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(54) **Title**: METHODS OF TREATING CONDITIONS WITH ANTIBODIES THAT BIND COLONY STIMULATING FACTOR 1 RECEPTOR (CSF1R)

(57) **Abstract**: Methods of reducing cytokine levels and methods of treating conditions with antibodies that bind colony stimulating factor 1 receptor (CSF1R) are provided. Such methods include, but are not limited to, methods of treating inflammatory conditions, such as rheumatoid arthritis.

METHODS OF TREATING CONDITIONS WITH ANTIBODIES THAT BIND COLONY STIMULATING FACTOR 1 RECEPTOR (CSF1R)

TECHNICAL FIELD

[001] Methods of treating conditions with antibodies that bind colony stimulating factor 1 receptor (CSF1R) are provided. Such methods include, but are not limited to, methods of treating inflammatory and autoimmune conditions, such as rheumatoid arthritis, multiple sclerosis, and systemic lupus erythematosus.

BACKGROUND

[002] Rheumatoid arthritis (RA) is a systemic inflammatory disease, characterized by symmetric polyarthritis involving primarily small joints of the hands and feet, although other joints are also affected. Patients with more aggressive – most commonly Rheumatoid Factor (RF) positive- disease may present with extra-articular manifestations, such as rheumatoid nodules, vasculitis, scleritis, pericarditis, and Felty's syndrome. The majority of patients with RA experience progressive deterioration of cartilage and bone in the affected joints, which may eventually lead to permanent disability. Historically, the long-term prognosis of RA has been poor, with approximately 50% of patients experiencing significant functional disability within 10 years from the time of diagnosis. RA has also been associated with a reduced life expectancy of about 3-10 years.

[003] Colony stimulating factor 1 receptor (referred to herein as CSF1R; also referred to in the art as FMS, FIM2, C-FMS, M-CSF receptor, and CDl15) is a single-pass transmembrane receptor with an N-terminal extracellular domain (ECD) and a C-terminal intracellular domain with tyrosine kinase activity. Ligand binding of CSF1 or the interleukin 34 ligand (referred to herein as IL-34; Lin et al., *Science* 320: 807-11 (2008)) to CSF1R leads to receptor dimerization, upregulation of CSF1R protein tyrosine kinase activity, phosphorylation of CSF1R tyrosine residues, and downstream signaling events. Both CSF1 and IL-34 stimulate monocyte survival, proliferation, and differentiation into macrophages, as well as other monocytic cell lineages such as osteoclasts, dendritic cells, and microglia.

[004] Many tumor cells have been found to secrete CSF1, which activates monocyte/macrophage cells through CSF1R. The level of CSF1 in tumors has been shown to correlate with the level of tumor-associated macrophages (TAMs) in the tumor. Higher levels of TAMs have been found to correlate with poorer patient prognoses. In addition, CSF1 has been found to promote tumor growth and progression to metastasis in, for example, human breast cancer xenografts in mice. See, e.g., Paulus et al., *Cancer Res.* 66:

4349-56 (2006). Further, CSF1R plays a role in osteolytic bone destruction in bone metastasis. *See, e.g.*, Ohno et al., *Mol. Cancer Ther.* 5: 2634-43 (2006).

[005] CSF1 and its receptor have also been found to be involved in various inflammatory and autoimmune diseases. See, e.g., Hamilton, *Nat. Rev.* 8: 533-44 (2008). For example, synovial endothelial cells from joints afflicted with rheumatoid arthritis have been found to produce CSF1, suggesting a role for CSF1 and its receptor in the disease. Blocking CSF1R activity with an antibody results in positive clinical effects in mouse models of arthritis, including a reduction in the destruction of bone and cartilage and a reduction in macrophage numbers. *See, e.g.*, Kitaura et al., *J. Clin. Invest.* 115: 3418-3427 (2005).

[006] Mature differentiated myeloid lineage cells such as macrophages, microglial cells, and osteoclasts contribute to pathology of various diseases such as rheumatoid arthritis, multiple sclerosis and diseases of bone loss. Differentiated myeloid lineage cells are derived from peripheral blood monocyte intermediates. CSF1R stimulation contributes to development of monocytes from bone marrow precursors, to monocyte proliferation and survival, and to differentiation of peripheral blood monocytes into differentiated myeloid lineage cells such as macrophages, microglial cells, and osteoclasts. CSF1R stimulation thus contributes to proliferation, survival, activation, and maturation of differentiated myeloid lineage cells, and in the pathologic setting, CSF1R stimulation contributes to the ability of differentiated myeloid lineage cells to mediate disease pathology.

SUMMARY

[007] In some embodiments, methods of reducing the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject are provided. In some embodiments, a method comprises administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to the subject, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R. In some embodiments, the subject has an inflammatory condition. In some embodiments, the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, lupus erythematosus, inflammatory bowel disease, inflammatory arthritis, and CD16+ disorders.

[008] In some embodiments, the method comprises reducing the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, the method comprises reducing the level of IL-6. In some such embodiments, the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, and Castleman's disease. In some embodiments, the method comprises reducing the level of TNF-α. In some such embodiments, the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis. In some embodiments, the method comprises reducing the level of IL-1β. In some such embodiments, the subject has a condition selected from rheumatoid arthritis and juvenile idiopathic arthritis. In some embodiments, the method comprises reducing the level of CXCL10.

[009] In some embodiments, the method comprises reducing the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, the method comprises reducing the level of IL-6; or the method comprises reducing the level of TNF-α; or the method comprises reducing the level of IL-1β; or the method comprises reducing the level of CXCL10; or the method comprises reducing the levels of IL-6 and TNF-α; or the method comprises reducing the levels of IL-6 and IL-1β; or the method comprises reducing the levels of IL-6 and CXCL10; or the method comprises reducing the levels of TNF-α and IL-1β; or the method comprises reducing the levels of TNF-α and CXCL10; or the method comprises reducing the levels of IL-1β and CXCL10; or the method comprises reducing the levels of IL-6, TNF-α, and IL-1β; or the method comprises reducing the levels of IL-6, TNF-α, and CXCL10; or the method comprises reducing the levels of TNF-α, IL-1β, and CXCL10; or the method comprises reducing the levels of IL-6, IL-1β, and CXCL10; or the method comprises reducing the levels of IL-6, IL-1β, TNF-α, and CXCL10.

[010] In some embodiments, methods of treating conditions associated with an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 are provided. In some embodiments, a method comprises administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to a subject with the condition, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R. In some embodiments, the antibody reduces the level of at least one, at least two, at least three, or at least four, at least

five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9. In some embodiments, the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, a condition is associated with an elevated level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, a condition is associated with an elevated level of IL-6. In some such embodiments, the condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, and Castleman's disease. In some embodiments, a condition is associated with an elevated level of TNF-α. In some such embodiments, the condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis. In some embodiments, a condition is associated with an elevated level of IL-1β. In some such embodiments, the condition is selected from rheumatoid arthritis and juvenile idiopathic arthritis. In some embodiments, a condition is associated with an elevated level of CXCL10.

[011] In some embodiments, a method of treating inflammatory arthritis is provided. In some embodiments, the method comprises administering an effective amount of an antibody that binds CSF1R to a subject with inflammatory arthritis, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9. In some embodiments, the inflammatory arthritis is selected from rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, and juvenile idiopathic arthritis.

[012] In some embodiments, methods of treating an inflammatory condition are provided. In some embodiments, a method comprises administering an effective amount of an antibody that binds CSF1R to a subject with an inflammatory condition, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6,

MMP-7, MMP-2, and MMP-9. In some embodiments, the inflammatory condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease.

[013] In some embodiments, methods of treating CD16+ disorder are provided. In some embodiments, a method comprises administering an effective amount of an antibody that binds CSF1R to a subject with a CD16+ disorder, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9. In some embodiments, the antibody reduces the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, the CD16+ disorder is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody.

[014] In any of the embodiments described herein, the antibody may reduce the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 *in vitro*.

[015] In any of the embodiments described herein, the subject may have an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 prior to administration of the antibody.

[016] In some embodiments, a method further comprises administering at least one additional therapeutic agent selected from methotrexate, an anti-TNF agent, a glucocorticoid, cyclosporine, leflunomide, azathioprine, a JAK inhibitor, a SYK inhibitor, an anti-IL-6 agent, an anti-CD20 agent, an anti-CD19 agent, an anti-GM-CSF agent, an anti-IL-1 agent, and a CTLA4 agent. In some embodiments, the at least one additional

therapeutic agent is selected from methotrexate, an anti-TNF-α antibody, a soluble TNF receptor, a glucocorticoid, cyclosporine, leflunomide, azathioprine, a JAK inhibitor, a SYK inhibitor, an anti-IL-6 antibody, an anti-IL-6 receptor antibody, an anti-CD20 antibody, an anti-CD19 antibody, an anti-GM-CSF antibody, and anti-GM-CSF receptor antibody, an anti-IL-1 antibody, an IL-1 receptor antagonist, and a CTLA4-Ig fusion molecule. In some embodiments, the condition is resistant to methotrexate.

[017] In some embodiments, a method of treating an inflammatory condition is provided, wherein the method comprises (a) determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with the inflammatory condition; and (b) if the level of at least one of the factors is elevated in the subject, administering to the subject an effective amount of an antibody that binds CSF1R and blocks binding of IL-34 to CSF1R, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

[018] In some embodiments, a method of treating an inflammatory condition is provided, wherein the method comprises (a) detecting an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with the inflammatory condition; and (b) administering to the subject an effective amount of an antibody that binds CSF1R and blocks binding of IL-34 to CSF1R, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

[019] In any of the methods described herein, the antibody may reduce the level of IL-6; or the antibody may reduce the level of TNF-α; or the antibody may reduce the level of IL-1β; or the antibody may reduce the level of CXCL10; or the antibody may reduce the levels of IL-6 and TNF-α; or the antibody may reduce the levels of IL-6 and IL-1β; or the antibody may reduce the levels of IL-6 and CXCL10; or the antibody may reduce the levels of TNF-α and IL-1β; or the antibody may reduce the levels of TNF-α and CXCL10; or the

antibody may reduce the levels of IL-1β and CXCL10; or the antibody may reduce the levels of IL-6, TNF-α, and IL-1β; or the antibody may reduce the levels of IL-6, TNF-α, and CXCL10; or the antibody may reduce the levels of TNF-α, IL-1β, and CXCL10; or the method comprises reducing the levels of IL-6, IL-1β, and CXCL10; or the antibody may reduce the levels of IL-6, IL-1β, TNF-α, and CXCL10.

[020] In some embodiments, a method of identifying a subject who may benefit from an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R is provided, comprising determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject, wherein an elevated level of at least one of the factors in the subject indicates that the subject may benefit from the antibody that binds CSF1R. In some embodiments, the subject has a CD16+ disorder. In some embodiments, the subject has rheumatoid arthritis. In some embodiments, the subject has an elevated level of CD16+ monocytes.

[021] In some embodiments, a method of predicting responsiveness in a subject suffering from an inflammatory condition to an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R is provided, comprising determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject, wherein an elevated level of at least one of the factors in the subject indicates that the subject is more likely to respond to the antibody that binds CSF1R. In some embodiments, the subject has a CD16+ disorder. In some embodiments, the subject has rheumatoid arthritis. In some embodiments, the subject has an elevated level of CD16+ monocytes.

[022] In any of the embodiments described herein, a condition may be resistant to methotrexate and/or the subject may be a methotrexate inadequate responder. Further, in any of the embodiments described herein, a condition may be resistant to a TNF inhibitor and/or the subject may be a TNF inhibitor inadequate responder.

[023] In some embodiments, a method of treating a methotrexate inadequate responder is provided, comprising administering to the methotrexate inadequate responder an effective amount of an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R. In some embodiments, a method

of treating a TNF inhibitor inadequate responder is provided, comprising administering to the TNF inhibitor inadequate responder an effective amount of an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R. In some embodiments, the inadequate responder has a CD16+ disorder. In some embodiments, the CD16+ disorder is rheumatoid arthritis. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody. In some embodiments, the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the methotrexate and/or TNF-inhibitor inadequate responder is reduced following administration of the antibody.

[024] In any of the methods described herein, the antibody may be administered at a dose of 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg. In any of the methods described herein, an effective amount of the antibody may be 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg. In some embodiments, a method of treating rheumatoid arthritis is provided, comprising administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to the subject, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R, wherein the effective amount is 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg.

[025] In some embodiments, a method of reducing bone resorption in a subject with rheumatoid arthritis is provided, comprising administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to the subject, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R. In some embodiments, the effective amount is 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg. In some embodiments, a reduction in bone resorption is measured by determining the level of one or more of TRAP5b, NTx, and CTx, wherein a reduction in the level of one or more of TRAP5b, NTx, and CTx indicates a reduction in bone resorption. In some embodiments, a level of TRAP5b is determined in serum or plasma. In some embodiments, a level of NTx is determined in urine. In some embodiments, a level of CTx is determined in serum.

[026] In any of the embodiments described herein, measurement of a factor following administration of an antibody that binds CSF1R may be within 6 hours, within 8

hours, within 12 hours, within 18 hours, within 1 day, within 2 days, within 3 days, within 1 week, or within 2 weeks following administration of the antibody.

[027] In some embodiments, following administration of the effective dose of an antibody that binds CSF1R, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R, the AST and/or ALT level in a serum sample from the subject does not exceed 8 times the upper limit of normal (ULN). In some embodiments, following administration the creatine kinase (CK) level in a serum sample from the subject does not exceed 10 times ULN. In some embodiments, following administration the aspartate aminotransferase (AST) and/or alanine aminotransferase (ALT) level in a serum sample from the subject does not exceed 3 times ULN and the total bilirubin in the serum sample from the subject does not exceed 2 times ULN. In some embodiments, a level of AST, ALT, CK, and/or bilirubin is determined within 6 hours, within 8 hours, within 12 hours, within 18 hours, within 1 day, within 2 days, within 3 days, within 1 week, or within 2 weeks following administration of an antibody that binds CSF1R.

[028] In any of the methods described herein, the antibody heavy chain and/or the antibody light chain may have the structure described below.

[029] In any of the methods described herein, the antibody heavy chain may comprise a sequence that is at least 90%, at least 95%, at least 97%, at least 99%, or 100% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45. In any of the methods described herein, the antibody light chain may comprise a sequence that is at least 90%, at least 95%, at least 97%, at least 99%, or 100% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52. In any of the methods described herein, the antibody heavy chain may comprise a sequence that is at least 90%, at least 95%, at least 97%, at least 99%, or 100% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45, and the antibody light chain may comprise a sequence that is at least 90%, at least 95%, at least 97%, at least 99%, or 100% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52.

[030] In any of the methods described herein, the HC CDR1, HC CDR2, and HC CDR3 may comprise a set of sequences selected from: (a) SEQ ID NOs: 15, 16, and 17; (b) SEQ ID NOs: 21, 22, and 23; and (c) SEQ ID NOs: 27, 28, and 29. In any of the methods described herein, the LC CDR1, LC CDR2, and LC CDR3 may comprise a set of sequences selected from: (a) SEQ ID NOs: 18, 19, and 20; (b) SEQ ID NOs: 24, 25, and 26; and (c) SEQ ID NOs: 30, 31, and 32.

[031] In any of the methods described herein, the heavy chain may comprise an HC CDR1, HC CDR2, and HC CDR3, wherein the HC CDR1, HC CDR2, and HC CDR3 comprise a set of sequences selected from: (a) SEQ ID NOs: 15, 16, and 17; (b) SEQ ID NOs: 21, 22, and 23; and (c) SEQ ID NOs: 27, 28, and 29; and the light chain may comprise an LC CDR1, LC CDR2, and LC CDR3, wherein the LC CDR1, LC CDR2, and LC CDR3 comprise a set of sequences selected from: (a) SEQ ID NOs: 18, 19, and 20; (b) SEQ ID NOs: 24, 25, and 26; and (c) SEQ ID NOs: 30, 31, and 32.

[032] In any of the methods described herein, the antibody that binds CSF1R may comprise: (a) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 9 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 10; (b) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 11 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 12; (c) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 13 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 14; (d) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 39 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 46; (e) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 40 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 46; (f) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 41 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 46; (g) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 39 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 47; (h) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 40 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 47; (i) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 41 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 47; and (j) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or

100% identical to SEQ ID NO: 42 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 48; (k) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 42 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 49; (l) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 42 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 50; (m) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 43 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 48; (n) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 43 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 49; (o) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 43 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 50; (p) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 44 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 51; (q) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 44 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 52; (r) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 45 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 51; or (s) a heavy chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 45 and a light chain comprising a sequence that is at least 95%, at least 97%, at least 99%, or 100% identical to SEQ ID NO: 52.

[033] In any of the methods described herein, the antibody may comprise: (a) a heavy chain comprising a heavy chain (HC) CDR1 having the sequence of SEQ ID NO: 15, an HC CDR2 having the sequence of SEQ ID NO: 16, and an HC CDR3 having the sequence of SEQ ID NO: 17, and a light chain comprising a light chain (LC) CDR1 having the sequence of SEQ ID NO: 18, a LC CDR2 having the sequence of SEQ ID NO: 19, and a LC CDR3 having the sequence of SEQ ID NO: 20; (b) a heavy chain comprising a heavy chain (HC) CDR1 having the sequence of SEQ ID NO: 21, an HC CDR2 having the

sequence of SEQ ID NO: 22, and an HC CDR3 having the sequence of SEQ ID NO: 23, and a light chain comprising a light chain (LC) CDR1 having the sequence of SEQ ID NO: 24, a LC CDR2 having the sequence of SEQ ID NO: 25, and a LC CDR3 having the sequence of SEQ ID NO: 26; or (c) a heavy chain comprising a heavy chain (HC) CDR1 having the sequence of SEQ ID NO: 27, an HC CDR2 having the sequence of SEQ ID NO: 28, and an HC CDR3 having the sequence of SEQ ID NO: 29, and a light chain comprising a light chain (LC) CDR1 having the sequence of SEQ ID NO: 30, a LC CDR2 having the sequence of SEQ ID NO: 31, and a LC CDR3 having the sequence of SEQ ID NO: 32.

[034] In any of the methods described herein, the antibody may comprise: (a) a heavy chain comprising a sequence of SEQ ID NO: 53 and a light chain comprising a sequence of SEQ ID NO: 60; (b) a heavy chain comprising a sequence of SEQ ID NO: 53 and a light chain comprising a sequence of SEQ ID NO: 61; or (c) a heavy chain comprising a sequence of SEQ ID NO: 58 and a light chain comprising a sequence of SEQ ID NO: 65. In some embodiments, an antibody comprises a heavy chain and a light chain, wherein the antibody comprises: (a) a heavy chain consisting of the sequence of SEQ ID NO: 53 and a light chain consisting of the sequence of SEQ ID NO: 60; (b) a heavy chain consisting of the sequence of SEQ ID NO: 53 and a light chain consisting of the sequence of SEQ ID NO: 61; or (c) a heavy chain consisting of the sequence of SEQ ID NO: 58 and a light chain consisting of the sequence of SEQ ID NO: 65.

[035] In any of the methods described herein, the antibody may be a humanized antibody. In any of the methods described herein, the antibody may be selected from a Fab, an Fv, an scFv, a Fab', and a $(Fab')_2$. In any of the methods described herein, the antibody may be a chimeric antibody. In any of the methods described herein, the antibody may be selected from an IgA, an IgG, and an IgD. In any of the methods described herein, the antibody may be an IgG. In any of the methods described herein, the antibody may be an IgG4. In any of the methods described herein, the antibody may be an IgG4 comprising an S241P mutation in at least one IgG4 heavy chain constant region.

[036] In any of the methods described herein, the antibody may bind to human CSF1R and/or binds to cynomolgus CSF1R. In any of the methods described herein, the antibody may block ligand binding to CSF1R. In any of the methods described herein, the antibody may block binding of CSF1 and/or IL-34 to CSF1R. In any of the methods described herein, the antibody may block binding of both CSF1 and IL-34 to CSF1R. In any of the methods described herein, the antibody may inhibit ligand-induced CSF1R phosphorylation. In any of the methods described herein, the antibody may inhibit CSF1-

and/or IL-34-induced CSF1R phosphorylation. In any of the methods described herein, the antibody may bind to human CSF1R with an affinity (K_D) of less than 1 nM. In any of the methods described herein, the antibody may inhibit monocyte proliferation and/or survival responses in the presence of CSF1 or IL-34.

[037] In some embodiments, a pharmaceutical composition comprising an antibody that binds CSF1R is provided. In some embodiments, antibodies that bind CSF1R and compositions comprising antibodies that bind CSF1R are provided for use in any of the methods of treatment described herein.

BRIEF DESCRIPTION OF THE FIGURES

[038] **FIG. 1A-C** show an alignment of the humanized heavy chain variable regions for each of humanized antibodies huAb1 to huAb16, as discussed in Example 1. Boxed residues are amino acids in the human acceptor sequence that were changed back to the corresponding mouse residue.

[039] **FIG. 2A-C** show an alignment of the humanized light chain variable regions for each of humanized antibodies huAb1 to huAb16, as discussed in Example 1. Boxed amino acids are residues in the human acceptor sequence that were changed back to the corresponding mouse residue.

[040] **FIG. 3** shows IL-6 cytokine concentration determined by ELISA on tissue culture media of intact synovial explants (n = 6 patients with rheumatoid arthritis) treated for 4 days with 1 μg/ml huAb1 or IgG4 isotype control, as described in Example 2.

[041] **FIG. 4A-L** show cytokine and matrix metalloproteinase concentrations determined by multiplex Luminex® analysis on tissue culture media of intact synovial explants (n = 4 patients with rheumatoid arthritis) treated for 4 days with huAb1 or IgG4 isotype control, as described in Example 2.

[042] **FIG. 5** shows (A) CXCL7, (B) CXCL11, and (C) CXCL12 levels determined by multiplex Luminex® analysis on tissue culture media of intact synovial explants (n = 6 patients with rheumatoid arthritis) treated for 4 days with huAb1 or IgG4 isotype control, as described in Example 2.

[043] **FIG. 6** shows macrophage numbers in (A) front paws and (B) knees in mice with collagen-induced arthritis, treated with anti-CSF1R antibody prophylactically, as described in Example 3.

[044] **FIG. 7** shows macrophage numbers in (A) front paws and (B) knees in mice with collagen-induced arthritis, treated with anti-CSF1R antibody therapeutically, as described in Example 3.

DETAILED DESCRIPTION

[045] Methods of reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject comprising administering antibodies that bind CSF1R and block CSF1 and IL-34 ligand binding are provided. As discussed herein, antibodies that bind CSF1R and block CSF1 and IL-34 ligand binding are effective for reducing the levels of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 and treating conditions associated with elevated levels of those factors. Exemplary such conditions include, but are not limited to, rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. The present inventors found that contacting synovial biopsy samples from rheumatoid arthritis patients with an antibody that binds CSF1R reduces the levels of IL-6, IL-1β, IL-8, CCL2 (also referred to as MCP-1), CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

[046] The section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described. All references cited herein, including patent applications and publications, are incorporated herein by reference in their entireties for any purpose.

Definitions

[047] Unless otherwise defined, scientific and technical terms used in connection with the present invention shall have the meanings that are commonly understood by those of ordinary skill in the art. Further, unless otherwise required by context, singular terms shall include pluralities and plural terms shall include the singular.

[048] Exemplary techniques used in connection with recombinant DNA, oligonucleotide synthesis, tissue culture and transformation (e.g., electroporation, lipofection), enzymatic reactions, and purification techniques are known in the art. Many such techniques and procedures are described, e.g., in Sambrook et al. *Molecular Cloning: A Laboratory Manual* (2nd ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989)), among other places. In addition, exemplary techniques for chemical syntheses, chemical analyses, pharmaceutical preparation, formulation, and delivery, and treatment of patients are also known in the art.

[049] In this application, the use of "or" means "and/or" unless stated otherwise. In the context of a multiple dependent claim, the use of "or" refers back to more than one

preceding independent or dependent claim in the alternative only. Also, terms such as "element" or "component" encompass both elements and components comprising one unit and elements and components that comprise more than one subunit unless specifically stated otherwise.

[050] As utilized in accordance with the present disclosure, the following terms, unless otherwise indicated, shall be understood to have the following meanings:

[051] The terms "**nucleic acid molecule**" and "**polynucleotide**" may be used interchangeably, and refer to a polymer of nucleotides. Such polymers of nucleotides may contain natural and/or non-natural nucleotides, and include, but are not limited to, DNA, RNA, and PNA. "**Nucleic acid sequence**" refers to the linear sequence of nucleotides that comprise the nucleic acid molecule or polynucleotide.

[052] The terms "**polypeptide**" and "**protein**" are used interchangeably to refer to a polymer of amino acid residues, and are not limited to a minimum length. Such polymers of amino acid residues may contain natural or non-natural amino acid residues, and include, but are not limited to, peptides, oligopeptides, dimers, trimers, and multimers of amino acid residues. Both full-length proteins and fragments thereof are encompassed by the definition. The terms also include post-expression modifications of the polypeptide, for example, glycosylation, sialylation, acetylation, phosphorylation, and the like. Furthermore, for purposes of the present invention, a "polypeptide" refers to a protein which includes modifications, such as deletions, additions, and substitutions (generally conservative in nature), to the native sequence, as long as the protein maintains the desired activity. These modifications may be deliberate, as through site-directed mutagenesis, or may be accidental, such as through mutations of hosts which produce the proteins or errors due to PCR amplification.

[053] The term "**CSF1R**" refers herein to the full-length CSF1R, which includes the N-terminal ECD, the transmembrane domain, and the intracellular tyrosine kinase domain, with or without an N-terminal leader sequence. In some embodiments, the CSF1R is a human CSF1R having the amino acid sequence of SEQ ID NO: 1 or SEQ ID NO: 2.

[054] The term "**CSF1R extracellular domain**" ("**CSF1R ECD**") as used herein refers to a CSF1R polypeptide that lacks the intracellular and transmembrane domains. CSF1R ECDs include the full-length CSF1R ECD and CSF1R ECD fragments that are capable of binding CSF1 and/or IL-34. The human full-length CSF1R ECD is defined herein as comprising either amino acids 1 to 512 (i.e., including the leader sequence) or amino acids 20 to 512 (i.e., lacking the leader sequence) of SEQ ID NO: 2. In some

embodiments, a human CSF1R ECD fragment comprises amino acids 20 to 506 of SEQ ID NO: 2 (see SEQ ID NO: 5). In some embodiments, a human CSF1R fragment ends at amino acid 507, 508, 509, 510, or 511. In some embodiments, a cyno CSF1R ECD comprises the sequence of SEQ ID NO: 7 (with leader sequence) or amino acids 20 to 506 of SEQ ID NO: 7 (without leader sequence).

[055] With reference to anti-CSF1R antibodies the term "**blocks binding of**" a ligand, such as CSF1 and/or IL-34, and grammatical variants thereof, are used to refer to the ability to inhibit the interaction between CSF1R and a CSF1R ligand, such as CSF1 and/or IL-34. Such inhibition may occur through any mechanism, including direct interference with ligand binding, e.g., because of overlapping binding sites on CSF1R, and/or conformational changes in CSF1R induced by the antibody that alter ligand affinity, etc. Antibodies and antibody fragments referred to as "functional" are characterized by having such properties.

[056] An "**immunological**" activity refers only to the ability to induce the production of an antibody against an antigenic epitope possessed by a native or naturally-occurring CSF1R polypeptide.

[057] The term "**antibody**" as used herein refers to a molecule comprising at least complementarity-determining region (CDR) 1, CDR2, and CDR3 of a heavy chain and at least CDR1, CDR2, and CDR3 of a light chain, wherein the molecule is capable of binding to antigen. The term antibody includes, but is not limited to, fragments that are capable of binding antigen, such as Fv, single-chain Fv (scFv), Fab, Fab', and $(Fab')_2$. The term antibody also includes, but is not limited to, chimeric antibodies, humanized antibodies, and antibodies of various species such as mouse, human, cynomolgus monkey, etc.

[058] In some embodiments, an antibody comprises a heavy chain variable region and a light chain variable region. In some embodiments, an antibody comprises at least one heavy chain comprising a heavy chain variable region and at least a portion of a heavy chain constant region, and at least one light chain comprising a light chain variable region and at least a portion of a light chain constant region. In some embodiments, an antibody comprises two heavy chains, wherein each heavy chain comprises a heavy chain variable region and at least a portion of a heavy chain constant region, and two light chains, wherein each light chain comprises a light chain variable region and at least a portion of a light chain constant region. As used herein, a single-chain Fv (scFv), or any other antibody that comprises, for example, a single polypeptide chain comprising all six CDRs (three heavy chain CDRs and three light chain CDRs) is considered to have a heavy chain and a light

chain. In some such embodiments, the heavy chain is the region of the antibody that comprises the three heavy chain CDRs and the light chain in the region of the antibody that comprises the three light chain CDRs.

[059] The term "**heavy chain variable region**" as used herein refers to a region comprising heavy chain CDR1, framework (FR) 2, CDR2, FR3, and CDR3. In some embodiments, a heavy chain variable region also comprises at least a portion of an FR1 and/or at least a portion of an FR4. In some embodiments, a heavy chain CDR1 corresponds to Kabat residues 26 to 35; a heavy chain CDR2 corresponds to Kabat residues 50 to 65; and a heavy chain CDR3 corresponds to Kabat residues 95 to 102. *See, e.g.*, Kabat Sequences of Proteins of Immunological Interest (1987 and 1991, NIH, Bethesda, Md.); and Figure 1. In some embodiments, a heavy chain CDR1 corresponds to Kabat residues 31 to 35; a heavy chain CDR2 corresponds to Kabat residues 50 to 65; and a heavy chain CDR3 corresponds to Kabat residues 95 to 102. *See id.*

[060] The term "**heavy chain constant region**" as used herein refers to a region comprising at least three heavy chain constant domains, C_H1, C_H2, and C_H3. Nonlimiting exemplary heavy chain constant regions include γ, δ, and α. Nonlimiting exemplary heavy chain constant regions also include ε and μ. Each heavy constant region corresponds to an antibody isotype. For example, an antibody comprising a γ constant region is an IgG antibody, an antibody comprising a δ constant region is an IgD antibody, and an antibody comprising an α constant region is an IgA antibody. Further, an antibody comprising a μ constant region is an IgM antibody, and an antibody comprising an ε constant region is an IgE antibody. Certain isotypes can be further subdivided into subclasses. For example, IgG antibodies include, but are not limited to, IgG1 (comprising a γ_1 constant region), IgG2 (comprising a γ_2 constant region), IgG3 (comprising a γ_3 constant region), and IgG4 (comprising a γ_4 constant region) antibodies; IgA antibodies include, but are not limited to, IgA1 (comprising an α_1 constant region) and IgA2 (comprising an α_2 constant region) antibodies; and IgM antibodies include, but are not limited to, IgM1 and IgM2.

[061] In some embodiments, a heavy chain constant region comprises one or more mutations (or substitutions), additions, or deletions that confer a desired characteristic on the antibody. A nonlimiting exemplary mutation is the S241P mutation in the IgG4 hinge region (between constant domains C_H1 and C_H2), which alters the IgG4 motif CPSCP to CPPCP, which is similar to the corresponding motif in IgG1. That mutation, in some embodiments, results in a more stable IgG4 antibody. See, e.g., Angal et al., *Mol. Immunol.* 30: 105-108

(1993); Bloom et al., *Prot. Sci.* 6: 407-415 (1997); Schuurman et al., *Mol. Immunol.* 38: 1-8 (2001).

[062] The term "**heavy chain**" as used herein refers to a polypeptide comprising at least a heavy chain variable region, with or without a leader sequence. In some embodiments, a heavy chain comprises at least a portion of a heavy chain constant region. The term "**full-length heavy chain**" as used herein refers to a polypeptide comprising a heavy chain variable region and a heavy chain constant region, with or without a leader sequence.

[063] The term "**light chain variable region**" as used herein refers to a region comprising light chain CDR1, framework (FR) 2, CDR2, FR3, and CDR3. In some embodiments, a light chain variable region also comprises an FR1 and/or an FR4. In some embodiments, a light chain CDR1 corresponds to Kabat residues 24 to 34; a light chain CDR2 corresponds to Kabat residues 50 to 56; and a light chain CDR3 corresponds to Kabat residues 89 to 97. *See, e.g.*, Kabat Sequences of Proteins of Immunological Interest (1987 and 1991, NIH, Bethesda, Md.); and Figure 1.

[064] The term "**light chain constant region**" as used herein refers to a region comprising a light chain constant domain, C_L. Nonlimiting exemplary light chain constant regions include λ and κ.

[065] The term "**light chain**" as used herein refers to a polypeptide comprising at least a light chain variable region, with or without a leader sequence. In some embodiments, a light chain comprises at least a portion of a light chain constant region. The term "**full-length light chain**" as used herein refers to a polypeptide comprising a light chain variable region and a light chain constant region, with or without a leader sequence.

[066] A "**chimeric antibody**" as used herein refers to an antibody comprising at least one variable region from a first species (such as mouse, rat, cynomolgus monkey, etc.) and at least one constant region from a second species (such as human, cynomolgus monkey, etc.). In some embodiments, a chimeric antibody comprises at least one mouse variable region and at least one human constant region. In some embodiments, a chimeric antibody comprises at least one cynomolgus variable region and at least one human constant region. In some embodiments, a chimeric antibody comprises at least one rat variable region and at least one mouse constant region. In some embodiments, all of the variable regions of a chimeric antibody are from a first species and all of the constant regions of the chimeric antibody are from a second species.

[067] A "**humanized antibody**" as used herein refers to an antibody in which at least one amino acid in a framework region of a non-human variable region has been replaced with the corresponding amino acid from a human variable region. In some embodiments, a humanized antibody comprises at least one human constant region or fragment thereof. In some embodiments, a humanized antibody is a Fab, an scFv, a $(Fab')_2$, etc.

[068] A "**CDR-grafted antibody**" as used herein refers to a humanized antibody in which the complementarity determining regions (CDRs) of a first (non-human) species have been grafted onto the framework regions (FRs) of a second (human) species.

[069] A "**human antibody**" as used herein refers to antibodies produced in humans, antibodies produced in non-human animals that comprise human immunoglobulin genes, such as XenoMouse®, and antibodies selected using in vitro methods, such as phage display, wherein the antibody repertoire is based on a human immunoglobulin sequences.

[070] The term "**leader sequence**" refers to a sequence of amino acid residues located at the N terminus of a polypeptide that facilitates secretion of a polypeptide from a mammalian cell. A leader sequence may be cleaved upon export of the polypeptide from the mammalian cell, forming a mature protein. Leader sequences may be natural or synthetic, and they may be heterologous or homologous to the protein to which they are attached. Exemplary leader sequences include, but are not limited to, antibody leader sequences, such as, for example, the amino acid sequences of SEQ ID NOs: 3 and 4, which correspond to human light and heavy chain leader sequences, respectively. Nonlimiting exemplary leader sequences also include leader sequences from heterologous proteins. In some embodiments, an antibody lacks a leader sequence. In some embodiments, an antibody comprises at least one leader sequence, which may be selected from native antibody leader sequences and heterologous leader sequences.

[071] The term "**vector**" is used to describe a polynucleotide that may be engineered to contain a cloned polynucleotide or polynucleotides that may be propagated in a host cell. A vector may include one or more of the following elements: an origin of replication, one or more regulatory sequences (such as, for example, promoters and/or enhancers) that regulate the expression of the polypeptide of interest, and/or one or more selectable marker genes (such as, for example, antibiotic resistance genes and genes that may be used in colorimetric assays, e.g., β-galactosidase). The term "**expression vector**" refers to a vector that is used to express a polypeptide of interest in a host cell.

[072] A "**host cell**" refers to a cell that may be or has been a recipient of a vector or isolated polynucleotide. Host cells may be prokaryotic cells or eukaryotic cells. Exemplary eukaryotic cells include mammalian cells, such as primate or non-primate animal cells; fungal cells, such as yeast; plant cells; and insect cells. Nonlimiting exemplary mammalian cells include, but are not limited to, NSO cells, PER.C6® cells (Crucell), and 293 and CHO cells, and their derivatives, such as 293-6E and DG44 cells, respectively.

[073] The term "**isolated**" as used herein refers to a molecule that has been separated from at least some of the components with which it is typically found in nature. For example, a polypeptide is referred to as "isolated" when it is separated from at least some of the components of the cell in which it was produced. Where a polypeptide is secreted by a cell after expression, physically separating the supernatant containing the polypeptide from the cell that produced it is considered to be "isolating" the polypeptide. Similarly, a polynucleotide is referred to as "isolated" when it is not part of the larger polynucleotide (such as, for example, genomic DNA or mitochondrial DNA, in the case of a DNA polynucleotide) in which it is typically found in nature, or is separated from at least some of the components of the cell in which it was produced, e.g., in the case of an RNA polynucleotide. Thus, a DNA polynucleotide that is contained in a vector inside a host cell may be referred to as "isolated" so long as that polynucleotide is not found in that vector in nature.

[074] The term "**elevated level**" means a higher level of a protein, such as a cytokine or matrix metalloproteinase, in a particular tissue of a subject relative to the same tissue in a control, such as an individual or individuals who are not suffering from an inflammatory condition or other condition described herein. The elevated level may be the result of any mechanism, such as increased expression, increased stability, decreased degradation, increased secretion, decreased clearance, etc., of the protein.

[075] The term "**reduce**" or "**reduces**" means to lower the level of a protein, such as a cytokine or matrix metalloproteinase, in a particular tissue of a subject by at least 10%. In some embodiments, an agent, such as an antibody that binds CSF1R, reduces the level of a protein, such as a cytokine or matrix metalloproteinase, in a particular tissue of a subject by at least 15%, at least 20%, at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, or at least 90%. In some embodiments, the level of a protein is reduced relative to the level of the protein prior to contacting with an agent, such as an antibody that binds CSF1R.

[076] The term "**resistant**," when used in the context of resistance to a therapeutic agent, means a decreased response or lack of response to a standard dose of the therapeutic agent, relative to the subject's response to the standard dose of the therapeutic agent in the past, or relative to the expected response of a similar subject with a similar disorder to the standard dose of the therapeutic agent. Thus, in some embodiments, a subject may be resistant to therapeutic agent although the subject has not previously been given the therapeutic agent, or the subject may develop resistance to the therapeutic agent after having responded to the agent on one or more previous occasions.

[077] The terms "**subject**" and "**patient**" are used interchangeably herein to refer to a human. In some embodiments, methods of treating other mammals, including, but not limited to, rodents, simians, felines, canines, equines, bovines, porcines, ovines, caprines, mammalian laboratory animals, mammalian farm animals, mammalian sport animals, and mammalian pets, are also provided.

[078] The term "**sample**," as used herein, refers to a composition that is obtained or derived from a subject that contains a cellular and/or other molecular entity that is to be characterized, quantitated, and/or identified, for example based on physical, biochemical, chemical and/or physiological characteristics. An exemplary sample is a tissue sample. Another exemplary sample is serum or plasma sample.

[079] The term "**tissue sample**" refers to a collection of similar cells obtained from a tissue of a subject. The source of the tissue sample may be solid tissue as from a fresh, frozen and/or preserved organ or tissue sample or biopsy or aspirate; blood or any blood constituents; bodily fluids such as cerebral spinal fluid, amniotic fluid, peritoneal fluid, synovial fluid, or interstitial fluid; cells from any time in gestation or development of the subject. In some embodiments, a tissue sample is a synovial biopsy tissue sample and/or a synovial fluid sample. In some embodiments, a tissue sample is a synovial fluid sample. The tissue sample may also be primary or cultured cells or cell lines. Optionally, the tissue sample is obtained from a disease tissue/organ. The tissue sample may contain compounds that are not naturally intermixed with the tissue in nature such as preservatives, anticoagulants, buffers, fixatives, nutrients, antibiotics, or the like. A "control sample" or "control tissue", as used herein, refers to a sample, cell, or tissue obtained from a source known, or believed, not to be afflicted with the disease for which the subject is being treated.

[080] For the purposes herein a "**section**" of a tissue sample means a part or piece of a tissue sample, such as a thin slice of tissue or cells cut from a solid tissue sample.

[081] As used herein, "**rheumatoid arthritis**" or "**RA**" refers to a recognized disease state that may be diagnosed according to the 1987, 2000, or 2010 criteria for the classification of RA (American Rheumatism Association or Americal College of Rheumatology), or any similar criteria. In some embodiments, the term "rheumatoid arthritis" refers to a chronic autoimmune disease characterized primarily by inflammation of the lining (synovium) of the joints, which can lead to joint damage, resulting in chronic pain, loss of function, and disability. Because RA can affect multiple organs of the body, including skin, lungs, and eyes, it is referred to as a systemic illness.

[082] The term "rheumatoid arthritis" includes not only active and early RA, but also incipient RA, as defined below. Physiological indicators of RA include, symmetric joint swelling which is characteristic though not invariable in RA. Fusiform swelling of the proximal interphalangeal (PIP) joints of the hands as well as metacarpophalangeal (MCP), wrists, elbows, knees, ankles, and metatarsophalangeal (MTP) joints are commonly affected and swelling is easily detected. Pain on passive motion is the most sensitive test for joint inflammation, and inflammation and structural deformity often limits the range of motion for the affected joint. Typical visible changes include ulnar deviation of the fingers at the MCP joints, hyperextension, or hyperflexion of the MCP and PIP joints, flexion contractures of the elbows, and subluxation of the carpal bones and toes. The subject with RA may be resistant to a disease-modifying anti-rheumatic drug (DMARD), and/or a non-steroidal anti-inflammatory drug (NSAID). Nonlimiting exemplary "DMARDs" include hydroxychloroquine, sulfasalazine, methotrexate (MTX), leflunomide, etanercept, infliximab (plus oral and subcutaneous MTX), azathioprine, D-penicillamine, gold salts (oral), gold salts (intramuscular), minocycline, cyclosporine including cyclosporine A and topical cyclosporine, staphylococcal protein A (Goodyear and Silverman, *J. Exp. Med.*, 197(9):1125-1139 (2003)), including salts and derivatives thereof, etc. Further candidates for therapy according to this invention include those who have experienced an inadequate response to previous or current treatment with TNF inhibitors such as etanercept, infliximab, golimumab, certolizumab, and/or adalimumab because of toxicity, inadequate efficacy, and/or resistance.

[083] A patient with "**active rheumatoid arthritis**" means a patient with active and not latent symptoms of RA. Subjects with "**early active rheumatoid arthritis**" are those subjects with active RA diagnosed for at least 8 weeks but no longer than four years, according to the revised 1987, 2000, or 2010 criteria for the classification of RA (American Rheumatism Association or Americal College of Rheumatology).

[084] Subjects with "**early rheumatoid arthritis**" are those subjects with RA diagnosed for at least eight weeks but no longer than four years, according to the revised 1987, 2000, or 2010 criteria for classification of RA (American Rheumatism Association or Americal College of Rheumatology). RA includes, for example, juvenile-onset RA, juvenile idiopathic arthritis (JIA), or juvenile RA (JRA).

[085] Patients with "**incipient RA**" have early polyarthritis that does not fully meet ACR criteria for a diagnosis of RA, in association with the presence of RA-specific prognostic biomarkers such as anti-CCP and shared epitope. They include patients with positive anti-CCP antibodies who present with polyarthritis, but do not yet have a diagnosis of RA, and are at high risk for going on to develop bona fide ACR criteria RA (95% probability).

[086] The term "**inflammatory arthritis**" encompasses any arthritis caused by an autoimmune condition. Nonlimiting examples of inflammatory arthritis and autoimmune conditions that may involve inflammatory arthritis include rheumatoid arthritis (including juvenile-onset RA, juvenile idiopathic arthritis (JIA), and juvenile rheumatoid arthritis (JRA)), ankylosing spondylitis, mixed connective tissue disease (MCTD), psoriatic arthritis, reactive arthritis, scleroderma, Still's disease, systemic lupus erythematosus, acute and chronic arthritis, rheumatoid synovitis, gout or gouty arthritis, acute immunological arthritis, chronic inflammatory arthritis, degenerative arthritis, type II collagen-induced arthritis, infectious arthritis, septic arthritis, Lyme arthritis, proliferative arthritis, vertebral arthritis, osteoarthritis, arthritis chronica progrediente, arthritis deformans, polyarthritis chronica primaria, reactive arthritis, menopausal arthritis, estrogen-depletion arthritis, Felty's syndrome, and rheumatic autoimmune disease other than RA.

[087] "**Joint damage**" is used in the broadest sense and refers to damage or partial or complete destruction to any part of one or more joints, including the connective tissue and cartilage, where damage includes structural and/or functional damage of any cause, and may or may not cause joint pain/arthalgia. It includes, without limitation, joint damage associated with or resulting from inflammatory joint disease as well as non-inflammatory joint disease. This damage may be caused by any condition, such as an autoimmune disease, especially inflammatory arthritis, and most especially rheumatoid arthritis. For purposes herein, joints are points of contact between elements of a skeleton (of a vertebrate such as an animal) with the parts that surround and support it and include, but are not limited to, for example, hips, joints between the vertebrae of the spine, joints between the spine and pelvis (sacroiliac joints), joints where the tendons and ligaments attach to bones, joints between the

ribs and spine, shoulders, knees, feet, elbows, hands, fingers, ankles and toes, but especially joints in the hands and feet.

[088] The term "**lupus**" as used herein is an autoimmune disease or disorder that in general involves antibodies that attack connective tissue. The principal form of lupus is a systemic one, systemic lupus erythematosus (SLE), including cutaneous SLE and subacutecutaneous SLE, as well as other types of lupus (including nephritis, extrarenal, cerebritis, pediatric, non-renal, discoid, and alopecia). In certain embodiments, the term "**systemic lupus erythematosus**" refers to a chronic autoimmune disease that can result in skin lesions, joint pain and swelling, kidney disease (lupus nephritis), fluid around the heart and/or lungs, inflammation of the heart, and various other systemic conditions. In certain embodiments, the term "**lupus nephritis**" refers to inflammation of the kidneys that occurs in patients with SLE. Lupus nephritis may include, for example, glomerulonephritis and/or interstitial nephritis, and can lead to hypertension, proteinuria, and kidney failure. Lupus nephritis may be classified based on severity and extent of disease, for example, as defined by the International Society of Nephrology/Renal/Pathology Society. Lupus nephritis classes include class I (minimal mesangial lupus nephritis), class II (mesangial proliferative lupus nephritis), class III (focal lupus nephritis), class IV (diffuse segmental (IV-S) or diffuse global (IV-G) lupus nephritis), class V (membranous lupus nephritis), and class VI (advanced sclerosing lupus nephritis). The term "lupus nephritis" encompasses all of the classes.

[089] The term "**multiple sclerosis**" ("**MS**") refers to the chronic and often disabling disease of the central nervous system characterized by the progressive destruction of the myelin. "**Demyelination**" occurs when the myelin sheath becomes inflamed, injured, and detaches from the nerve fiber. There are four internationally recognized forms of MS, namely, primary progressive multiple sclerosis (PPMS), relapsing-remitting multiple sclerosis (RRMS), secondary progressive multiple sclerosis (SPMS), and progressive relapsing multiple sclerosis (PRMS).

[090] "**Primary progressive multiple sclerosis**" or "**PPMS**" is characterized by a gradual progression of the disease from its onset with no superimposed relapses and remissions at all. There may be periods of a leveling off of disease activity and there may be good and bad days or weeks. PPMS differs from RRMS and SPMS in that onset is typically in the late thirties or early forties, men are as likely as women to develop it, and initial disease activity is often in the spinal cord and not in the brain. PPMS often migrates into the brain, but is less likely to damage brain areas than RRMS or SPMS; for example, people

with PPMS are less likely to develop cognitive problems. PPMS is the sub-type of MS that is least likely to show inflammatory (gadolinium enhancing) lesions on MRI scans. The primary progressive form of the disease affects between 10 and 15% of all people with multiple sclerosis. PPMS may be defined according to the criteria in McDonald et al. *Ann Neurol* 50:121-7 (2001). The subject with PPMS treated herein is usually one with a probable or definitive diagnosis of PPMS.

[091] "**Relapsing-remitting multiple sclerosis**" or "**RRMS**" is characterized by relapses (also known as exacerbations) during which time new symptoms can appear and old ones resurface or worsen. The relapses are followed by periods of remission, during which time the person fully or partially recovers from the deficits acquired during the relapse. Relapses can last for days, weeks, or months, and recovery can be slow and gradual or almost instantaneous. The vast majority of people presenting with MS are first diagnosed with RRMS. This is typically when they are in their twenties or thirties, though diagnoses much earlier or later are known. Twice as many women as men present with this sub-type of MS. During relapses, myelin, a protective insulating sheath around the nerve fibers (neurons) in the white matter regions of the central nervous system (CNS), may be damaged in an inflammatory response by the body's own immune system. This causes a wide variety of neurological symptoms that vary considerably depending on which areas of the CNS are damaged. Immediately after a relapse, the inflammatory response dies down and a special type of glial cell in the CNS (called an oligodendrocyte) sponsors remyelination – a process whereby the myelin sheath around the axon may be repaired. It is this remyelination that may be responsible for the remission. Approximately 50% of patients with RRMS convert to SPMS within 10 years of disease onset. After 30 years, this figure rises to 90%. At any one time, the relapsing-remitting form of the disease accounts around 55% of all people with MS.

[092] "**Secondary progressive multiple sclerosis**" or "**SPMS**" is characterized by a steady progression of clinical neurological damage with or without superimposed relapses and minor remissions and plateau. People who develop SPMS will have previously experienced a period of RRMS which may have lasted anywhere from two to forty years or more. Any superimposed relapses and remissions tend to tail off over time. From the onset of the secondary progressive phase of the disease, disability starts advancing much quicker than it did during RRMS though the progress can still be quite slow in some individuals. SPMS tends to be associated with lower levels of inflammatory lesion formation than in

RRMS but the total burden of disease continues to progress. At any one time, SPMS accounts around 30% of all people with multiple sclerosis.

[093] "**Progressive relapsing multiple sclerosis**" or "**PRMS**" is characterized by a steady progression of clinical neurological damage with superimposed relapses and remissions. There is significant recovery immediately following a relapse but between relapses there is a gradual worsening of symptoms. PRMS affects around 5% of all people with multiple sclerosis. Some neurologists believe PRMS is a variant of PPMS.

[094] The term "**CD16+ disorder**" means a disease in which CD16+ monocytes of a mammal cause, mediate or otherwise contribute to morbidity in the mammal. Also included are diseases in which reduction of CD16+ monocytes has an ameliorative effect on progression of the disease. Included within this term are CD16+ inflammatory diseases, infectious diseases, immunodeficiency diseases, neoplasia, etc. In some embodiments, CD16+ inflammatory diseases include inflammatory diseases that are not responsive to methotrexate therapy. In some embodiments, CD16+ inflammatory diseases include methotrexate-resistant rheumatoid arthritis, methotrexate-resistant multiple sclerosis, methotrexate-resistant lupus, methotrexate-resistant inflammatory bowel disease, methotrexate-resistant Crohn's disease, methotrexate-resistant asthma, and methotrexate-resistant psoriasis. In certain embodiments, patients having methotrexate-resistant diseases, such as methotrexate-resistant rheumatoid arthritis, are referred to as methotrexate incomplete responders or methotrexate inadequate responders. In some embodiments, a subject with a CD16+ disorder is a methotrexate inadequate responder. In some embodiments, patients having TNF inhibitor-resistant diseases, such as TNF inhibitor-resistant rheumatoid arthritis, are referred to as TNF inhibitor incomplete responders or TNF inhibitor inadequate responders. In some embodiments, a subject with a CD16+ disorder is a TNF inhibitor inadequate responder.

[095] Examples of CD16+ disorders that can be treated according to the invention include, but are not limited to, systemic lupus erythematosus, lupus nephritis, rheumatoid arthritis, juvenile chronic arthritis, juvenile idiopathic arthritis (JIA) (including systemic JIA and polyarticular course JIA), psoriatic arthritis, polymyalgia rheumatic, osteoarthritis, adult-onset Still's disease, spondyloarthropathies, ankylosing spondylitis, systemic sclerosis (scleroderma), idiopathic inflammatory myopathies (dermatomyositis, polymyositis), Sjogren's syndrome, systemic vasculitis, sarcoidosis, autoimmune hemolytic anemia (immune pancytopenia, paroxysmal nocturnal hemoglobinuria), autoimmune thrombocytopenia (idiopathic thrombocytopenic purpura, immune-mediated

thrombocytopenia), uveitis, thyroiditis (Grave's disease, Hashimoto's thyroiditis, juvenile lymphocytic thyroiditis, atrophic thyroiditis, chronic thyroiditis), diabetes mellitus, immune-mediated renal disease (glomerulonephritis, tubulointerstitial nephritis), nephritis (such as mesangium proliferative nephritis), osteoporosis, cachexia (including cancerous cachexia), tumors, prostate cancer, choroidal neovascularization (such as age-related macular degeneration, idiopathic choroidal neovascularization, cyopic choroidal neovascularization, idiopathic choroidal neovascularization), ocular inflammatory disease (e.g. panuveitis, anterior aveitis, intermediate uveitis, scleritis, keratitis, orbital inflammation, optic neuritis, dry eye, diabetic retinopathy, proliferative vitreoretinopathy, postoperative inflammation), muscle atrophy, demyelinating diseases of the central and peripheral nervous systems such as multiple sclerosis, idiopathic demyelinating polyneuropathy or Guillain-Barre syndrome, and chronic inflammatory demyelinating polyneuropathy, hepatobiliary diseases such as infectious hepatitis (hepatitis A, B, C, D, E and other non-hepatotropic viruses), autoimmune chronic active hepatitis, primary biliary cirrhosis, granulomatous hepatitis, and sclerosing cholangitis, inflammatory bowel disease (IBD), including ulcerative colitis, Crohn's disease, gluten-sensitive enteropathy, and Whipple's disease, pancreatitis, islet transplantation (e.g., pancreatic islet transplantation), autoimmune or immune-mediated skin diseases including bullous skin diseases, erythema multiforme and contact dermatitis, psoriasis, allergic diseases such as asthma, allergic rhinitis, atopic dermatitis, delayed hypersensitivity, food hypersensitivity and urticaria, immunologic diseases of the lung such as eosinophilic pneumonia, idiopathic pulmonary fibrosis and hypersensitivity pneumonitis, transplantation associated diseases including graft rejection and graft-versus-host-disease, chronic rejection; fibrosis, including kidney fibrosis and hepatic fibrosis, cardiovascular disease, including atherosclerosis and coronary artery disease, giant cell arteritis (GCA), Takayasu's arteritis (TA), arteritis nodosa, cardiovascular events associated with chronic kidney disease, myocardial infarction, ischemia-induced severe arrhythmia, and congestive heart failure, diabetes, including type II diabetes, Bronchiolitis obliterans with organizing pneumonia (BOOP), hemophagocytic syndrome, macrophage activation syndrome, sarcoidosis, and periodontitis. Infectious diseases including viral diseases such as AIDS (HIV infection), hepatitis A, B, C, D, and E, herpes, etc., bacterial infections, fungal infections, protozoal infections and parasitic infections.

[096] The term "**methotrexate inadequate responder**" as used herein refers to a subject who has experienced, or is experiencing, an inadequate response to methotrexate treatment, for example, because of toxicity and/or inadequate efficacy at standard doses. In

some embodiments, a methotrexate inadequate responder has experienced, or is experiencing, an inadequate response to methotrexate after receiving a standard dose for at least two weeks, at least three weeks, at least four weeks, at least six weeks, or at least twelve weeks.

[097] The term "**TNF inhibitor inadequate responder**" as used herein refers to a subject who has experienced, or is experiencing, an inadequate response to a TNF inhibitor, for example, because of toxicity and/or inadequate efficacy at standard doses. In some embodiments, a TNF inhibitor inadequate responder has experienced, or is experiencing, an inadequate response to a TNF inhibitor after receiving a standard dose for at least two weeks, at least three weeks, at least four weeks, at least six weeks, or at least twelve weeks. In some embodiments, a TNF inhibitor inadequate responder has experienced, or is experiencing, an inadequate response to a TNF inhibitor selected from infliximab, adalimumab, certolizumab pegol, golimumab, and etanercept. In some embodiments, the TNF inhibitor is a TNF-α inhibitor.

[098] The term "**substantially the same**" and "**substantially unchanged**" and grammatical variants thereof, when used to refer to the level of a protein or cell type, such as CD16- monocytes, denote a sufficiently high degree of similarity between the levels being compared, *e.g.*, as indicated by numeric values, such that one of skill in the art would consider the difference between the levels to be of little or no biological and/or statistical significance.

[099] The term "**substantially reduced**" and "**substantially decreased**" and grammatical variants thereof, when used to refer to the level of a protein or cell type, such as CD16+ monocytes, denote a sufficiently high degree of difference between the levels being compared, *e.g.*, as indicated by numeric values, such that one of skill in the art would consider the difference between the levels to be of biological and/or statistical significance.

[0100] An "**anti-[factor] agent**" or a "[factor] inhibitor" as used herein, refer to an agent that antagonizes the factor activity, such as by binding to the factor or a receptor for the factor (if any), or by specifically inhibiting expression of the factor or a receptor for the factor (if any). Exemplary anti-[factor] agents include, but are not limited to, anti-[factor] antibodies, anti-[factor] receptor antibodies, soluble [factor] receptors that bind to the factor, small molecules that bind the [factor] or [factor] receptor, antisense oligonucleotides that are complementary to [factor] or [factor] receptor pre-mRNA or mRNA, etc. Nonlimiting exemplary factors include TNF-α, IL-1, IL-6, CD20, CD19, and GM-CSF.

[0101] An agent "**antagonizes**" factor activity when the agent neutralizes, blocks, inhibits, abrogates, reduces, and/or interferes with the activity of the factor, including its binding to one or more receptors when the factor is a ligand.

[0102] "**Treatment**," as used herein, refers to both therapeutic treatment and prophylactic or preventative measures, wherein the object is to prevent or slow down (lessen) the targeted pathologic condition or disorder. In certain embodiments, the term "**treatment**" covers any administration or application of a therapeutic for disease in a mammal, including a human, and includes inhibiting or slowing the disease or progression of the disease; partially or fully relieving the disease, for example, by causing regression, or restoring or repairing a lost, missing, or defective function; stimulating an inefficient process; or causing the disease plateau to have reduced severity. The term "**treatment**" also includes reducing the severity of any phenotypic characteristic and/or reducing the incidence, degree, or likelihood of that characteristic. Those in need of treatment include those already with the disorder as well as those prone to have the disorder or those in whom the disorder is to be prevented.

[0103] "**Chronic**" administration refers to administration of an agent in a continuous mode as opposed to an acute mode, so as to maintain the initial therapeutic effect (activity) for an extended period of time. "**Intermittent**" administration is treatment that is not consecutively done without interruption, but rather is cyclic in nature.

[0104] The term "**effective amount**" or "**therapeutically effective amount**" refers to an amount of a drug effective to treat a disease or disorder in a subject. In certain embodiments, an effective amount refers to an amount effective, at dosages and for periods of time necessary, to achieve the desired therapeutic or prophylactic result. A therapeutically effective amount of an anti-CSF1R antibody of the invention may vary according to factors such as the disease state, age, sex, and weight of the individual, and the ability of the anti-CSF1R antibody to elicit a desired response in the individual. A therapeutically effective amount encompasses an amount in which any toxic or detrimental effects of the anti-CSF1R antibody are outweighed by the therapeutically beneficial effects. In some embodiments, the expression "effective amount" refers to an amount of the antibody that is effective for treating the CD16+ disorder. When the disorder is RA, such effective amount can result in one or more of: reducing the signs or symptoms of RA (e.g. achieving ACR20, ACR50, or ACR70 response at week 24 and/or week 48), reducing disease activity (e.g. Disease Activity Score, DAS28), slowing the progression of structural joint damage, improving physical function, etc.

[0105] A "**prophylactically effective amount**" refers to an amount effective, at dosages and for periods of time necessary, to achieve the desired prophylactic result. Typically, but not necessarily, since a prophylactic dose is used in subjects prior to or at an earlier stage of disease, the prophylactically effective amount would be less than the therapeutically effective amount.

[0106] Administration "**in combination with**" one or more further therapeutic agents includes simultaneous (concurrent) and consecutive administration in any order.

[0107] A "**pharmaceutically acceptable carrier**" refers to a non-toxic solid, semisolid, or liquid filler, diluent, encapsulating material, formulation auxiliary, or carrier conventional in the art for use with a therapeutic agent that together comprise a "**pharmaceutical composition**" for administration to a subject. A pharmaceutically acceptable carrier is non-toxic to recipients at the dosages and concentrations employed and is compatible with other ingredients of the formulation. The pharmaceutically acceptable carrier is appropriate for the formulation employed. For example, if the therapeutic agent is to be administered orally, the carrier may be a gel capsule. If the therapeutic agent is to be administered subcutaneously, the carrier ideally is not irritable to the skin and does not cause injection site reaction.

Anti-CSF1R Antibodies

[0108] Anti-CSF1R antibodies include, but are not limited to, humanized antibodies, chimeric antibodies, mouse antibodies, human antibodies, and antibodies comprising the heavy chain and/or light chain CDRs discussed herein.

Exemplary Humanized Antibodies

[0109] In some embodiments, humanized antibodies that bind CSF1R are provided. Humanized antibodies are useful as therapeutic molecules because humanized antibodies reduce or eliminate the human immune response to non-human antibodies (such as the human anti-mouse antibody (HAMA) response), which can result in an immune response to an antibody therapeutic, and decreased effectiveness of the therapeutic.

[0110] Nonlimiting exemplary humanized antibodies include huAb1 through huAb16, described herein. Nonlimiting exemplary humanized antibodies also include antibodies comprising a heavy chain variable region of an antibody selected from huAb1 to huAb16 and/or a light chain variable region of an antibody selected from huAb1 to huAb16. Nonlimiting exemplary humanized antibodies include antibodies comprising a heavy chain variable region selected from SEQ ID NOs: 39 to 45 and/or a light chain variable region selected from SEQ ID NOs: 46 to 52. Exemplary humanized antibodies also include, but are

not limited to, humanized antibodies comprising heavy chain CDR1, CDR2, and CDR3, and/or light chain CDR1, CDR2, and CDR3 of an antibody selected from 0301, 0302, and 0311.

[0111] In some embodiments, a humanized anti-CSF1R antibody comprises heavy chain CDR1, CDR2, and CDR3 and/or a light chain CDR1, CDR2, and CDR3 of an antibody selected from 0301, 0302, and 0311. Nonlimiting exemplary humanized anti-CSF1R antibodies include antibodies comprising sets of heavy chain CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 15, 16, and 17; SEQ ID NOs: 21, 22, and 23; and SEQ ID NOs: 27, 28, and 29. Nonlimiting exemplary humanized anti-CSF1R antibodies also include antibodies comprising sets of light chain CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 18, 19, and 20; SEQ ID NOs: 24, 25, and 26; and SEQ ID NOs: 30, 31, and 32.

[0112] Nonlimiting exemplary humanized anti-CSF1R antibodies include antibodies comprising the sets of heavy chain CDR1, CDR2, and CDR3, and light chain CDR1, CDR2, and CDR3 in Table 1 (SEQ ID NOs shown; see Table 8 for sequences). Each row of Table 1 shows the heavy chain CDR1, CDR2, and CDR3, and light chain CDR1, CDR2, and CDR3 of an exemplary antibody.

Table 1: Heavy chain and light chain CDRs

	Heavy chain			**Light chain**		
Ab	**CDR1 SEQ ID**	**CDR2 SEQ ID**	**CDR3 SEQ ID**	**CDR1 SEQ ID**	**CDR2 SEQ ID**	**CDR3 SEQ ID**
0301	15	16	17	18	19	20
0302	21	22	23	24	25	26
0311	27	28	29	30	31	32

Further exemplary humanized antibodies

[0113] In some embodiments, a humanized anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45, and wherein the antibody binds CSF1R. In some embodiments, a humanized anti-CSF1R antibody comprises a light chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10,

12, 14, and 46 to 52, wherein the antibody binds CSF1R. In some embodiments, a humanized anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45; and a light chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52; wherein the antibody binds CSF1R.

[0114] As used herein, whether a particular polypeptide is, for example, at least 95% identical to an amino acid sequence can be determined using, e.g., a computer program. When determining whether a particular sequence is, for example, 95% identical to a reference sequence, the percentage of identity is calculated over the full length of the reference amino acid sequence.

[0115] In some embodiments, a humanized anti-CSF1R antibody comprises at least one of the CDRs discussed herein. That is, in some embodiments, a humanized anti-CSF1R antibody comprises at least one CDR selected from a heavy chain CDR1 discussed herein, a heavy chain CDR2 discussed herein, a heavy chain CDR3 discussed herein, a light chain CDR1 discussed herein, a light chain CDR2 discussed herein, and a light chain CDR3 discussed herein. Further, in some embodiments, a humanized anti-CSF1R antibody comprises at least one mutated CDR based on a CDR discussed herein, wherein the mutated CDR comprises 1, 2, 3, or 4 amino acid substitutions relative to the CDR discussed herein. In some embodiments, one or more of the amino acid substitutions are conservative amino acid substitutions. One skilled in the art can select one or more suitable conservative amino acid substitutions for a particular CDR sequence, wherein the suitable conservative amino acid substitutions are not predicted to significantly alter the binding properties of the antibody comprising the mutated CDR.

[0116] Exemplary humanized anti-CSF1R antibodies also include antibodies that compete for binding to CSF1R with an antibody described herein. Thus, in some embodiments, a humanized anti-CSF1R antibody is provided that competes for binding to CSF1R with an antibody selected from Fabs 0301, 0302, and 0311; and bivalent (i.e., having two heavy chains and two light chains) antibody versions of those Fabs.

Exemplary humanized antibody constant regions

[0117] In some embodiments, a humanized antibody described herein comprises one or more human constant regions. In some embodiments, the human heavy chain constant

region is of an isotype selected from IgA, IgG, and IgD. In some embodiments, the human light chain constant region is of an isotype selected from κ and λ. In some embodiments, a humanized antibody described herein comprises a human IgG constant region. In some embodiments, a humanized antibody described herein comprises a human IgG4 heavy chain constant region. In some such embodiments, a humanized antibody described herein comprises an S241P mutation in the human IgG4 constant region. In some embodiments, a humanized antibody described herein comprises a human IgG4 constant region and a human κ light chain.

[0118] The choice of heavy chain constant region can determine whether or not an antibody will have effector function *in vivo*. Such effector function, in some embodiments, includes antibody-dependent cell-mediated cytotoxicity (ADCC) and/or complement-dependent cytotoxicity (CDC), and can result in killing of the cell to which the antibody is bound. In some methods of treatment, including methods of treating some cancers, cell killing may be desirable, for example, when the antibody binds to a cell that supports the maintenance or growth of the tumor. Exemplary cells that may support the maintenance or growth of a tumor include, but are not limited to, tumor cells themselves, cells that aid in the recruitment of vasculature to the tumor, and cells that provide ligands, growth factors, or counter-receptors that support or promote tumor growth or tumor survival. In some embodiments, when effector function is desirable, an anti-CSF1R antibody comprising a human IgG1 heavy chain or a human IgG3 heavy chain is selected.

[0119] In some methods of treatment, effector function may not be desirable. For example, in some embodiments, it may be desirable that antibodies used in the treatment of lupus and/or MS and/or RA and/or osteolysis do not have effector function. Thus, in some embodiments, anti-CSF1R antibodies developed for the treatment of cancer may not be suitable for use in treatment of lupus and/or MS and/or RA and/or osteolysis. Accordingly, in some embodiments, an anti-CSF1R antibody that lacks significant effector function is used in treatment of lupus and/or MS and/or RA and/or osteolysis. In some embodiments, an anti-CSF1R antibody for treatment of lupus and/or MS and/or RA and/or osteolysis comprises a human IgG4 or IgG2 heavy chain constant region. In some embodiments, an IgG4 constant region comprises an S241P mutation.

[0120] An antibody may be humanized by any method. Nonlimiting exemplary methods of humanization include methods described, e.g., in U.S. Patent Nos. 5,530,101; 5,585,089; 5,693,761; 5,693,762; 6,180,370; Jones et al., *Nature* 321: 522-525 (1986);

Riechmann et al., *Nature* 332: 323-27 (1988); Verhoeyen et al., Science 239: 1534-36 (1988); and U.S. Publication No. US 2009/0136500.

[0121] As noted above, a humanized antibody is an antibody in which at least one amino acid in a framework region of a non-human variable region has been replaced with the amino acid from the corresponding location in a human framework region. In some embodiments, at least two, at least three, at least four, at least five, at least six, at least seven, at least eight, at least nine, at least 10, at least 11, at least 12, at least 15, or at least 20 amino acids in the framework regions of a non-human variable region are replaced with an amino acid from one or more corresponding locations in one or more human framework regions.

[0122] In some embodiments, some of the corresponding human amino acids used for substitution are from the framework regions of different human immunoglobulin genes. That is, in some such embodiments, one or more of the non-human amino acids may be replaced with corresponding amino acids from a human framework region of a first human antibody or encoded by a first human immunoglobulin gene, one or more of the non-human amino acids may be replaced with corresponding amino acids from a human framework region of a second human antibody or encoded by a second human immunoglobulin gene, one or more of the non-human amino acids may be replaced with corresponding amino acids from a human framework region of a third human antibody or encoded by a third human immunoglobulin gene, etc. Further, in some embodiments, all of the corresponding human amino acids being used for substitution in a single framework region, for example, FR2, need not be from the same human framework. In some embodiments, however, all of the corresponding human amino acids being used for substitution are from the same human antibody or encoded by the same human immunoglobulin gene.

[0123] In some embodiments, an antibody is humanized by replacing one or more entire framework regions with corresponding human framework regions. In some embodiments, a human framework region is selected that has the highest level of homology to the non-human framework region being replaced. In some embodiments, such a humanized antibody is a CDR-grafted antibody.

[0124] In some embodiments, following CDR-grafting, one or more framework amino acids are changed back to the corresponding amino acid in a mouse framework region. Such "back mutations" are made, in some embodiments, to retain one or more mouse framework amino acids that appear to contribute to the structure of one or more of the CDRs and/or that may be involved in antigen contacts and/or appear to be involved in

the overall structural integrity of the antibody. In some embodiments, ten or fewer, nine or fewer, eight or fewer, seven or fewer, six or fewer, five or fewer, four or fewer, three or fewer, two or fewer, one, or zero back mutations are made to the framework regions of an antibody following CDR grafting.

[0125] In some embodiments, a humanized antibody also comprises a human heavy chain constant region and/or a human light chain constant region.

Exemplary Chimeric Antibodies

[0126] In some embodiments, an anti-CSF1R antibody is a chimeric antibody. In some embodiments, an anti-CSF1R antibody comprises at least one non-human variable region and at least one human constant region. In some such embodiments, all of the variable regions of an anti-CSF1R antibody are non-human variable regions, and all of the constant regions of an anti-CSF1R antibody are human constant regions. In some embodiments, one or more variable regions of a chimeric antibody are mouse variable regions. The human constant region of a chimeric antibody need not be of the same isotype as the non-human constant region, if any, it replaces. Chimeric antibodies are discussed, e.g., in U.S. Patent No. 4,816,567; and Morrison et al. *Proc. Natl. Acad. Sci. USA* 81: 6851-55 (1984).

[0127] Nonlimiting exemplary chimeric antibodies include chimeric antibodies comprising the heavy and/or light chain variable regions of an antibody selected from 0301, 0302, and 0311. Additional nonlimiting exemplary chimeric antibodies include chimeric antibodies comprising heavy chain CDR1, CDR2, and CDR3, and/or light chain CDR1, CDR2, and CDR3 of an antibody selected from 0301, 0302, and 0311.

[0128] Nonlimiting exemplary chimeric anti-CSF1R antibodies include antibodies comprising the following pairs of heavy and light chain variable regions: SEQ ID NOs: 9 and 10; SEQ ID NOs: 11 and 12; and SEQ ID NOs: 13 and 14.

[0129] Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising a set of heavy chain CDR1, CDR2, and CDR3, and light chain CDR1, CDR2, and CDR3 shown above in Table 1.

Further exemplary chimeric antibodies

[0130] In some embodiments, a chimeric anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45, wherein the antibody binds CSF1R. In some embodiments, a chimeric anti-CSF1R antibody comprises a

light chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52, wherein the antibody binds CSF1R. In some embodiments, a chimeric anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45; and a light chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52; wherein the antibody binds CSF1R.

[0131] In some embodiments, a chimeric anti-CSF1R antibody comprises at least one of the CDRs discussed herein. That is, in some embodiments, a chimeric anti-CSF1R antibody comprises at least one CDR selected from a heavy chain CDR1 discussed herein, a heavy chain CDR2 discussed herein, a heavy chain CDR3 discussed herein, a light chain CDR1 discussed herein, a light chain CDR2 discussed herein, and a light chain CDR3 discussed herein. Further, in some embodiments, a chimeric anti-CSF1R antibody comprises at least one mutated CDR based on a CDR discussed herein, wherein the mutated CDR comprises 1, 2, 3, or 4 amino acid substitutions relative to the CDR discussed herein. In some embodiments, one or more of the amino acid substitutions are conservative amino acid substitutions. One skilled in the art can select one or more suitable conservative amino acid substitutions for a particular CDR sequence, wherein the suitable conservative amino acid substitutions are not predicted to significantly alter the binding properties of the antibody comprising the mutated CDR.

[0132] Exemplary chimeric anti-CSF1R antibodies also include chimeric antibodies that compete for binding to CSF1R with an antibody described herein. Thus, in some embodiments, a chimeric anti-CSF1R antibody is provided that competes for binding to CSF1R with an antibody selected from Fabs 0301, 0302, and 0311; and bivalent (i.e., having two heavy chains and two light chains) antibody versions of those Fabs.

Exemplary chimeric antibody constant regions

[0133] In some embodiments, a chimeric antibody described herein comprises one or more human constant regions. In some embodiments, the human heavy chain constant region is of an isotype selected from IgA, IgG, and IgD. In some embodiments, the human light chain constant region is of an isotype selected from κ and λ. In some embodiments, a

chimeric antibody described herein comprises a human IgG constant region. In some embodiments, a chimeric antibody described herein comprises a human IgG4 heavy chain constant region. In some such embodiments, a chimeric antibody described herein comprises an S241P mutation in the human IgG4 constant region. In some embodiments, a chimeric antibody described herein comprises a human IgG4 constant region and a human κ light chain.

[0134] As noted above, whether or not effector function is desirable may depend on the particular method of treatment intended for an antibody. Thus, in some embodiments, when effector function is desirable, a chimeric anti-CSF1R antibody comprising a human IgG1 heavy chain constant region or a human IgG3 heavy chain constant region is selected. In some embodiments, when effector function is not desirable, a chimeric anti-CSF1R antibody comprising a human IgG4 or IgG2 heavy chain constant region is selected.

Exemplary Human Antibodies

[0135] Human antibodies can be made by any suitable method. Nonlimiting exemplary methods include making human antibodies in transgenic mice that comprise human immunoglobulin loci. See, e.g., Jakobovits et al., *Proc. Natl. Acad. Sci. USA* 90: 2551-55 (1993); Jakobovits et al., *Nature* 362: 255-8 (1993); Lonberg et al., *Nature* 368: 856-9 (1994); and U.S. Patent Nos. 5,545,807; 6,713,610; 6,673,986; 6,162,963; 5,545,807; 6,300,129; 6,255,458; 5,877,397; 5,874,299; and 5,545,806.

[0136] Nonlimiting exemplary methods also include making human antibodies using phage display libraries. See, e.g., Hoogenboom et al., *J. Mol. Biol.* 227: 381-8 (1992); Marks et al., *J. Mol. Biol.* 222: 581-97 (1991); and PCT Publication No. WO 99/10494.

[0137] In some embodiments, a human anti-CSF1R antibody binds to a polypeptide having the sequence of SEQ ID NO: 1. Exemplary human anti-CSF1R antibodies also include antibodies that compete for binding to CSF1R with an antibody described herein. Thus, in some embodiments, a human anti-CSF1R antibody is provided that competes for binding to CSF1R with an antibody selected from Fabs 0301, 0302, and 0311, and bivalent (i.e., having two heavy chains and two light chains) antibody versions of those Fabs.

[0138] In some embodiments, a human anti-CSF1R antibody comprises one or more human constant regions. In some embodiments, the human heavy chain constant region is of an isotype selected from IgA, IgG, and IgD. In some embodiments, the human light chain constant region is of an isotype selected from κ and λ. In some embodiments, a human antibody described herein comprises a human IgG constant region. In some embodiments, a human antibody described herein comprises a human IgG4 heavy chain constant region. In

some such embodiments, a human antibody described herein comprises an S241P mutation in the human IgG4 constant region. In some embodiments, a human antibody described herein comprises a human IgG4 constant region and a human κ light chain.

[0139] In some embodiments, when effector function is desirable, a human anti-CSF1R antibody comprising a human IgG1 heavy chain constant region or a human IgG3 heavy chain constant region is selected. In some embodiments, when effector function is not desirable, a human anti-CSF1R antibody comprising a human IgG4 or IgG2 heavy chain constant region is selected.

Additional Exemplary Anti-CSF1R Antibodies

[0140] Exemplary anti-CSF1R antibodies also include, but are not limited to, mouse, humanized, human, chimeric, and engineered antibodies that comprise, for example, one or more of the CDR sequences described herein. In some embodiments, an anti-CSF1R antibody comprises a heavy chain variable region described herein. In some embodiments, an anti-CSF1R antibody comprises a light chain variable region described herein. In some embodiments, an anti-CSF1R antibody comprises a heavy chain variable region described herein and a light chain variable region described herein. In some embodiments, an anti-CSF1R antibody comprises heavy chain CDR1, CDR2, and CDR3 described herein. In some embodiments, an anti-CSF1R antibody comprises light chain CDR1, CDR2, and CDR3 described herein. In some embodiments, an anti-CSF1R antibody comprises heavy chain CDR1, CDR2, and CDR3 described herein and light chain CDR1, CDR2, and CDR3 described herein.

[0141] In some embodiments, an anti-CSF1R antibody comprises a heavy chain variable region of an antibody selected from Fabs 0301, 0302, and 0311. Nonlimiting exemplary anti-CSF1R antibodies also include antibodies comprising a heavy chain variable region of an antibody selected from humanized antibodies huAb1 to huAb16. Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising a heavy chain variable region comprising a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45.

[0142] In some embodiments, an anti-CSF1R antibody comprises a light chain variable region of an antibody selected from Fabs 0301, 0302, and 0311. Nonlimiting exemplary anti-CSF1R antibodies also include antibodies comprising a light chain variable region of an antibody selected from humanized antibodies huAb1 to huAb16. Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising a light chain variable region comprising a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52.

[0143] In some embodiments, an anti-CSF1R antibody comprises a heavy chain variable region and a light chain variable region of an antibody selected from Fabs 0301, 0302, and 0311. Nonlimiting exemplary anti-CSF1R antibodies also include antibodies comprising a heavy chain variable region and a light chain variable region of an antibody selected from humanized antibodies huAb1 to huAb16. Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising the following pairs of heavy and light chain variable regions: SEQ ID NOs: 9 and 10; SEQ ID NOs: 11 and 12; and SEQ ID NOs: 13 and 14; SEQ ID NOs: 39 and 40; SEQ ID NOs: 41 and 42; SEQ ID NOs: 43 and 44; SEQ ID NOs: 45 and 46; SEQ ID NOs: 47 and 48; SEQ ID NOs: 49 and 50; and SEQ ID NOs: 51 and 52. Nonlimiting exemplary anti-CSF1R antibodies also include antibodies comprising the following pairs of heavy and light chains: SEQ ID NOs: 33 and 34; SEQ ID NOs: 35 and 36; and SEQ ID NOs: 37 and 38.

[0144] In some embodiments, an anti-CSF1R antibody comprises heavy chain CDR1, CDR2, and CDR3 of an antibody selected from Fabs 0301, 0302, and 0311. Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising sets of heavy chain CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 15, 16, and 17; SEQ ID NOs: 21, 22, and 23; and SEQ ID NOs: 27, 28,and 29.

[0145] In some embodiments, an anti-CSF1R antibody comprises light chain CDR1, CDR2, and CDR3 of an antibody selected from Fabs 0301, 0302, and 0311. Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising sets of light chain CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 18, 19, and 20; SEQ ID NOs: 24, 25, and 26; and SEQ ID NOs: 30, 31, and 32.

[0146] In some embodiments, an anti-CSF1R antibody comprises heavy chain CDR1, CDR2, and CDR3, and light chain CDR1, CDR2, and CDR3 of an antibody selected from Fabs 0301, 0302, and 0311.

[0147] Nonlimiting exemplary anti-CSF1R antibodies include antibodies comprising the sets of heavy chain CDR1, CDR2, and CDR3, and light chain CDR1, CDR2, and CDR3 shown above in Table 1.

Further exemplary antibodies

[0148] In some embodiments, an anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45, wherein the antibody binds CSF1R. In some embodiments, an anti-CSF1R antibody comprises a light

chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52, wherein the antibody binds CSF1R. In some embodiments, an anti-CSF1R antibody comprises a heavy chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45; and a light chain comprising a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52; wherein the antibody binds CSF1R.

[0149] In some embodiments, an anti-CSF1R antibody comprises at least one of the CDRs discussed herein. That is, in some embodiments, an anti-CSF1R antibody comprises at least one CDR selected from a heavy chain CDR1 discussed herein, a heavy chain CDR2 discussed herein, a heavy chain CDR3 discussed herein, a light chain CDR1 discussed herein, a light chain CDR2 discussed herein, and a light chain CDR3 discussed herein. Further, in some embodiments, an anti-CSF1R antibody comprises at least one mutated CDR based on a CDR discussed herein, wherein the mutated CDR comprises 1, 2, 3, or 4 amino acid substitutions relative to the CDR discussed herein. In some embodiments, one or more of the amino acid substitutions are conservative amino acid substitutions. One skilled in the art can select one or more suitable conservative amino acid substitutions for a particular CDR sequence, wherein the suitable conservative amino acid substitutions are not predicted to significantly alter the binding properties of the antibody comprising the mutated CDR.

[0150] Exemplary anti-CSF1R antibodies also include antibodies that compete for binding to CSF1R with an antibody described herein. Thus, in some embodiments, an anti-CSF1R antibody is provided that competes for binding to CSF1R with an antibody selected from Fabs 0301, 0302, and 0311, and bivalent (i.e., having two heavy chains and two light chains) antibody versions of those Fabs.

Exemplary antibody constant regions

[0151] In some embodiments, an antibody described herein comprises one or more human constant regions. In some embodiments, the human heavy chain constant region is of an isotype selected from IgA, IgG, and IgD. In some embodiments, the human light chain constant region is of an isotype selected from κ and λ. In some embodiments, an antibody

described herein comprises a human IgG constant region. In some embodiments, an antibody described herein comprises a human IgG4 heavy chain constant region. In some such embodiments, an antibody described herein comprises an S241P mutation in the human IgG4 constant region. In some embodiments, an antibody described herein comprises a human IgG4 constant region and a human κ light chain.

[0152] As noted above, whether or not effector function is desirable may depend on the particular method of treatment intended for an antibody. Thus, in some embodiments, when effector function is desirable, an anti-CSF1R antibody comprising a human IgG1 heavy chain constant region or a human IgG3 heavy chain constant region is selected. In some embodiments, when effector function is not desirable, an anti-CSF1R antibody comprising a human IgG4 or IgG2 heavy chain constant region is selected.

Exemplary Anti-CSF1R Heavy Chain Variable Regions

[0153] In some embodiments, anti-CSF1R antibody heavy chain variable regions are provided. In some embodiments, an anti-CSF1R antibody heavy chain variable region is a mouse variable region, a human variable region, or a humanized variable region.

[0154] An anti-CSF1R antibody heavy chain variable region comprises a heavy chain CDR1, FR2, CDR2, FR3, and CDR3. In some embodiments, an anti-CSF1R antibody heavy chain variable region further comprises a heavy chain FR1 and/or FR4. Nonlimiting exemplary heavy chain variable regions include, but are not limited to, heavy chain variable regions having an amino acid sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45.

[0155] In some embodiments, an anti-CSF1R antibody heavy chain variable region comprises a CDR1 comprising a sequence selected from SEQ ID NOs: 15, 21, and 27.

[0156] In some embodiments, an anti-CSF1R antibody heavy chain variable region comprises a CDR2 comprising a sequence selected from SEQ ID NOs: 16, 22, and 28.

[0157] In some embodiments, an anti-CSF1R antibody heavy chain variable region comprises a CDR3 comprising a sequence selected from SEQ ID NOs: 17, 23, and 29.

[0158] Nonlimiting exemplary heavy chain variable regions include, but are not limited to, heavy chain variable regions comprising sets of CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 15, 16, and 17; SEQ ID NOs: 21, 22, and 23; and SEQ ID NOs: 27, 28, and 29.

[0159] In some embodiments, an anti-CSF1R antibody heavy chain comprises a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to

a sequence selected from SEQ ID NOs: 9, 11, 13, and 39 to 45, wherein the heavy chain, together with a light chain, is capable of forming an antibody that binds CSF1R.

[0160] In some embodiments, an anti-CSF1R antibody heavy chain comprises at least one of the CDRs discussed herein. That is, in some embodiments, an anti-CSF1R antibody heavy chain comprises at least one CDR selected from a heavy chain CDR1 discussed herein, a heavy chain CDR2 discussed herein, and a heavy chain CDR3 discussed herein. Further, in some embodiments, an anti-CSF1R antibody heavy chain comprises at least one mutated CDR based on a CDR discussed herein, wherein the mutated CDR comprises 1, 2, 3, or 4 amino acid substitutions relative to the CDR discussed herein. In some embodiments, one or more of the amino acid substitutions are conservative amino acid substitutions. One skilled in the art can select one or more suitable conservative amino acid substitutions for a particular CDR sequence, wherein the suitable conservative amino acid substitutions are not predicted to significantly alter the binding properties of the heavy chain comprising the mutated CDR.

[0161] In some embodiments, a heavy chain comprises a heavy chain constant region. In some embodiments, a heavy chain comprises a human heavy chain constant region. In some embodiments, the human heavy chain constant region is of an isotype selected from IgA, IgG, and IgD. In some embodiments, the human heavy chain constant region is an IgG constant region. In some embodiments, a heavy chain comprises a human igG4 heavy chain constant region. In some such embodiments, the human IgG4 heavy chain constant region comprises an S241P mutation.

[0162] In some embodiments, when effector function is desirable, a heavy chain comprises a human IgG1 or IgG3 heavy chain constant region. In some embodiments, when effector function is less desirable, a heavy chain comprises a human IgG4 or IgG2 heavy chain constant region.

Exemplary Anti-CSF1R Light Chain Variable Regions

[0163] In some embodiments, anti-CSF1R antibody light chain variable regions are provided. In some embodiments, an anti-CSF1R antibody light chain variable region is a mouse variable region, a human variable region, or a humanized variable region.

[0164] An anti-CSF1R antibody light chain variable region comprises a light chain CDR1, FR2, CDR2, FR3, and CDR3. In some embodiments, an anti-CSF1R antibody light chain variable region further comprises a light chain FR1 and/or FR4. Nonlimiting exemplary light chain variable regions include light chain variable regions having an amino acid sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52.

[0165] In some embodiments, an anti-CSF1R antibody light chain variable region comprises a CDR1 comprising a sequence selected from SEQ ID NOs: 18, 24 and 30.

[0166] In some embodiments, an anti-CSF1R antibody light chain variable region comprises a CDR2 comprising a sequence selected from SEQ ID NOs: 19, 25, and 31.

[0167] In some embodiments, an anti-CSF1R antibody light chain variable region comprises a CDR3 comprising a sequence selected from SEQ ID NOs: 20, 26, and 32.

[0168] Nonlimiting exemplary light chain variable regions include, but are not limited to, light chain variable regions comprising sets of CDR1, CDR2, and CDR3 selected from: SEQ ID NOs: 18, 19, and 20; SEQ ID NOs: 24, 25, and 26; and SEQ ID NOs: 30, 31, and 32.

[0169] In some embodiments, an anti-CSF1R antibody light chain comprises a variable region sequence that is at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99% identical to a sequence selected from SEQ ID NOs: 10, 12, 14, and 46 to 52, wherein the light chain, together with a heavy chain, is capable of forming an antibody that binds CSF1R.

[0170] In some embodiments, an anti-CSF1R antibody light chain comprises at least one of the CDRs discussed herein. That is, in some embodiments, an anti-CSF1R antibody light chain comprises at least one CDR selected from a light chain CDR1 discussed herein, a light chain CDR2 discussed herein, and a light chain CDR3 discussed herein. Further, in some embodiments, an anti-CSF1R antibody light chain comprises at least one mutated CDR based on a CDR discussed herein, wherein the mutated CDR comprises 1, 2, 3, or 4 amino acid substitutions relative to the CDR discussed herein. In some embodiments, one or more of the amino acid substitutions are conservative amino acid substitutions. One skilled in the art can select one or more suitable conservative amino acid substitutions for a particular CDR sequence, wherein the suitable conservative amino acid substitutions are not predicted to significantly alter the binding properties of the light chain comprising the mutated CDR.

[0171] In some embodiments, a light chain comprises a human light chain constant region. In some embodiments, a human light chain constant region is selected from a human κ and a human λ light chain constant region.

Exemplary Additional CSF1R Binding Molecules

[0172] In some embodiments, additional molecules that bind CSF1R are provided. Such molecules include, but are not limited to, non-canonical scaffolds, such as anti-calins, adnectins, ankyrin repeats, etc. See, e.g., Hosse et al., *Prot. Sci.* 15:14 (2006); Fiedler, M.

and Skerra, A., "Non-Antibody Scaffolds," pp.467-499 in Handbook of Therapeutic Antibodies, Dubel, S., ed., Wiley-VCH, Weinheim, Germany, 2007.

Exemplary Properties of anti-CSF1R antibodies

[0173] In some embodiments, an antibody having a structure described above binds to the CSF1R with a binding affinity (K_D) of less than 1 nM, blocks binding of CSF1 and/or IL-34 to CSF1R, and inhibits CSF1R phosphorylation induced by CSF1 and/or IL-34.

[0174] In some embodiments, an anti-CSF1R antibody binds to the extracellular domain of CSF1R (CSF1R-ECD). In some embodiments, an anti-CSF1R antibody has a binding affinity (K_D) for CSF1R of less than 1 nM, less than 0.5 nM, less than 0.1 nM, or less than 0.05 nM. In some embodiments, an anti-CSF1R antibody has a K_D of between 0.01 and 1 nM, between 0.01 and 0.5 nM, between 0.01 and 0.1 nM, between 0.01 and 0.05 nM, or between 0.02 and 0.05 nM.

[0175] In some embodiments, an anti-CSF1R antibody blocks ligand binding to CSF1R. In some embodiments, an anti-CSF1R antibody blocks binding of CSF1 to CSF1R. In some embodiments, an anti-CSF1R antibody blocks binding of IL-34 to CSF1R. In some embodiments, an anti-CSF1R antibody blocks binding of both CSF1 and IL-34 to CSF1R. In some embodiments, an antibody that blocks ligand binding binds to the extracellular domain of CSF1R. In some embodiments, an antibody blocks ligand binding to CSF1R when it reduces the amount of detectable binding of a ligand to CSF1R by at least 50%, using the assay described, *e.g.*, U.S. Patent No. 8,206,715 B2, Example 7, which is incorporated herein by reference for any purpose. In some embodiments, an antibody reduces the amount of detectable binding of a ligand to CSF1R by at least 60%, at least 70%, at least 80%, or at least 90%. In some such embodiments, the antibody is said to block ligand binding by at least 50%, at least 60%, at least 70%, etc.

[0176] In some embodiments, an anti-CSF1R antibody inhibits ligand-induced CSF1R phosphorylation. In some embodiments, an anti-CSF1R antibody inhibits CSF1-induced CSF1R phosphorylation. In some embodiments, an anti-CSF1R antibody inhibits IL-34-induced CSF1R phosphorylation. In some embodiments, an anti-CSF1R antibody inhibits both CSF1-induced and IL-34-induced CSF1R phosphorylation. In some embodiments, an antibody is considered to "inhibit ligand-induced CSF1R phosphorylation" when it reduces the amount of detectable ligand-induced CSF1R phosphorylation by at least 50%, using the assay described, *e.g.*, U.S. Patent No. 8,206,715 B2, Example 6, which is incorporated herein by reference for any purpose. In some embodiments, an antibody reduces the amount of detectable ligand-induced CSF1R phosphorylation by at least 60%, at

least 70%, at least 80%, or at least 90%. In some such embodiments, the antibody is said to inhibit ligand-induced CSF1R phosphorylation by at least at least 50%, at least 60%, at least 70%, etc.

[0177] In some embodiments, an antibody inhibits monocyte proliferation and/or survival responses in the presence of CSF1 and/or IL-34. In some embodiments, an antibody is considered to "inhibit monocyte proliferation and/or survival responses" when it reduces the amount of monocyte proliferation and/or survival responses in the presence of CSF1 and/or IL-34 by at least 50%, using the assay described, *e.g.*, U.S. Patent No. 8,206,715 B2, Example 10, which is incorporated herein by reference for any purpose. In some embodiments, an antibody reduces the amount of monocyte proliferation and/or survival responses in the presence of CSF1 and/or IL-34 by at least 60%, at least 70%, at least 80%, or at least 90%. In some such embodiments, the antibody is said to inhibit monocyte proliferation and/or survival responses by at least at least 50%, at least 60%, at least 70%, etc.

Exemplary Antibody Conjugates

[0178] In some embodiments, an anti-CSF1R antibody is conjugated to a label and/or a cytotoxic agent. As used herein, a label is a moiety that facilitates detection of the antibody and/or facilitates detection of a molecule to which the antibody binds. Nonlimiting exemplary labels include, but are not limited to, radioisotopes, fluorescent groups, enzymatic groups, chemiluminescent groups, biotin, epitope tags, metal-binding tags, etc. One skilled in the art can select a suitable label according to the intended application.

[0179] As used herein, a cytotoxic agent is a moiety that reduces the proliferative capacity of one or more cells. A cell has reduced proliferative capacity when the cell becomes less able to proliferate, for example, because the cell undergoes apoptosis or otherwise dies, the cell fails to proceed through the cell cycle and/or fails to divide, the cell differentiates, etc. Nonlimiting exemplary cytotoxic agents include, but are not limited to, radioisotopes, toxins, and chemotherapeutic agents. One skilled in the art can select a suitable cytotoxic according to the intended application.

[0180] In some embodiments, a label and/or a cytotoxic agent is conjugated to an antibody using chemical methods *in vitro*. Nonlimiting exemplary chemical methods of conjugation are known in the art, and include services, methods and/or reagents commercially available from, e.g., Thermo Scientific Life Science Research Produces (formerly Pierce; Rockford, IL), Prozyme (Hayward, CA), SACRI Antibody Services (Calgary, Canada), AbD Serotec (Raleigh, NC), etc. In some embodiments, when a label

and/or cytotoxic agent is a polypeptide, the label and/or cytotoxic agent can be expressed from the same expression vector with at least one antibody chain to produce a polypeptide comprising the label and/or cytotoxic agent fused to an antibody chain. One skilled in the art can select a suitable method for conjugating a label and/or cytotoxic agent to an antibody according to the intended application.

Exemplary Leader Sequences

[0181] In order for some secreted proteins to express and secrete in large quantities, a leader sequence from a heterologous protein may be desirable. In some embodiments, a leader sequence is selected from SEQ ID NOs: 3 and 4, which are light chain and heavy chain leader sequences, respectively. In some embodiments, employing heterologous leader sequences may be advantageous in that a resulting mature polypeptide may remain unaltered as the leader sequence is removed in the ER during the secretion process. The addition of a heterologous leader sequence may be required to express and secrete some proteins.

[0182] Certain exemplary leader sequence sequences are described, e.g., in the online Leader sequence Database maintained by the Department of Biochemistry, National University of Singapore. *See* Choo et al., *BMC* Bioinformatics, 6: 249 (2005); and PCT Publication No. WO 2006/081430.

Nucleic Acid Molecules Encoding Anti-CSF1R Antibodies

[0183] Nucleic acid molecules comprising polynucleotides that encode one or more chains of anti-CSF1R antibodies are provided. In some embodiments, a nucleic acid molecule comprises a polynucleotide that encodes a heavy chain or a light chain of an anti-CSF1R antibody. In some embodiments, a nucleic acid molecule comprises both a polynucleotide that encodes a heavy chain and a polynucleotide that encodes a light chain, of an anti-CSF1R antibody. In some embodiments, a first nucleic acid molecule comprises a first polynucleotide that encodes a heavy chain and a second nucleic acid molecule comprises a second polynucleotide that encodes a light chain.

[0184] In some such embodiments, the heavy chain and the light chain are expressed from one nucleic acid molecule, or from two separate nucleic acid molecules, as two separate polypeptides. In some embodiments, such as when an antibody is an scFv, a single polynucleotide encodes a single polypeptide comprising both a heavy chain and a light chain linked together.

[0185] In some embodiments, a polynucleotide encoding a heavy chain or light chain of an anti-CSF1R antibody comprises a nucleotide sequence that encodes a leader sequence, which, when translated, is located at the N terminus of the heavy chain or light

chain. As discussed above, the leader sequence may be the native heavy or light chain leader sequence, or may be another heterologous leader sequence.

[0186] Nucleic acid molecules may be constructed using recombinant DNA techniques conventional in the art. In some embodiments, a nucleic acid molecule is an expression vector that is suitable for expression in a selected host cell.

Anti-CSF1R Antibody Expression and Production

Vectors

[0187] Vectors comprising polynucleotides that encode anti-CSF1R heavy chains and/or anti-CSF1R light chains are provided. Vectors comprising polynucleotides that encode anti-CSF1R heavy chains and/or anti-CSF1R light chains are also provided. Such vectors include, but are not limited to, DNA vectors, phage vectors, viral vectors, retroviral vectors, etc. In some embodiments, a vector comprises a first polynucleotide sequence encoding a heavy chain and a second polynucleotide sequence encoding a light chain. In some embodiments, the heavy chain and light chain are expressed from the vector as two separate polypeptides. In some embodiments, the heavy chain and light chain are expressed as part of a single polypeptide, such as, for example, when the antibody is an scFv.

[0188] In some embodiments, a first vector comprises a polynucleotide that encodes a heavy chain and a second vector comprises a polynucleotide that encodes a light chain. In some embodiments, the first vector and second vector are transfected into host cells in similar amounts (such as similar molar amounts or similar mass amounts). In some embodiments, a mole- or mass-ratio of between 5:1 and 1:5 of the first vector and the second vector is transfected into host cells. In some embodiments, a mass ratio of between 1:1 and 1:5 for the vector encoding the heavy chain and the vector encoding the light chain is used. In some embodiments, a mass ratio of 1:2 for the vector encoding the heavy chain and the vector encoding the light chain is used.

[0189] In some embodiments, a vector is selected that is optimized for expression of polypeptides in CHO or CHO-derived cells, or in NSO cells. Exemplary such vectors are described, e.g., in Running Deer et al., *Biotechnol. Prog.* 20:880-889 (2004).

[0190] In some embodiments, a vector is chosen for *in vivo* expression of anti-CSF1R heavy chains and/or anti-CSF1R light chains in animals, including humans. In some such embodiments, expression of the polypeptide is under the control of a promoter that functions in a tissue-specific manner. For example, liver-specific promoters are described, e.g., in PCT Publication No. WO 2006/076288.

Host Cells

[0191] In various embodiments, anti-CSF1R heavy chains and/or anti-CSF1R light chains may be expressed in prokaryotic cells, such as bacterial cells; or in eukaryotic cells, such as fungal cells (such as yeast), plant cells, insect cells, and mammalian cells. Such expression may be carried out, for example, according to procedures known in the art. Exemplary eukaryotic cells that may be used to express polypeptides include, but are not limited to, COS cells, including COS 7 cells; 293 cells, including 293-6E cells; CHO cells, including CHO-S and DG44 cells; PER.C6® cells (Crucell); and NSO cells. In some embodiments, anti-CSF1R heavy chains and/or anti-CSF1R light chains may be expressed in yeast. See, e.g., U.S. Publication No. US 2006/0270045 A1. In some embodiments, a particular eukaryotic host cell is selected based on its ability to make desired post-translational modifications to the anti-CSF1R heavy chains and/or anti-CSF1R light chains. For example, in some embodiments, CHO cells produce polypeptides that have a higher level of sialylation than the same polypeptide produced in 293 cells.

[0192] Introduction of one or more nucleic acids into a desired host cell may be accomplished by any method, including but not limited to, calcium phosphate transfection, DEAE-dextran mediated transfection, cationic lipid-mediated transfection, electroporation, transduction, infection, etc. Nonlimiting exemplary methods are described, e.g., in Sambrook et al., *Molecular Cloning, A Laboratory Manual,* 3rd ed. Cold Spring Harbor Laboratory Press (2001). Nucleic acids may be transiently or stably transfected in the desired host cells, according to any suitable method.

[0193] In some embodiments, one or more polypeptides may be produced *in vivo* in an animal that has been engineered or transfected with one or more nucleic acid molecules encoding the polypeptides, according to any suitable method.

Purification of Anti-CSF1R Antibodies

[0194] Anti-CSF1R antibodies may be purified by any suitable method. Such methods include, but are not limited to, the use of affinity matrices or hydrophobic interaction chromatography. Suitable affinity ligands include the CSF1R ECD and ligands that bind antibody constant regions. For example, a Protein A, Protein G, Protein A/G, or an antibody affinity column may be used to bind the constant region and to purify an anti-CSF1R antibody. Hydrophobic interactive chromatography, for example, a butyl or phenyl column, may also suitable for purifying some polypeptides. Many methods of purifying polypeptides are known in the art.

Cell-free Production of Anti-CSF1R Antibodies

[0195] In some embodiments, an anti-CSF1R antibody is produced in a cell-free system. Nonlimiting exemplary cell-free systems are described, e.g., in Sitaraman et al., *Methods Mol. Biol.* 498: 229-44 (2009); Spirin, *Trends Biotechnol.* 22: 538-45 (2004); Endo et al., *Biotechnol. Adv.* 21: 695-713 (2003).

Methods of Detecting Factors

[0196] The present disclosure relates to methods of reducing one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9. In some embodiments, a subject has an elevated level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 prior to treatment with the antibodies described herein. In some embodiments, the level of a factor is determined by detecting the level of the protein. Nonlimiting exemplary amino acid sequences for human IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-9, and MMP-2 are shown in SEQ ID NOs: 96 to 108, respectively. Any native forms of the proteins, including naturally-occurring variants, such as variants comprising substitutions and/or deletions (such as truncations), variants comprising post-translational modifications, splice variants, and allelic variants, are specifically contemplated.

[0197] In some embodiments, the level of the factor is determined by detecting the level of the mRNA. Exemplary nucleotide sequences for human IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 mRNA (or its complement, cDNA) are known in the art. In some instances, the level of an mRNA may correlate with the level of the encoded protein, so that detection of the mRNA level may be used to determine whether the level of the protein is, for example, elevated prior to treatment, or has been reduced following treatment. In some embodiments, the level of the protein is determined. It should be noted, however, that it is not necessary to determine the level of the factor(s) before or after treatment with the antibody in order to carry out the methods described herein. It can be assumed, in some instances, that a particular condition involves an elevated level of one or more of the recited factors, and therefore that a subject with the condition would benefit from a treatment that reduces one or more of the recited factors. Therefore, unless explicitly stated, detecting the level of one or more factors before or after treatment is not required in order to carry out the claimed methods.

[0198] Any method of detecting the level of a protein in a sample is contemplated. One skilled in the art can select a suitable method depending on the type of sample being

analyzed and the identity and number of proteins being detected. Nonlimiting exemplary such methods include immunohistochemistry, ELISA, Western blotting, multiplex analyte detection (using, for example, Luminex® technology), mass spectrometry, etc.

[0199] Similarly, any method of detecting the level of an mRNA in a sample is contemplated. One skilled in the art can select a suitable method depending on the type of sample being analyzed and the identity and number of mRNAs being detected. Nonlimiting exemplary such methods include RT-PCR, quantitative RT-PCR and microarray-based methods, etc.

[0200] Any method of determining the levels of CD16+ and/or CD16- monocytes is contemplated. One skilled in the art can select a suitable method depending on the type of sample being analyzed. Nonlimiting exemplary methods of determining the levels of CD16+ and/or CD16- monocytes include methods provided by commercial kits, such as CD16+ Moncyte Isolation Kit (Miltenyl Biotec, Bergisch Gladbach, Germany).

Therapeutic Compositions and Methods

Methods of Treating Diseases using Anti-CSF1R Antibodies

[0201] Provided herein are methods of reducing the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject comprising administering an effective amount an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. In some embodiments, the method comprises reducing at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

[0202] The amino acid sequences for exemplary mature human IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-9, and MMP-2 are shown in Table 9 (Table of Sequences; SEQ ID NOs: 96 to 108, respectively). Additional native mature sequences may also exist. In some embodiments, native mature sequences have 1 to 10 or more amino acids deleted from the amino terminus of the mature sequences shown in Table 9. In some embodiments, native mature sequences have one or more amino acid additions, deletions, and/or substitutions in relative to the mature sequences shown in Table 9. All of the native mature forms of each factor are intended to be encompassed herein.

[0203] Provided herein are methods of treating conditions associated with elevated levels of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α,

CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject comprising administering an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. Exemplary conditions that are associated with elevated levels of one or more of those factors include, but are not limited to, rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, the antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding is selected from huAb1 to huAb16, described herein. In some embodiments, the antibody is huAb1.

[0204] In some embodiments, a method of reducing the level of IL-6 in a subject is provided, comprising administering to the subject an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. Reducing the level of IL-6 is beneficial, in some embodiments, in the treatment of a condition associated with elevated IL-6, such as rheumatoid arthritis, juvenile idiopathic arthritis, and Castleman's disease. In some embodiments, a method of reducing the level of TNF-α in a subject is provided, comprising administering to the subject an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. Reducing the level of TNF-α is beneficial, in some embodiments, in the treatment of a condition associated with elevated TNF-α, such as rheumatoid arthritis, juvenile idiopathic arthritis, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis. In some embodiments, a method of reducing the level of IL-1β in a subject is provided, comprising administering to the subject an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. Reducing the level of IL-1β is beneficial, in some embodiments, in the treatment of a condition associated with elevated IL-1β, such as rheumatoid arthritis and juvenile idiopathic arthritis. In any of the embodiments herein, the antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding may be selected from huAb1 to huAb16, described herein. In any of the embodiments herein, the antibody may be huAb1.

[0205] In some embodiments, a method comprises reducing IL-6 and IL-1β. In some embodiments, the method comprises reducing IL-6 and TNF-α. In some embodiments, a method comprises reducing IL-6 and CXCL10. In some embodiments, a method comprises reducing IL-1β and TNF-α. In some embodiments, a method comprises reducing IL-1β and CXCL10. In some embodiments, a method comprises reducing TNF-α and CXCL10. In some embodiments, a method comprises reducing IL-6, IL-1β, and TNF-α. In some embodiments, a method comprises reducing IL-6, IL-1β, and CXCL10. In some

embodiments, a method comprises reducing IL-6, TNF-α, and CXCL10. In some embodiments, a method comprises reducing TNF-α, IL-1β, and CXCL10. In some embodiments, a method comprises reducing IL-6, IL-1β, TNF-α, and CXCL10.

[0206] Methods of treating an inflammatory condition are provided, comprising administering to a subject with an inflammatory condition an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. In some embodiments, a method of treating an inflammatory condition comprises reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with an inflammatory condition, comprising administering an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. In some embodiments, the method comprises reducing at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, the antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding is selected from huAb1 to huAb16, described herein. In some embodiments, the antibody is huAb1. Nonlimiting exemplary inflammatory conditions include rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, lupus erythematosus, inflammatory bowel disease, inflammatory arthritis, and CD16+ disorders.

[0207] Methods of treating inflammatory arthritis are provided, comprising administering to a subject with an inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. In some embodiments, a method of treating inflammatory arthritis comprises reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with inflammatory arthritis, comprising administering an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding. In some embodiments, the method comprises reducing at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10. In some embodiments, the antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding is selected from huAb1 to huAb16, described herein. In some embodiments, the antibody is huAb1.

[0208] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34

ligand binding, such as huAb1 to huAb16, reduces inflammation, reduces pannus formation, reduces cartilage damage, reduces bone resorption, reduces macrophage numbers in the joints, reduces autoantibody formation, and/or reduces bone loss.

[0209] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces inflammation. Reducing inflammation, in some embodiments, comprises reducing erythrocyte sedimentation rate and/or reducing the levels of C-reactive proteins in blood. When inflammation is present in a subject, the erythrocyte sedimentation rate increases, possibly due to increased levels of fibrinogen in the blood. The erythrocyte sedimentation rate may be determined by any method in the art, including, but not limited to, calculating the rate by measuring the change in height of anticoagulated erythrocytes in one hour in a Westergren tube. See also *Procedures for the Erythrocyte Sedimentation Rate Test; Approved Standard—Fifth Edition.* CLSI document H02-A5. Wayne, PA: Clinical and Laboratory Standards Institute; 2011. Levels of C-reactive protein in blood may be determined by any methods in the art, including but not limited to using the RAPITEX® CRP test kit (Siemens).

[0210] Reducing inflammation, in some embodiments, comprises reducing peripheral edema, which is tissue swelling due to the buildup of fluids. Peripheral edema may occur, in some instances, in the ankles, feet, legs, and/or calves of a subject with rheumatoid arthritis. Reducing inflammation, in some embodiments, comprises reducing infiltration of inflammatory cells in the synovium of one or more affected joints. Synovial fluid may be collected, in some embodiments, by athrocentesis.

[0211] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces pannus formation. Reducing pannus formation, in some embodiments, comprises reducing infiltration of pannus into cartilage and/or subchondrial bone, and/or reducing hard tissue destruction resulting from pannus infiltration. Pannus formation can be measured by any method in the art, including, but not limited to, imaging one or more affected joints. Nonlimiting exemplary imaging techniques for detecting pannus formation include magnetic resonance imaging (MRI), computed

tomography (CT) scan, arthroscopy, ultrasonography, duplex ultrasonography, and power doppler imaging. In some embodiments, the progression of pannus formation is slowed following administration of the antibody and/or during a particular time interval during which the subject is undergoing treatment with the antibody. The treatment may be a single dose or multiple doses.

[0212] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces cartilage damage. Reducing cartilage damage, in some embodiments, comprises reducing chondrocyte loss, reducing collagen disruption, and/or reducing cartilage loss. Cartilage damage can be measured by any method in the art, including, but not limited to, imaging one or more affected joints. Nonlimiting exemplary imaging techniques for detecting cartilage damage include MRI, CT scan, arthroscopy, and x-ray imaging. In some embodiments, the progression of cartilage damage is slowed following administration of the antibody and/or during a particular time interval during which the subject is undergoing treatment with the antibody. The treatment may be a single dose or multiple doses.

[0213] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces bone resorption. Reducing bone resorption, in some embodiments, comprises reducing the number of osteoclasts in joints affected by rheumatoid arthritis.

[0214] In some embodiments, bone resorption may be measured by determining the level of TRAP5b in serum or plasma from the subject, wherein an elevated level of TRAP5b indicates elevated bone resorption in the subject. Thus, in some embodiments, a reduced level of TRAP5b indicates a reduction in bone resorption. TRAP5b levels may be determined, in certain instances, before and after treatment with an antibody that binds CSF1R, and/or may be determined periodically throughout the course of treatment to monitor the effectiveness of the treatment in reducing bone loss. TRAP5b levels may be determined using any method in the art, including, but not limited to, ELISA (including

FAICEA, or fragments absorbed immunocapture enzymatic assay; *see, e.g.*, Quidel® TRAP5b assay, TECOmedical Group, Sissach, Switzerland).

[0215] In some embodiments, bone resorption may be measured by determining the level of N-terminal telopeptide (NTx) in urine from the subject, wherein an elevated level of NTx indicates elevated bone resorption in the subject. Thus, in some embodiments, a reduced level of NTx indicates a reduction in bone resorption. NTx levels may be determined, in certain instances, before and after treatment with an antibody that binds CSF1R, and/or may be determined periodically throughout the course of treatment to monitor the effectiveness of the treatment in reducing bone loss. NTx levels may be determined using any method in the art, including, but not limited to, ELISA. Nonlimiting exemplary assays to determine NTx levels include Osteomark® NTx Urine ELISA (Alere Inc., Waltham, MA), and various assays provided by laboratories such as Quest Diagnostics, Mayo Medical Laboratories, etc.

[0216] In some embodiments, bone resorption may be measured by determining the level of C-terminal telopeptide (CTx) in serum from the subject, wherein an elevated level of CTx indicates elevated bone resorption in the subject. Thus, in some embodiments, a reduced level of CTx indicates a reduction in bone resorption. CTx levels may be determined, in certain instances, before and after treatment with an antibody that binds CSF1R, and/or may be determined periodically throughout the course of treatment to monitor the effectiveness of the treatment in reducing bone loss. CTx levels may be determined using any method in the art, including, but not limited to, ELISA. Nonlimiting exemplary assays to determine CTx levels include Serum CrossLaps® (CTx-1) ELISA (Immunodiagnostic Systems, Inc., Scottsdale, AZ), and various assays provided by laboratories such as Quest Diagnostics, Mayo Medical Laboratories, etc.

[0217] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces bone loss. Bone loss may be determined using any method in the art, including, but not limited to, x-ray imaging, MRI, CT, bone densitometry, single and dual photon absorptiometry (SPA, DPA), single and dual energy x-ray absorptiometry (SXA, DXA), ultrasonography, scintigraphy, and by measuring levels of serum markers of bone formation and resorption. Nonlimiting exemplary serum markers of bone formation and bone resorption are shown in Table 2.

Table 2: Serum markers of bone formation and resorption

Formation Markers	Resorption Markers
Serum osteocalcin (OC)	Serum and urinary hydroxyproline (Hyp)
Serum total alkaline phosphatase (ALP)	Urinary total pyridinoline (Pyr)
Serum bone specific alkaline phosphatase (BSAP, BALP, or B-ALP)	Urinary total deoxypyridinoline (dPyr)
Serum procollagen I carboxyterminal propeptide (PICP)	Urinary free pyridinoline (f-Pyr, also known as Pyrilinks® (Metra Biosystems))
Serum procollagen type 1 N-terminal propeptide (PINP)	Urinary free deoxypyridinoline (f-dPyr, also known as Pyrilinks-D®)
Bone sialoprotein	Serum and urinary collagen type I cross-linked N-telopeptide (NTx, also referred to as Osteomark)
	Serum and urinary collagen type I cross-linked C- terminal telopeptide (CTx, also referred to as CrossLaps®)
	Serum carboxyterminal telopeptide of type I collagen (ITCP)
	Tartrate-resistant acid phosphatase (TRAP or TRACP)

[0218] In some embodiments, the progression of bone loss is slowed following administration of the antibody and/or during a particular time interval during which the subject is undergoing treatment with the antibody. The treatment may be a single dose or multiple doses.

[0219] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, reduces autoantibody levels. The levels of autoantibodies may be determined by any method in the art. In some embodiments, autoantibody levels are determined by the level of rheumatoid factor (RF) and/or anti-citrullinated protein antibodies (ACPA) and/or anti-nuclear antibodies (ANA).

[0220] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, substantially reduces the number of monocyte lineage cells, such as macrophages and/or CD16+ monocytes, in joints (including synovial fluid) affected by the inflammatory arthritis.

[0221] In some embodiments, in addition to reducing the level of one or more factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9, administering to a subject with inflammatory arthritis an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, substantially reduces the number of CD16+ monocytes. In some embodiments, the subject has an autoimmune condition selected from rheumatoid arthritis and SLE (lupus). In some embodiments, following administration of an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, the number of CD16- monocytes is substantially unchanged. In some embodiments, CD16+ monocytes are reduced to a greater extent than CD16- monocytes are reduced when an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding is administered to the subject. In some embodiments, CD16+ monocytes are reduced by at least 20%, at least 30%, at least 50%, at least 60%, at least 70%, at least 80%, or at least 90%. In some embodiments, CD16- monocytes are reduced by less than 30%, less than 20%, or less than 10%. In some embodiments, the CD16+ monocytes are CD16+ peripheral blood monocytes. In some embodiments, the CD16- monocytes are CD16- peripheral blood monocytes.

[0222] In some embodiments, methods of treating a CD16+ disorder are provided, comprising administering to a subject with a CD16+ disorder an effective amount of an antibody that binds CSF1R and blocks CSF1 and IL-34 ligand binding, such as huAb1 to huAb16, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9. Nonlimiting exemplary CD16+ disorders include rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, a subject with a CD16+ disorder has an elevated level of CD16+ monocytes, compared to the level of CD16+ monocytes in a healthy individual or a pool of healthy individuals. In some embodiments, a subject with a CD16+ disorder has an elevated level of CD16+ monocytes, compared to the subject's CD16+ monocyte level prior to developing the CD16+ disorder (for example, in some embodiments, substantially prior to developing any symptoms of the CD16+ disorder such that the subject would, in retrospect, be considered "healthy" at the time).

[0223] In some embodiments, methods of identifying subjects who may benefit from an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and

blocks binding of IL-34 to CSF1R (such as huAb1 to huAb16) are provided. In some such embodiments, a method comprises determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject. In some embodiments, an elevated level of at least one of the factors in the subject indicates that the subject may benefit from the antibody that binds CSF1R. In some embodiments, the subject has a CD16+ disorder. In some embodiments, the subject has rheumatoid arthritis. In some embodiments, the subject has an elevated level of CD16+ monocytes.

[0224] In some embodiments, methods of predicting responsiveness in a subject suffering from an inflammatory condition to an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R (such as huAb1 to huAb16) are provided. In some such embodiments, a method comprises determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject. In some embodiments, an elevated level of at least one of the factors in the subject indicates that the subject is more likely to respond to the antibody that binds CSF1R. In some embodiments, the subject has a CD16+ disorder. In some embodiments, the subject has rheumatoid arthritis. In some embodiments, the subject has an elevated level of CD16+ monocytes.

[0225] Many patients have an inadequate response to methotrexate, alone or in combination with a TNF inhibitor. In some embodiments of the methods described herein, the subject has a condition that is resistant to methotrexate (e.g., the subject is methotrexate inadequate responder). A subject with a condition that is resistant to methotrexate, such as a subject who is a methotrexate inadequate responder, may have previously responded to methotrexate, but may have become resistant to methotrexate, or the subject may have never responded to methotrexate. Resistance to methotrexate means that aspects of the condition that would be expected to improve following a standard dose of methotrexate do not improve, and/or improvement only occurs if greater than a standard dose of methotrexate is administered. In some embodiments, a methotrexate inadequate responder has experienced, or is experiencing, an inadequate response to methotrexate after receiving a standard dose for at least two weeks, at least three weeks, at least four weeks, at least six weeks, or at least twelve weeks. A "standard" dose is determined by a medical professional, and may depend

on the subject's age, weight, healthy history, severity of disease, the frequency of dosing, etc.

[0226] In some embodiments of the methods described herein, the subject is a TNF inhibitor inadequate responder. A subject who is a TNF inhibitor inadequate responder, may have previously responded to a TNF inhibitor, but may have become less responsive to the TNF inhibitor, or the subject may have never responded to the TNF inhibitor. Inadequate response to a TNF inhibitor means that aspects of the condition that would be expected to improve following a standard dose of the TNF inhibitor do not improve, and/or improvement only occurs if greater than a standard dose is administered. In some embodiments, a TNF inhibitor inadequate responder has experienced, or is experiencing, an inadequate response to the TNF inhibitor after receiving a standard dose for at least two weeks, at least three weeks, at least four weeks, at least six weeks, or at least twelve weeks. A "standard" dose is determined by a medical professional, and may depend on the subject's age, weight, healthy history, severity of disease, the frequency of dosing, etc. In some embodiments, a TNF inhibitor inadequate responder has experienced, or is experiencing, an inadequate response to a TNF inhibitor selected from infliximab, adalimumab, certolizumab pegol, golimumab, and etanercept.

[0227] In some embodiments, methods of treating a methotrexate inadequate responder are provided. In some embodiments, a method comprises administering to the methotrexate inadequate responder an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, such as huAb1 to huAb16. In some embodiments, the inadequate responder has a CD16+ disorder. In some embodiments, the CD16+ disorder is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, the CD16+ disorder is rheumatoid arthritis. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody. In some embodiments, the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the inadequate responder is reduced following administration of the antibody. In some embodiments, the inadequate responder has an elevated level of CD16+ monocytes, for example, as compared to the level of CD16+

monocytes in a healthy individual or pool of healthy individuals. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody.

[0228] In some embodiments, methods of treating a TNF inhibitor inadequate responder are provided. In some embodiments, a method comprises administering to the TNF inhibitor inadequate responder an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, such as huAb1 to huAb16. In some embodiments, the inadequate responder has a CD16+ disorder. In some embodiments, the CD16+ disorder is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease. In some embodiments, the CD16+ disorder is rheumatoid arthritis. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody. In some embodiments, the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the inadequate responder is reduced following administration of the antibody. In some embodiments, the inadequate responder has an elevated level of CD16+ monocytes, for example, as compared to the level of CD16+ monocytes in a healthy individual or pool of healthy individuals. In some embodiments, the antibody substantially reduces the number of CD16+ monocytes. In some embodiments, the number of CD16- monocytes are substantially unchanged following administration of the antibody.

Routes of Administration and Carriers

[0229] In various embodiments, anti-CSF1R antibodies may be administered *in vivo* by various routes, including, but not limited to, oral, intra-arterial, parenteral, intranasal, intramuscular, intracardiac, intraventricular, intratracheal, buccal, rectal, intraperitoneal, intradermal, topical, transdermal, and intrathecal, or otherwise by implantation or inhalation. The subject compositions may be formulated into preparations in solid, semi-solid, liquid, or gaseous forms; including, but not limited to, tablets, capsules, powders, granules, ointments, solutions, suppositories, enemas, injections, inhalants, and aerosols. A nucleic acid molecule encoding an anti-CSF1R antibody may be coated onto gold microparticles and delivered

intradermally by a particle bombardment device, or "gene gun," as described in the literature (see, e.g., Tang et al., *Nature* 356:152-154 (1992)). The appropriate formulation and route of administration may be selected according to the intended application.

[0230] In various embodiments, compositions comprising anti-CSF1R antibodies are provided in formulations with a wide variety of pharmaceutically acceptable carriers (see, e.g., Gennaro, *Remington: The Science and Practice of Pharmacy with Facts and Comparisons: Drugfacts Plus*, 20th ed. (2003); Ansel et al., *Pharmaceutical Dosage Forms and Drug Delivery Systems,* 7th ed., Lippencott Williams and Wilkins (2004); Kibbe et al., *Handbook of Pharmaceutical Excipients,* 3rd ed., Pharmaceutical Press (2000)). Various pharmaceutically acceptable carriers, which include vehicles, adjuvants, and diluents, are available. Moreover, various pharmaceutically acceptable auxiliary substances, such as Ph adjusting and buffering agents, tonicity adjusting agents, stabilizers, wetting agents and the like, are also available. Non-limiting exemplary carriers include saline, buffered saline, dextrose, water, glycerol, ethanol, and combinations thereof.

[0231] In various embodiments, compositions comprising anti-CSF1R antibodies may be formulated for injection, including subcutaneous administration, by dissolving, suspending, or emulsifying them in an aqueous or nonaqueous solvent, such as vegetable or other oils, synthetic aliphatic acid glycerides, esters of higher aliphatic acids, or propylene glycol; and if desired, with conventional additives such as solubilizers, isotonic agents, suspending agents, emulsifying agents, stabilizers and preservatives. In various embodiments, the compositions may be formulated for inhalation, for example, using pressurized acceptable propellants such as dichlorodifluoromethane, propane, nitrogen, and the like. The compositions may also be formulated, in various embodiments, into sustained release microcapsules, such as with biodegradable or non-biodegradable polymers. A non-limiting exemplary biodegradable formulation includes poly lactic acid-glycolic acid polymer. A non-limiting exemplary non-biodegradable formulation includes a polyglycerin fatty acid ester. Certain methods of making such formulations are described, for example, in EP 1 125 584 A1.

[0232] Pharmaceutical packs and kits comprising one or more containers, each containing one or more doses of an anti-CSF1R antibody are also provided. In some embodiments, a unit dosage is provided wherein the unit dosage contains a predetermined amount of a composition comprising an anti-CSF1R antibody, with or without one or more additional agents. In some embodiments, such a unit dosage is supplied in single-use prefilled syringe for injection. In various embodiments, the composition contained in the

unit dosage may comprise saline, sucrose, or the like; a buffer, such as phosphate, or the like; and/or be formulated within a stable and effective Ph range. Alternatively, in some embodiments, the composition may be provided as a lyophilized powder that may be reconstituted upon addition of an appropriate liquid, for example, sterile water. In some embodiments, the composition comprises one or more substances that inhibit protein aggregation, including, but not limited to, sucrose and arginine. In some embodiments, a composition of the invention comprises heparin and/or a proteoglycan.

[0233] Pharmaceutical compositions are administered in an amount effective for treatment or prophylaxis of the specific indication. The therapeutically effective amount is typically dependent on the weight of the subject being treated, his or her physical or health condition, the extensiveness of the condition to be treated, or the age of the subject being treated. In general, anti-CSF1R antibodies may be administered in an amount in the range of about 10 μg/kg body weight to about 100 mg/kg body weight per dose. In some embodiments, anti-CSF1R antibodies may be administered in an amount in the range of about 50 μg/kg body weight to about 5 mg/kg body weight per dose. In some embodiments, anti-CSF1R antibodies may be administered in an amount in the range of about 100 μg/kg body weight to about 10 mg/kg body weight per dose. In some embodiments, anti-CSF1R antibodies may be administered in an amount in the range of about 100 μg/kg body weight to about 20 mg/kg body weight per dose. In some embodiments, anti-CSF1R antibodies may be administered in an amount in the range of about 0.5 mg/kg body weight to about 20 mg/kg body weight per dose. In some embodiments, anti-CSF1R antibodies may be administered at a dose of 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg body weight.

[0234] By appropriate dosing of an anti-CSF1R antibody (such as huAb1), effective treatment may be achieved while minimizing certain adverse events, including, but not limited to, elevation of creatine kinase (CK) and/or elevation of one or more hepatic transaminases, such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT), and/or elevation of total bilirubin. In some embodiments, a dose of an anti-CSF1R antibody (such as huAb1) is selected such that CK levels are less than 10x the upper limit of normal (ULN). In some embodiments, a dose of an anti-CSF1R antibody (such as huAb1) is selected such that AST and/or ALT levels are less than 8x the upper limit of normal (ULN). In some embodiments, a dose of an anti-CSF1R antibody (such as huAb1) is selected such that AST and/or ALT levels are less than 3x ULN and total bilirubin is less than 2x ULN. CK, bilirubin, AST, and/or ALT levels may be determined by any method in the art. Methods of determining CK, AST, ALT, and bilirubin levels, and for determining

the upper limit of normal, are known in the art. In some embodiments, a baseline level of CK, AST, ALT and/or bilirubin is determined for a subject prior to beginning treatment. In some embodiments, levels CK, AST, ALT and/or bilirubin are determined during treatment, *e.g.*, to detect possible hepatic toxicity.

[0235] Methods of determining CK, AST, ALT and bilirubin levels are known in the art. In some embodiments, levels AST and ALT are determined using a coupled enzyme reaction and measuring the decrease of NADH. In some embodiments, CK level is determined using a coupled enzyme reaction and measuring formation of NADH. In some embodiments, bilirubin level is determined by reacting bilirubin in a sample with diazotized sulfanilic acid and photometrically measuring azobilirubin. Assays to determine CK, AST, ALT and bilirubin levels are available from (and/or run by) many laboratories, such as Quest Diagnostics, Mayo Medical Laboratories, etc. In some embodiments, the baseline level and the treatment level of CK, AST, ALT and/or bilirubin are determined by the same laboratory. Typically, each laboratory that assays CK, AST, ALT and/or bilirubin levels has determined a normal range and ULN for CK, AST, ALT and/or bilirubin assays in that laboratory. In various embodiments, CK, AST, ALT and/or bilirubin levels are determined in serum, plasma, or whole blood. In some embodiments, CK, AST, ALT and/or bilirubin levels are determined in serum or plasma. Information concerning drug-induced liver injury may be found, *e.g.*, in "Guidance for Industry: Drug-Induced Liver Injury: Permarketing Climical Evaluation," U.S. Department of Health and Human Sevices, Food and Drug Administration, Center for Drug Evaluation and Research (CDER), and Center for Biologics Evaluation and Research (CBER), July 2009. *See also* Watkins et al., 2011, *Drug Saf.* 34(3): 243-252.

[0236] The anti-CSF1R antibody compositions may be administered as needed to subjects. Determination of the frequency of administration may be made by persons skilled in the art, such as an attending physician based on considerations of the condition being treated, age of the subject being treated, severity of the condition being treated, general state of health of the subject being treated and the like. In some embodiments, an effective dose of an anti-CSF1R antibody is administered to a subject one or more times. In various embodiments, an effective dose of an anti-CSF1R antibody is administered to the subject once a month, less than once a month, such as, for example, every two months or every three months. In other embodiments, an effective dose of an anti-CSF1R antibody is administered more than once a month, such as, for example, every three weeks, every two weeks or every week. An effective dose of an anti-CSF1R antibody is administered to the

subject at least once. In some embodiments, the effective dose of an anti-CSF1R antibody may be administered multiple times, including for periods of at least a month, at least six months, or at least a year.

Combination Therapy

[0237] Anti-CSF1R antibodies may be administered alone or with other modes of treatment. They may be provided before, substantially contemporaneous with, or after other modes of treatment, for example, surgery, chemotherapy, radiation therapy, or the administration of a biologic, such as another therapeutic antibody. For treatment of inflammatory arthritis (including rheumatoid arthritis, juvenile idiopathic arthritis, ankylosing spondylitis, etc.), anti-CSF1R antibodies may be administered with other therapeutic agents, for example, methotrexate, anti-TNF agents, including anti-TNF antibodies such as Remicade® (infliximab), Humira® (adalimumab), Simponi® (golimumab), and certolizumab pegol, and soluble TNF receptors, such as Enbrel® (etanercept); glucocorticoids such as prednisone; leflunomide; azathioprine; JAK inhibitors such as CP 590690; SYK inhibitors such as R788; anti-IL-6 agents, including anti-IL-6 antibodies such as elsilimomab, siltuximab, and sirukumab, and anti-IL-6R antibodies such as Actermra® (tocilizumab); anti-CD-20 agents, including anti-CD20 antibodies such as Rituxin® (rituximab), ibritumomab tiuxetan, ofatumumab, ocrelizumab, veltuzumab, and tositumomab; anti-CD19 agents, such as anti-CD19 antibodies; anti-GM-CSF agents, such as anti-GM-CSF antibodies and anti-GM-CSFR antibodies; anti-IL-1 agents, such as IL-1 receptor antagonists, including anakinra; CTLA-4 agonists, such as CTLA4-Ig fusions, including abatacept and belatacept; immunosuppressants such as cyclosporine.

[0238] For treatment of systemic lupus erythematosus, anti-CSF1R antibodies may be administered with other therapeutic agents, for example, hydroxychloroquine (Plaquenil®); corticosteroids, such as prednisone, methylprednisone, and prednisolone; immunosuppressants, such as cyclophosphamide (Cytoxan®), azathioprine (Imuran®, Azasan®), mycophenolate (Cellcept®), leflunomide (Arava®), methotrexate (Trexall™), and belimumab (Benlysta®).

[0239] For treatment of multiple sclerosis, anti-CSF1R antibodies may be administered with other therapeutic agents, for example, interferon alpha; interferon beta; prednisone; anti-alpha4 integrin antibodies such as Tysabri®; anti-CD20 antibodies such as Rituxan®; FTY720 (fingolimod; Gilenya®); and cladribine (Leustatin®).

EXAMPLES

[0240] The examples discussed below are intended to be purely exemplary of the invention and should not be considered to limit the invention in any way. The examples are not intended to represent that the experiments below are all or the only experiments performed. Efforts have been made to ensure accuracy with respect to numbers used (for example, amounts, temperature, etc.) but some experimental errors and deviations should be accounted for. Unless indicated otherwise, parts are parts by weight, molecular weight is weight average molecular weight, temperature is in degrees Centigrade, and pressure is at or near atmospheric.

Example 1: Humanized anti-CSF1R antibodies

[0241] Various humanized anti-CSF1R antibodies were developed previously. *See, e.g.*, PCT Publication No. WO 2011/140249.

[0242] The sequences for each of the humanized heavy chain variable regions and humanized light chain variable regions, aligned with the sequences of the parental chimeric antibody variable regions and the sequences of the human acceptor variable framework regions are shown in Figures 1 (heavy chains) and 2 (light chains). The changes in humanized variable region sequences relative to the human acceptor variable framework region sequences are boxed. Each of the CDRs for each of the variable regions is shown in a boxed region, and labeled as "CDR" above the boxed sequences.

[0243] Table 9, below, shows the full sequences for the humanized heavy chains and humanized light chains of antibodies huAb1 to huAb16. The name and SEQ ID Nos of the humanized heavy chain and humanized light chain of each of those antibodies is shown in Table 3.

Table 3: Humanized heavy chains and light chains of huAb1 to huAb16

Humanized antibody	Humanized HC	SEQ ID NO	Humanized LC	SEQ ID NO
huAb1	h0301-H0	53	h0301-L0	60
huAb2	h0301-H1	54	h0301-L0	60
huAb3	h0301-H2	55	h0301-L0	60
huAb4	h0301-H0	53	h0301-L1	61
huAb5	h0301-H1	54	h0301-L1	61
huAb6	h0301-H2	55	h0301-L1	61
huAb7	h0302-H1	56	h0302-L0	62

huAb8	h0302-H1	56	h0302-L1	63
huAb9	h0302-H1	56	h0302-L2	64
huAb10	h0302-H2	57	h0302-L0	62
huAb11	h0302-H2	57	h0302-L1	63
huAb12	h0302-H2	57	h0302-L2	64
huAb13	h0311-H1	58	h0311-L0	65
huAb14	h0311-H1	58	h0311-L1	66
huAb15	h0311-H2	59	h0311-L0	65
huAb16	h0311-H2	59	h0311-L1	66

[0244] The 16 humanized antibodies were tested for binding to human, cynomolgus monkey, and mouse CSF1R ECD, as described previously. *See, e.g.*, PCT Publication No. WO 2011/140249. The antibodies were found to bind to both human and cynomolgus monkey CSF1R ECD, but not to mouse CSF1R ECD. The humanized antibodies were also found to block binding of CSF1 and IL-34 to both human and mouse CSF1R and to inhibit CSF1-induced and IL-34-induced phosphorylation of human CSF1R expressed in CHO cells. *See, e.g.*, PCT Publication No. WO 2011/140249.

[0245] The k_a, k_d, and K_D for binding to human CSF1R ECD were previously determined and are shown in Table 4. *See, e.g.*, PCT Publication No. WO 2011/140249.

Table 4: Humanized antibody binding affinity for human CSF1R

huAb	**k_a ($M^{-1}s^{-1}$)**	**K_d (s^{-1})**	**K_D (Nm)**
huAb 0301-L0H0	3.22 x 10^6	1.11 x 10^{-03}	0.35
huAb 0301-L0H1	3.56 x 10^6	1.22 x 10^{-03}	0.34
huAb 0301-L0H2	2.32 x 10^6	6.60 x 10^{-04}	0.28
huAb 0301-L1H0	3.29 x 10^6	1.15 x 10^{-03}	0.35
huAb 0301-L1H1	2.87 x 10^6	9.21 x 10^{-04}	0.32
huAb 0301-L1H2	2.95 x 10^6	7.42 x 10^{-04}	0.25
huAb 0302-L0H1	3.54 x 10^6	3.69 x 10^{-03}	1.04
huAb 0302-L1H1	3.47 x 10^6	4.04 x 10^{-03}	1.17
huAb 0302-L2H1	1.60 x 10^6	9.14 x 10^{-04}	0.57
huAb 0302-L0H2	3.40 x 10^6	1.79 x 10^{-03}	0.53
huAb 0302-L1H2	2.71 x 10^6	1.53 x 10^{-03}	0.56
huAb 0302-L2H2	1.84 x 10^6	8.40 x 10^{-04}	0.46
huAb 0311-L0H1	1.22 x 10^6	5.40 x 10^{-04}	0.44

huAb 0311-L1H1	1.32 x 10^6	6.64 x 10^{-04}	0.50
huAb 0311-L0H2	1.34 x 10^6	4.73 x 10^{-04}	0.35
huAb 0311-L1H2	1.51 x 10^6	6.09 x 10^{-04}	0.40

Example 2: HuAb1 alters cytokine and certain matrix metalloproteinase production in synovial biopsy explants

[0246] Synovial tissue samples were obtained from the joints of rheumatoid arthritis patients. Patients had clinically active disease and tissue was obtained from clinically active joints. All patients provided written informed consent and these studies were approved by the Medical Ethics Committee of the Academic Medical Center (AMC) at the University of Amsterdam. The clinical characteristics of the six patients from whom biopsy samples were taken are shown in Table 5.

Table 5: Clinical features of patients with RA (n = 6)

Biopsy	Age (y)	Sex	Disease duration (y)	ESR (mm/h)	CRP (mg/l)	DAS28	RF	ACCP
1	56	M	10	12	3.4	3.64	positive	negative
2	42	F	21		1	2.59	positive	positive
3	68	F	23	10	2	4.01	positive	positive
4	78	F	10	44	51.1	4.32	positive	positive
5	61	M	18				positive	positive
6	71	F	25	14	3.3	4.21	negative	negative

ACCP, anti-cyclic citrullinated peptide; CRP, C-reactive peptide; DAS28, 28-joint disease activity score; ESR, erythrocyte sedimentation rate; RF, rheumatoid factor.

[0247] Synovial biopsy samples with a volume of approximately 5 mm^3 were cultured in triplicate in complete medium comprising DMEM (Life Technologies, Grand Island, NY) with 2 Mm L-glutamine, 100 U/ml penicillin, 50 mg/ml gentamicin, 20 Mm HEPES buffer, and 10% FCS. Cultures were performed at 37°C in a 5% CO_2/95% air-humidified environment. Synovial samples were cultured for 4 days in the absence or presence of increasing concentrations of huAb1 or control IgG4 antibody ET904 (Eureka Therapeutics, Emeryville, CA). Cell-free supernatants were collected and stored at -80°C in two separate aliquots. One aliquot was evaluated for production of IL-6 by ELISA. The other aliquot was evaluated for multiplex analysis of cytokine and matrix metalloproteinase production using Luminex® technology (Millipore, Billerica, MA). The three tissue fragments in each culture condition were pooled, snap-frozen and preserved for Mrna expression analysis. Some biopsies showed cytokine and/or metalloproteinase levels below the limit of detection, however such data was still included in the tables and figures discussed below.

[0248] The results of the IL-6 production analysis by ELISA are shown in Table 6.

Table 6: Effect of huAb1 treatment on intact synovial biopsy IL-6 production (ELISA)

	IL-6 Levels (pg/ml) per mg of Tissue						
Biopsy	Medium	0.1 µg/ml IgG4	1 µg/ml IgG4	10 µg/ml IgG4	0.1 µg/ml HuAb1	1 µg/ml HuAb1	10 µg/ml HuAb1
1	1.26	51.92	99.27	21.43	60.74	36.06	17.05
2	151.05	151.21	127.24	7.81	31.50	13.19	4.62
3	77.76	428.04	292.85	116.80	180.45	13.24	30.58
4	1.77	10.62	90.36	291.33	6.75	7.64	30.03
5	323.00	385.10	1285.00	470.90	528.50	1243.00	352.40
6	176.90	111.40	99.02	62.54	33.46	38.59	41.92
Mean	121.96	189.72	332.29	161.80	140.23	225.29	79.43
SEM	50.08	71.57	193.1	74.75	81.59	203.6	54.84

[0249] IL-6 production was reduced in all samples after culturing for 4 days in the presence of 1 µg/ml or 10 µg/ml huAb1, as compared to incubation in the same concentration of control antibody. IL-6 production was reduced in four of the six samples after culturing for 4 days in the presence of 0.1 µg/ml huAb1, as compared to incubation in 0.1 µg/ml of control antibody. Figure 3 shows a plot of the reduction in IL-6 production in the four samples after culturing for 4 days in the presence of 1 µg/ml control antibody or 1 µg/ml huAb1. The mean decrease in IL-6 production was statistically significant at both 1 µg/ml and 10 µg/ml huAb1 ($p=0.0313$ at each dose).

[0250] Figure 4 shows the results of the multiplex analysis after culturing four of the synovial biopsy explants in 1 µg/ml huAb1 or control antibody for 4 days. Levels of IL-6, IL-1β, IL-8, CCL2 (also referred to as MCP-1), CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, and MMP-9 were reduced in all four samples after incubation with 1 µg/ml huAb1, relative to incubation with 1 µg/ml control antibody. Levels of MMP-7 were reduced in the two samples with measurable levels of MMP-7 in the control antibody-treated groups.

[0251] Table 7 below shows the results of the multiplex analysis for the four synovial biopsy explants shown in Figure 4. In Table 7, the average cytokine level in the four explants is shown after incubation in medium alone, 0.1 µg/ml, 1 µg/ml, or 10 µg/ml IgG4 control, or 0.1 µg/ml, 1 µg/ml, or 10 µg/ml huAb1.

[0252] Multiplex analysis of IL-8, CCL2 (also referred to as MCP-1), CCL7 (also referred to as MCP3), CXCL5, CXCL6, CXCL9 (also referred to as MIG), CXCL10 (also referred to as IP-10), TNF-α, MMP-2, MMP-7, and MMP-9 levels after culturing two additional synovial biopsy explants in the presence of medium alone, 0.1 µg/ml, 1 µg/ml, or 10 µg/ml IgG4 control, or 0.1 µg/ml, 1 µg/ml, or 10 µg/ml huAb1 was performed

substantially as described above. In addition, multiplex analysis of CXCL7, CXCL11, and CXCL12 levels after culturing all six synovial biopsy explants in the presence of medium alone, 0.1 μg/ml, 1 μg/ml, or 10 μg/ml IgG4 control, or 0.1 μg/ml, 1 μg/ml, or 10 μg/ml huAb1 was performed substantially as described above. Table 8 below shows the results of the multiplex analysis for all six synovial biopsy explants tested. Figure 5 shows the results of the multiplex analysis for (A) CXCL7, (B) CXCL11, and (C) CXCL12 after culturing four of the synovial biopsy explants in 1 μg/ml huAb1 or control antibody for 4 days.

Table 7: Effect of huAb1 treatment on intact synovial biopsy cytokine production (n=4)

Cytokine	Analyte (pg/ml) per mg of Tissue: Mean (SEM), n = 4						
	Medium	0.1 μg/ml IgG4	1 μg/ml IgG4	10 μg/ml IgG4	0.1 μg/ml huAb1	1 μg/ml huAb1	10 μg/ml huAb1
IL-1b	0.017 (0.009)	0.013 (0.011)	0.012 (0.007)	0.006 (0.005)	0.002 (0.001)	0.002 (0.001)	0.01 (0.009)
IL-6	240.680 (146.459)	178.805 (111.722)	275.159 (107.706)	95.311 (46.076)	45.728 (18.001)	52.086 (38.818)	35.980 (9.206)
IL-8	2237.972 (1594.031)	831.625 (431.551)	1375.193 (311.382)	610.201 (353.051)	244.370 (62.781)	180.821 (87.654)	298.966 (188.495)
CCL2/MPC1	1051.721 (646.236)	547.190 (241.904)	1045.432 (218.350)	435.346 (256.548)	178.260 (42.634)	164.516 (128.962)	209.883 (103.918)
CCL7/MCP3	8.883 (4.843)	6.427 (2.200)	12.160 (4.515)	5.682 (4.518)	2.773 (2.054)	1.598 (0.852)	3.514 (2.864)
CXCL5	80.589 (46.550)	30.389 (13.460)	70.981 (13.990)	67.473 (55.635)	11.212 (2.086)	10.875 (5.341)	33.917 (26.600)
CXCL6	17.730 (11.385)	8.191 (4.189)	10.017 (3.417)	4.083 (1.310)	3.779 (1.273)	1.588 (0.893)	1.105 (0.225)
CXCL9/MIG	65.274 (39.238)	65.798 (27.685)	95.255 (20.943)	34.273 (19.210)	34.781 (6.520)	21.748 (14.365)	24.291 (8.065)
CXCL10/IP-10	55.609 (29.571)	40.343 (21.332)	48.644 (12.545)	15.895 (11.744)	14.615 (5.766)	12.951 (7.450)	16.019 (8.897)
MMP2	532.546 (298.570)	407.589 (177.550)	588.994 (218.276)	438.448 (252.070)	419.529 (136.061)	276.579 (141.318)	210.636 (77.979)
MMP7	9.931 (9.572)	1.786 (1.298)	2.946 (1.706)	5.588 (3.566)	0.518 (0.518)	0.273 (0.273)	24.226 (23.603)
MMP9	92.909 (46.738)	191.612 (158.806)	290.114 (209.547)	135.964 (98.550)	119.953 (88.836)	98.286 (81.116)	148.330 (109.991)
TNF-α	0.215 (0.1411)	0.104 (0.045)	0.256 (0.111)	0.074 (0.066)	0.033 (0.018)	0.016 (0.009)	0.018 (0.015)

Table 8: Effect of huAb1 treatment on intact synovial biopsy cytokine production (n=6)

Cytokine	Analyte (pg/ml) per mg of Tissue: Mean (SEM), n = 6						
	Medium	0.1 μg/ml IgG4	1 μg/ml IgG4	10 μg/ml IgG4	0.1 μg/ml huAb1	1 μg/ml huAb1	10 μg/ml huAb1
IL-8	1670.9	818.3	1262.9	683.9	412.0	597.1	585.9

	(1077.0)	(328.9)	(325.0)	(308.6)	(216.5)	(445.7)	(331.6)
CCL2/MCP1	1224.4 (433.2)	910.1 (322.0)	1144.8 (250.5)	821.9 (338.0)	408.5 (246.7)	507.0 (356.2)	590.0 (331.7)
CCL7/MCP3	8.3 (3.5)	7.8 (3.0)	12.7 (4.5)	7.0 (3.8)	4.5 (2.6)	4.9 (3.6)	4.9 (2.6)
CXCL5	55.5 (33.4)	26.0 (9.6)	59.5 (14.1)	51.3 (36.8)	15.2 (5.6)	22.3 (13.1)	36.7 (18.0)
CXCL6	13.7 (7.8)	6.6 (3.0)	9.3 (3.0)	5.4 (2.4)	3.6 (1.2)	5.5 (4.3)	4.2 (3.2)
CXCL7	47.4 (39.1)	57.5 (28.8)	70.2 (34.2)	58.6 (27.7)	55.1 (27.2)	72.5 (37.5)	64.8 (28.2)
CXCL9/MIG	177.4 (84.0)	205.7 (109.4)	139.5 (31.4)	96.8 (48.1)	137.8 (85.5)	60.1 (29.7)	90.9 (44.2)
CXCL10/IP-10	77.4 (26.6)	39.2 (15.3)	47.7 (8.0)	27.9 (12.7)	38.5 (23.7)	19.4 (9.3)	22.3 (8.1)
CXCL11	0.159 (0.077)	0.068 (0.018)	0.086 (0.023)	0.048 (0.020)	0.080 (0.028)	0.065 (0.030)	0.069 (0.021)
CXCL12	4.6 (2.4)	3.7 (1.8)	2.9 (1.6)	5.0 (2.3)	2.7 (1.3)	3.0 (1.9)	6.2 (4.6)
TNF-α	0.158 (0.097)	0.091 (0.034)	0.207 (0.082)	0.105 (0.063)	0.065 (0.041)	0.071 (0.059)	0.040 (0.028)
MMP2	736.3 (232.6)	666.3 (226.4)	893.3 (289.1)	844.3 (306.0)	765.7 (254.8)	600.4 (243.2)	610.1 (350.9)
MMP7	9.3 (6.4)	4.0 (2.7)	7.4 (5.2)	6.1 (2.9)	3.8 (3.4)	2.5 (2.3)	22.6 (15.8)
MMP9	82.0 (31.5)	160.2 (103.6)	220.3 (140.1)	113.8 (65.1)	96.5 (58.9)	83.0 (52.8)	143.4 (69.7)

Example 3: Anti-CSF1R Antibody treatment reduces tissue macrophage numbers in joints in mouse models of rheumatoid arthritis

[0253] Male DBA/1 mice were injected intradermally at the base of the tail on day 0 and day 21 with 150 µl of bovine type II collagen (2 mg/ml) emulsified in Freund's Complete Adjuvant. For prophylactic dosing, mice were dosed starting on day 0 with vehicle, anti-CSF1R antibody (a chimeric rat anti-mouse CSF1R monoclonal antibody containing a mouse IgG1 Fc region) at 30 mg/kg, or Enbrel® at 10 mg/kg. Treatment continued 3 times weekly through day 32. For therapeutic dosing, mice were randomized into treatment groups once swelling was established in at least one paw. Group mean paw swelling scores were 0.5-1 (out of a possible maximal score of 5) at the time of enrollment. Mice were dosed 3 times a week with vehicle, anti-CSF1R antibody at 30 mg/kg, or with Enbrel® at 10 mg/kg. Mice were terminated on arthritis day 23.

[0254] For both the prophylactic and the therapeutic models, 4 animals from each dose group were selected as representative animals based on arthritis scores comparable to the median score sum within the group. At termination, paws and knees were collected into formalin, paraffin embedded, sectioned, and stained for F4/80, to identify tissue macrophage. F4/80 cells were counted in the entire peri-articular soft tissue and dermis of each paw or knee section present. F4/80-positive cells in the bone marrow were not counted. Total counts were then normalized to counts per five 200x fields. This was done to account for the multifocal nature of the F4/80-positive cellular infiltrate. The tissues were generally of similar sizes with small variations accounted for in the conversion. Statistical significance was determined by one-way ANOVA followed with a Tukey's post test comparing each group to each other.

[0255] The results of the prophylactic anti-CSF1R antibody treatment are shown in Figure 6. Prophylactic treatment of mice with collagen-induced arthritis with anti-CSF1R antibody resulted in a significant decrease in the number of macrophages in front paws (A) and knees (B), and in both cases the reduction was greater than the reduction following treatment with Enbrel® (*** = $p \leq 0.001$; * = $p \leq 0.05$; ns = not significant).

[0256] The results of the therapeutic anti-CSF1R antibody treatment are shown in Figure 7. Therapeutic treatment of mice with collagen-induced arthritis with anti-CSF1R antibody resulted in a significant decrease in the number of macrophages in front paws (A) and knees (B), and in both cases the reduction was greater than the reduction following treatment with Enbrel® (*** = $p \leq 0.001$; ** = $p \leq 0.01$; ns = not significant).

TABLE OF SEQUENCES

[0257] Table 9 provides certain sequences discussed herein. All polypeptide and antibody sequences are shown without leader sequences, unless otherwise indicated.

Table 9: Sequences and Descriptions

SEQ ID NO	Description	Sequence
1	hCSF1R (full-length, no leader sequence)	IPVIEPSVPE LVVKPGATVT LRCVGNGSVE WDGPPSPHWT LYSDGSSSIL STNNATFQNT GTYRCTEPGD PLGGSAAIHL YVKDPARPWN VLAQEVVVFE DQDALLPCLL TDPVLEAGVS LVRVRGRPLM RHTNYSFSPW HGFTIHRAKF IQSQDYQCSA LMGGRKVMSI SIRLKVQKVI PGPPALTLVP AELVRIRGEA AQIVCSASSV DVNFDVFLQH NNTKLAIPQQ SDFHNNRYQK VLTLNLDQVD FQHAGNYSCV ASNVQGKHST SMFFRVVESA YLNLSSEQNL IQEVTVGEGL NLKVMVEAYP GLQGFNWTYL GPFSDHQPEP KLANATTKDT YRHTFTLSLP RLKPSEAGRY SFLARNPGGW RALTFELTLR YPPEVSVIWT FINGSGTLLC AASGYPQPNV TWLQCSGHTD RCDEAQVLQV WDDPYPEVLS QEPFHKVTVQ SLLTVETLEH NQTYECRAHN SVGSGSWAFI PISAGAHTHP PDEFLFTPVV VACMSIMALL LLLLLLLLYK YKQKPKYQVR WKIIESYEGN SYTFIDPTQL PYNEKWEFPR NNLQFGKTLG AGAFGKVVEA TAFGLGKEDA VLKVAVKMLK STAHADEKEA LMSELKIMSH LGQHENIVNL LGACTHGGPV LVITEYCCYG DLLNFLRRKA EAMLGPSLSP GQDPEGGVDY KNIHLEKKYV RRDSGFSSQG VDTYVEMRPV STSSNDSFSE QDLDKEDGRP LELRDLLHFS SQVAQGMAFL ASKNCIHRDV AARNVLLTNG HVAKIGDFGL ARDIMNDSNY IVKGNARLPV KWMAPESIFD CVYTVQSDVW SYGILLWEIF SLGLNPYPGI LVNSKFYKLV KDGYQMAQPA FAPKNIYSIM QACWALEPTH RPTFQQICSF LQEQAQEDRR ERDYTNLPSS SRSGGSGSSS SELEEESSSE HLTCCEQGDI AQPLLQPNNY QFC
2	hCSF1R (full-length, + leader sequence)	MGPGVLLLLL VATAWHGQGI PVIEPSVPEL VVKPGATVTL RCVGNGSVEW DGPPSPHWTL YSDGSSSILS TNNATFQNTG TYRCTEPGDP LGGSAAIHLY VKDPARPWNV LAQEVVVFED QDALLPCLLT DPVLEAGVSL VRVRGRPLMR HTNYSFSPWH GFTIHRAKFI QSQDYQCSAL MGGRKVMSIS IRLKVQKVIP GPPALTLVPA ELVRIRGEAA QIVCSASSVD VNFDVFLQHN NTKLAIPQQS DFHNNRYQKV LTLNLDQVDF QHAGNYSCVA SNVQGKHSTS MFFRVVESAY LNLSSEQNLI QEVTVGEGLN LKVMVEAYPG LQGFNWTYLG PFSDHQPEPK LANATTKDTY RHTFTLSLPR LKPSEAGRYS FLARNPGGWR ALTFELTLRY PPEVSVIWTF INGSGTLLCA ASGYPQPNVT WLQCSGHTDR CDEAQVLQVW DDPYPEVLSQ EPFHKVTVQS LLTVETLEHN QTYECRAHNS VGSGSWAFIP ISAGAHTHPP DEFLFTPVVV ACMSIMALLL LLLLLLLYKY KQKPKYQVRW KIIESYEGNS YTFIDPTQLP YNEKWEFPRN NLQFGKTLGA GAFGKVVEAT AFGLGKEDAV LKVAVKMLKS TAHADEKEAL MSELKIMSHL GQHENIVNLL GACTHGGPVL VITEYCCYGD LLNFLRRKAE AMLGPSLSPG QDPEGGVDYK NIHLEKKYVR RDSGFSSQGV DTYVEMRPVS TSSNDSFSEQ DLDKEDGRPL ELRDLLHFSS QVAQGMAFLA SKNCIHRDVA ARNVLLTNGH VAKIGDFGLA RDIMNDSNYI VKGNARLPVK WMAPESIFDC VYTVQSDVWS YGILLWEIFS LGLNPYPGIL VNSKFYKLVK DGYQMAQPAF APKNIYSIMQ ACWALEPTHR PTFQQICSFL QEQAQEDRRE RDYTNLPSSS RSGGSGSSSS ELEEESSSEH LTCCEQGDIA QPLLQPNNYQ FC
5	hCSF1R ECD.506	IPVIEPSVPE LVVKPGATVT LRCVGNGSVE WDGPPSPHWT LYSDGSSSIL STNNATFQNT GTYRCTEPGD PLGGSAAIHL YVKDPARPWN VLAQEVVVFE DQDALLPCLL TDPVLEAGVS LVRVRGRPLM RHTNYSFSPW HGFTIHRAKF IQSQDYQCSA LMGGRKVMSI SIRLKVQKVI PGPPALTLVP AELVRIRGEA AQIVCSASSV DVNFDVFLQH NNTKLAIPQQ SDFHNNRYQK VLTLNLDQVD FQHAGNYSCV ASNVQGKHST SMFFRVVESA YLNLSSEQNL IQEVTVGEGL NLKVMVEAYP GLQGFNWTYL GPFSDHQPEP KLANATTKDT YRHTFTLSLP RLKPSEAGRY SFLARNPGGW RALTFELTLR YPPEVSVIWT FINGSGTLLC AASGYPQPNV TWLQCSGHTD RCDEAQVLQV WDDPYPEVLS QEPFHKVTVQ

		SLLTVETLEH NQTYECRAHN SVGSGSWAFI PISAGAH
6	hCSF1R ECD.506-Fc	IPVIEPSVPE LVVKPGATVT LRCVGNGSVE WDGPPSPHWT LYSDGSSSIL STNNATFQNT GTYRCTEPGD PLGGSAAIHL YVKDPARPWN VLAQEVVVFE DQDALLPCLL TDPVLEAGVS LVRVRGRPLM RHTNYSFSPW HGFTIHRAKF IQSQDYQCSA LMGGRKVMSI SIRLKVQKVI PGPPALTLVP AELVRIRGEA AQIVCSASSV DVNFDVFLQH NNTKLAIPQQ SDFHNNRYQK VLTLNLDQVD FQHAGNYSCV ASNVQGKHST SMFFRVVESA YLNLSSEQNL IQEVTVGEGL NLKVMVEAYP GLQGFNWTYL GPFSDHQPEP KLANATTKDT YRHTFTLSLP RLKPSEAGRY SFLARNPGGW RALTFELTLR YPPEVSVIWT FINGSGTLLC AASGYPQPNV TWLQCSGHTD RCDEAQVLQV WDDPYPEVLS QEPFHKVTVQ SLLTVETLEH NQTYECRAHN SVGSGSWAFI PISAGAHEPK SSDKTHTCPP CPAPELLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSH EDPEVKFNWY VDGVEVHNAK TKPREEQYNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKAL PAPIEKTISK AKGQPREPQV YTLPPSRDEL TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS KLTVDKSRWQ QGNVFSCSVM HEALHNHYTQ KSLSLSPGK
7	cynoCSF1R ECD (with leader sequence)	MGPGVLLLLL VVTAWHGQGI PVIEPSGPEL VVKPGETVTL RCVGNGSVEW DGPISPHWTL YSDGPSSVLT TTNATFQNTR TYRCTEPGDP LGGSAAIHLY VKDPARPWNV LAKEVVVFED QDALLPCLLT DPVLEAGVSL VRLRGRPLLR HTNYSFSPWH GFTIHRAKFI QGQDYQCSAL MGSRKVMSIS IRLKVQKVIP GPPALTLVPA ELVRIRGEAA QIVCSASNID VDFDVFLQHN TTKLAIPQRS DFHDNRYQKV LTLSLGQVDF QHAGNYSCVA SNVQGKHSTS MFFRVVESAY LDLSSEQNLI QEVTVGEGLN LKVMVEAYPG LQGFNWTYLG PFSDHQPEPK LANATTKDTY RHTFTLSLPR LKPSEAGRYS FLARNPGGWR ALTFELTLRY PPEVSVIWTS INGSGTLLCA ASGYPQPNVT WLQCAGHTDR CDEAQVLQVW VDPHPEVLSQ EPFQKVTVQS LLTAETLEHN QTYECRAHNS VGSGSWAFIP ISAGAR
8	cynoCSF1R ECD-Fc (with leader sequence)	MGPGVLLLLL VVTAWHGQGI PVIEPSGPEL VVKPGETVTL RCVGNGSVEW DGPISPHWTL YSDGPSSVLT TTNATFQNTR TYRCTEPGDP LGGSAAIHLY VKDPARPWNV LAKEVVVFED QDALLPCLLT DPVLEAGVSL VRLRGRPLLR HTNYSFSPWH GFTIHRAKFI QGQDYQCSAL MGSRKVMSIS IRLKVQKVIP GPPALTLVPA ELVRIRGEAA QIVCSASNID VDFDVFLQHN TTKLAIPQRS DFHDNRYQKV LTLSLGQVDF QHAGNYSCVA SNVQGKHSTS MFFRVVESAY LDLSSEQNLI QEVTVGEGLN LKVMVEAYPG LQGFNWTYLG PFSDHQPEPK LANATTKDTY RHTFTLSLPR LKPSEAGRYS FLARNPGGWR ALTFELTLRY PPEVSVIWTS INGSGTLLCA ASGYPQPNVT WLQCAGHTDR CDEAQVLQVW VDPHPEVLSQ EPFQKVTVQS LLTAETLEHN QTYECRAHNS VGSGSWAFIP ISAGARGSEP KSSDKTHTCP PCPAPELLGG PSVFLFPPKP KDTLMISRTP EVTCVVVDVS HEDPEVKFNW YVDGVEVHNA KTKPREEQYN STYRVVSVLT VLHQDWLNGK EYKCKVSNKA LPAPIEKTIS KAKGQPREPQ VYTLPPSRDE LTKNQVSLTC LVKGFYPSDI AVEWESNGQP ENNYKTTPPV LDSDGSFFLY SKLTVDKSRW QQGNVFSCSV MHEALHNHYT QKSLSLSPGK
3	Light chain leader sequence	METDTLLLWV LLLWVPGSTG
4	Heavy chain leader sequence	MAVLGLLLCL VTFPSCVLS
9	Fab 0301 heavy chain variable region	EVQLQQSGPE LVRPGASVKM SCKASGYTFT DNYMIWVKQS HGKSLEWIGD INPYNGGTTF NQKFKGKATL TVEKSSSTAY MQLNSLTSED SAVYYCARES PYFSNLYVMD YWGQGTSVTV SS
10	Fab 0301 light chain variable	NIVLTQSPAS LAVSLGQRAT ISCKASQSVD YDGDNYMNWY QQKPGQPPKL LIYAASNLES GIPARFSGSG SGTDFTLNIH PVEEEDAATY YCHLSNEDLS

	region	TFGGGTKLEI K
11	Fab 0302 heavy chain variable region	EIQLQQSGPE LVKPGASVKM SCKASGYTFS DFNIHWVKQK PGQGLEWIGY INPYTDVTVY NEKFKGKATL TSDRSSSTAY MDLSSLTSED SAVYYCASYF DGTFDYALDY WGQGTSITVS S
12	Fab 0302 light chain variable region	DVVVTQTPAS LAVSLGQRAT ISCRASESVD NYGLSFMNWF QQKPGQPPKL LIYTASNLES GIPARFSGGG SRTDFTLTID PVEADDAATY FCQQSKELPW TFGGGTRLEI K
13	Fab 0311 heavy chain variable region	EIQLQQSGPD LMKPGASVKM SCKASGYIFT DYNMHWVKQN QGKSLEWMGE INPNNGVVVY NQKFKGTTTL TVDKSSSTAY MDLHSLTSED SAVYYCTRAL YHSNFGWYFD SWGKGTTLTV SS
14	Fab 0311 light chain variable region	DIVLTQSPAS LAVSLGQRAT ISCKASQSVD YDGDSHMNWY QQKPGQPPKL LIYTASNLES GIPARFSGSG SGADFTLTIH PVEEEDAATY YCQQGNEDPW TFGGGTRLEI K
15	0301 heavy chain CDR1	GYTFTDNYMI
16	0301 heavy chain CDR2	DINPYNGGTT FNQKFKG
17	0301 heavy chain CDR3	ESPYFSNLYV MDY
18	0301 light chain CDR1	KASQSVDYDG DNYMN
19	0301 light chain CDR2	AASNLES
20	0301 light chain CDR3	HLSNEDLST
21	0302 heavy chain CDR1	GYTFSDFNIH
22	0302 heavy chain CDR2	YINPYTDVTV YNEKFKG
23	0302 heavy chain CDR3	YFDGTFDYAL DY
24	0302 light chain CDR1	RASESVDNYG LSFMN
25	0302 light chain CDR2	TASNLES
26	0302 light chain CDR3	QQSKELPWT
27	0311 heavy chain CDR1	GYIFTDYNMH
28	0311 heavy chain CDR2	EINPNNGVVV YNQKFKG
29	0311 heavy chain CDR3	ALYHSNFGWY FDS
30	0311 light	KASQSVDYDG DSHMN

	chain CDR1	
31	0311 light chain CDR2	TASNLES
32	0311 light chain CDR3	QQGNEDPWT
33	cAb 0301 heavy chain	EVQLQQSGPE LVRPGASVKM SCKASGYTFT DNYMIWVKQS HGKSLEWIGD INPYNGGTTF NQKFKGKATL TVEKSSSTAY MQLNSLTSED SAVYYCARES PYFSNLYVMD YWGQGTSVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
34	cAb 0301 light chain	NIVLTQSPAS LAVSLGQRAT ISCKASQSVD YDGDNYMNWY QQKPGQPPKL LIYAASNLES GIPARFSGSG SGTDFTLNIH PVEEEDAATY YCHLSNEDLS TFGGGTKLEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
35	cAb 0302 heavy chain	EIQLQQSGPE LVKPGASVKM SCKASGYTFS DFNIHWVKQK PGQGLEWIGY INPYTDVTVY NEKFKGKATL TSDRSSSTAY MDLSSLTSED SAVYYCASYF DGTFDYALDY WGQGTSITVS SASTKGPSVF PLAPCSRSTS ESTAALGCLV KDYFPEPVTV SWNSGALTSG VHTFPAVLQS SGLYSLSSVV TVPSSSLGTK TYTCNVDHKP SNTKVDKRVE SKYGPPCPPC PAPEFLGGPS VFLFPPKPKD TLMISRTPEV TCVVVDVSQE DPEVQFNWYV DGVEVHNAKT KPREEQFNST YRVVSVLTVL HQDWLNGKEY KCKVSNKGLP SSIEKTISKA KGQPREPQVY TLPPSQEEMT KNQVSLTCLV KGFYPSDIAV EWESNGQPEN NYKTTPPVLD SDGSFFLYSR LTVDKSRWQE GNVFSCSVMH EALHNHYTQK SLSLSLGK
36	cAb 0302 light chain	DVVVTQTPAS LAVSLGQRAT ISCRASESVD NYGLSFMNWF QQKPGQPPKL LIYTASNLES GIPARFSGGG SRTDFTLTID PVEADDAATY FCQQSKELPW TFGGGTRLEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
37	cAb 0311 heavy chain	EIQLQQSGPD LMKPGASVKM SCKASGYIFT DYNMHWVKQN QGKSLEWMGE INPNNGVVVY NQKFKGTTTL TVDKSSSTAY MDLHSLTSED SAVYYCTRAL YHSNFGWYFD SWGKGTTLTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
38	cAb 0311 light chain	DIVLTQSPAS LAVSLGQRAT ISCKASQSVD YDGDSHMNWY QQKPGQPPKL LIYTASNLES GIPARFSGSG SGADFTLTIH PVEEEDAATY YCQQGNEDPW TFGGGTRLEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
39	h0301-H0 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWMGD INPYNGGTTF NQKFKGRVTI TADKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SS
40	h0301-H1 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWMGD INPYNGGTTF NQKFKGRVTI TVDKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SS

41	h0301-H2 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWIGD INPYNGGTTF NQKFKGRATL TVDKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SS
42	H0302-H1 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYTFS DFNIHWVRQA PGQGLEWMGY INPYTDVTVY NEKFKGRVTI TSDKSTSTAY MELSSLRSED TAVYYCASYF DGTFDYALDY WGQGTLVTVS S
43	H0302-H2 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYTFS DFNIHWVRQA PGQGLEWIGY INPYTDVTVY NEKFKGRATL TSDKSTSTAY MELSSLRSED TAVYYCASYF DGTFDYALDY WGQGTLVTVS S
44	H0311-H1 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYIFT DYNMHWVRQA PGQGLEWMGE INPNNGVVVY NQKFKGRVTI TVDKSTSTAY MELSSLRSED TAVYYCTRAL YHSNFGWYFD SWGQGTLVTV SS
45	H0311-H2 heavy chain variable region	QVQLVQSGAE VKKPGSSVKV SCKASGYIFT DYNMHWVRQA PGQGLEWMGE INPNNGVVVY NQKFKGTTTL TVDKSTSTAY MELSSLRSED TAVYYCTRAL YHSNFGWYFD SWGQGTLVTV SS
46	h0301-L0 light chain variable region	EIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDNYMNWY QQKPGQAPRL LIYAASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCHLSNEDLS TFGGGTKVEI K
47	h0301-L1 light chain variable region	NIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDNYMNWY QQKPGQAPRL LIYAASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCHLSNEDLS TFGGGTKVEI K
48	H0302-L0 light chain variable region	EIVLTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI K
49	H0302-L1 light chain variable region	EIVLTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SRTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI K
50	H0302-L2 light chain variable region	EIVVTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWF QQKPGQAPRL LIYTASNLES GIPARFSGSG SRTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI K
51	H0311-L0 light chain variable region	EIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDSHMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCQQGNEDPW TFGQGTKVEI K
52	H0311-L1 light chain variable region	DIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDSHMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGADFTLTIS SLEPEDFAVY YCQQGNEDPW TFGQGTKVEI K
53	h0301-H0 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWMGD INPYNGGTTF NQKFKGRVTI TADKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK

		DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
54	h0301-H1 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWMGD INPYNGGTTF NQKFKGRVTI TVDKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
55	h0301-H2 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYTFT DNYMIWVRQA PGQGLEWIGD INPYNGGTTF NQKFKGRATL TVDKSTSTAY MELSSLRSED TAVYYCARES PYFSNLYVMD YWGQGTLVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
56	H0302-H1 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYTFS DFNIHWVRQA PGQGLEWMGY INPYTDVTVY NEKFKGRVTI TSDKSTSTAY MELSSLRSED TAVYYCASYF DGTFDYALDY WGQGTLVTVS SASTKGPSVF PLAPCSRSTS ESTAALGCLV KDYFPEPVTV SWNSGALTSG VHTFPAVLQS SGLYSLSSVV TVPSSSLGTK TYTCNVDHKP SNTKVDKRVE SKYGPPCPPC PAPEFLGGPS VFLFPPKPKD TLMISRTPEV TCVVVDVSQE DPEVQFNWYV DGVEVHNAKT KPREEQFNST YRVVSVLTVL HQDWLNGKEY KCKVSNKGLP SSIEKTISKA KGQPREPQVY TLPPSQEEMT KNQVSLTCLV KGFYPSDIAV EWESNGQPEN NYKTTPPVLD SDGSFFLYSR LTVDKSRWQE GNVFSCSVMH EALHNHYTQK SLSLSLGK
57	H0302-H2 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYTFS DFNIHWVRQA PGQGLEWIGY INPYTDVTVY NEKFKGRATL TSDKSTSTAY MELSSLRSED TAVYYCASYF DGTFDYALDY WGQGTLVTVS SASTKGPSVF PLAPCSRSTS ESTAALGCLV KDYFPEPVTV SWNSGALTSG VHTFPAVLQS SGLYSLSSVV TVPSSSLGTK TYTCNVDHKP SNTKVDKRVE SKYGPPCPPC PAPEFLGGPS VFLFPPKPKD TLMISRTPEV TCVVVDVSQE DPEVQFNWYV DGVEVHNAKT KPREEQFNST YRVVSVLTVL HQDWLNGKEY KCKVSNKGLP SSIEKTISKA KGQPREPQVY TLPPSQEEMT KNQVSLTCLV KGFYPSDIAV EWESNGQPEN NYKTTPPVLD SDGSFFLYSR LTVDKSRWQE GNVFSCSVMH EALHNHYTQK SLSLSLGK
58	H0311-H1 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYIFT DYNMHWVRQA PGQGLEWMGE INPNNGVVVY NQKFKGRVTI TVDKSTSTAY MELSSLRSED TAVYYCTRAL YHSNFGWYFD SWGQGTLVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
59	H0311-H2 heavy chain	QVQLVQSGAE VKKPGSSVKV SCKASGYIFT DYNMHWVRQA PGQGLEWMGE INPNNGVVVY NQKFKGTTTL TVDKSTSTAY MELSSLRSED TAVYYCTRAL YHSNFGWYFD SWGQGTLVTV SSASTKGPSV FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ SSGLYSLSSV VTVPSSSLGT KTYTCNVDHK PSNTKVDKRV ESKYGPPCPP CPAPEFLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSQ EDPEVQFNWY VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL

		DSDGSFFLYS RLTVDKSRWQ EGNVFSCSVM HEALHNHYTQ KSLSLSLGK
60	h0301-L0 light chain	EIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDNYMNWY QQKPGQAPRL LIYAASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCHLSNEDLS TFGGGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
61	h0301-L1 light chain	NIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDNYMNWY QQKPGQAPRL LIYAASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCHLSNEDLS TFGGGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
62	H0302-L0 light chain	EIVLTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
63	H0302-L1 light chain	EIVLTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SRTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
64	H0302-L2 light chain	EIVVTQSPAT LSLSPGERAT LSCRASESVD NYGLSFMNWF QQKPGQAPRL LIYTASNLES GIPARFSGSG SRTDFTLTIS SLEPEDFAVY YCQQSKELPW TFGQGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
65	H0311-L0 light chain	EIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDSHMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YCQQGNEDPW TFGQGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
66	H0311-L1 light chain	DIVLTQSPAT LSLSPGERAT LSCKASQSVD YDGDSHMNWY QQKPGQAPRL LIYTASNLES GIPARFSGSG SGADFTLTIS SLEPEDFAVY YCQQGNEDPW TFGQGTKVEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS STLTLSKADY EKHKVYACEV THQGLSSPVT KSFNRGEC
67	Human CSF1	EEVSEYCSHM IGSGHLQSLQ RLIDSQMETS CQITFEFVDQ EQLKDPVCYL KKAFLLVQDI MEDTMRFRDN TPNAIAIVQL QELSLRLKSC FTKDYEEHDK ACVRTFYETP LQLLEKVKNV FNETKNLLDK DWNIFSKNCN NSFAECSSQG HERQSEGS
68	Human IL-34	NEPLEMWPLT QNEECTVTGF LRDKLQYRSR LQYMKHYFPI NYKISVPYEG VFRIANVTRL QRAQVSEREL RYLWVLVSLSATESVQDVLL EGHPSWKYLQ EVQTLLLNVQ QGLTDVEVSP KVESVLSLLN APGPNLKLVR PKALLDNCFR VMELLYCSCC KQSSVLNWQD CEVPSPQSCS PEPSLQYAAT QLYPPPPWSP SSPPHSTGSV RPVRAQGEGL LP
69	Human acceptor A FR1	QVQLVQSGAE VKKPGSSVKV SCKAS
70	Human acceptor A FR2	WVRQAPGQGL EWMG
71	Human acceptor A FR3	RVTITADKST STAYMELSSL RSEDTAVYYC AR

72	Human acceptor A FR4	WGQGTLVTVS S
73	Human acceptor B FR1	QVQLVQSGAE VKKPGSSVKV SCKAS
74	Human acceptor B FR2	WVRQAPGQGL EWMG
75	Human acceptor B FR3	RVTITADKST STAYMELSSL RSEDTAVYYC AR
76	Human acceptor B FR4	WGQGTLVTVSS
77	Human acceptor C FR1	QVQLVQSGAE VKKPGSSVKV SCKAS
78	Human acceptor C FR2	WVRQAPGQGL EWMG
79	Human acceptor C FR3	RVTITADKST STAYMELSSL RSEDTAVYYC AR
80	Human acceptor C FR4	WGQGTLVTVS S
81	Human acceptor D FR1	EIVLTQSPAT LSLSPGERAT LSC
82	Human acceptor D FR2	WYQQKPGQAP RLLIY
83	Human acceptor D FR3	GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YC
84	Human acceptor D FR4	FGGGTKVEIK
85	Human acceptor E FR1	EIVLTQSPAT LSLSPGERAT LSC
86	Human acceptor E FR2	WYQQKPGQAP RLLIY
87	Human acceptor E FR3	GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YC
88	Human acceptor E FR4	FGQGTKVEIK

89	Human acceptor F FR1	EIVLTQSPAT LSLSPGERAT LSC
90	Human acceptor F FR2	WYQQKPGQAP RLLIY
91	Human acceptor F FR3	GIPARFSGSG SGTDFTLTIS SLEPEDFAVY YC
92	Human acceptor F FR4	FGQGTKVEIK
93	mCSF1R ECD-Fc	APVIEPSGPE LVVEPGETVT LRCVSNGSVE WDGPISPYWT LDPESPGSTL TTRNATFKNT GTYRCTELED PMAGSTTIHL YVKDPAHSWN LLAQEVTVVE GQEAVLPCLI TDPALKDSVS LMREGGRQVL RKTVYFFSPW RGFIIRKAKV LDSNTYVCKT MVNGRESTST GIWLKVNRVH PEPPQIKLEP SKLVRIRGEA AQIVCSATNA EVGFNVILKR GDTKLEIPLN SDFQDNYYKK VRALSLNAVD FQDAGIYSCV ASNDVGTRTA TMNFQVVESA YLNLTSEQSL LQEVSVGDSL ILTVHADAYP SIQHYNWTYL GPFFEDQRKL EFITQRAIYR YTFKLFLNRV KASEAGQYFL MAQNKAGWNN LTFELTLRYP PEVSVTWMPV NGSDVLFCDV SGYPQPSVTW MECRGHTDRC DEAQALQVWN DTHPEVLSQK PFDKVIIQSQ LPIGTLKHNM TYFCKTHNSV GNSSQYFRAV SLGQSKQEPK SSDKTHTCPP CPAPELLGGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSH EDPEVKFNWY VDGVEVHNAK TKPREEQYNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKAL PAPIEKTISK AKGQPREPQV YTLPPSRDEL TKNQVSLTCL VKGFYPSDIA VEWESNGQPE NNYKTTPPVL DSDGSFFLYS KLTVDKSRWQ QGNVFSCSVM HEALHNHYTQ KSLSLSPGK
94	Human IgG4 S241P	ASTKGPSVFP LAPCSRSTSE STAALGCLVK DYFPEPVTVS WNSGALTSGV HTFPAVLQSS GLYSLSSVVT VPSSSLGTKT YTCNVDHKPS NTKVDKRVES KYGPPCPPCP APEFLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSQED PEVQFNWYVD GVEVHNAKTK PREEQFNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKGLPS SIEKTISKAK GQPREPQVYT LPPSQEEMTK NQVSLTCLVK GFYPSDIAVE WESNGQPENN YKTTPPVLDS DGSFFLYSRL TVDKSRWQEG NVFSCSVMHE ALHNHYTQKS LSLSLGK
95	Human Igκ	RTVAAPSVFI FPPSDEQLKS GTASVVCLLN NFYPREAKVQ WKVDNALQSG NSQESVTEQD SKDSTYSLSS TLTLSKADYE KHKVYACEVT HQGLSSPVTK SFNRGEC
96	Human IL-6; mature	VPPGEDSKDV AAPHRQPLTS SERIDKQIRY ILDGISALRK ETCNKSNMCE SSKEALAENN LNLPKMAEKD GCFQSGFNEE TCLVKIITGL LEFEVYLEYL QNRFESSEEQ ARAVQMSTKV LIQFLQKKAK NLDAITTPDP TTNASLLTKL QAQNQWLQDM TTHLILRSFK EFLQSSLRAL RQM
97	Human IL-1β; mature	APVRSLNCTL RDSQQKSLVM SGPYELKALH LQGQDMEQQV VFSMSFVQGE ESNDKIPVAL GLKEKNLYLS CVLKDDKPTL QLESVDPKNY PKKKMEKRFV FNKIEINNKL EFESAQFPNW YISTSQAENM PVFLGGTKGG QDITDFTMQF VSS
98	Human IL-8; mature	EGAVLPRSAK ELRCQCIKTY SKPFHPKFIK ELRVIESGPH CANTEIIVKL SDGRELCLDP KENWVQRVVE KFLKRAENS
99	Human CCL2; mature	QPDAINAPVT CCYNFTNRKI SVQRLASYRR ITSSKCPKEA VIFKTIVAKE ICADPKQKWV QDSMDHLDKQ TQTPKT
100	Human CXCL10; mature	VPLSRTVRCT CISISNQPVN PRSLEKLEII PASQFCPRVE IIATMKKKGE KRCLNPESKA IKNLLKAVSK ERSKRSP

101	Human soluble TNF-α	VRSSSRTPSD KPVAHVVANP QAEGQLQWLN RRANALLANG VELRDNQLVV PSEGLYLIYS QVLFKGQGCP STHVLLTHTI SRIAVSYQTK VNLLSAIKSP CQRETPEGAE AKPWYEPIYL GGVFQLEKGD RLSAEINRPD YLDFAESGQV YFGIIAL
102	Human CCL7; mature	QPVGINTSTT CCYRFINKKI PKQRLESYRR TTSSHCPREA VIFKTKLDKE ICADPTQKWV QDFMKHLDKK TQTPKL
103	Human CXCL5; mature	AGPAAAVLRE LRCVCLQTTQ GVHPKMISNL QVFAIGPQCS KVEVVASLKN GKEICLDPEA PFLKKVIQKI LDGGNKEN
104	Human CXCL9; mature	TPVVRKGRCS CISTNQGTIH LQSLKDLKQF APSPSCEKIE IIATLKNGVQ TCLNPDSADV KELIKKWEKQ VSQKKKQKNG KKHQKKKVLK VRKSQRSRQK KTT
105	Human CXCL6; mature	GPVSAVLTEL RCTCLRVTLR VNPKTIGKLQ VFPAGPQCSK VEVVASLKNG KQVCLDPEAP FLKKVIQKIL DSGNKKN
106	Human MMP-7; mature	YSLFPNSPKW TSKVVTYRIV SYTRDLPHIT VDRLVSKALN MWGKEIPLHF RKVVWGTADI MIGFARGAHG DSYPFDGPGN TLAHAFAPGT GLGGDAHFDE DERWTDGSSL GINFLYAATH ELGHSLGMGH SSDPNAVMYP TYGNGDPQNF KLSQDDIKGI QKLYGKRSNS RKK
107	Human MMP-9; mature	MRTPRCGVPD LGRFQTFEGD LKWHHHNITY WIQNYSEDLP RAVIDDAFAR AFALWSAVTP LTFTRVYSRD ADIVIQFGVA EHGDGYPFDG KDGLLAHAFP PGPGIQGDAH FDDDELWSLG KGVVVPTRFG NADGAACHFP FIFEGRSYSA CTTDGRSDGL PWCSTTANYD TDDRFGFCPS ERLYTQDGNA DGKPCQFPFI FQGQSYSACT TDGRSDGYRW CATTANYDRD KLFGFCPTRA DSTVMGGNSA GELCVFPFTF LGKEYSTCTS EGRGDGRLWC ATTSNFDSDK KWGFCPDQGY SLFLVAAHEF GHALGLDHSS VPEALMYPMY RFTEGPPLHK DDVNGIRHLY GPRPEPEPRP PTTTTPQPTA PPTVCPTGPP TVHPSERPTA GPTGPPSAGP TGPPTAGPST ATTVPLSPVD DACNVNIFDA IAEIGNQLYL FKDGKYWRFS EGRGSRPQGP FLIADKWPAL PRKLDSVFEE RLSKKLFFFS GRQVWVYTGA SVLGPRRLDK LGLGADVAQV TGALRSGRGK MLLFSGRRLW RFDVKAQMVD PRSASEVDRM FPGVPLDTHD VFQYREKAYF CQDRFYWRVS SRSELNQVDQ VGYVTYDILQ CPED
108	Human MMP-2, mature	APSPIIKFPG DVAPKTDKEL AVQYLNTFYG CPKESCNLFV LKDTLKKMQK FFGLPQTGDL DQNTIETMRK PRCGNPDVAN YNFFPRKPKW DKNQITYRII GYTPDLDPET VDDAFARAFQ VWSDVTPLRF SRIHDGEADI MINFGRWEHG DGYPFDGKDG LLAHAFAPGT GVGGDSHFDD DELWTLGEGQ VVRVKYGNAD GEYCKFPFLF NGKEYNSCTD TGRSDGFLWC STTYNFEKDG KYGFCPHEAL FTMGGNAEGQ PCKFPFRFQG TSYDSCTTEG RTDGYRWCGT TEDYDRDKKY GFCPETAMST VGGNSEGAPC VFPFTFLGNK YESCTSAGRS DGKMWCATTA NYDDDRKWGF CPDQGYSLFL VAAHEFGHAM GLEHSQDPGA LMAPIYTYTK NFRLSQDDIK GIQELYGASP DIDLGTGPTP TLGPVTPEIC KQDIVFDGIA QIRGEIFFFK DRFIWRTVTP RDKPMGPLLV ATFWPELPEK IDAVYEAPQE EKAVFFAGNE YWIYSASTLE RGYPKPLTSL GLPPDVQRVD AAFNWSKNKK TYIFAGDKFW RYNEVKKKMD PGFPKLIADA WNAIPDNLDA VVDLQGGGHS YFFKGAYYLK LENQSLKSVK FGSIKSDWLG C

CLAIMS

1. A method of reducing the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject, comprising administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to the subject, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R.

2. The method of claim 1, wherein the method comprises reducing the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

3. The method of claim 1 or claim 2, wherein the method comprises reducing the level of IL-6.

4. The method of claim 3, wherein the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, and Castleman's disease.

5. The method of any one of the preceding claims, wherein the method comprises reducing the level of TNF-α.

6. The method of claim 5, wherein the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis.

7. The method of any one of the preceding claims, wherein the method comprises reducing the level of IL-1β.

8. The method of claim 7, wherein the subject has a condition selected from rheumatoid arthritis and juvenile idiopathic arthritis.

9. The method of any one of the preceding claims, wherein the method comprises reducing the level of CXCL10.

10. A method of treating a condition associated with an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 comprising administering an effective amount of an antibody that binds CSF1R to a subject with the condition, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, wherein the antibody reduces the level of at least one of the factors.

11. The method of claim 10, wherein the condition is associated with an elevated level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

12. The method of claim 10 or claim 11, wherein the condition is associated with an elevated level of IL-6.

13. The method of claim 12, wherein the condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, and Castleman's disease.

14. The method of any one of claims 10 to 13, wherein the condition is associated with an elevated level of TNF-α.

15. The method of claim 14, wherein the condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis.

16. The method of any one of claims 10 to 15, wherein the condition is associated with an elevated level of IL-1β.

17. The method of claim 16, wherein the condition is selected from rheumatoid arthritis and juvenile idiopathic arthritis.

18. The method of any one of claims 10 to 17, wherein the condition is associated with an elevated level of CXCL10.

19. The method of any one of the preceding claims, wherein the subject has a condition selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease.

20. A method of treating inflammatory arthritis comprising administering an effective amount of an antibody that binds CSF1R to a subject with inflammatory arthritis, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

21. The method of claim 20, wherein the antibody reduces the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

22. The method claim 20 or claim 21, wherein the antibody reduces the level of IL-6.

23. The method of any one of claims 20 to 22, wherein the antibody reduces the level of TNF-α.

24. The method of any one of claims 20 to 23, wherein the antibody reduces the level of IL-1β.

25. The method of any one of claims 20 to 24, wherein the antibody reduces the level of CXCL10.

26. The method of any one of claims 20 to 25, wherein the inflammatory arthritis is selected from rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, and juvenile idiopathic arthritis.

27. A method of treating an inflammatory condition comprising administering an effective amount of an antibody that binds CSF1R to a subject with an inflammatory condition, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

28. The method of claim 27, wherein the antibody reduces the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

29. The method claim 27 or claim 28, wherein the antibody reduces the level of IL-6.

30. The method of any one of claims 27 to 29, wherein the antibody reduces the level of TNF-α.

31. The method of any one of claims 27 to 30, wherein the antibody reduces the level of IL-1β.

32. The method of any one of claims 27 to 31, wherein the antibody reduces the level of CXCL10.

33. The method of any one of claims 27 to 32, wherein the inflammatory condition is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease.

34. A method of treating CD16+ disorder comprising administering an effective amount of an antibody that binds CSF1R to a subject with a CD16+ disorder, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, and

wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

35. The method of claim 34, wherein the antibody reduces the level of at least one, at least two, at least three, or four factors selected from IL-6, IL-1β, TNF-α, and CXCL10.

36. The method claim 34 or claim 35, wherein the antibody reduces the level of IL-6.

37. The method of any one of claims 34 to 36, wherein the antibody reduces the level of TNF-α.

38. The method of any one of claims 34 to 37, wherein the antibody reduces the level of IL-1β.

39. The method of any one of claims 34 to 38, wherein the antibody reduces the level of CXCL10.

40. The method of any one of claims 34 to 39, wherein the CD16+ disorder is selected from rheumatoid arthritis, juvenile idiopathic arthritis, Castleman's disease, psoriasis, psoriatic arthritis, ankylosing spondylitis, Crohn's disease, and ulcerative colitis, lupus erythematosus, and inflammatory bowel disease.

41. The method of any one of claims 36 to 40, wherein the antibody substantially reduces the number of CD16+ monocytes.

42. The method of any one of claims 36 to 41, wherein the number of CD16- monocytes are substantially unchanged following administration of the antibody.

43. The method of any one of claims 22 to 42, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 *in vitro*.

44. The method of any one of the preceding claims, wherein the subject has an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 prior to administration of the antibody.

45. The method of any one of the preceding claims, wherein the condition is

resistant to methotrexate and/or wherein the subject is a methotrexate inadequate responder.

46. The method of any one of the preceding claims, wherein the condition is resistant to a TNF inhibitor and/or the subject is a TNF inhibitor inadequate responder.

47. A method of treating a methotrexate inadequate responder comprising administering to the methotrexate inadequate responder an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R.

48. A method of treating a TNF inhibitor inadequate responder comprising administering to the TNF inhibitor inadequate responder an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R.

49. The method of claim 47 or 48, wherein the inadequate responder has a CD16+ disorder.

50. The method of claim 49, wherein the CD16+ disorder is rheumatoid arthritis.

51. The method of any one of claims 47 to 50, wherein the antibody substantially reduces the number of CD16+ monocytes.

52. The method of any one of claims 47 to 51, wherein the number of CD16- monocytes are substantially unchanged following administration of the antibody.

53. The method of any one of claims 47 to 52, wherein the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the inadequate responder is reduced following administration of the antibody.

54. A method of identifying a subject who may benefit from an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, comprising determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject, wherein elevated level of at least one of the factors in the subject indicates that the subject may benefit from the antibody that binds CSF1R.

55. A method of predicting responsiveness in a subject suffering from an inflammatory condition to an antibody that binds CSF1R, wherein the antibody blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, comprising determining

the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in the subject, wherein elevated level of at least one of the factors in the subject indicates that the subject is more likely to respond to the antibody that binds CSF1R.

56. The method of claim 54 or 55, wherein the subject is a methotrexate inadequate responder.

57. The method of any one of claims 54 to 56, wherein the subject is a TNF inhibitor inadequate responder.

58. The method of any one of claims 54 to 57, wherein the subject has CD16+ disorder.

59. The method of any one of claims 54 to 58, wherein the subject has rheumatoid arthritis.

60. The method of any one of claims 54 to 59, wherein the subject has elevated level of CD16+ monocytes.

61. The method of any one of claims 54 to 60, wherein the method further comprises administering the antibody that binds CSF1R.

62. The method of any one of the preceding claims, wherein the method further comprises administering at least one additional therapeutic agent selected from a DMARD, methotrexate, a TNF inhibitor, an anti-TNF agent, a glucocorticoid, cyclosporine, leflunomide, azathioprine, a JAK inhibitor, a SYK inhibitor, an anti-IL-6 agent, an anti-CD20 agent, an anti-CD19 agent, an anti-GM-CSF agent, an anti-IL-1 agent, and a CTLA4 agent.

63. The method of claim 62, wherein the at least one additional therapeutic agent is selected from methotrexate, an anti-TNF-α antibody, a soluble TNF receptor, a glucocorticoid, cyclosporine, leflunomide, azathioprine, a JAK inhibitor, a SYK inhibitor, an anti-IL-6 antibody, an anti-IL-6 receptor antibody, an anti-CD20 antibody, an anti-CD19 antibody, an anti-GM-CSF antibody, and anti-GM-CSF receptor antibody, an anti-IL-1 antibody, an IL-1 receptor antagonist, and a CTLA4-Ig fusion molecule.

64. A method of treating an inflammatory condition comprising:

(a) determining the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with the inflammatory condition; and

(b) if the level of at least one of the factors is elevated in the subject, administering to the subject an effective amount of an antibody that binds CSF1R and blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

65. A method of treating an inflammatory condition comprising:

(a) detecting an elevated level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9 in a subject with the inflammatory condition; and

(b) administering to the subject an effective amount of an antibody that binds CSF1R and blocks binding of CSF1 to CSF1R and blocks binding of IL-34 to CSF1R, wherein the antibody reduces the level of at least one, at least two, at least three, or at least four, at least five, at least six, at least seven, at least eight, at least nine, or at least ten factors selected from IL-6, IL-1β, IL-8, CCL2, CXCL10, TNF-α, CCL7, CXCL5, CXCL9, CXCL6, MMP-7, MMP-2, and MMP-9.

66. The method of any one of the preceding claims, wherein the antibody inhibits ligand-induced CSF1R phosphorylation *in vitro*.

67. The method of any one of the preceding claims, wherein the antibody is selected from:

a) an antibody comprising a heavy chain comprising the sequence of SEQ ID NO: 39 and a light chain comprising the sequence of SEQ ID NO: 46;

b) an antibody comprising a heavy chain comprising a heavy chain (HC) CDR1 having the sequence of SEQ ID NO: 15, an HC CDR2 having the sequence of SEQ ID NO: 16, and an HC CDR3 having the sequence of SEQ ID NO: 17, and a light chain comprising a light chain (LC) CDR1 having the sequence of SEQ ID NO: 18, a LC CDR2 having the sequence of SEQ ID NO: 19, and a LC CDR3 having the sequence of SEQ ID NO: 20; and

c) an antibody comprising a heavy chain comprising the sequence of SEQ ID NO: 53 and a light chain comprising the sequence of SEQ ID NO: 60.

68. The method of claim 67, wherein the antibody is a humanized antibody.

69. The method of claim 67 or claim 68, wherein the antibody is selected from a Fab, an Fv, an scFv, a Fab', and a $(Fab')_2$.

70. The method of any one of the preceding claims, wherein the antibody is

administered at a dose of 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg.

71. The method of claim 70, wherein following administrationthe aspartate aminotransferase (AST) and/or alanine aminotransferase (ALT) level in a serum sample from the subject does not exceed 8 times the upper limit of normal (ULN).

72. The method of claim 70 or claim 71, wherein following administrationthe creatine kinase (CK) level in a serum sample from the subject does not exceed 10 times ULN.

73. The method of any one of claims 70 to 72, wherein following administration the AST and/or ALT level in a serum sample from the subject does not exceed 3 times ULN and the total bilirubin in the serum sample from the subject does not exceed 2 times ULN.

74. A method of treating rheumatoid arthritis in a subject, comprising administering an effective amount of an antibody that binds colony stimulating factor 1 receptor (CSF1R) to the subject, wherein the antibody blocks binding of colony stimulating factor 1 (CSF1) to CSF1R and blocks binding of IL-34 to CSF1R, wherein the effective amount is 0.2 mg/kg, 1 mg/kg, 3 mg/kg, or 10 mg/kg.

75. The method of claim 74, wherein following administration the AST and/or ALT level in a serum sample from the subject does not exceed 8 times the upper limit of normal (ULN).

76. The method of claim 74 or claim 75, wherein following administration the CK level in a serum sample from the subject does not exceed 10 times ULN.

77. The method of any one of claims 74 to 76, wherein following administration the AST and/or ALT level in a serum sample from the subject does not exceed 3 times ULN and the total bilirubin in the serum sample from the subject does not exceed 2 times ULN.

78. The method of any one of claims 74 to 77, wherein the antibody inhibits ligand-induced CSF1R phosphorylation *in vitro*.

79. The method of any one of claims 74 to 78, wherein the antibody is selected from:

a) an antibody comprising a heavy chain comprising the sequence of SEQ ID NO: 39 and a light chain comprising the sequence of SEQ ID NO: 46;

b) an antibody comprising a heavy chain comprising a heavy chain (HC) CDR1 having the sequence of SEQ ID NO: 15, an HC CDR2 having the sequence of SEQ ID NO: 16, and an HC CDR3 having the sequence of SEQ ID NO: 17, and a light chain comprising a light chain (LC) CDR1 having the sequence of SEQ ID NO: 18, a LC CDR2 having the sequence of SEQ ID NO: 19, and a LC CDR3 having the sequence of SEQ ID NO: 20; and

c) an antibody comprising a heavy chain comprising the sequence of SEQ ID NO: 53 and a light chain comprising the sequence of SEQ ID NO: 60.

80. The method of claim 79, wherein the antibody is a humanized antibody.

81. The method of claim 79 or claim 80, wherein the antibody is selected from a Fab, an Fv, an scFv, a Fab', and a $(Fab')_2$.

Ab ID	L/H chains	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	CDRH1 26	27	28	29	30	alt. CDRH1 31	32	33	34	35	36	37	38	39	40	41	42	43
cAb0301	parental	E	V	Q	L	Q	Q	S	G	P	E	L	V	R	P	G	A	S	V	K	M	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	K	Q	S	H	G	K
human acceptor A		Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab1	h0301-L0H0	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab2	h0301-L0H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab3	h0301-L0H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab4	h0301-L1H0	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab5	h0301-L1H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
Ab6	h0301-L1H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	N	Y	M	I	W	V	R	Q	A	P	G	Q
cAb0302	parental	E	I	Q	L	Q	Q	S	G	P	E	L	V	K	P	G	A	S	V	K	M	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	K	K	Q	K	P	G	Q
human acceptor B		Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab7	h0302-L0H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab8	h0302-L1H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab9	h0302-L2H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab10	h0302-L0H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab11	h0302-L1H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
Ab12	h0302-L2H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	S	D	F	N	I	H	W	V	R	Q	A	P	G	Q
cAb 0311	parental	E	I	Q	L	Q	Q	S	G	P	D	L	M	K	P	G	A	S	V	K	M	S	C	K	A	S	G	Y	I	F	T	D	Y	N	M	H	W	V	K	K	Q	N	Q	G	K
human acceptor C		Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	T	F	T	D	Y	N	M	H	W	V	R	Q	A	P	G	Q
Ab13	h0311-L0H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	I	F	T	D	Y	N	M	H	W	V	R	Q	A	P	G	Q
Ab14	h0311-L1H1	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	I	F	T	D	Y	N	M	H	W	V	R	Q	A	P	G	Q
Ab15	h0311-L0H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	I	F	T	D	Y	N	M	H	W	V	R	Q	A	P	G	Q
Ab16	h0311-L1H2	Q	V	Q	L	V	Q	S	G	A	E	V	K	K	P	G	S	S	V	K	V	S	C	K	A	S	G	Y	I	F	T	D	Y	N	M	H	W	V	R	Q	A	P	G	Q

FIG. 1A

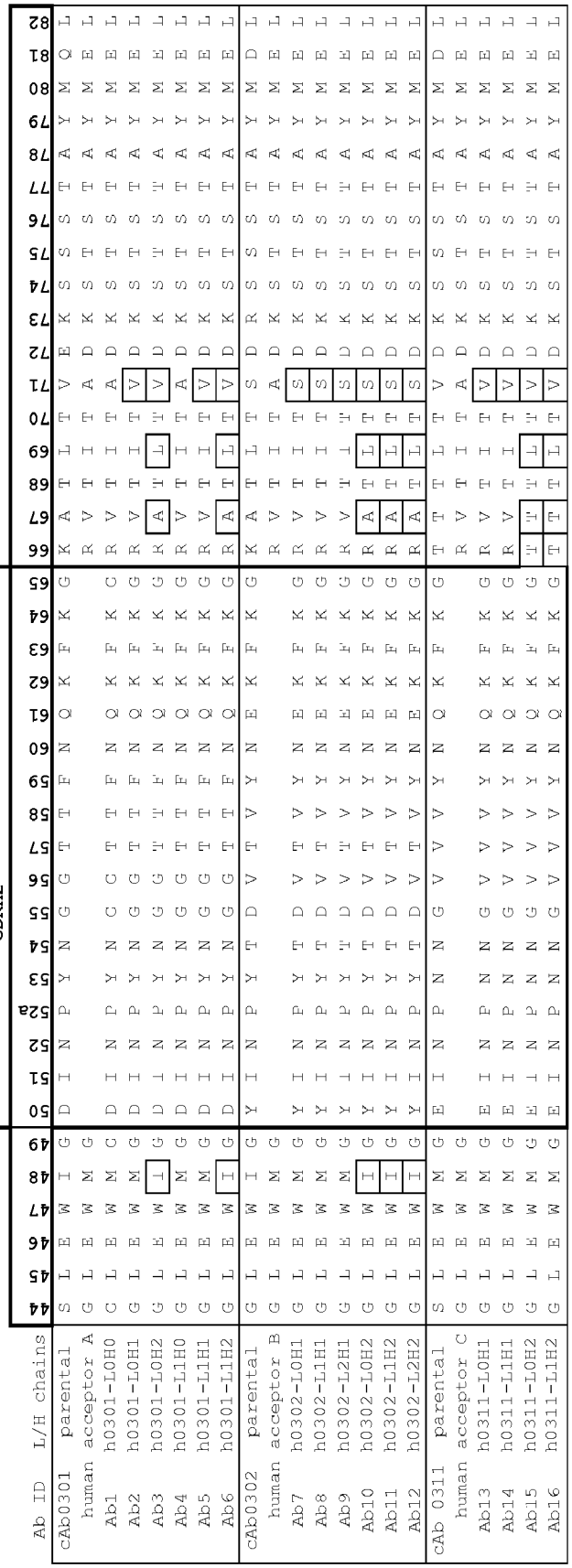

CDRH2
Ab ID L/H chains
44 45 46 47 48 49 50 51 52 52a 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82
cAb0301 parental S L E W I G D I N P Y N G G T F N Q K F K G R V T I T A D K S T S T A Y M E L
human acceptor A G L E W M G D I N P Y N G G T F N Q K F K G R V T I T A D K S T S T A Y M E L
Ab1 h0301-L0H0 C L E W M C D I N P Y N C C T F N Q K F K C R V T I T A D K S T S T A Y M E L
Ab2 h0301-L0H1 G L E W M G D I N P Y N G G T T F N Q K F K G R V T I T V D K S T S T A Y M E L
Ab3 h0301-L0H2 G L E W I G D I N P Y N G G T T F N Q K F K G K A T I T V D K S T S T A Y M E L
Ab4 h0301-L1H0 G L E W M G D I N P Y N G G T T F N Q K F K G R V T I T A D K S T S T A Y M E L
Ab5 h0301-L1H1 G L E W M G D I N P Y N G G T T F N Q K F K G R V T I T V D K S T S T A Y M E L
Ab6 h0301-L1H2 G L E W I G D I N P Y N G G T T F N Q K F K G R A T I T V D K S T S T A Y M E L
cAb0302 parental G L E W I G Y I N P Y T D V T V Y N E K F K G K A T L T S D S S T A Y M D L
human acceptor B G L E W M G Y I N P Y T D V T V Y N E K F K G R V T I T A D K S T S T A Y M E L
Ab7 h0302-L0H1 G L E W M G Y I N P Y T D V T V Y N E K F K G R V T I T S D K S T S T A Y M E L
Ab8 h0302-L1H1 G L E W M G Y I N P Y T D V T V Y N E K F K G R V T I T S D K S T S T A Y M E L
Ab9 h0302-L2H1 G L E W M G Y I N P Y T D V T V Y N E K F K G K V T I T S D K S T S T A Y M E L
Ab10 h0302-L0H2 G L E W I G Y I N P Y T D V T V Y N E K F K G R A T L T S D K S T S T A Y M E L
Ab11 h0302-L1H2 G L E W I G Y I N P Y T D V T V Y N E K F K G R A T L T S D K S T S T A Y M E L
Ab12 h0302-L2H2 G L E W I G Y I N P Y T D V T V Y N E K F K G R A T L T S D K S T S T A Y M E L
cAb 0311 parental S L E W M G E I N P N G V V V Y N Q K F K G T T T L T V D K S S S T A Y M D L
human acceptor C G L E W M G E I N P N G V V V Y N Q K F K G R V T I T A D K S T S T A Y M E L
Ab13 h0311-L0H1 G L E W M G E I N P N G V V V Y N Q K F K G R V T I T V D K S T S T A Y M E L
Ab14 h0311-L1H1 G L E W M G E I N P N G V V V Y N Q K F K G R V T I T V D K S T S T A Y M E L
Ab15 h0311-L0H2 G L E W M G E I N P N G V V V Y N Q K F K G T T L T V D K S T S T A Y M E L
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FIG. 1B

Ab ID	L/H chains	82a	82b	82b	82b	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	100a	100b	100c	100d	100e	101	102	103	104	105	106	107	108	109	110	111	112	113	SEQ ID NO
cAb0301	parental	N	S	L	S	T	S	E	D	S	A	V	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	S	V	T	V	S	S	9
human acceptor A		S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	69-72
Ab1	h0301-L0H0	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	39
Ab2	h0301-L0H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	40
Ab3	h0301-L0H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	41
Ab4	h0301-L1H0	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	39
Ab5	h0301-L1H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	40
Ab6	h0301-L1H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R	E	S	P	Y	F	S	N	L	Y	V	M	D	Y	W	G	Q	G	T	L	V	T	V	S	S	41
cAb0302	parental	S	S	L	T	S	E	D	S	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	S	T	T	V	S	S	11
human acceptor B		S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R																										73-76
Ab7	h0302-L0H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	42
Ab8	h0302-L1H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	42
Ab9	h0302-L2H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	42
Ab10	h0302-L0H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	43
Ab11	h0302-L1H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	43
Ab12	h0302-L2H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	S	Y	F	D	G	T	F	D	Y	A	L		D	Y	W	G	Q	G	T	L	V	T	V	S	S	43
cAb 0311	parental	H	S	L	T	S	E	D	S	A	V	Y	Y	Y	C	T	K	A	L	Y	H	S	N	F	G	W	Y	F	D	S	W	G	K	G	T	T	L	T	V	S	S	13
human acceptor C		S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	A	R																										77-80
Ab13	h0311-L0H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	T	R	A	L	Y	H	S	N	F	G	W	Y	F	D	S	W	G	Q	G	T	L	V	T	V	S	S	44
Ab14	h0311-L1H1	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	T	R	A	L	Y	H	S	N	F	G	W	Y	F	D	S	W	G	Q	G	T	L	V	T	V	S	S	44
Ab15	h0311-L0H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	T	R	A	L	Y	H	S	N	F	G	W	Y	F	D	S	W	G	Q	G	T	L	V	T	V	S	S	45
Ab16	h0311-L1H2	S	S	L	R	S	E	D	T	A	V	Y	Y	Y	C	T	R	A	L	Y	H	S	N	F	G	W	Y	F	D	S	W	G	Q	G	T	L	V	T	V	S	S	45

CDRH3

SEQ ID NO

FIG. 1C

Ab ID	L/H chains	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	CDRL1 24	25	26	27	27a	27b	27c	27d	28	29	30	31	32	33	34
cAb0301	parental	N	I	V	L	T	Q	S	P	A	S	L	A	V	S	L	G	Q	R	A	T	I	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
human acceptor D		E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	C	E	R	A	T	L	S	C															
Ab1	h0301-L0H0	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
Ab2	h0301-L0H1	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
Ab3	h0301-L0H2	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
Ab4	h0301-L1H0	N	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
Ab5	h0301-L1H1	N	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
Ab6	h0301-L1H2	N	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	N	Y	M	N
cAb0302	parental	D	V	V	V	T	Q	T	P	A	S	L	A	V	S	L	G	Q	R	A	T	I	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
human acceptor E		E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C															
Ab7	h0302-L0H1	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
Ab8	h0302-L1H1	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
Ab9	h0302-L2H1	E	I	V	V	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
Ab10	h0302-L0H2	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
Ab11	h0302-L1H2	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
Ab12	h0302-L2H2	E	I	V	V	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	R	A	S	E	S	V	D	N	Y	G	L	S	F	M	N
cAb 0311	parental	D	I	V	L	T	Q	S	P	A	S	L	A	V	S	L	G	Q	R	A	T	I	S	C	K	A	S	Q	S	V	D	Y	D	G	D	S	H	M	N
human acceptor F		E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C															
Ab13	h0311-L0H1	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	S	H	M	N
Ab14	h0311-L1H1	D	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	S	H	M	N
Ab15	h0311-L0H2	E	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	C	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	C	D	S	H	M	N
Ab16	h0311-L1H2	D	I	V	L	T	Q	S	P	A	T	L	S	L	S	P	G	E	R	A	T	L	S	C	K	A	S	Q	S	V	D	Y	D	G	D	S	H	M	N

FIG. 2A

Ab ID	L/H chains	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
																	CDRL2																					
cAb0301	parental	W	Y	Q	Q	K	P	G	Q	P	P	K	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
human acceptor D		W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y								G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab1	h0301-L0H0	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab2	h0301-L0H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab3	h0301-L0H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab4	h0301-L1H0	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab5	h0301-L1H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab6	h0301-L1H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	A	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
cAb0302	parental	W	F	Q	Q	K	P	G	Q	P	P	K	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	R	T	D
human acceptor F		W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y								G	T	P	A	R	F	S	G	G	G	S	G	T	D
Ab7	h0302-L0H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	G	T	D
Ab8	h0302-L1H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	R	T	D
Ab9	h0302-L2H1	W	F	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	R	T	D
Ab10	h0302-L0H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab11	h0302-L1H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	R	T	D
Ab12	h0302-L2H2	W	F	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	R	T	D
cAb 0311	parental	W	Y	Q	Q	K	P	G	Q	P	P	K	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	G	A	D
human acceptor F		W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y								G	I	P	A	R	F	S	G	G	G	S	G	T	D
Ab13	h0311-L0H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	G	T	D
Ab14	h0311-L1H1	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	G	G	S	G	A	D
Ab15	h0311-L0H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	T	D
Ab16	h0311-L1H2	W	Y	Q	Q	K	P	G	Q	A	P	R	L	L	I	Y	T	A	S	N	L	E	S	G	I	P	A	R	F	S	G	S	G	S	G	A	D

FIG. 2B

Ab ID	L/H chains	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	CDRL3 89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	SEQ ID NO
cAb0301	parental	F	T	L	N	I	H	P	V	E	E	E	D	A	A	T	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	L	E	I	K	10
human	acceptor D	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	81-84
Ab1	h0301-L0H0	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	46
Ab2	h0301-L0H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	46
Ab3	h0301-L0H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	46
Ab4	h0301-L1H0	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	47
Ab5	h0301-L1H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	47
Ab6	h0301-L1H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	H	L	S	N	E	D	L	S	T	F	G	G	G	T	K	V	E	I	K	47
cAb0302	parental	F	T	L	T	I	D	P	V	E	A	D	D	A	A	T	Y	F	C	Q	S	K	E	L	P	W	T	F	G	G	G	T	R	L	E	I	K	12
human	acceptor E	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	85-88
Ab7	h0302-L0H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	48
Ab8	h0302-L1H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	49
Ab9	h0302-L2H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	50
Ab10	h0302-L0H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	48
Ab11	h0302-L1H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	49
Ab12	h0302-L2H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	S	K	E	L	P	W	T	F	G	G	Q	T	K	V	E	I	K	50
cAb 0311	parental	F	T	L	T	I	H	P	V	E	E	E	D	A	A	T	Y	Y	C	Q	G	N	E	D	P	W	T	F	G	G	G	T	R	L	E	I	K	14
human	acceptor F	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	F	C	Q	C	T	K	V	E	I	K	89-92										
Ab13	h0311-L0H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	G	N	E	D	P	W	T	F	G	G	Q	T	K	V	E	I	K	51
Ab14	h0311-L1H1	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	G	N	E	D	P	W	T	F	G	G	Q	T	K	V	E	I	K	52
Ab15	h0311-L0H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	G	N	E	D	P	W	T	F	G	G	Q	T	K	V	E	I	K	51
Ab16	h0311-L1H2	F	T	L	T	I	S	S	L	E	P	E	D	F	A	V	Y	Y	C	Q	G	N	E	D	P	W	T	F	G	G	Q	T	K	V	E	I	K	52

FIG. 2C

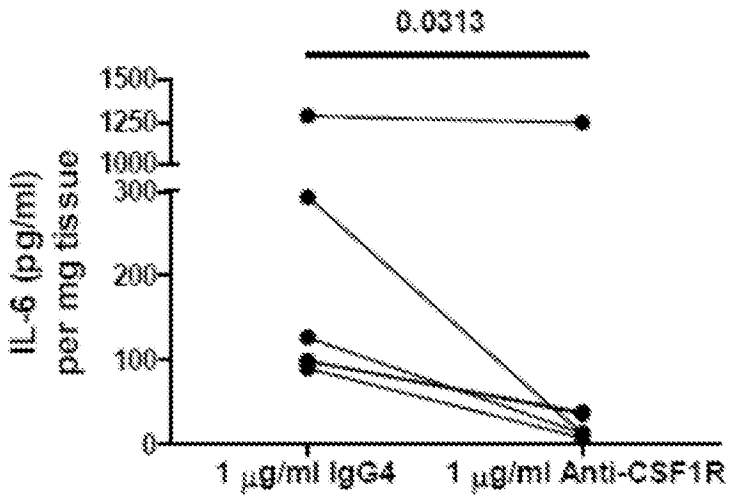

0.0313
1500
1250
1000
300
200
100
0
IL-6 (pg/ml) per mg tissue
1 μg/ml IgG4
1 μg/ml Anti-CSF1R

FIG. 3

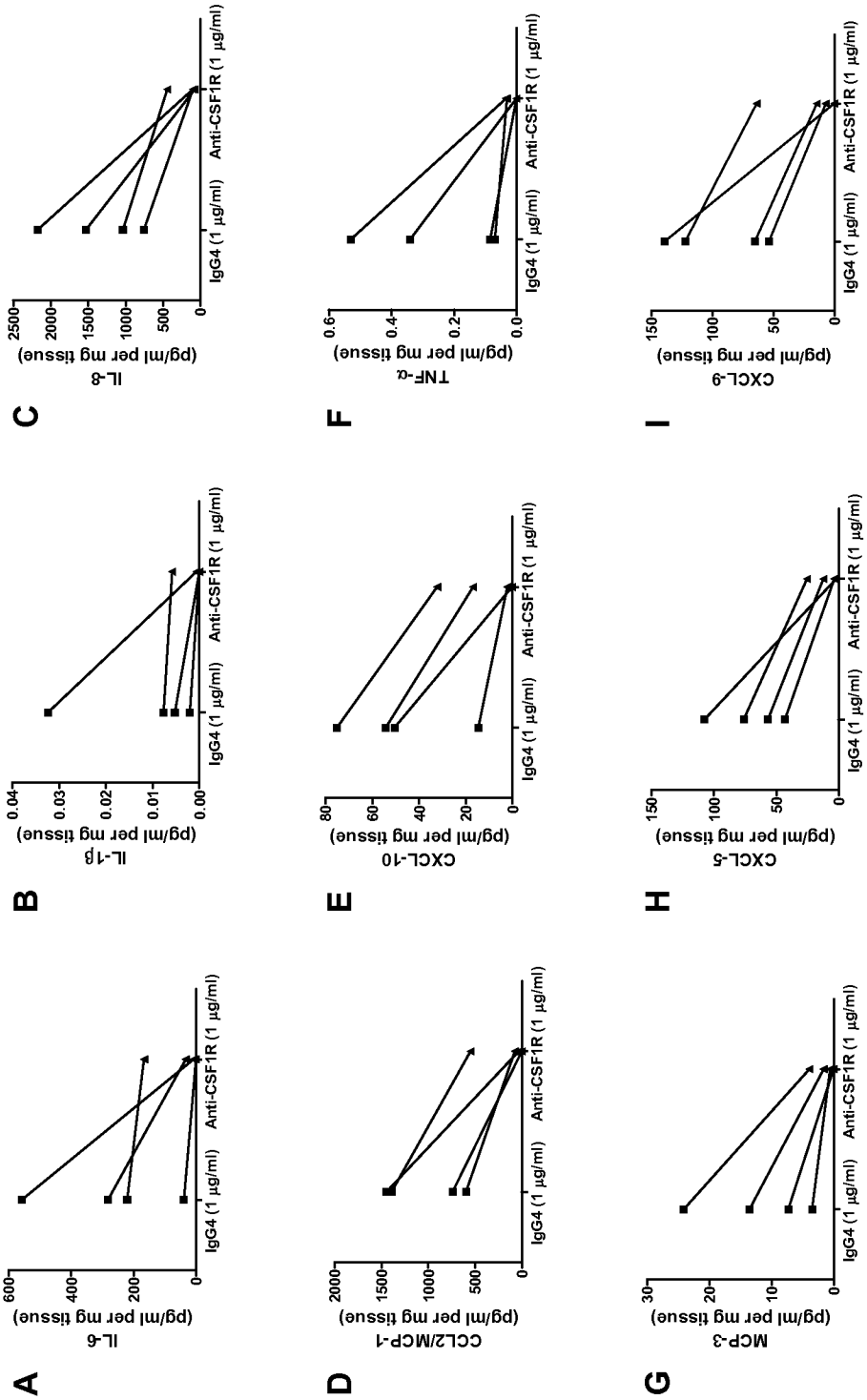

A
IL-6
(pg/ml per mg tissue)
600
400
200
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
B
IL-1β
(pg/ml per mg tissue)
0.04
0.03
0.02
0.01
0.00
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
C
IL-8
(pg/ml per mg tissue)
2500
2000
1500
1000
500
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
D
CCL2/MCP-1
(pg/ml per mg tissue)
2000
1500
1000
500
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
E
CXCL-10
(pg/ml per mg tissue)
80
60
40
20
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
F
TNF-α
(pg/ml per mg tissue)
0.6
0.4
0.2
0.0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
G
MCP-3
(pg/ml per mg tissue)
30
20
10
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
H
CXCL-5
(pg/ml per mg tissue)
150
100
50
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
I
CXCL-9
(pg/ml per mg tissue)
150
100
50
0
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)

FIG. 4

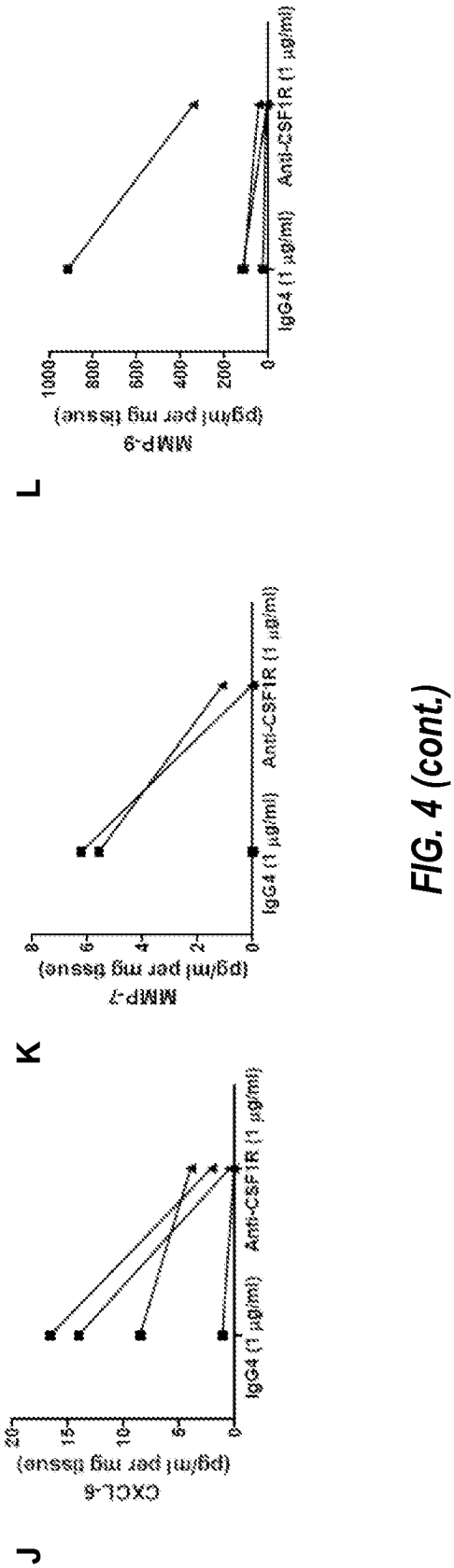
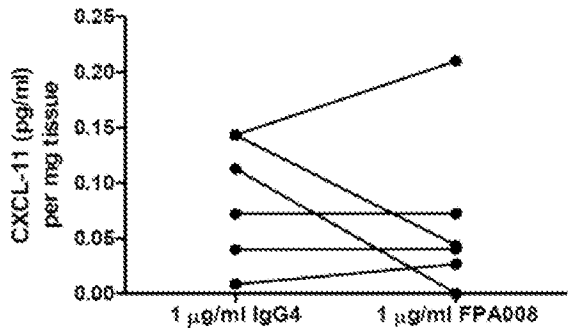
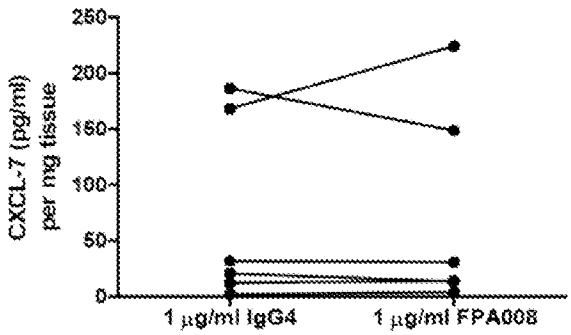

J
CXCL-6
(pg/ml per mg tissue)
0
5
10
15
20
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
K
MMP-7
(pg/ml per mg tissue)
0
2
4
6
8
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)
L
MMP-9
(pg/ml per mg tissue)
0
200
400
600
800
1000
IgG4 (1 µg/ml)
Anti-CSF1R (1 µg/ml)

FIG. 4 (cont.)

A


CXCL-11 (pg/ml) per mg tissue
0.25
0.20
0.15
0.10
0.05
0.00
1 μg/ml IgG4
1 μg/ml FPA008

B


CXCL-7 (pg/ml) per mg tissue
250
200
150
100
50
0
1 μg/ml IgG4
1 μg/ml FPA008

C

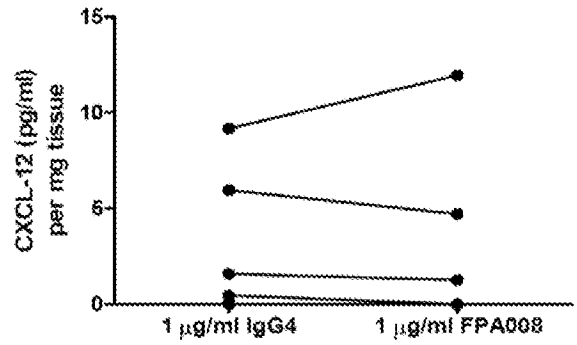

CXCL-12 (pg/ml) per mg tissue
15
10
5
0
1 μg/ml IgG4
1 μg/ml FPA008

FIG. 5

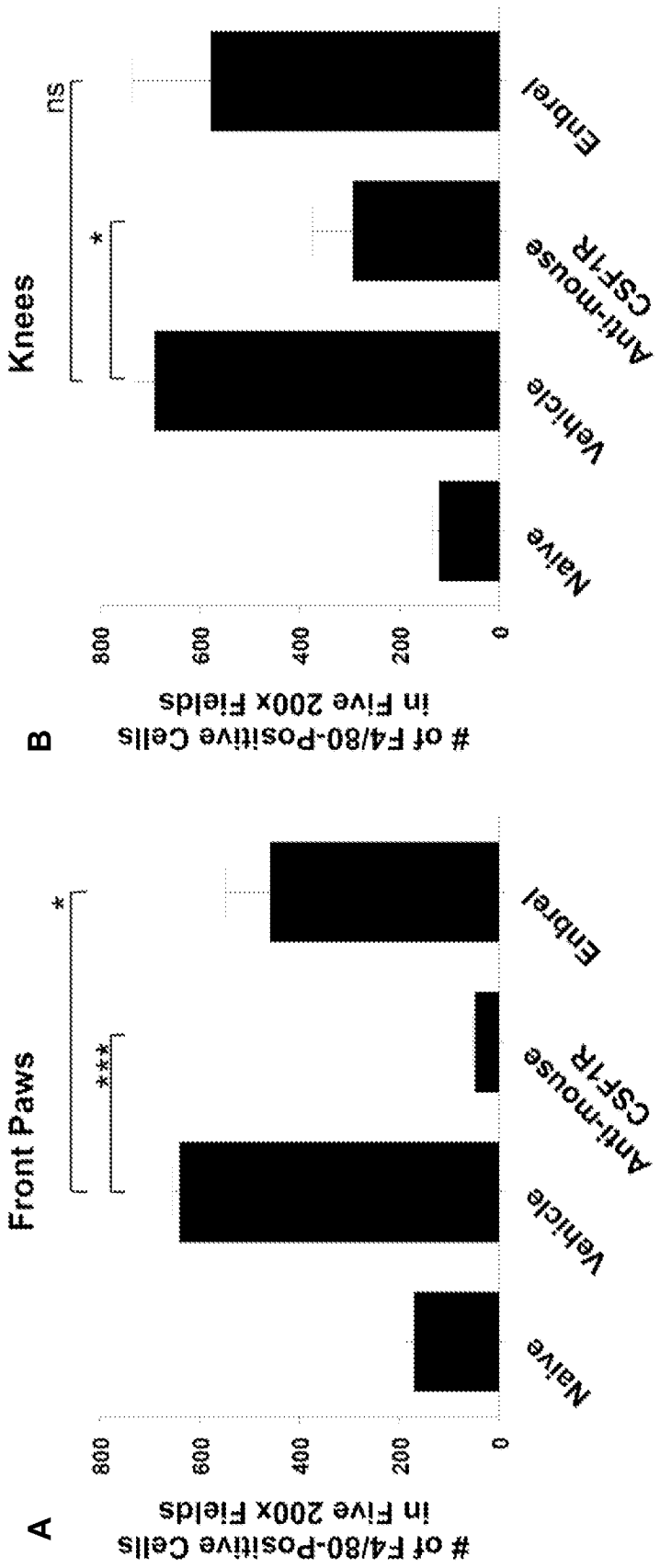

A
# of F4/80-Positive Cells
in Five 200x Fields
800
600
400
200
0
Naive
Vehicle
Anti-mouse
CSF1R
Enbrel
Front Paws
*
***
B
# of F4/80-Positive Cells
in Five 200x Fields
800
600
400
200
0
Naive
Vehicle
Anti-mouse
CSF1R
Enbrel
Knees
*
ns

FIG. 6

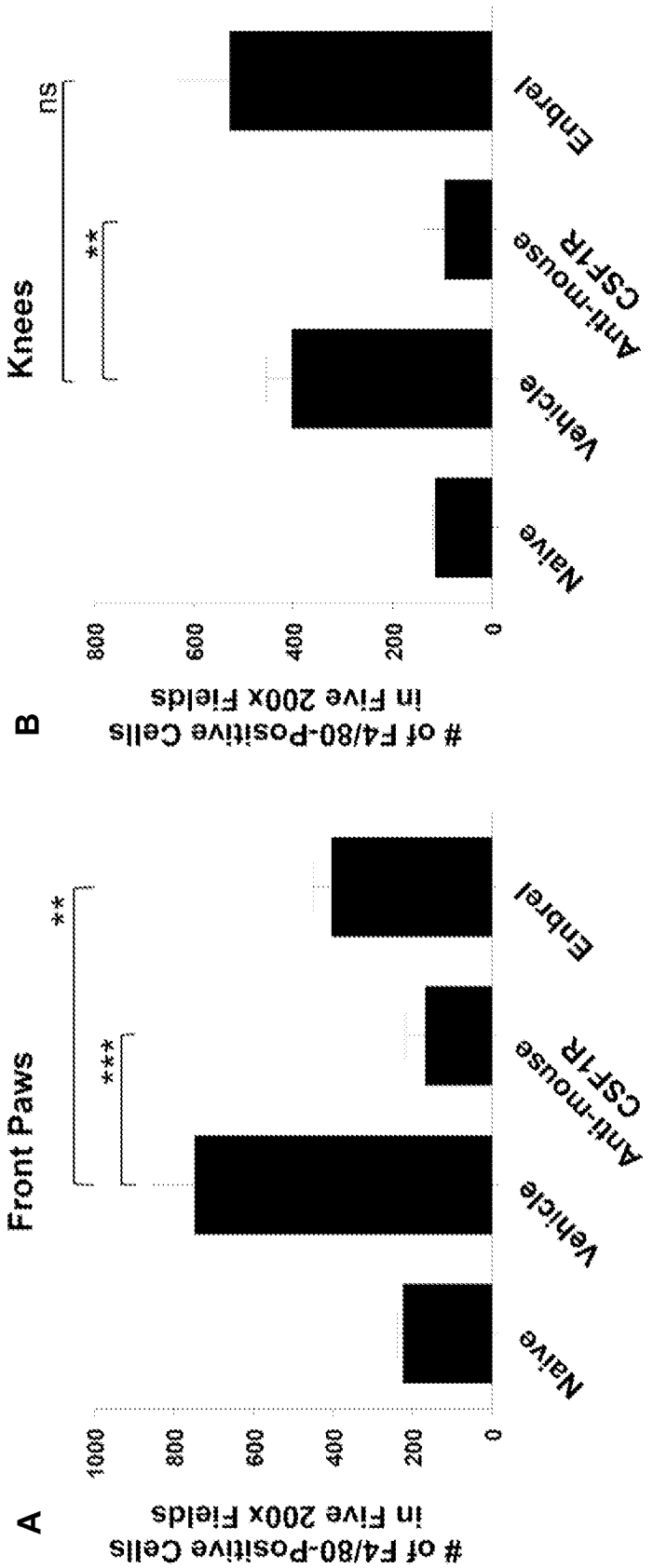

A
# of F4/80-Positive Cells in Five 200x Fields
1000
800
600
400
200
0
Front Paws
**
***
Naive
Vehicle
Anti-mouse CSF-1R
Enbrel
B
# of F4/80-Positive Cells in Five 200x Fields
800
600
400
200
0
Knees
ns
**
Naive
Vehicle
Anti-mouse CSF-1R
Enbrel

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/57442

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61K 39/395; A61P 19/02, 29/00; C07K 16/28; C12Q 1/48; G01N 33/564 (2013.01)
USPC - 424/130.1, 141.1, 143.1; 530/388.1, 388.15
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A61K 38/00, 39/395; A61P 19/02, 29/00; C07K 16/28; C12P 21/08; C12Q 1/48; G01N 33/564; G01N 33/68 (2013.01)
USPC - 424/130.1, 141.1, 143.1; 530/387.1, 387.3, 388.22, 386, 388.1, 388.15

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest; 'CSF-1R/cFMS blocking antibody,' 'CSF-1,' 'IL-34,' 'IL-6,' 'TNF-alpha,' 'Methotrexate inadequate responder,' 'TNF inadequate responder,' 'rheumatoid arthritis'

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 8206715 B2 (WONG, J et al.) June 26, 2012; abstract; column 5, lines 59-60; column 6, lines 23-25; column 6, lines 29-32; column 6, lines 59-60; column 7, lines 1-3; column 9, lines 4-7; column 28, lines 64-66; column 29, lines 1-38; column 30, lines 59-64; column 31, lines 3-6; figures 8, 9	74 ----- 1, 2, 3/1, 3/2, 4/3/1, 4/3/2, 10, 11, 12/10, 12/11, 13/12/10, 13/12/11, 20-22, 27, 28, 29/27, 29/28, 34, 35, 36/34, 36/35, 47, 48, 49/47, 49/48, 50/49/47, 50/49/48, 54, 55, 56/54, 56/55, 64, 65, 75, 76/74, 76/75
Y	IRVINE, KM et al. A CSF-1 Receptor Kinase Inhibitor Targets Effector Functions And Inhibits Pro-Inflammatory Cytokine Production From Murine Macrophage Populations. September 2006. Vol. 20; pages 1921-1923; abstract; page E1320, column 1, paragraph 2; page E1321, column 2, paragraph 2; figures 6B, 7D.	1, 2, 3/1, 3/2, 4/3/1, 4/3/2, 10, 11, 12/10, 12/11, 13/12/10, 13/12/11, 20, 21, 22/21, 22/20, 27, 28, 29/27, 29/28, 34, 35, 36/34, 36/35, 54, 55, 56/54, 56/55, 64, 65
Y	WO 2012/082573 A1 (PAULDING, C et al.) June 21, 2012; page 2, paragraph 2; page 27, paragraph 6; page 28, paragraph 1; page 74, paragraph 2.	47, 48, 49/47, 49/48, 50/49/47, 50/49/48, 56/54, 56/55
Y	SEEFF, KB. Should There Be A Standard Of Care (SOC) For Drug-Induced Liver Injury (DILI)? 23 March 2011. Presentation: Slides 1-20; Slides 8, 10.	75, 76/75

☒ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 December 2013 (23.12.2013)	07 JAN 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/57442

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 5-9, 14-19, 23-26, 30-33, 37-46, 51-53, 57-63, 66-73, 77-81
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/57442

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PASTERNAK, RC. ACC/AHA/NHLBI Clinical Advisory On The Use And Safety Of Statins. 07 August 2002. Vol. 40: pages 567-572; page 567, column 2, paragraph 2; page 570, column 1, paragraph 6.	76/74, 76/75