

Supplementary Information**Sample selection:**

Patients with evidence of lupus nephritis, as defined by the following criteria, were excluded: >2 inpatient or non-diagnostic outpatient medical claims with a diagnosis of acute or chronic glomerulonephritis (including lupus glomerulonephritis), acute or chronic renal failure, nephritis or nephrotic syndrome (including lupus nephrotic syndrome), renal failure or proteinuria OR >2 inpatient or non-diagnostic outpatient medical claims where the service provider was a nephrologist.

(24)

Supplementary Table 1. Codes used to identify SLE diagnosis, evidence of belimumab administration and lupus nephritis

Condition/event identified	Codes
Inpatient claim with a diagnosis of SLE or non-diagnostic outpatient claim	ICD-9-CM code 710.0 or ICD-10-CM code M32
Evidence of belimumab administration	NDC (49401010101, 49401010201) or HCPC (Q2044, J0490)
Belimumab administration algorithm	CPT 96413, ICD-9-CM codes 140.x-165.x and 170.x-209.3x, ICD-10-CM codes C00-C96, HCPCS J9310 or NDC for Rituximab (50242005306)
Lupus nephritis	ICD-9-CM codes 580.xx-586 or ICD-10-CM codes M32.14, M32.15, E08.21, E08.29, E09.21, E09.29, E13.21, E13.29, M35.04, N00-N19

CPT, Current Procedural Terminology; HCPC/a, Healthcare Common Procedure Coding System; NDC, national drug codes; ICD-9/10-CM; International Classification of Diseases 9th revision/10th revision clinical modification; SLE, systemic lupus erythematosus.

Supplementary Table 2. Diagnosis codes used to identify lupus nephritis

Code Type	Code	Description
ICD-9-CM Dx	580.0	Acute glomerulonephritis with lesion of proliferative glomerulonephritis
ICD-9-CM Dx	580.4	Acute glomerulonephritis with lesion of rapidly progressive glomerulonephritis
ICD-9-CM Dx	580.8	Acute glomerulonephritis with other specified pathological lesion in kidney
ICD-9-CM Dx	580.81	Acute glomerulonephritis in diseases classified elsewhere
ICD-9-CM Dx	580.89	Acute glomerulonephritis with other specified pathological lesion in kidney
ICD-9-CM Dx	580.9	Acute glomerulonephritis with unspecified pathological lesion in kidney
ICD-9-CM Dx	581.0	Nephrotic syndrome with lesion of proliferative glomerulonephritis
ICD-9-CM Dx	581.1	Nephrotic syndrome with lesion of membranous glomerulonephritis
ICD-9-CM Dx	581.2	Nephrotic syndrome with lesion of membranoproliferative glomerulonephritis
ICD-9-CM Dx	581.3	Nephrotic syndrome with lesion of minimal change glomerulonephritis
ICD-9-CM Dx	581.8	Nephrotic syndrome with other specified pathological lesion in kidney
ICD-9-CM Dx	581.81	Nephrotic syndrome in diseases classified elsewhere
ICD-9-CM Dx	581.89	Nephrotic syndrome with other specified pathological lesion in kidney
ICD-9-CM Dx	581.9	Nephrotic syndrome with unspecified pathological lesion in kidney

ICD-9-CM Dx	582.0	Chronic glomerulonephritis with lesion of proliferative glomerulonephritis
ICD-9-CM Dx	582.1	Chronic glomerulonephritis with lesion of membranous glomerulonephritis
ICD-9-CM Dx	582.2	Chronic glomerulonephritis with lesion of membranoproliferative glomerulonephritis
ICD-9-CM Dx	582.4	Chronic glomerulonephritis with lesion of rapidly progressive glomerulonephritis
ICD-9-CM Dx	582.8	Chronic glomerulonephritis with other specified pathological lesion in kidney
ICD-9-CM Dx	582.81	Chronic glomerulonephritis in diseases classified elsewhere
ICD-9-CM Dx	582.89	Chronic glomerulonephritis with other specified pathological lesion in kidney
ICD-9-CM Dx	582.9	Chronic glomerulonephritis with unspecified pathological lesion in kidney
ICD-9-CM Dx	583.0	Nephritis and nephropathy, not specified as acute or chronic, with lesion of proliferative glomerulonephritis
ICD-9-CM Dx	583.1	Nephritis and nephropathy, not specified as acute or chronic, with lesion of membranous glomerulonephritis
ICD-9-CM Dx	583.2	Nephritis and nephropathy, not specified as acute or chronic, with lesion of membranoproliferative glomerulonephritis
ICD-9-CM Dx	583.4	Nephritis and nephropathy, not specified as acute or chronic, with lesion of rapidly progressive glomerulonephritis
ICD-9-CM Dx	583.6	Nephritis and nephropathy, not specified as acute or chronic, with lesion of renal cortical necrosis
ICD-9-CM Dx	583.7	Nephritis and nephropathy, not specified as acute or chronic, with lesion of renal medullary necrosis
ICD-9-CM Dx	583.8	Nephritis and nephropathy, not specified as acute or chronic, with other specified pathological lesion in kidney

ICD-9-CM Dx	583.81	Nephritis and nephropathy, not specified as acute or chronic, in diseases classified elsewhere
ICD-9-CM Dx	583.89	Nephritis and nephropathy, not specified as acute or chronic, with other specified pathological lesion in kidney
ICD-9-CM Dx	583.9	Nephritis and nephropathy, not specified as acute or chronic, with unspecified pathological lesion in kidney
ICD-9-CM Dx	584.5	Acute kidney failure with lesion of tubular necrosis
ICD-9-CM Dx	584.6	Acute kidney failure with lesion of renal cortical necrosis
ICD-9-CM Dx	584.7	Acute kidney failure with lesion of renal medullary [papillary] necrosis
ICD-9-CM Dx	584.8	Acute kidney failure with other specified pathological lesion in kidney
ICD-9-CM Dx	584.9	Acute kidney failure, unspecified
ICD-9-CM Dx	585.1	Chronic kidney disease, Stage I
ICD-9-CM Dx	585.2	Chronic kidney disease, Stage II
ICD-9-CM Dx	585.3	Chronic kidney disease, Stage III
ICD-9-CM Dx	585.4	Chronic kidney disease, Stage IV
ICD-9-CM Dx	585.5	Chronic kidney disease, Stage V
ICD-9-CM Dx	585.6	End stage renal disease
ICD-9-CM Dx	585.9	Chronic kidney disease, unspecified
ICD-9-CM Dx	586	Renal failure, unspecified

ICD-9-CM Dx	791.0	Proteinuria
ICD-10-CM Dx	M3214	Glomerular disease in systemic lupus erythematosus
ICD-10-CM Dx	M3215	Tubulo-interstitial nephropathy in systemic lupus erythematosus
ICD-10-CM Dx	E0821	Diabetes mellitus due to underlying condition with diabetic nephropathy
ICD-10-CM Dx	E0829	Diabetes mellitus due to underlying condition with other diabetic kidney complication
ICD-10-CM Dx	E0921	Drug or chemical induced diabetes mellitus with diabetic nephropathy
ICD-10-CM Dx	E0929	Drug or chemical induced diabetes mellitus with other diabetic kidney complication
ICD-10-CM Dx	E1321	Other specified diabetes mellitus with diabetic nephropathy
ICD-10-CM Dx	E1329	Other specified diabetes mellitus with other diabetic kidney complication
ICD-10-CM Dx	M3215	Tubulo-interstitial nephropathy in systemic lupus erythematosus
ICD-10-CM Dx	M3504	Sicca syndrome with tubulo-interstitial nephropathy
ICD-10-CM Dx	N000	Acute nephritic syndrome with minor glomerular abnormality
ICD-10-CM Dx	N001	Acute nephritic syndrome with focal and segmental glomerular lesions
ICD-10-CM Dx	N002	Acute nephritic syndrome with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N003	Acute nephritic syndrome with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N004	Acute nephritic syndrome with diffuse endocapillary proliferative glomerulonephritis

ICD-10-CM Dx	N005	Acute nephritic syndrome with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N006	Acute nephritic syndrome with dense deposit disease
ICD-10-CM Dx	N007	Acute nephritic syndrome with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N008	Acute nephritic syndrome with other morphologic changes
ICD-10-CM Dx	N009	Acute nephritic syndrome with unspecified morphologic changes
ICD-10-CM Dx	N010	Rapidly progressive nephritic syndrome with minor glomerular abnormality
ICD-10-CM Dx	N011	Rapidly progressive nephritic syndrome with focal and segmental glomerular lesions
ICD-10-CM Dx	N012	Rapidly progressive nephritic syndrome with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N013	Rapidly progressive nephritic syndrome with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N014	Rapidly progressive nephritic syndrome with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N015	Rapidly progressive nephritic syndrome with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N016	Rapidly progressive nephritic syndrome with dense deposit disease
ICD-10-CM Dx	N017	Rapidly progressive nephritic syndrome with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N018	Rapidly progressive nephritic syndrome with other morphologic changes
ICD-10-CM Dx	N019	Rapidly progressive nephritic syndrome with unspecified morphologic changes
ICD-10-CM Dx	N020	Recurrent and persistent haematuria with minor glomerular abnormality

ICD-10-CM Dx	N021	Recurrent and persistent haematuria with focal and segmental glomerular lesions
ICD-10-CM Dx	N022	Recurrent and persistent haematuria with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N023	Recurrent and persistent haematuria with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N024	Recurrent and persistent haematuria with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N025	Recurrent and persistent haematuria with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N026	Recurrent and persistent haematuria with dense deposit disease
ICD-10-CM Dx	N027	Recurrent and persistent haematuria with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N028	Recurrent and persistent haematuria with other morphologic changes
ICD-10-CM Dx	N029	Recurrent and persistent haematuria with unspecified morphologic changes
ICD-10-CM Dx	N030	Chronic nephritic syndrome with minor glomerular abnormality
ICD-10-CM Dx	N031	Chronic nephritic syndrome with focal and segmental glomerular lesions
ICD-10-CM Dx	N032	Chronic nephritic syndrome with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N033	Chronic nephritic syndrome with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N034	Chronic nephritic syndrome with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N035	Chronic nephritic syndrome with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N036	Chronic nephritic syndrome with dense deposit disease

ICD-10-CM Dx	N037	Chronic nephritic syndrome with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N038	Chronic nephritic syndrome with other morphologic changes
ICD-10-CM Dx	N039	Chronic nephritic syndrome with unspecified morphologic changes
ICD-10-CM Dx	N040	Nephrotic syndrome with minor glomerular abnormality
ICD-10-CM Dx	N041	Nephrotic syndrome with focal and segmental glomerular lesions
ICD-10-CM Dx	N042	Nephrotic syndrome with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N043	Nephrotic syndrome with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N044	Nephrotic syndrome with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N045	Nephrotic syndrome with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N046	Nephrotic syndrome with dense deposit disease
ICD-10-CM Dx	N047	Nephrotic syndrome with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N048	Nephrotic syndrome with other morphologic changes
ICD-10-CM Dx	N049	Nephrotic syndrome with unspecified morphologic changes
ICD-10-CM Dx	N050	Unspecified nephritic syndrome with minor glomerular abnormality
ICD-10-CM Dx	N051	Unspecified nephritic syndrome with focal and segmental glomerular lesions
ICD-10-CM Dx	N052	Unspecified nephritic syndrome with diffuse membranous glomerulonephritis

ICD-10-CM Dx	N053	Unspecified nephritic syndrome with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N054	Unspecified nephritic syndrome with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N055	Unspecified nephritic syndrome with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N056	Unspecified nephritic syndrome with dense deposit disease
ICD-10-CM Dx	N057	Unspecified nephritic syndrome with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N058	Unspecified nephritic syndrome with other morphologic changes
ICD-10-CM Dx	N059	Unspecified nephritic syndrome with unspecified morphologic changes
ICD-10-CM Dx	N060	Isolated proteinuria with minor glomerular abnormality
ICD-10-CM Dx	N061	Isolated proteinuria with focal and segmental glomerular lesions
ICD-10-CM Dx	N062	Isolated proteinuria with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N063	Isolated proteinuria with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N064	Isolated proteinuria with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N065	Isolated proteinuria with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N066	Isolated proteinuria with dense deposit disease
ICD-10-CM Dx	N067	Isolated proteinuria with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N068	Isolated proteinuria with other morphologic lesion

ICD-10-CM Dx	N069	Isolated proteinuria with unspecified morphologic lesion
ICD-10-CM Dx	N070	Hereditary nephropathy, not elsewhere classified, with minor glomerular abnormality
ICD-10-CM Dx	N071	Hereditary nephropathy, not elsewhere classified, with focal and segmental glomerular lesions
ICD-10-CM Dx	N072	Hereditary nephropathy, not elsewhere classified, with diffuse membranous glomerulonephritis
ICD-10-CM Dx	N073	Hereditary nephropathy, not elsewhere classified, with diffuse mesangial proliferative glomerulonephritis
ICD-10-CM Dx	N074	Hereditary nephropathy, not elsewhere classified, with diffuse endocapillary proliferative glomerulonephritis
ICD-10-CM Dx	N075	Hereditary nephropathy, not elsewhere classified, with diffuse mesangiocapillary glomerulonephritis
ICD-10-CM Dx	N076	Hereditary nephropathy, not elsewhere classified, with dense deposit disease
ICD-10-CM Dx	N077	Hereditary nephropathy, not elsewhere classified, with diffuse crescentic glomerulonephritis
ICD-10-CM Dx	N078	Hereditary nephropathy, not elsewhere classified, with other morphologic lesions
ICD-10-CM Dx	N079	Hereditary nephropathy, not elsewhere classified, with unspecified morphologic lesions
ICD-10-CM Dx	N08	Glomerular disorders in diseases classified elsewhere
ICD-10-CM Dx	N12	Tubulo-interstitial nephritis, not specified as acute or chronic
ICD-10-CM Dx	N140	Analgesic nephropathy
ICD-10-CM Dx	N141	Nephropathy induced by other drugs, medicaments and biological substances

ICD-10-CM Dx	N142	Nephropathy induced by unspecified drug, medicament or biological substance
ICD-10-CM Dx	N144	Toxic nephropathy, not elsewhere classified
ICD-10-CM Dx	N150	Balkan nephropathy
ICD-10-CM Dx	N158	Other specified renal tubulo-interstitial diseases
ICD-10-CM Dx	N159	Renal tubulo-interstitial disease, unspecified
ICD-10-CM Dx	N16	Renal tubulo-interstitial disorders in diseases classified elsewhere
ICD-10-CM Dx	N170	Acute kidney failure with tubular necrosis
ICD-10-CM Dx	N171	Acute kidney failure with acute cortical necrosis
ICD-10-CM Dx	N172	Acute kidney failure with medullary necrosis
ICD-10-CM Dx	N178	Other acute kidney failure
ICD-10-CM Dx	N179	Acute kidney failure, unspecified
ICD-10-CM Dx	N181	Chronic kidney disease, stage 1
ICD-10-CM Dx	N182	Chronic kidney disease, stage 2 (mild)
ICD-10-CM Dx	N183	Chronic kidney disease, stage 3 (moderate)
ICD-10-CM Dx	N184	Chronic kidney disease, stage 4 (severe)
ICD-10-CM Dx	N185	Chronic kidney disease, stage 5

ICD-10-CM Dx	N186	End stage renal disease
ICD-10-CM Dx	N189	Chronic kidney disease, unspecified
ICD-10-CM Dx	N19	Unspecified kidney failure
ICD-10-CM Dx	R800	Isolated proteinuria
ICD-10-CM Dx	R801	Persistent proteinuria, unspecified
ICD-10-CM Dx	R803	Bence Jones proteinuria
ICD-10-CM Dx	R808	Other proteinuria
ICD-10-CM Dx	R809	Proteinuria, unspecified

Dx, diagnosis; ICD-9/10-CM; International Classification of Diseases 9th revision/10th revision clinical modification.

Supplementary Table 3. Concomitant SLE-related medications

Medication Class	Generic Name
Antimalarials	Artemether/Lumefantrine
	Atovaquone/Proguanil HCL
	Chloroquine
	Halofantrine HCL
	Hydroxychloroquine Sulphate
	Mefloquine HCL
	Primaquine Phosphate
	Pyrimethamine
	Pyrimethamine/Sulphadoxine
	Quinine Sulfate
Oral Corticosteroids	Betamethasone
	Cortisone Acetate
	Dexamethasone
	Fludrocortisone Acetate
	Hydrocortisone
	Methylprednisolone
	Prednisolone
	Prednisone
	Triamcinolone
Intravenous/Injectable Corticosteroids	Betamethasone Acetate/Sodium Phosphate Norflurane HFC
	Betamethasone Acetate/Betamethasone Sodium Phosphate
	Cortisone Acetate
	Dexamethasone
	Dexamethasone Phosphate/Lidocaine HCL
	Hydrocortisone
	Methylprednisolone Acetate
	Methylprednisolone Sodium Succinate
	Prednisone Acetate
	Triamcinolone Acetonide
	Triamcinolone Acetonide/Lidocaine HCL
	Triamcinolone
Immunosuppressive Agents	Azathioprine
	Basiliximab
	Belatacept
	Cyclosporine
	Daclizumab
	Everolimus
	Muromonab-CD3

	Mycophenolate Mofetil
	Sirolimus
	Tacrolimus
NSAIDs	Bromfenac Sodium
	Celecoxib
	Celecoxib/Capsaicin/Menthol
	Celecoxib/Lidocaine/Menthol
	Chlorpheniramine Maleate/Phenylephrine HCL/Ibuprofen
	Chlorpheniramine Maleate/Pseudoephedrine HCL/Ibuprofen
	Diclofenac
	Etodolac
	Fenoprofen Calcium
	Flurbiprofen
	Hydrocodone/Ibuprofen
	Ibuprofen
	Ibuprofen/Diphenhydramine
	Ibuprofen/Famotidine
	Ibuprofen/Oxycodone HCL
	Ibuprofen/Phenylephrine HCL
	Ibuprofen/Pseudoephedrine HCL
	Indomethacin
	Ketoprofen
	Ketorolac Tromethamine
	Lansoprazole/Naproxen
	Meclofenamate Sodium
	Mefenamic Acid
	Meloxicam
	Nabumetone
	Naproxen
	Naproxen Sodium/Pseudoephedrine HCL
	Naproxen/Capsaicin/Menthol
	Naproxen/Capsaicin/Menthol/Methyl Salicylate
	Nepafenac
	Oxaprozin
	Phenylephrine HCL/Ketorolac tromethamine
	Piroxicam
	Rofecoxib
Sulindac	
Sumatriptan Succinate/Naproxen Sodium	
Suprofen	
Tolmetin Sodium	

	Valdecoxib
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HCL, hydrochloride

Supplementary Table 4. Algorithm for identifying flares and categorising flare severity in administrative claims data (27, 50, 51)

Mild flares	Moderate flares	Severe flares
<ul style="list-style-type: none"> • Initiation of any of the following: <ul style="list-style-type: none"> ○ Hydroxychloroquine or other antimalarial ○ OCS with prednisone-equivalent dose of ≤ 7.5 mg/day ○ Non-immunosuppressive therapy (e.g., NSAIDs, androgens) 	<ul style="list-style-type: none"> • Initiation of any of the following: <ul style="list-style-type: none"> ○ OCS with prednisone-equivalent dose of >7.5 mg/day but ≤ 40 mg/day ○ Immunosuppressive therapy, except for cyclophosphamide OR • ED visit with primary diagnosis of SLE (no hospital IP admission within 1 day) OR • ED visit or office visit with primary or secondary diagnosis for a specified SLE-related condition* 	<ul style="list-style-type: none"> • Initiation of any of the following: <ul style="list-style-type: none"> ○ OCS with prednisone-equivalent dose of >40 mg/day ○ Cyclophosphamide OR • Hospital IP admission with primary diagnosis of SLE (no IP admission within 1 day) OR • Hospital IP admission with primary or secondary diagnosis for a specified SLE-related condition[†]

ED, emergency department; IP, inpatient; kg, kilograms; mg, milligrams; OCS, oral corticosteroid; NSAID, non-steroid anti-inflammatory drug; SLE, systemic lupus erythematosus.

*Moderate SLE-related conditions: acute pancreatitis, arthritis/arthralgia, chorioretinitis, demyelinating syndrome/acute inflammatory demyelinating polyradiculoneuropathy, dry eye/tear film insufficiency, episcleritis/scleritis, haemolytic anaemia, hepatitis (non-viral), ischemic necrosis of bone, nephritis, renal impairment other than nephritis or end stage renal disease, low white blood cell count (leukopenia, neutropenia, lymphocytopenia), lupus enteritis/colitis, lymph node enlargement, mononeuropathy/polyneuropathy, myalgia/myositis, myelopathy, myocarditis, pericarditis, pleurisy/pleural effusion, pseudotumor cerebri, rash, seizure, urticaria, uveitis, vasculitis (excluding aortitis);[†]Severe SLE-related conditions: moderate SLE-related conditions or acute confusional state/psychosis, arthritis/arthralgia, aortitis, arterial/venous thrombosis, aseptic meningitis, cardiac tamponade, cranial neuropathy, dry eye/tear film insufficiency, intestinal pseudo-obstruction, end stage renal disease, low white blood cell count (leukopenia, neutropenia, lymphocytopenia, lymph node enlargement, myalgia/myositis, optic neuritis, pulmonary haemorrhage, rash, stroke/transient ischemic attack, urticaria.