Supplemental Table 1: Data Definitions

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| --- | --- | --- | --- |
| Attribute | Classification Criteria | Definition | Notes |
| Acute Cutaneous Lupus | SLICCEULAR/ACR | (ICD-9: 694.5, 695.15, 695.4, 696.2, 692.72ORICD-10-CM: L12.0, L12.8, L41.0, L41.1, L41.8, L51.2, L56.0, L56.2, L93.0, L93.2ORMedications: (Plaquenil (brand/trade name) OR hydrochloroquine (generic name)):RXNORM\_CUI,description:93787,"Hydroxychloroquine Oral Tablet [Plaquenil]"202462, "Plaquenil"979093,"Hydroxychloroquine Sulfate 200 MG [Plaquenil]"979094,"Plaquenil 200 MG Oral Tablet"979094,"Hydroxychloroquine Sulfate 200 MG Oral Tablet [Plaquenil]"979094,"Plaquenil 200 MG Oral Tablet"1181266,"Plaquenil Oral Product"1181267,"Plaquenil Pill"AND(ICD9: 782.1 OR ICD10: R21)))AND NOT(ICD-9: 710.3ICD-10-CM: M33.90) | patients need to have 2 of the inclusion codes, or the listed lupus medication with either of the 2 rash ICD diagnosis codes, on $\geq $ 2 separate dates |
| Alopecia | SLICCEULAR/ACR | ICD-9: 704.00, 704.01ORICD-10-CM: L66.0, L66.2, L66.8, L95.9AND NOT(ICD-9: 280.8, 280.9ICD-10-CM: D50.8, D50.9) |  |
| Anti-dsDNA Antibodies | SLICCEULAR/ACR | LOINC: 11013-0, 34187-5 (value >1:10)ORLOINC: 6457-6, 12277-0, 31348-6, 81716-3 (value positive or similar)ORLOINC: 42200-6, 47299-3, 32677-7, 5130-0 (value>5 IU/mL) |  |
| Anti-Nuclear Antibodies | ACRSLICCEULAR/ACR | LOINC: 29953-7, 33253-6, 40655-3, 5048-4 (value >=1:80)ORLOINC: 42254-3, 47383-5, 59069-5, 8061-4 (value positive or similar)ORLOINC: 5047-6, 9423-5 (value >=8 IU/mL) |  |
| Anti-Phospholipid Antibodies | SLICCEULAR/ACR | LOINC: 3181-5,3182-3,8065-5,8067-1, 43363-1,55445-1,3180-7,55443-6,8062-2,43362-3,55446-9 (value >20 G/MPL);ORLOINC: 75882-1 (value positive or similar);ORLOINC: 21108-6, 40456-6, 44448-9, 44449-7, 16135-6, 16136-4,44447-1, 56538-2, 72488-0, 1880-4 (value>20 U/ml);OR(LOINC: 20507-0, 5292-8 (value reactive or similar)AND LOINC: 5393-4 (value negative)) |  |
| Anti-Smith Antibodies | SLICCEULAR/ACR | LOINC: 17589-3, 17590-1, 9722-0 (value >= 1:80)ORLOINC: 17591-9, 31627-3, 5355-3, 5356-1, 5357-9, 56730-5 (value positive or similar)ORLOINC: 17592-7, 43182-5,33567-9,33460-7 (value >=20) |  |
| Arthritis | ACRSLICCEULAR/ACR | (ICD-9: 716.40, 716.48, 716.5\*, 716.9\*, 716.80, 716.88, 716.89, 719.00, 719.08, 719.49, 719.80, 719.88,719.89, V13.4, 719.6\*, 719.9\*ORICD-10-CM: M12.80, M12.88, M12.89, M13.0, M25.40, M25.48, M25.50, M25.9)AND NOT(ICD-9: 715.\*ICD-10-CM: M15.0, M15.9, M15.1, M15.2, M19.91, M19.019, M19.029, M19.039, M19.049, M16.10, M17.10, M19.079, M19.93, M19.219, M19.229, M19.239, M19.249, M16.7, M17.5, M19.279, M19.93, M19.90, M18.9, M16.9, M17.9, M15.8, M15.3) | Patients need to have 2 inclusion codes on $\geq $ 2 separate dates |
| Chronic Cutaneous Lupus | SLICCEULAR/ACR | ICD-9: 373.34, 729.30, 991.5, 695.4ORICD-10-CM: L93.0, H01.129, M79.3, T69.1XXA | patients need to have 2 of the inclusion codes on $\geq $2 separate dates |
| Delirium/psychosis | EULAR/ACR | (ICD-9: 345.80, 345.2, 345.10, 323.81, 355.9, 349.9, 323.82, 294.9, 323.9, 345.90, 345.81, 730.70, 289.9, 293.0, 780.39, 298.9, 345.9, 356.8, 345.50, 293.9, 345.40, 730.20ORICD-10-CM: G40.909, F05, G40.301, G40.901, F29, R56.9, G40.911, G40.89, F44.5)AND NOTICD-9: 042,136.9,250.60,250.62,357.2,709.1,457.1ICD-10-CM: B20, B89, B99.9, E08.42, E09.42, E10.42, E11.40, E11.42, E13.42, I89.0, L95.9, G04.00, G04.01, G04.02, G04.2, G04.30, G04.31, G04.32, G04.39, G92AND NOT the following if within 7 days of an inclusion codeICD-9: 959.\*ICD-10: S09.8XXA, S09.90XA, S09.93XA, S19.9XXA, S29.8XXA, S39.81XA, S39.840A, S39.848A, S39.82XA, S49.80XA, S49.90XA, S59.809A, S59.819A, S59.909A, S59.919A, S69.80XA, S69.90XA, S79.819A, S79.829A, S79.919A, S79.929A, S89.80XA, S89.90XA, S99.819A, S99.919A, T07.XXXA, T14.90XA) |  |
| Direct Coombs Test | SLICC | LOINC: 1007-4, 1006-6, 51006-5 (value positive or similar) |  |
| Discoid Rash | ACR | ICD-9: 757.33, 695.4, 373.34, V12.29ORICD-10-CM: L93.0, L93.2, H01.129, Z86.2, Z86.39 | Patients need to have 2 of the inclusion codes on $\geq $2 separate dates |
| Fever | EULAR/ACR | ICD-9: 780.60ORICD-10-CM: R50.9 |  |
| Hematologic Disorder | ACR | (ICD9: 289.9, 283.9, 283.0, V12.3, 288.51, 287.5, 288.59, 288.50ORICD-10-CM: D75.9, D59.9, D59.0, D59.1, Z86.2, D72.810, D69.6, D72.818, D72.819)ORHemolytic Anemia Attribute (see below)ORThrombocytopenia Attribute (see below)ORLeukopenia Attribute (see below) |  |
| Hemolytic Anemia | SLICCEULAR/ACR | ((LOINC: 718-7, 20509-6, 30350-3, 30352-9, 30351-1 (value < 8 g/dl) OR LOINC: 4544-3, 41654-5, 32354-3 (value < 28)) AND NOT the following if within 7 days of an inclusion code: ICD-9: 642.4\*, 642.5\*, 642.6\*, 642.7\* ICD-10: O14.\*, O11.\*ORLOINC: 31111-8, 4679-7, 17849-1, 31112-6 (value >3%))ANDLOINC: 2532-0, 14804-9, 14805-6 (value > 468 u/L) |  |
| Immunologic Disorder | ACR | ICD9: 279.9ORICD-10-CM: D89.9ORAnti-dsDNA Antibodies Attribute (see below)ORAnti-Sm Antibodies Attribute (see below) |  |
| Leukopenia | SLICCEULAR/ACR | LOINC: 731-0, 26474-7 (value <1.5 K/uL)LOINC: 26464-8, 6690-2 (value <4 K/uL)AND NOTICD-9: 288.03, 305.90, 572.3, 714.1ICD-10-CM: F18.10, K76.6, M05.00, M30.\*, M31.\*, D70.1, D70.2 |  |
| Low Complement | SLICC | C3 (see below)ORC4 (see below) |  |
| Low Complement C3 | EULAR/ACR | LOINC: 4485-9 (value C3 <70 mg/dL) or (<80 mg/dL) depending on laboratory reference for “low normal” | To determine low C3 values, threshold should be set to be less than the documented “low normal” value provided for the test. If no low normal value is provided for the test, <70 mg/dL is suggested |
| Low Complement C4 | EULAR/ACR | LOINC: 4498-2 (value C4 <9 mg/dL) or (<11 mg/dL) depending on laboratory reference for “low normal” | To determine low C4 values, threshold should be set to be less than the documented “low normal” value provided for the test. If no low normal value is provided for the test, < 9 mg/dL is suggested |
| Malar Rash | ACR | (ICD9: 782.1 OR ICD10: R21))AND(Medications: (Plaquenil (brand/trade name) OR hydroxychloroquine (generic name)):RXNORM\_CUI, description:93787,"Hydroxychloroquine Oral Tablet [Plaquenil]"202462, "Plaquenil"979093,"Hydroxychloroquine Sulfate 200 MG [Plaquenil]"979094,"Plaquenil 200 MG Oral Tablet"979094,"Hydroxychloroquine Sulfate 200 MG Oral Tablet [Plaquenil]"979094,"Plaquenil 200 MG Oral Tablet"1181266,"Plaquenil Oral Product"1181267,"Plaquenil Pill")AND NOT(ICD-9: 710.3ICD-10-CM: M33.90) | ICD9 and 10 codes delineating Malar Rash were too general, so medications were added to confirm association with lupus. Rash codes |
| Neurological Conditions | ACR | (ICD9: 349.9, 294.9, 780.39, 298.9, V11.8ORICD-10-CM: R56.9, F29, Z86.59)AND NOTICD-9: 042,136.9,250.60,250.62,357.2,709.1,457.1ICD-10-CM: B20, B89, B99.9, E08.42, E09.42, E10.42, E11.40, E11.42, E13.42, I89.0, L95.9, G04.00, G04.01, G04.02, G04.2, G04.30, G04.31, G04.32, G04.39, G92AND NOT the following if within 7 days of an inclusion codeICD-9: 959.xxICD-10: S09.8XXA, S09.90XA, S09.93XA, S19.9XXA, S29.8XXA, S39.81XA, S39.840A, S39.848A, S39.82XA, S49.80XA, S49.90XA, S59.809A, S59.819A, S59.909A, S59.919A, S69.80XA, S69.90XA, S79.819A, S79.829A, S79.919A, S79.929A, S89.80XA, S89.90XA, S99.819A, S99.919A, T07.XXXA,T14.90XA |  |
| Neurological Condition | SLICC | (ICD-9: 053.13, 293.0, 293.9, 294.9, 298.9, 300.11, 323.81, 323.82, 323.9, 345.10, 345.40, 345.50, 345.80, 345.81, 345.9%, 349.9, 354.2, 354.5, 354.8, 355.8, 355.9, 356.4, 356.8, 356.9, 357.1, 357.6, 357.7, 357.9, 730.07, 730.18, 730.20, 730.25, 730.70, 780.39ORICD-10-CM: B02.23, F05, F06.8, F29, F44.5, G04.89, G04.90, G04.91, G40.%, G56.80, G56.90, G57.90, G57.91, G58.0, G58.7, G58.9, G60.3, G60.8, G60.9, G62.0, G62.2, G62.9, G63, G90.09, G96.9, M86.072, M86.179, M86.279, M86.8X8, M86.9, M89.60, R56.9)AND NOTICD-9: 042,136.9, 250.60, 250.62, 357.2, 709.1, 457.1ICD-10-CM: B20, B89, B99.9, E08.42, E09.42, E10.42, E11.40, E11.42, E13.42, I89.0, L95.9, G04.00, G04.01, G04.02, G04.2, G04.30, G04.31, G04.32, G04.39, G92AND NOT the following if within 7 days of an inclusion codeICD-9: 959.%ICD-10: S09.8XXA, S09.90XA, S09.93XA, S19.9XXA, S29.8XXA, S39.81XA, S39.840A, S39.848A, S39.82XA, S49.80XA, S49.90XA, S59.809A, S59.819A, S59.909A, S59.919A, S69.80XA, S69.90XA, S79.819A, S79.829A, S79.919A, S79.929A, S89.80XA, S89.90XA, S99.819A, S99.919A, T07.XXXA, T14.90XA) |  |
| Oral Ulcer | ACRSLICCEULAR/ACR | (ICD-9: 478.19, 528.2, 528.9, 529.9ORICD-10-CM: J34.1, J34.89, K12, K13.79)AND NOT(ICD-9: 054.9, 099.3, 136.1, 447.6, 536.8, 555.9, 560.89ORICD-10-CM: B00.9, K30, K50.90, K56.69, L95, M02.30, M35.2) | Patients need to have 2 inclusion codes on $\geq $2 separate dates |
| Photosensitivity | ACR | ICD-9: 692.72ORICD-10-CM: L56.0, L41.1, L41.8, L56.2 |  |
| Renal Disease | ACR | ICD9: 593.6, 593.81, 593.9, 791.7, 583.81, V13.09, 791.0, 583.8\*, 583.9\*ORICD-10-CM: N28.9, N28.0, R80, R80.9, N08, Z87.448, R80.3, N05.8, N05.9ORLOINC: 5820-6, 33825-1 (value >0 or >0/hpf or >0/lpf or presence), 51790-4, 33804-6, 5807-3, 5793-5, 25160-3 |  |
| Renal Disease | SLICC | ICD-9: 593.6, 593.81, 791.7ORICD-10-CM: N28.0, N28.9, R80, R80.9, R82.99ORLOINC: 2889-4, 21482-5 (value >500mg (/24H), >0.5g (/24H))ORLOINC: 51790-4, 33804-6,5807-3 (value >0/hpf or /lpf) |  |
| Renal Disease | EULAR/ACR | LOINC: 2889-4,21482-5 (value >500mg/24H, >0.5g/24H) |  |
| Seizure | EULAR/ACR | (ICD-9: 345.81, 345.90, 293.0, 345.50, 345.40, 345.10, 345.80, 345.9, 780.39, 298.9ORICD-10-CM: F44.5, G40.301, G40.009, G40.911, G40.89, G40.901, G40.201, G40.209, G40.501, G40.909)AND NOT(ICD-9: 042, 136.9, 250.60, 250.62, 357.2, 709.1, 457.1ICD-10-CM: B20, B89, B99.9, E08.42, E09.42, E10.42, E11.40, E11.42, E13.42, I89.0, L95.9, G04.00, G04.01, G04.02, G04.2, G04.30, G04.31, G04.32, G04.39, G92AND NOT the following if within 7 days of an inclusion codeICD-9: 959.\*ICD-10: S09.8XXA, S09.90XA, S09.93XA, S19.9XXA, S29.8XXA, S39.81XA, S39.840A, S39.848A, S39.82XA, S49.80XA, S49.90XA, S59.809A, S59.819A, S59.909A, S59.919A, S69.80XA, S69.90XA, S79.819A, S79.829A, S79.919A, S79.929A, S89.80XA, S89.90XA, S99.819A, S99.919A, T07.XXXA, T14.90XA) |  |
| Serositis | ACRSLICCEULAR/ACR | (ICD-9: 420.0, 420.9\*, 423.2, 423.9, 511.0, 511.89, 511.9, 785.3, 786.51, 786.52,786.7ORICD-10-CM: I30.0, I30.8, I30.9, I31.1, I31.3, I31.9, I32, J90, J91.8, J94.2, J94.8, J94.9, R07.1, R07.2, R07.81, R09.1, R09.89)AND NOTICD-9: 041.9, 788.99ICD-10-CM: B96.89, R30.1, R39.2, R39.82, R39.89AND NOT the following if within 7 days of an inclusion code:ICD-9: 486, 415.1\*, 416.2\*, V12.55, 786.50, 410.\*, 412.\*ICD-10: J18.9, I26.\*, I27.82, S09.8XXA, S09.90XA, S09.93XA, S19.9XXA, S29.8XXA, S39.81XA, S39.840A, S39.848A, S39.82XA, S49.80XA, S49.90XA, S59.809A, S59.819A, S59.909A, S59.919A, S69.80XA, S69.90XA, S79.819A, S79.829A, S79.919A, S79.929A, S89.80XA, S89.90XA, S99.819A, S99.919A, T07.XXXA, T14.90XA, Z48.89, I21.\*, I22.\*, I23.\*, I25.2CPT: 33510, 33511, 33512, 33513, 33514, 33515, 33516, 33517, 33518, 33519, 33520, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536, 33542, 33545, 33548, 33390, 33391, 33474, 33927, 33928, 33929, 33930, 33933, 33935, 33940, 33944, 33945, 32035, 32036, 32096, 32097, 32098, 32100, 32110, 32120, 32124, 32140, 32141, 32150, 32151, 32160, 32505, 32506, 32507, 32440, 32442, 32445, 32480, 32482, 32484, 32486, 32488, 32491, 32503, 32504, 32850, 32851, 32852, 32853, 32854, 32905, 32906 ICD-9-Procedure-Codes: 35.1\* ,36.1\*,37.5\*, 35.51, 35.53, 36.03, 36.2, 37.33, 37.91, 39.61, 39.62, 07.12, 41.33, 43.89, 44.15, 45.15, 45.26, 45.7\*, 48.25, 48.43, 48.52, 50.12, 50.23, 51.13, 52.12, 53.01, 53.02, 53.03, 53.04, 53.11, 53.12, 53.13, 53.14, 53.15, 53.16, 53.41, 53.49, 53.61, 53.69, 53.72, 53.84, 54.12, 55.24, 55.32, 56.34, 57.34, 57.59, 32.23ICD-10-Procedure-Codes: 02xx0xx, 02YA\*, 3E080GC, 0Dxx0xx, 0Fxx0xx, 0Yxx0xx, 0Bxx0xx, 0Wxx0xx, 07xx0xx, 0Gxx0xx, 0Txx0xx | patients need to have 2 inclusion codes on $\geq $ 2 separate dates |
| Thrombocytopenia | SLICCEULAR/ACR | LOINC: 26515-7, 777-3 (value < 100 K/uL)AND NOT the following if within 7 days of an inclusion code: ICD-9: 642.4\*, 642.5\*, 642.6\*, 642.7\* ICD-10: O14.\*, O11.\*AND NOTICD-9: 287.39, 287.49, 572.3ICD-10-CM: D69.49, D69.59, K76.6 |  |

Supplemental Table 2: Sensitivity and Specificity of Classification Attributes for SLE Cohort, Healthy Cohort

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| --- | --- | --- | --- | --- | --- |
| Criterion | Classification Criteria Domain | Lupus Classification Criteria | SLE Cohort | Healthy Cohort | Combined |
| ACR 1997 | SLICC 2012 | EULAR / ACR 2019 | Sensitivity | Specificity | Sensitivity | Specificity | Sensitivity | Specificity |
| Acute Cutaneous Lupus | Clinical |  | X | X | 51.6% | 56.9% | 0% | 99.6% | 51.6% | 94.7% |
| Alopecia | Clinical |  | X | X | 13.5% | 92.8% | 56.3% | 97.7% | 13.5% | 92.8% |
| Arthritis (Synovitis) | Clinical | X | X | X | 8.1% | 96.8% | 2% | 11.1% | 75.6% | 98.1% |
| Chronic Cutaneous Lupus | Clinical |  | X | X | 58.3% | 68.5% | 0% | 99.8% | 58.3% | 86.9% |
| Delirium | Clinical |  |  | X | 0% | 78.6% | 0% | 94.2% | 0% | 86.6% |
| Discoid Rash | Clinical | X |  |  | 58.8% | 64.8% | 0% | 99.2% | 58.2% | 84.4% |
| Fever | Clinical |  |  | X | 25.9% | 86.4% | 0% | 93.4% | 25.9% | 90.3% |
| Hematological Disorder | Clinical | X |  |  | 98.6% | 13.5% | 50% | 72.4% | 96.9% | 55.9% |
| Hemolytic Anemia | Clinical |  | X | X | 22.7% | 94.6% | 0% | 99.4% | 22.2% | 97.2% |
| Leukopenia | Clinical |  | X | X | 93.1% | 52.5% | 83.3% | 73.7% | 92.9% | 72.1% |
| Malar Rash | Clinical | X |  |  | 31.6% | 77.0% | 0% | 99.5% | 31.5% | 92.3% |
| Neurologic Disorder | Clinical | X |  |  | 40.7% | 87.2% | 0% | 95.5% | 30.6% | 91.6% |
| Neurologic Disorder | Clinical |  | X |  | 49.0% | 82.7% | 11.1% | 94.7% | 45.9% | 89.5% |
| Oral Ulcers | Clinical | X | X | X | 6.8% | 95.2% | 0% | 98.9% | 6.8% | 97.8% |
| Photosensitivity | Clinical | X |  |  | 7.1% | 94.6% | 0% | 99.4% | 7.1% | 98.3% |
| Renal Disorder | Clinical | X |  |  | 91.5% | 58.6% | 33.3% | 93.2% | 87.6% | 79.9% |
| Renal Disorder | Clinical |  | X |  | 77.0% | 72.1% | 18.2% | 94.1% | 73.5% | 85.8% |
| Renal Disorder | Clinical |  |  | X | 68.3% | 84.6% | 11.1% | 98.8% | 63.6% | 92.7% |
| Seizure | Clinical |  |  | X | 54.8% | 89.6% | 38.5% | 98.4% | 50.0% | 94.2% |
| Serositis | Clinical | X | X | X | 29.9% | 86.6% | 0% | 99.1% | 28.4% | 94.4% |
| Thrombocytopenia | Clinical |  | X | X | 68.9% | 88.9% | 50% | 99.4% | 68.3% | 94.6% |
| Anti-dsDNA Ab | Immunologic |  | X | X | 93.6% | 67.8% | 0% | 100% | 92.8% | 92.8% |
| Anti-Nuclear Ab | Immunologic | X | X | X | 69.0% | 41.2% | 12.5% | 97.1% | 67.1% | 95.2% |
| Anti-Phospholipid Ab | Immunologic |  | X | X | 65.4% | 83.8% | 0% | 99.0% | 64.3% | 92.8% |
| Anti-Smith Ab | Immunologic |  | X | X | 52.4% | 86.9% | 0% | 100% | 52.4% | 94.5% |
| Direct Coombs Test | Immunologic |  | X |  | 16.7% | 95% | 0% | 99.8% | 16.7% | 97.5% |
| Immunological Disorders | Immunologic | X |  |  | 90.3% | 59.5% | 0% | 99.8% | 89.8% | 92.4% |
| Low Complement | Immunologic |  | X |  | 85.8% | 84.4% | 0% | 100% | 85.8% | 96.4% |
| Low Complement C3 | Immunologic |  |  | X | 85.7% | 81.2% | 0% | 100% | 85.7% | 94.5% |
| Low Complement C4 | Immunologic |  |  | X | 84.2% | 90.3% | 0% | 100% | 84.2% | 97.2% |