**Supplemental Material**

**Table S-1. Summary of Treatment Categories**

| **Treatment Type** | **Definition** |
| --- | --- |
| NSAIDs, oral | ATC codes of M01A1, M01A3 (cyclooxygenase [COX]-2 selective inhibitors) |
| NSAIDs, topical | ATC code of M02A |
| csDMARDs | Agent specific codes within ATC codes A07E1, L01A, L01B, L04X, M01C, P01D |
| Biologic DMARDs | Agent specific codes within ATC codes L04B, L04C, M01C |
| Corticosteroids | ATC code of H02A |
| Opioids | ATC code of N02A |
| Antidepressants | ATC code of N06A |
| Anxiolytics | ATC codes of N05B, N05C |

cs = conventional synthetic; DMARD = disease-modifying antirheumatic drug; NSAID = nonsteroidal anti‑inflammatory drug.

**Table S-2. ICD-10 Codes for Charlson Comorbidity Index**

| **Condition** | **Weight** | **ICD-10 Code [1]** |
| --- | --- | --- |
| Myocardial infarction | 1 | I21.x, I22.x, I25.2 |
| Congestive heart failure | 1 | I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5–I42.9, I43.x, I50.x, P29.0 |
| Peripheral vascular disease | 1 | I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9 |
| Cerebrovascular disease | 1 | G45.x, G46.x, H34.0, I60.x–I69.x |
| Dementia | 1 | F00.x–F03.x, F05.1, G30.x, G31.1 |
| Chronic pulmonary disease | 1 | I27.8, I27.9, J40.x–J47.x, J60.x–J67.x, J68.4, J70.1, J70.3 |
| Rheumatologic disease | 1 | M05.x, M06.x, M31.5, M32.x–M34.x, M35.1, M35.3, M36.0 |
| Peptic ulcer disease | 1 | K25.x–K28.x |
| Mild liver disease | 1 | B18.x, K70.0–K70.3, K70.9, K71.3–K71.5, K71.7, K73.x, K74.x, K76.0, K76.2–K76.4, K76.8, K76.9, Z94.4 |
| Diabetes | 1 | E10.0, E10.1, E10.6, E10.8, E10.9, E11.0, E11.1, E11.6, E11.8, E11.9, E12.0, E12.1, E12.6, E12.8, E12.9, E13.0, E13.1, E13.6, E13.8, E13.9, E14.0, E14.1, E14.6, E14.8, E14.9 |
| Diabetes with chronic complications | 2 | E10.2–E10.5, E10.7, E11.2–E11.5, E11.7, E12.2–E12.5, E12.7, E13.2–E13.5, E13.7, E14.2–E14.5, E14.7 |
| Hemiplegia or paraplegia | 2 | G04.1, G11.4, G80.1, G80.2, G81.x, G82.x, G83.0–G83.4, G83.9 |
| Renal disease | 2 | I12.0, I13.1, N03.2–N03.7, N05.2–N05.7, N18.x, N19.x, N25.0, Z49.0–Z49.2, Z94.0, Z99.2 |
| Any malignancy including leukemia and lymphoma | 2 | C00.x–C26.x, C30.x–C34.x, C37.x–C41.x, C43.x, C45.x–C58.x, C60.x–C76.x, C81.x–C85.x, C88.x, C90.x–C97.x |
| Moderate or severe liver disease | 3 | I85.0, I85.9, I86.4, I98.2, K70.4, K71.1, K72.1, K72.9, K76.5, K76.6, K76.7 |
| Metastatic solid tumor | 6 | C77.x–C80.x |
| AIDS | 6 | B20.x–B22.x, B24.x |

ICD-10 = *International Classification of Diseases, Tenth Revision*.

Sources: [1] Quan et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care. 2005;43:1130-9.

**Table S-3. ICD-10 Diagnosis Codes for Other Select Comorbidities**

| **Condition** | **ICD-10 Code  [1-3]** |
| --- | --- |
| Anxiety | [F40] Phobic anxiety disorders  [F41] Other anxiety disorder |
| Atrioventricular block | [I44] Atrioventricular and left bundle-branch block  [I45] Other conduction disorders |
| Chronic renal disease | [N18] Chronic kidney disease |
| Coxarthropathy | [M12.05] Chronic postrheumatic arthropathy, pelvic region and thigh |
| Crohn’s disease | [K50] Crohn’s disease |
| Dactylitis | [M65] Synovitis and tenosynovitis |
| Depression | [F32] Major depressive disorder, single episode  [F33] Major depressive disorder, recurrent  [F34] Persistent mood [affective] disorders |
| Diabetes mellitus | [E10] Type 1 diabetes mellitus  [E11] Type 2 diabetes mellitus  [E12] Malnutrition-related diabetes mellitus  [E13] Other specified diabetes mellitus  [E14] Unspecified diabetes mellitus |
| Enthesitis | [M76] Enthesopathies of lower limb, excluding foot  [M77] Other enthesopathies |
| Fibromyalgia | [M79.7] Fibromyalgia |
| Hyperlipidemia | [E78] Disorders of lipoprotein metabolism and other lipidemias |
| Hypertensive diseases | [I10] Essential (primary) hypertension  [I11] Hypertensive heart disease  [I12] Hypertensive renal disease  [I13] Hypertensive heart and renal disease  [I15] Secondary hypertension |
| Ischemic heart diseases | [I20] Angina pectoris  [I21] Acute myocardial infarction  [I22] Subsequent myocardial infarction  [I23] Certain current complications following acute myocardial infarction  [I24] Other acute ischemic heart diseases  [I25] Chronic ischemic heart disease |
| Low back pain | [M48.0] Spinal stenosis  [M48.8] Other specified spondylopathies  [M48.9] Other specified spondylopathies  [M51.1] Lumbar and other intervertebral disc disorders with radiculopathy  [M51.2] Other thoracic, thoracolumbar, and lumbosacral intervertebral disc displacement  [M51.3] Other thoracic, thoracolumbar, and lumbosacral intervertebral disc degeneration  [M51.4] Schmorl’s nodes  [M51.9] Intervertebral disc disorder, unspecified  [M53.2] Spinal instabilities  [M54.4] Lumbago with sciatica  [M54.5] Low back pain |
| Lung diseases including sarcoidosis and bronchiectasis | [D86] Sarcoidosis  [J47] Bronchiectasis |
| Neck pain | [M50] Cervical disc disorders  [M53.1] Cervicobrachial syndrome  [M54.2] Cervicalgia  [M54.8] Other dorsalgia |
| Osteoarthritis | [M15] Polyosteoarthritis  [M16] Osteoarthritis of hip  [M17] Osteoarthritis of knee  [M18] Osteoarthritis of first carpometacarpal joints  [M19] Other and unspecified osteoarthritis |
| Osteoporosis | [M80] Osteoporosis with pathological fracture  [M81] Osteoporosis without current pathological fracture  [M82] Osteoporosis in diseases classified elsewhere |
| Psoriasis (other than psoriatic arthritis) | [L40.0] Psoriasis vulgaris  [L40.1] Generalized pustular psoriasis  [L40.2] Acrodermatitis continua  [L40.4] Guttate psoriasis  [L40.8] Other psoriasis  [L40.9] Psoriasis, unspecified |
| Reactive arthritis | [M02] Reactive arthropathies |
| Rheumatoid arthritis | [M05] Rheumatoid arthritis with rheumatoid factor  [M06.0] Rheumatoid arthritis without rheumatoid factor  [M06.2] Rheumatoid bursitis  [M06.3] Rheumatoid nodule  [M06.8] Other specified rheumatoid arthritis  [M06.9] Rheumatoid arthritis, unspecified |
| Ulcerative colitis | [K51] Ulcerative colitis |
| Uveitis | [H20] Iridocyclitis  [H22] Disorders of iris and ciliary body in diseases classified elsewhere |

Sources:

[1] Li J, Liu Q, Chen Y, Gao S, Zhang J, Yang Y, Chen W. Treatment patterns, complications, and direct medical costs associated with ankylosing spondylitis in Chinese urban patients: a retrospective claims data set analysis. J Med Econ. 2017 Jan 2;20(1):91-7.

[2] World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision. 2016. Available at: https://icd.who.int/browse10/2016/en. Accessed: February 27, 2020.

[3] Bremander A, Petersson IF, Bergman S, Englund M. Population‐based estimates of common comorbidities and cardiovascular disease in ankylosing spondylitis. Arthritis Care Res. 2011 Apr;63(4):550-6.

**Table S-4. Procedure Codes for Imaging, Physical Therapy, and Surgeries**

|  |  |
| --- | --- |
| **Imaging/Physical Therapy/Surgery** | **Procedure Code(s)** |
| Computed tomography scan | E200, E203 |
| Magnetic Resonance Tomography | E201, E202 |
| X-ray | E002 |
| Physical therapy | H002 |
| Arthroscopic surgery | K028, K034, K035, K059-2,K065-2, K066, K067, K068, K069-2, K074-2, K0744, K076-2, K079-2, K080-2, K093-2 |
| Artificial joint replacement | K082 |
| Joint fusion | K078 |
| Spinal fusion/laminectomy | K142 |
| Osteotomy | K054, K055, K139, K140, K141-2 |

**Table S-5. Concomitant Medication Patterns During All Available Follow-up Among Patients Receiving Biologic DMARDs (n = 115)**

| **Concomitant Medication** | **Patients With AS Diagnosis and Biologic DMARD** | **Patients With AS Diagnosis and Adalimumab** | **Patients With AS Diagnosis and Infliximab** |
| --- | --- | --- | --- |
| AS-related concomitant medications, n (%)a, b | 102 (88.7) | 51 (86.4) | 47 (94.0) |
| NSAIDs - oral | 64 (62.8) | 35 (68.6) | 26 (55.3) |
| Methotrexate | 50 (49.0) | 29 (56.9) | 20 (42.6) |
| Corticosteroids | 48 (47.1) | 16 (31.4) | 31 (66.0) |
| NSAIDs - topical | 29 (28.4) | 21 (41.2) | 7 (14.9) |
| Sulfasalazine | 27 (26.5) | 11 (21.6) | 16 (34.0) |
| Azathioprine | 3 (2.9) | 0 (0.0) | 3 (6.4) |
| Days from treatment initiation to concomitant medication, mean (SD) | 4.2 (9.0) | 5.1 (10.2) | 3.6 (7.9) |

AS = ankylosing spondylitis; DMARDs = disease-modifying antirheumatic drugs; SD = standard deviation.

aAS-related medications that the patient was receiving for more than 30 days of the first 90 days after initiating index biologic DMARD will not be considered for treatment augmentation and will be considered as concomitant medications.

bOnly includes medications received by ≥ 1 patient.