

Appendix 1

RheumaTool, a novel clinical decision support system for the diagnosis of rheumatic diseases, and its first validation in a retrospective chart analysis

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Inclusion criteria

- Patients, 18 years or older, referred with unclear musculoskeletal complaints.
- Patients with established but questioned diagnosis of a rheumatic disease referred for a second opinion.

Exclusion criteria

- Referral for treatment only with a fully established diagnosis.
- Medical report did not contain as the main diagnosis one of the 98 diagnoses considered by RT in its calculation.
- Cases in which the musculoskeletal complaint remained unclear and could not be assigned to a diagnosis
- Medical report did not provide enough information for at least 5 matching disease characteristics in the RT search mask.

List of mandatory diseases in alphabetical order

- Ankylosing spondylitis (axial spondyloarthritis)
- Behçet's disease
- Calcium pyrophosphate dehydrate deposition disease (CPPD)
- Dermatomyositis
- Diffuse Systemic Sclerosis
- Enteropathic Spondyloarthritis
- Eosinophilic Granulomatosis with Polyangitis
- Giant cell Arteritis
- Gout
- Granulomatosis with Polyangitis
- Haemochromatosis
- Handosteoarthritis
- Juvenile Idiopathic Arthritis (JIA)
- Kneeosteoarthritis
- Microscopic Polyangitis
- Mixed connective tissue disease
- Osteonecrosis
- Polyarteritis Nodosa
- Polymyalgia Rheumatica
- Polymyositis
- Psoriatic Arthritis
- Reactive Arthritis
- Relapsing Polychondritis
- Rheumatoid Arthritis
- Sarcoidosis
- Sjögren syndrome
- Still's disease
- Systemic Lupus Erythematosus
- Limited Systemic Sclerosis
- Takayasu Arteritis

Diseases not covered by RheumaTool's algorithm in alphabetical order

- Abetalipoproteinemia
- Anti-Jo-1 syndrome
- Antisynthetase syndrome
- Asthma and rhinosinusitis
- Axial and peripheral spondylarthritis in Crohn's disease and psoriasis
- Bruxism
- Bursitis
- Carpal Tunnel Syndrome
- Cervicocephalic, thoracic and lumbospondylogenic pain syndrome
- Chilblain lupus erythematosus
- Chronic inflammatory bowel disease
- Coccygodynia
- Complex pain syndrome
- Costovertebral dysfunction
- Cryopyrin associated periodic syndrome
- Enchondroma
- Enthesopathy
- Eosinophilic fasciitis
- Eosinophilic myositis
- Epicondylopathia
- Erythema nodosa
- Exophthalmic ocular myositis
- Fasciitis plantaris
- Hypermobility syndrome
- Inactivity syndrome
- Insertionstendinopathy
- Insufficiency fracture
- Intermediate uveitis
- Intradural extramedullary mass
- Juvenile systemic sclerosis
- Ligamentary instability
- Ligamentous laxity
- Lupoid collagenosis
- Lymphocytic vasculitis
- Mechanical stress-related pain
- Meralgia paraesthetica
- Metabolic myopathy
- Morbus Buerger
- Morton's neuroma
- Multifactorial myalgia and muscle weakness
- Muscular dysbalance
- Myalgia as part of a vitamin D deficiency
- Myalgia pain syndrome
- Myofascial pain syndrome
- Nociceptive / neuropathic pain syndrome
- Osteomalacia
- Osteopenia
- Osteoporosis

- Pain syndrome
- Patellar dysplasia
- Periarthropathia coxae
- Periostitis
- Peripheral polyneuropathy
- Peripheral ulcerative keratitis
- Planovalgus foot
- Pneumonia
- Polyarthralgia with aromatase inhibitors
- Polyosteoarthritis
- Posttraumatic compression neuropathy
- Post-traumatic pain
- Psoriasis vulgaris
- Psychosomatic pain disorder
- Raynaud's syndrome
- Scoliosis
- Sicca syndrome
- Soft tissue infection
- Somatoform paresthesia
- Spinal stenosis
- Tendinitis
- Tendinopathy
- Tendon rupture
- Tenosynovitis
- Varicosis

The DCS used for establishing the reference diagnosis

Systemic Sclerosis	[1]
Systemic Lupus Erythematosus	[2]
Polymyalgia Rheumatica	[3]
Osteoarthritis of the Hand	[4]
Rheumatoid Arthritis	[5]
Polymyositis	[6]
Dermatomyositis	[6]
Psoriatic Arthritis	[7]
Ankylosing Spondylitis (Axial Spondyloarthritis)	[8]
Gout	[9]
Hyperlaxity	[10]
Sjögren Syndrome	[11]
Spondyloarthritis	[8]
Osteoarthritis of the Knee	[12]
Reactive Arthritis	[8]
Behçet's Disease	[13]
Fibromyalgia	[14]
Still's Disease	[15]
Osteoarthritis of the Hip	[16]
Complex Regional Pain Syndrome	[17]
Enteropathic Spondyloarthritis	[8]
Giant Cell Arteritis	[18]
Peripheral Spondyloarthritis	[8]
Granulomatosis with Polyangiitis	[19]
Mixed Connective Tissue Disease	[20,21]
Eosinophilic Granulomatosis with Polyangitis	[22]
Polyarteritis Nodosa	[23]
Relapsing Polychondritis	[24]

Diagnoses of all 160 cases included in the analysis

- Osteochondrosis dissecans
- Systemic sclerosis
- Systemic lupus erythematosus
- Systemic lupus erythematosus
- Polymyalgia rheumatica
- beginning osteoarthritis of the DIP and PIP joints
- Rheumatoid arthritis
- Parvovirus-associated polyarthritis
- Dermatomyositis
- Osteoarthritis of the hand
- Psoriatic arthritis
- Axial spondyloarthritis
- Secondary osteoarthritis talonavicular (whs. In the context of chronic gouty arthropathy)
- Axial spondyloarthritis
- Polymyositis
- Rheumatoid arthritis
- Arthralgia of the hand with hyperlaxicity
- Systemic lupus erythematosus
- Sjogren's syndrome
- Rheumatoid arthritis
- Axial spondyloarthritis
- Axial spondyloarthritis
- Axial spondylarthritis
- Acute gouty arthritis
- Gonarthrosis
- Polymyalgia rheumatica
- Axial spondylarthritis
- Rheumatoid arthritis
- Rheumatoid arthritis
- Systemic sclerosis
- Arthropathy in hemochromatosis
- systemic sclerosis, limited form
- CPPD arthropathy in primary hyperparathyroidism
- Axial spondyloarthritis
- Polymyalgia rheumatica
- Rheumatoid arthritis
- Axial spondylarthritis in psoriasis
- Osteoarthritis of the hand
- Axial spondyloarthritis
- M. Behçet
- Axial spondyloarthritis
- Acute gouty arthritis
- Sjogren's syndrome
- M. Behçet
- peripheral spondyloarthritis
- Gonarthrosis
- generalized soft tissue pain syndrome
- Dermatomyositis

- Still's disease
- Coxarthrosis
- Behçet's disease
- Psoriatic arthritis sine psoriasis
- Osteoarthritis of the hand
- CPPD arthropathy
- Gonarthrosis
- Seronegative Sjogren's syndrome
- Rheumatoid arthritis
- Generalized soft tissue pain syndrome
- Sjogren's syndrome
- Acute gouty arthritis
- Axial spondyloarthritis
- Seronegative spondyloarthritis
- Polymyalgia rheumatica
- Axial spondyloarthritis
- Axial spondyloarthritis
- Erosive oligoarthritis DD CPPD arthropathy
- Suspected spondyloarthritis DD beginning psoriatic arthritis
- Systemic sclerosis
- Polyarthritis most likely in the context of celiac disease
- Complex Regional Pain Syndrome
- Psoriasis arthrtis
- Finger polyarthrosis
- Enteropathic spondyloarthritis with predominantly peripheral involvement
- Adhesive shoulder capsulitis
- Septic arthritis
- Polymyalgia rheumatica
- Giant cell arteritis
- Systemic sclerosis
- Gonarthrosis
- Sjogren's syndrome
- Fibromyalgia
- Giant cell arteritis
- Chronic generalized pain syndrome
- Femoral patellar osteoarthritis
- Axial spondyloarthritis
- predominantly peripheral spondyloarthritis
- Axial spondyloarthritis
- Rheumatoid arthritis
- Undifferentiated arthritis
- undifferentiated spondyloarthritis
- Granulomatosis with polyangiitis
- Fibromyalgia
- Beginning finger polyarthrosis
- Femoral head necrosis
- beginning coxarthrosis
- Hypermobility syndrome
- Systemic sclerosis

- Axial spondyloarthritis
- Axial spondyloarthritis
- Axial spondyloarthritis
- Rheumatoid arthritis
- Psoriatic arthritis
- Early form of systemic sclerosis
- Sjogren's syndrome
- Mixed collagenosis
- Hypermobility syndrome
- Chronic fibromyalgiform soft tissue syndrome
- Axial spondyloarthritis
- Gonarthrosis
- Gonarthrosis
- Axial spondyloarthritis
- Beginning finger polyarthrosis
- Axial spondyloarthritis
- undifferentiated polyarthritits
- Axial spondyloarthritis
- Sjogren's syndrome
- Gonarthrosis
- Sjogren's syndrome
- Rheumatoid arthritis
- Polymyalgia rheumatica
- systemic sclerosis
- Gonarthrosis
- Still's disease
- Systemic sclerosis
- Systemic sclerosis
- Dermatomyositis
- Primary Sjogren's syndrome
- Fibromyalgia
- Systemic sclerosis
- Gonarthrosis
- Coxarthrosis
- Generalized pain syndrome
- Rheumatoid arthritis
- Systemic lupus erythematosus
- Symptomatic necrosis of the femur
- Polymyalgic syndrome DD Polymyalgia rheumatica
- Activated gonarthrosis in calcium pyrophosphate crystal arthropathy
- Inflammatory back and peripheral joint pain DD axial and peripheral spondyloarthritis
- Polymyalgia rheumatica
- Psoriasis arthrtis
- Undifferentiated polyarthritits DD psoriatic arthritits sine psoriase
- undifferentiated polyarthritits (DD: seronegative, rheumatoid arthritis in the foreground)
- undifferentiated polyarthritits (type of peripheral spondyloarthritis)
- undifferentiated polyarthritits (usually a predominantly peripheral spondyloarthritis)
- Undifferentiated arthritis
- Spondyloarthritis

- Undifferentiated arthritis
- Hemochromatosis
- Small vessel vasculitis is most likely microscopic polyangiitis
- MPO-ANCA-positive pauci-immune extracapillary proliferative glomerulonephritis with renal insufficiency whs microscopic polyangiitis
- Classic polyarteritis nodosa
- Classic polyarteritis nodosa
- Polymyositis
- Spondyloarthritis
- Recurrent polychondritis
- Granulomatosis with polyangiitis
- Sarcoidosis
- Sarcoidosis
- Polymyalgia rheumatica
- Extensive multifocal osteonecrosis of unclear etiology

Table S1

Table S1: Comparison of RheumaTool with other clinical decision support systems in rheumatology					
First author and year of publication	Number of diagnoses covered	Definition of output	Definition of reference diagnosis	Number of cases	Diagnostic precision
RheumaTool	98	Differential diagnosis list	DCS or expert consensus	160	63.8 % [CI 55.7–71.1]
Leitich et al. 2001 [25]	170	Differential diagnosis list	Diagnosis in medical report	54	48%
Godo et al. 2001 [26]	37	Single diagnosis	Diagnosis in medical report	32	75%
Athreya et al. 1998 [27]	59	Differential diagnosis list	Diagnosis in medical report	94	80%
Schewe et al. 1993 [28]	67	Single diagnosis	Diagnosis in medical report	51	89%
Moens et al. 1992 [29]	15	Single diagnosis	Expert consensus	570	76% and 80%
Schewe et al. 1990 [30]	32	Differential diagnosis list	unknown	358	74.4%
Fries et al. 1970 [31]	35	Single diagnosis	Expert consensus	190	76%
The decision support systems mentioned are too heterogeneous for a direct comparison. Neither are they freely available for a head-to-head study. The performance of the different tools can only be consulted in an informative manner.					

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