AS Project Analysis Notes

Tuesday, June 05, 2018

# AS case definition

* Denominator
  + At least 12 months of continuous enrollment
  + For annual prevalence (calendar year), continuous enrollment for at least 6 months of the calendar year
  + For overall, 12 months of continuous enrollment can span calendar years
  + Includes <65 year-olds
* Numerator
  + At least 2 diagnosis codes of 720.0
  + Both must be from a rheumatologist ambulatory visit
  + Both must be between 7-365 days apart
  + AS date is set as the date of the 2nd diagnosis
  + AS date must be within enrollment window (i.e., patient must also be in the denominator)
* Protocol states the numerator should be single diagnosis of 720.0, but this was considered (a posteriori) to be not specific
* We also considered broadening the scope of ICD-9 diagnosis codes to 720.xx (at least two codes); but also considered this to be not specific

# Exposure ascertainment

* Follows protocol

# Prevalent condition ascertainment

* 12-month period prevalence (±6 months from exposure date)
  + Other time windows were calculated but only 12-month is reported

# Propensity score model

* Model was a multinomial logistic regression model
  + The link function used was a generalized logit
* TNF exposure was used as the reference exposure
* Model output is probability of exposure to TNF, DMARD, and NSAID or no exposure
* Model estimation performed separately for the 3 data sources: MPCD, Marketscan, and Medicare
* Inverse probability treatment weight (IPTW) for TNF exposure
* The common support region lower bound is the maximum of the lowest TNF propensity score among the 3 exposure groups. The common support region upper bound is the minimum of the greatest TNF propensity score among the 3 exposure groups

# Incident outcome modeling

* Subjects with disease prior to exposure are excluded
  + Exception for hospitalized and opportunistic infections, and non-melanoma skin cancer
* Models are weighted using IPTW
* Subjects with propensity scores outside of common support region are excluded
* Additional covariates include
  + 6-month mean daily corticosteroid dose (5 level ordinal)
* Comparisons are between
  + TNF vs DMARD
  + TNF vs NSAID or no exposure

# Tables

Data in tables below do not reflect pending changes described in comment margins above.

## Prevalence of AS

Denominator:

* At least 12 months of continuous enrollment
* For annual prevalence, continuous enrollment for at least 6 months of the year
* For overall, 12 months of continuous enrollment can span calendar year
* Includes <65 year-olds

Numerator:

* At least 2 diagnosis codes of 720.0
* Both must be from a rheumatologist ambulatory visit
* Both must be between 7-365 days apart
* AS date is set as the date of the 2nd diagnosis
* AS date must be within enrollment window (i.e., patient must also be in the denominator)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **year** | **numer5pct** | **denom5pct** | **numerEstimated** | **denomEstimated** | **prev** |
| 2006 | 110 | 830,317 | 2,200 | 16,606,340 | 0.013% |
| 2007 | 169 | 896,578 | 3,380 | 17,931,560 | 0.019% |
| 2008 | 218 | 900,910 | 4,360 | 18,018,200 | 0.024% |
| 2009 | 257 | 904,231 | 5,140 | 18,084,620 | 0.028% |
| 2010 | 320 | 921,241 | 6,400 | 18,424,820 | 0.035% |
| 2011 | 383 | 956,052 | 7,660 | 19,121,040 | 0.040% |
| 2012 | 439 | 1,003,251 | 8,780 | 20,065,020 | 0.044% |
| 2013 | 538 | 1,123,450 | 10,760 | 22,469,000 | 0.048% |
| 2014 | 592 | 1,097,812 | 11,840 | 21,956,240 | 0.054% |
| OVERALL 2006-2014 | 580 | 1,734,873 | 11,600 | 34,697,460 | 0.033% |

Differences from earlier estimates

* Numerator used single diagnosis code of 720.0 (determined to have low specificity)
* Numerator used 2 diagnosis codes of 720.xx (determined to have low specificity)

## Demographic characteristics

AS and non-AS cohorts

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **cohort** | **database** | **denom** | **age** | **female** |
| AS | MPCD | 2,855 | 43.3 (13.5) | 35.5% (n = 1,013) |
| AS | Marketscan | 12,566 | 45.7 (13.4) | 41.0% (n = 5,155) |
| AS | Medicare | 11,699 | 58.7 (14.3) | 37.1% (n = 4,340) |
| Non-AS | MPCD | 1,139,225 | 50.1 (16.6) | 55.8% (n = 635,972) |
| Non-AS | Medicare | 1,854,650 | 68.9 (14.0) | 61.2% (n = 1,135,612) |

Exposed among AS cohort

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **cohort** | **database** | **denom** | **age** | **female** |
| Exposed | MPCD | 1,223 | 45.1 (14.2) | 38.0% (n = 465) |
| Exposed | Marketscan | 5,205 | 45.4 (13.7) | 45.1% (n = 2,350) |
| Exposed | Medicare | 6,690 | 58.4 (14.6) | 38.1% (n = 2,549) |
| Non-AS | MPCD | 1,139,225 | 50.1 (16.6) | 55.8% (n = 635,972) |
| Non-AS | Medicare | 1,854,650 | 68.9 (14.0) | 61.2% (n = 1,135,612) |

Exposure cohorts

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **database** | **exposure** | **denom** | **age** | **female** |
| MPCD | DMARD | 145 | 43.7 (15.0) | 42.1% (n = 61) |
| MPCD | NSAID | 265 | 43.6 (12.7) | 46.8% (n = 124) |
| MPCD | No exposure | 512 | 50.9 (13.9) | 34.6% (n = 177) |
| MPCD | TNF | 575 | 40.8 (12.7) | 37.4% (n = 215) |
| Marketscan | DMARD | 710 | 46.2 (13.2) | 54.9% (n = 390) |
| Marketscan | NSAID | 1,293 | 45.8 (14.0) | 47.8% (n = 618) |
| Marketscan | No exposure | 1,699 | 47.3 (14.6) | 40.5% (n = 688) |
| Marketscan | TNF | 2,864 | 43.8 (13.1) | 45.0% (n = 1,290) |
| Medicare | DMARD | 1,432 | 58.0 (14.3) | 46.9% (n = 671) |
| Medicare | NSAID | 2,755 | 58.3 (14.7) | 38.5% (n = 1,060) |
| Medicare | No exposure | 2,489 | 62.1 (14.1) | 33.9% (n = 843) |
| Medicare | TNF | 2,660 | 53.5 (14.2) | 37.2% (n = 990) |

## Prevalence of comorbidities

12-month prevalence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **outcomeCategory** | **disease** | **MPCD AS cohort**  **N = 2,855** | **Marketscan AS cohort**  **N = 12,566** | **Medicare AS cohort**  **N = 11,699** |
| Cancer | Hematologic Cancer | 0.2 (0.1-0.7) | 0.3 (0.2-0.5) | 1.0 (0.8-1.2) |
| Cancer | Non Melanoma Skin Cancer | 0 | 0.6 (0.4-0.8) | 0.9 (0.7-1.2) |
| Cancer | Solid Cancer | 3.0 (2.2-4.1) | 2.6 (2.2-3.1) | 7.6 (7.0-8.3) |
| Cardiac disease | Aortic Insufficiency/Aortic Regurgitation | 1.8 (1.2-2.7) | 1.1 (0.8-1.4) | 3.6 (3.2-4.1) |
| Cardiac disease | Conduction Block | 0.4 (0.2-0.9) | 0.8 (0.6-1.1) | 2.5 (2.1-2.9) |
| Cardiac disease | Myocardial infarction | 0.1 (0.0-0.4) | 0.2 (0.1-0.3) | 0.7 (0.5-0.9) |
| Infection | Hospitalized infection | 0.7 (0.3-1.2) | 2.6 (2.2-3.1) | 6.9 (6.3-7.5) |
| Infection | Opportunistic infection | 0.9 (0.5-1.6) | 1.0 (0.7-1.3) | 2.0 (1.7-2.3) |
| Inflammatory bowel disease | Crohn’s Disease | 3.2 (2.3-4.3) | 3.5 (3.0-4.0) | 5.0 (4.5-5.6) |
| Inflammatory bowel disease | Ulcerative Colitis | 2.6 (1.8-3.6) | 2.3 (1.9-2.7) | 2.5 (2.1-2.9) |
| Kidney disease | Amyloidosis | 0.1 (0.0-0.4) | 0.0 (0.0-0.1) | 0.1 (0.0-0.2) |
| Kidney disease | IgA nephropathy | 0.3 (0.1-0.8) | 0.2 (0.1-0.3) | 0.1 (0.1-0.2) |
| Kidney disease | Nephrotic syndrome | 0.1 (0.0-0.4) | 0.0 (0.0-0.1) | 0.2 (0.1-0.3) |
| Lung disease | Apical Pulmonary fibrosis | 0.0 (0.0-0.2) | 0 | 0.0 (0.0-0.1) |
| Lung disease | Interstitial lung disease | 0 | 0.1 (0.0-0.2) | 0.3 (0.2-0.5) |
| Lung disease | Restrictive lung disease | 0.8 (0.4-1.4) | 0.8 (0.6-1.1) | 2.6 (2.2-3.0) |
| Neurological Disease | Cauda Equina syndrome | 0.1 (0.0-0.4) | 0.0 (0.0-0.1) | 0.2 (0.1-0.3) |
| Neurological Disease | Spinal Cord compression | 0.1 (0.0-0.4) | 0.1 (0.0-0.2) | 0.3 (0.2-0.4) |
| Osteoporotic fracture | Clinical vertebral fracture | 1.2 (0.7-2.0) | 0.7 (0.5-0.9) | 2.2 (1.9-2.6) |
| Osteoporotic fracture | Non-vertebral osteoporotic fracture | 1.8 (1.2-2.7) | 0.9 (0.6-1.1) | 2.8 (2.4-3.2) |
| PsO/PsA | Psoriasis | 2.0 (1.3-2.9) | 3.1 (2.6-3.5) | 3.2 (2.8-3.7) |
| PsO/PsA | Psoriatic arthritis | 3.3 (2.4-4.4) | 3.9 (3.4-4.5) | 4.6 (4.1-5.2) |
| Uveitis | Uveitis | 8.1 (6.7-9.7) | 8.2 (7.5-9.0) | 6.9 (6.3-7.5) |

## Crude incidence

* Subjects with disease prior to exposure are excluded
  + Exception for hospitalized and opportunistic infections, and non-melanoma skin cancer

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| type | outcomeCategory | disease | MPCD TNF | MPCD DMARD | MPCD NSAID or no exposure | Marketscan TNF | Marketscan DMARD | Marketscan NSAID or no exposure | Medicare TNF | Medicare DMARD | Medicare NSAID or no exposure |
| Comorbidity | Cancer | Hematologic Cancer | 0.14 (0.00-0.76) | 0.00 (0.00-2.70) | 0.50 (0.14-1.27) | 0.14 (0.04-0.36) | 0.71 (0.23-1.65) | 0.41 (0.22-0.70) | 0.35 (0.24-0.50) | 0.25 (0.12-0.44) | 0.34 (0.25-0.44) |
| Comorbidity | Cancer | Non Melanoma Skin Cancer | 1.38 (0.66-2.53) | 1.48 (0.18-5.33) | 1.25 (0.60-2.30) | 0.61 (0.35-0.98) | 1.56 (0.78-2.80) | 0.76 (0.49-1.13) | 1.32 (1.09-1.59) | 1.48 (1.14-1.89) | 1.79 (1.58-2.02) |
| Comorbidity | Cancer | Solid Cancer | 1.40 (0.67-2.57) | 2.27 (0.47-6.63) | 3.76 (2.52-5.40) | 1.32 (0.92-1.82) | 2.24 (1.26-3.70) | 2.39 (1.88-3.01) | 1.68 (1.40-1.98) | 2.58 (2.10-3.13) | 3.22 (2.92-3.54) |
| Comorbidity | Cardiac disease | Aortic Insufficiency/Aortic Regurgitation | 0.68 (0.22-1.60) | 0.73 (0.02-4.08) | 1.40 (0.70-2.50) | 0.47 (0.25-0.80) | 0.85 (0.31-1.86) | 0.63 (0.39-0.98) | 1.13 (0.91-1.38) | 1.17 (0.87-1.55) | 1.67 (1.46-1.89) |
| Comorbidity | Cardiac disease | Conduction Block | 0.27 (0.03-0.98) | 0.00 (0.00-2.70) | 1.00 (0.43-1.97) | 0.65 (0.38-1.02) | 0.57 (0.15-1.45) | 1.02 (0.70-1.44) | 0.98 (0.78-1.21) | 1.38 (1.05-1.78) | 1.66 (1.46-1.89) |
| Comorbidity | Cardiac disease | Myocardial infarction | 0.41 (0.08-1.19) | 0.00 (0.00-2.70) | 0.00 (0.00-0.46) | 0.18 (0.06-0.42) | 0.14 (0.00-0.78) | 0.22 (0.09-0.45) | 0.44 (0.31-0.60) | 0.63 (0.42-0.91) | 0.66 (0.54-0.81) |
| Comorbidity | Infection | Hospitalized infection | 2.77 (1.69-4.29) | 0.74 (0.02-4.10) | 1.88 (1.05-3.11) | 5.20 (4.37-6.14) | 6.07 (4.35-8.23) | 4.69 (3.95-5.52) | 6.78 (6.20-7.39) | 8.38 (7.49-9.35) | 7.97 (7.49-8.46) |
| Comorbidity | Infection | Opportunistic infection | 0.96 (0.38-1.97) | 2.27 (0.47-6.65) | 0.25 (0.03-0.90) | 1.26 (0.88-1.76) | 2.30 (1.32-3.74) | 0.70 (0.44-1.06) | 1.54 (1.29-1.83) | 1.84 (1.45-2.30) | 1.20 (1.03-1.39) |
| Comorbidity | Kidney disease | Amyloidosis | 0.00 (0.00-0.50) | 0.00 (0.00-2.70) | 0.37 (0.08-1.08) | 0.04 (0.00-0.20) | 0.00 (0.00-0.52) | 0.00 (0.00-0.12) | 0.05 (0.01-0.12) | 0.00 (0.00-0.08) | 0.04 (0.01-0.08) |
| Comorbidity | Kidney disease | IgA nephropathy | 0.14 (0.00-0.76) | 0.00 (0.00-2.70) | 0.12 (0.00-0.69) | 0.07 (0.01-0.26) | 0.00 (0.00-0.52) | 0.09 (0.02-0.28) | 0.13 (0.06-0.22) | 0.09 (0.02-0.23) | 0.08 (0.04-0.14) |
| Comorbidity | Kidney disease | Nephrotic syndrome | 0.27 (0.03-0.98) | 0.00 (0.00-2.70) | 0.00 (0.00-0.46) | 0.07 (0.01-0.26) | 0.14 (0.00-0.78) | 0.03 (0.00-0.18) | 0.10 (0.05-0.19) | 0.11 (0.04-0.26) | 0.05 (0.02-0.10) |
| Comorbidity | Lung disease | Apical Pulmonary fibrosis | 0.00 (0.00-0.50) | 0.00 (0.00-2.70) | 0.12 (0.00-0.69) | 0.00 (0.00-0.13) | 0.00 (0.00-0.52) | 0.00 (0.00-0.12) | 0.00 (0.00-0.04) | 0.00 (0.00-0.08) | 0.01 (0.00-0.05) |
| Comorbidity | Lung disease | Interstitial lung disease | 0.00 (0.00-0.50) | 0.00 (0.00-2.70) | 0.00 (0.00-0.46) | 0.04 (0.00-0.20) | 0.14 (0.00-0.78) | 0.00 (0.00-0.12) | 0.23 (0.14-0.35) | 0.38 (0.22-0.61) | 0.12 (0.07-0.19) |
| Comorbidity | Lung disease | Restrictive lung disease | 0.55 (0.15-1.40) | 0.00 (0.00-2.70) | 1.12 (0.51-2.13) | 0.57 (0.33-0.93) | 0.43 (0.09-1.25) | 0.67 (0.41-1.02) | 1.32 (1.08-1.59) | 1.27 (0.95-1.66) | 1.43 (1.24-1.64) |
| Comorbidity | Neurological Disease | Cauda Equina syndrome | 0.00 (0.00-0.50) | 0.00 (0.00-2.70) | 0.12 (0.00-0.69) | 0.04 (0.00-0.20) | 0.00 (0.00-0.52) | 0.00 (0.00-0.12) | 0.06 (0.02-0.13) | 0.02 (0.00-0.12) | 0.04 (0.01-0.08) |
| Comorbidity | Neurological Disease | Spinal Cord compression | 0.00 (0.00-0.50) | 0.00 (0.00-2.70) | 0.12 (0.00-0.69) | 0.28 (0.12-0.56) | 0.14 (0.00-0.78) | 0.28 (0.13-0.54) | 0.15 (0.08-0.25) | 0.13 (0.05-0.29) | 0.14 (0.08-0.21) |
| Comorbidity | Osteoporotic fracture | Clinical vertebral fracture | 0.82 (0.30-1.79) | 0.00 (0.00-2.74) | 0.75 (0.28-1.63) | 0.47 (0.25-0.80) | 0.00 (0.00-0.52) | 0.66 (0.41-1.02) | 1.13 (0.91-1.38) | 1.20 (0.89-1.57) | 1.36 (1.18-1.56) |
| Comorbidity | Osteoporotic fracture | Non-vertebral osteoporotic fracture | 1.37 (0.66-2.53) | 1.48 (0.18-5.34) | 2.16 (1.26-3.46) | 1.16 (0.79-1.64) | 0.99 (0.40-2.05) | 0.99 (0.67-1.40) | 1.31 (1.07-1.58) | 2.18 (1.75-2.68) | 1.85 (1.63-2.09) |
| Disease manifestation | Inflammatory bowel disease | Crohn’s Disease | 1.87 (1.00-3.20) | 0.77 (0.02-4.29) | 1.65 (0.88-2.82) | 1.57 (1.13-2.12) | 1.48 (0.71-2.72) | 1.42 (1.03-1.90) | 0.83 (0.65-1.06) | 0.59 (0.38-0.87) | 0.83 (0.69-1.00) |
| Disease manifestation | Inflammatory bowel disease | Ulcerative Colitis | 0.56 (0.15-1.43) | 0.00 (0.00-2.70) | 0.88 (0.35-1.81) | 1.28 (0.89-1.78) | 1.29 (0.59-2.44) | 1.09 (0.75-1.52) | 0.64 (0.48-0.84) | 0.58 (0.38-0.86) | 0.59 (0.48-0.73) |
| Disease manifestation | PsO/PsA | Psoriasis | 1.82 (0.97-3.12) | 0.00 (0.00-2.73) | 0.88 (0.35-1.81) | 2.03 (1.53-2.64) | 1.74 (0.90-3.04) | 1.28 (0.92-1.75) | 1.15 (0.93-1.40) | 0.91 (0.64-1.24) | 0.86 (0.72-1.03) |
| Disease manifestation | PsO/PsA | Psoriatic arthritis | 2.75 (1.65-4.29) | 1.51 (0.18-5.45) | 1.13 (0.52-2.15) | 2.12 (1.60-2.75) | 2.65 (1.57-4.18) | 1.09 (0.76-1.53) | 1.12 (0.90-1.38) | 1.04 (0.75-1.40) | 0.63 (0.51-0.77) |
| Disease manifestation | Uveitis | Uveitis | 2.66 (1.58-4.20) | 2.43 (0.50-7.09) | 4.43 (3.05-6.22) | 3.52 (2.83-4.33) | 2.70 (1.60-4.27) | 4.03 (3.34-4.83) | 1.89 (1.60-2.22) | 1.31 (0.98-1.72) | 1.59 (1.39-1.81) |

## Hazard ratios

* Weighted using IPTW and adjusted for 6-month prednisone equivalent daily dose
* Comparisons are between
  + TNF vs DMARD
  + TNF vs NSAID or no exposure
* Only HRs significantly different from 1.0 are shown

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| disease | comparison | database | nTNF | nComparator | HazardRatio | RobustWaldLower | RobustWaldUpper |
| Hospitalized infection | TNF vs DMARD | MPCD | 537 | 139 | 14.58 | 1.86 | 114.22 |
| Clinical vertebral fracture | TNF vs DMARD | Marketscan | 2,814 | 708 | 8.01 | 1.02 | 63.09 |
| Hospitalized infection | TNF vs NSAID or no exposure | MPCD | 537 | 663 | 3.64 | 1.60 | 8.30 |
| Psoriatic arthritis | TNF vs NSAID or no exposure | MPCD | 519 | 656 | 3.28 | 1.09 | 9.85 |
| Interstitial lung disease | TNF vs NSAID or no exposure | Medicare | 2,188 | 4,253 | 2.71 | 1.20 | 6.11 |
| Psoriatic arthritis | TNF vs NSAID or no exposure | Marketscan | 2,705 | 2,607 | 2.02 | 1.29 | 3.18 |
| Psoriatic arthritis | TNF vs NSAID or no exposure | Medicare | 2,097 | 4,164 | 1.65 | 1.14 | 2.39 |
| Opportunistic infection | TNF vs NSAID or no exposure | Medicare | 2,197 | 4,262 | 1.37 | 1.03 | 1.82 |
| Conduction Block | TNF vs NSAID or no exposure | Medicare | 2,158 | 4,188 | 0.67 | 0.47 | 0.94 |
| Non-vertebral osteoporotic fracture | TNF vs DMARD | Medicare | 2,136 | 1,369 | 0.66 | 0.47 | 0.92 |
| Solid Cancer | TNF vs NSAID or no exposure | MPCD | 530 | 658 | 0.38 | 0.17 | 0.84 |
| Hematologic Cancer | TNF vs NSAID or no exposure | Marketscan | 2,817 | 2,648 | 0.23 | 0.07 | 0.73 |
| Hematologic Cancer | TNF vs DMARD | Marketscan | 2,817 | 708 | 0.21 | 0.06 | 0.79 |
| Conduction Block | TNF vs NSAID or no exposure | MPCD | 537 | 663 | 0.18 | 0.04 | 0.87 |