 (10.2%)	6,194 (10.1%)	-0.004	8,424 (10.3%)	8,174 (10.0%)	-0.010
2010	9,989 (9.8%)	5,997 (9.8%)	-0.001	7,975 (9.7%)	8,011 (9.8%)	0.001
2011	11,128 (10.9%)	6,851 (11.1%)	0.008	9,021 (11.0%)	8,958 (11.0%)	-0.002
2012	12,331 (12.1%)	7,482 (12.2%)	0.003	9,881 (12.1%)	9,932 (12.1%)	0.002
2013	13,686 (13.4%)	8,123 (13.2%)	-0.005	10,840 (13.3%)	10,969 (13.4%)	0.005
2014	16,656 (16.3%)	9,706 (15.8%)	-0.014	13,415 (16.4%)	12,947 (15.8%)	-0.016
2015	11,031 (10.8%)	6,641 (10.8%)	0.000	8,822 (10.8%)	8,850 (10.8%)	0.001
Socioeconomic Status						
Dual Eligibility						
None	69,338 (67.9%)	41,707 (67.9%)	0.000	55,103 (67.4%)	55,942 (68.4%)	0.022
Partial	9,557 (9.4%)	6,089 (9.9%)	0.019	7,632 (9.3%)	8,014 (9.8%)	0.016
Full	23,248 (22.8%)	13,664 (22.2%)	-0.013	19,067 (23.3%)	17,845 (21.8%)	-0.036
Quintiles of income						

1st	19,857 (19.4%)	11,865 (19.3%)	-0.003	16,042 (19.6%)	15,680 (19.2%)	-0.011
2nd	20,303 (19.9%)	12,491 (20.3%)	0.011	16,261 (19.9%)	16,533 (20.2%)	0.008
3rd	20,064 (19.6%)	12,146 (19.8%)	0.003	15,621 (19.1%)	16,589 (20.3%)	0.030
4th	20,218 (19.8%)	12,285 (20.0%)	0.005	15,846 (19.4%)	16,657 (20.4%)	0.025
5th	19,842 (19.4%)	11,575 (18.8%)	-0.015	16,541 (20.2%)	14,876 (18.2%)	-0.052
Missing	1,859 (1.8%)	1,098 (1.8%)	-0.003	1,491 (1.8%)	1,466 (1.8%)	-0.002

Geography

Region

East North Central	15,732 (15.4%)	9,939 (16.2%)	0.021	12,793 (15.6%)	12,878 (15.7%)	0.003
East South Central	8,225 (8.1%)	5,520 (9.0%)	0.033	5,953 (7.3%)	7,792 (9.5%)	0.081
Middle Atlantic	10,028 (9.8%)	5,889 (9.6%)	-0.008	8,533 (10.4%)	7,384 (9.0%)	-0.047
Mountain	6,499 (6.4%)	3,600 (5.9%)	-0.021	5,579 (6.8%)	4,520 (5.5%)	-0.054
New England	4,563 (4.5%)	2,674 (4.4%)	-0.006	3,468 (4.2%)	3,769 (4.6%)	0.018
Pacific	12,897 (12.6%)	6,519 (10.6%)	-0.063	10,349 (12.7%)	9,067 (11.1%)	-0.048
South Atlantic	21,907 (21.4%)	13,646 (22.2%)	0.018	17,589 (21.5%)	17,964 (22.0%)	0.011
West North Central	8,518 (8.3%)	5,404 (8.8%)	0.016	6,160 (7.5%)	7,762 (9.5%)	0.070
West South Central	13,774 (13.5%)	8,269 (13.5%)	-0.001	11,378 (13.9%)	10,665 (13.0%)	-0.026
Urban	72,776 (71.2%)	42,984 (69.9%)	-0.029	59,589 (72.8%)	56,171 (68.7%)	-0.092

Medications/Treatment

DMARD

Methotrexate	51,459 (50.4%)	31,618 (51.4%)	0.021	40,052 (49.0%)	43,025 (52.6%)	0.073
Abatacept	9,431 (9.2%)	6,261 (10.2%)	0.032	8,417 (10.3%)	7,275 (8.9%)	-0.047
Adalimumab	7,844 (7.7%)	4,233 (6.9%)	-0.030	6,079 (7.4%)	5,998 (7.3%)	-0.004
Certolizumab	2,650 (2.6%)	1,336 (2.2%)	-0.028	2,226 (2.7%)	1,760 (2.2%)	-0.037
Etanercept	9,978 (9.8%)	5,018 (8.2%)	-0.056	7,403 (9.0%)	7,593 (9.3%)	0.008
Golimumab	1,825 (1.8%)	1,068 (1.7%)	-0.004	1,547 (1.9%)	1,346 (1.6%)	-0.019
Infliximab	11,427 (11.2%)	6,566 (10.7%)	-0.016	9,102 (11.1%)	8,891 (10.9%)	-0.008
Rituximab	3,800 (3.7%)	2,683 (4.4%)	0.033	3,523 (4.3%)	2,960 (3.6%)	-0.035
Tocilizumab	2,713 (2.7%)	2,029 (3.3%)	0.038	2,548 (3.1%)	2,194 (2.7%)	-0.026
Tofacitinib	1,016 (1.0%)	648 (1.1%)	0.006	905 (1.1%)	759 (0.9%)	-0.018

Prior biologics

None	66,946 (65.5%)	38,330 (62.4%)	-0.066	51,336 (62.8%)	53,940 (65.9%)	0.067
1	24,691 (24.2%)	15,399 (25.1%)	0.020	20,601 (25.2%)	19,489 (23.8%)	-0.032
2	7,439 (7.3%)	5,311 (8.6%)	0.050	6,803 (8.3%)	5,947 (7.3%)	-0.039
≥3	3,067 (3.0%)	2,420 (3.9%)	0.051	3,062 (3.7%)	2,425 (3.0%)	-0.043

Medication use past 3 months

Sulfasalazine	4,430 (4.3%)	2,682 (4.4%)	0.001	4,045 (4.9%)	3,067 (3.7%)	-0.059
Leflunomide	5,863 (5.7%)	4,344 (7.1%)	0.054	5,345 (6.5%)	4,862 (5.9%)	-0.024

HCQ	15,178 (14.9%)	10,025 (16.3%)	0.040	12,934 (15.8%)	12,269 (15.0%)	-0.023
Methotrexate	70,968 (69.5%)	44,073 (71.7%)	0.049	56,524 (69.1%)	58,517 (71.5%)	0.053
NSAIDs	27,084 (26.5%)	14,986 (24.4%)	-0.049	21,179 (25.9%)	20,891 (25.5%)	-0.008
Opioids	43,114 (42.2%)	30,690 (49.9%)	0.155	36,918 (45.1%)	36,886 (45.1%)	-0.001
PPI	31,293 (30.6%)	21,314 (34.7%)	0.086	26,497 (32.4%)	26,110 (31.9%)	-0.010

Comorbid Conditions

Charlson	2 [0-3]	2 [0-4]	0.086	2 [0-4]	2 [0-3]	-0.038
Diabetes	22,745 (22.3%)	12,885 (21.0%)	-0.032	17,720 (21.7%)	17,910 (21.9%)	0.006
Hypertension	58,318 (57.1%)	36,754 (59.8%)	0.055	47,862 (58.5%)	47,210 (57.7%)	-0.016
CKD	7,666 (7.5%)	5,409 (8.8%)	0.047	6,641 (8.1%)	6,434 (7.9%)	-0.009
COPD	10,474 (10.3%)	8,686 (14.1%)	0.119	9,661 (11.8%)	9,499 (11.6%)	-0.006
Asthma	7,212 (7.1%)	5,487 (8.9%)	0.069	6,698 (8.2%)	6,001 (7.3%)	-0.032
CVD	2,502 (2.4%)	1,658 (2.7%)	0.016	2,107 (2.6%)	2,053 (2.5%)	-0.004
Obesity	10,401 (10.2%)	6,024 (9.8%)	-0.013	8,425 (10.3%)	8,000 (9.8%)	-0.017
CHF	7,822 (7.7%)	5,967 (9.7%)	0.073	6,935 (8.5%)	6,854 (8.4%)	-0.004
CAD	19,523 (19.1%)	12,973 (21.1%)	0.050	16,446 (20.1%)	16,050 (19.6%)	-0.012
PUD	1,900 (1.9%)	1,296 (2.1%)	0.018	1,630 (2.0%)	1,566 (1.9%)	-0.006
Extra-articular RA	2,374 (2.3%)	1,837 (3.0%)	0.041	2,092 (2.6%)	2,119 (2.6%)	0.002
Anemia	21,882 (21.4%)	15,308 (24.9%)	0.083	18,853 (23.0%)	18,337 (22.4%)	-0.015
ESRD	229 (0.2%)	142 (0.2%)	0.001	187 (0.2%)	184 (0.2%)	-0.001
MI	739 (0.7%)	529 (0.9%)	0.015	670 (0.8%)	598 (0.7%)	-0.010
Depression	17,149 (16.8%)	11,393 (18.5%)	0.046	14,435 (17.6%)	14,107 (17.2%)	-0.011
Chronic pain	21,520 (21.1%)	14,283 (23.2%)	0.052	18,448 (22.6%)	17,355 (21.2%)	-0.032

Healthcare Utilization/Prior Infections

Outpatient visits	13 [8-18]	14 [9-20]	0.153	13 [9-19]	13 [9-19]	-0.056
Rheumatology outpatient visits	4 [3-6]	4 [3-6]	0.123	4 [3-6]	4 [3-6]	-0.068
ED visits						
None	67,144 (65.7%)	35,632 (58.0%)	-0.160	51,550 (63.0%)	51,226 (62.6%)	-0.008
1	20,457 (20.0%)	13,970 (22.7%)	0.066	17,044 (20.8%)	17,383 (21.3%)	0.010
2	7,614 (7.5%)	5,884 (9.6%)	0.076	6,719 (8.2%)	6,779 (8.3%)	0.003
≥3	6,928 (6.8%)	5,974 (9.7%)	0.107	6,489 (7.9%)	6,413 (7.8%)	-0.003
Hospitalizations						
None	81,201 (79.5%)	45,515 (74.1%)	-0.129	63,429 (77.5%)	63,287 (77.4%)	-0.004
1	14,023 (13.7%)	10,194 (16.6%)	0.080	12,109 (14.8%)	12,108 (14.8%)	0.000
2	4,471 (4.4%)	3,533 (5.7%)	0.063	3,981 (4.9%)	4,023 (4.9%)	0.002
≥3	2,448 (2.4%)	2,218 (3.6%)	0.071	2,283 (2.8%)	2,383 (2.9%)	0.007
Hospitalized infection						
None	94,331 (92.4%)	54,780 (89.1%)	-0.111	74,518 (91.1%)	74,593 (91.2%)	0.003
1	6,081 (6.0%)	4,986 (8.1%)	0.085	5,564 (6.8%)	5,503 (6.7%)	-0.003

2	1,237 (1.2%)	1,152 (1.9%)	0.054	1,210 (1.5%)	1,179 (1.4%)	-0.003
≥3	494 (0.5%)	542 (0.9%)	0.048	510 (0.6%)	526 (0.6%)	0.002
Antibiotics	30,739 (30.1%)	22,553 (36.7%)	0.140	26,914 (32.9%)	26,378 (32.2%)	-0.014
Durable Medical Equipment/Disability						
Disability	43,333 (42.4%)	25,987 (42.3%)	-0.003	34,526 (42.2%)	34,794 (42.5%)	0.007
SNF past year	6,664 (6.5%)	5,288 (8.6%)	0.079	5,917 (7.2%)	6,035 (7.4%)	0.006
Durable Medical Equipment						
Walker	4,325 (4.2%)	3,075 (5.0%)	0.037	3,669 (4.5%)	3,731 (4.6%)	0.004
Oxygen	4,608 (4.5%)	3,831 (6.2%)	0.076	4,276 (5.2%)	4,163 (5.1%)	-0.006
Lift	526 (0.5%)	416 (0.7%)	0.021	468 (0.6%)	474 (0.6%)	0.001
Wheelchair	3,683 (3.6%)	2,784 (4.5%)	0.047	3,209 (3.9%)	3,258 (4.0%)	0.003
Hospital bed	1,409 (1.4%)	1,019 (1.7%)	0.023	1,251 (1.5%)	1,177 (1.4%)	-0.007
Any DME	12,876 (12.6%)	9,706 (15.8%)	0.091	11,340 (13.9%)	11,242 (13.7%)	-0.003
Preventive Treatment						
Cancer Screening						
Breast cancer	58,938 (57.7%)	34,256 (55.7%)	-0.040	46,884 (57.3%)	46,310 (56.6%)	-0.014
Colon cancer	46,795 (45.8%)	28,292 (46.0%)	0.004	37,973 (46.4%)	37,114 (45.4%)	-0.021
Prostate cancer	13,767 (13.5%)	8,520 (13.9%)	0.011	11,188 (13.7%)	11,099 (13.6%)	-0.003
Cervical cancer	34,711 (34.0%)	19,503 (31.7%)	-0.048	27,367 (33.5%)	26,847 (32.8%)	-0.013
Lung cancer	12,967 (12.7%)	9,735 (15.8%)	0.090	11,670 (14.3%)	11,032 (13.5%)	-0.023
Immunizations						
Influenza vaccine (past year)	56,829 (55.6%)	34,612 (56.3%)	0.014	45,735 (55.9%)	45,706 (55.9%)	-0.001
Pneumococcal vaccine (ever)	29,978 (29.3%)	18,380 (29.9%)	0.012	24,403 (29.8%)	23,955 (29.3%)	-0.012
Herpes zoster vaccination (ever)	7,456 (7.3%)	3,956 (6.4%)	-0.034	5,860 (7.2%)	5,552 (6.8%)	-0.015

Mean (standard deviation), N (percent), or median [interquartile range] shown.

Standardized mean differences (SMD) were considered meaningful across the exposure (glucocorticoids) if > 0.1 and across the IV if > 0.026 (0.2 times the complier rate) – these values are bolded.

DMARD = disease-modifying anti-rheumatic drug; HCQ = hydroxychloroquine; NSAIDs = nonsteroidal anti-inflammatory drugs; PPI = proton pump inhibitor; CKD = chronic kidney disease; COPD = chronic obstructive pulmonary disease; CVD = cerebrovascular disease; CHF = congestive heart failure; CAD = coronary artery disease; PUD = peptic ulcer disease; ESRD = end-stage renal disease; MI = myocardial infarction; ED = emergency department; DME = durable medical equipment