Table 2. Comparison of biologic agents: mechanisms of action, indications, dosing, and half-lives [3, 14, 19-28]

Drug	Mechanism of Action	On Label Indications	Off Label Indications	Dosing	Half-Life
Remicade (infliximab)	Chimeric IgG1κ monoclonal antibody (human constant region and murine variable region) specific for human tumor necrosis factor-alpha. Binds to both soluble and membrane-bound TNF-alpha.	Crohn's disease; ulcerative colitis; rheumatoid arthritis in combination with methotrexate; ankylosing spondylitis; psoriatic arthritis; plaque psoriasis	For anti-TNF agents as a class: sarcoidosis; pyoderma gangrenosum; Behcet's; apthous stomatitis; hidradenitis suppuritiva; pemphigus vulgaris; graft versus host disease; granuloma annulare; necrobiosis lipoidica diabeticorum; erythema multiforme; Sweet's syndrome; subcorneal pustular dermatosis; vasculitis (e.g., Wegener's granulomatosis); pityriasis rubra pilaris; SAPHO syndrome; multicentric reticulohistiocytosis[16]	For plaque psoriasis, the recommended dose is 5 mg/kg given as an intravenous induction regimen at 0, 2, and 6 weeks, then every 8 weeks. If there is a suboptimal response , we shorten the interval by 1 to 2 weeks to a minimum of every four weeks, and if that does not work, we increase the dose to 10mg/kg. Once 10mg/kg at q4weeks fails, it is time to switch therapies. Infuse over not less than 2 hours. Have medication for treatment of hypersensitivity on hand: acetaminophen, antihistamines, corticosteroids, and/or epinephrine.	7.7-9.5 days
Enbrel (etanercept)	Enbrel is a dimeric fusion protein consisting of the extracellular ligand-binding portion of the human tumor necrosis factor receptor linked to the Fc portion of human IgG1. Etancercpt blocks both TNF-alpha and TNF-beta. Therapeutic efficacy recapture rates are very high.	Rheumatoid arthritis alone or with methotrexate; polyarticular juvenile idiopathic arthritis ages 2 and up; psoriatic arthritis with or without methotrexate in patients who do not respond to methotrexate alone; ankylosing spondylitis; plaque psoriasis in adults	See infliximab	For psoriasis, a starting dose of 50 mg s.c. twice weekly is given for three months followed by 50 mg once weekly. For psoriatic arthritis, the dose is just 50mg sc weekly. If proper training is received, the patient can self-administer the medication. Off label: pediatric psoriasis at 0.8mg/kg up to 50mg weekly[14]	102 hours
Humira (adalimumab)	Recombinant human IgG1 monoclonal antibody specific for human tumor necrosis	Rheumatoid arthritis; juvenile idiopathic arthritis (ages 4 and up); psoriatic arthritis; ankylosing spondylitis; Crohn's disease; plaque	See infliximab	The recommended dosage for Humira is an initial dose of 80 mg followed by 40 mg every other week starting one week after the initial dose. With proper training, the patient can self-administer the	2 weeks

	factor-alpha.	psoriasis		medication subcutaneously.	
Simponi (golimumab)	Human IgG1κ monoclonal antibody that binds to both the soluble and transmembrane bioactive forms of human TNF-alpha	Adults with rheumatoid arthritis in combination with methotrexate; psoriatic arthritis alone or in combination with methotrexate; ankylosing spondylitis	See infliximab	Simponi is given subcutaneously once a month at a dose of 50 mg. With proper training, the patient can self-administer the medication.	2 weeks
Cimzia (certolizumab)	Recombinant, humanized antibody Fab' fragment with specificity for TNF-alpha, conjugated to polyethylene glycol	Crohn's disease in adults with moderately to severely active disease who have failed conventional therapy; treatment of adults with moderately to severely active rheumatoid arthritis. Not indicated for children.	See infliximab	Rheumatoid arthritis dosing: 400 mg initially and at weeks 2 and 4 followed by 200 mg every other week. For maintenance dosing, 400 mg every 4 weeks can be considered. For Crohn's, 400mg initially and at weeks 2 and 4 followed by 400mg every four weeks.	2 weeks
Amevive (alefacept)	Dimeric fusion protein consisting of the extracellular CD-2 binding portion of the human leukocyte function antigen-3 (LFA-3) linked to the Fc portion of human IgG1. Interferes with lymphocyte activation by specifically binding to the lymphocyte antigen, CD2, inhibiting LFA-3/CD2 interaction. Induces reductions in CD4+ and CD8+ T lymphocyte counts.	Moderate to severe plaque psoriasis	Psoriatic arthritis	The recommended dose of Amevive is 15 mg given intramuscularly as an injection once weekly for 12 weeks. Another 12 weeks of medication can be given if CD4+ counts are normal. At least 12 weeks must pass between courses. Some extend the initial course to 16 weeks. Use within four hours of reconstitution.	270 hours

Stelara (ustekinumab)	Human IgG1κ monoclonal antibody against the p40 subunit of the interleukin-12 and -23 cytokines.	Plaque psoriasis of adults	Psoriatic arthritis	The recommended dose for patients weighing less than 100 kg is 45 mg initially followed by 45 mg given 4 weeks later. Then, 45 mg is given every 12 weeks. If the patient is >100 kg the dose is 90 mg at the same intervals. Stelara is given by subcutaneous injection by a healthcare provider.	14.9-45.6 days
Rituxan (rituximab)	Chimeric murine/human monoclonal IgG1 kappa antibody against CD20 antigen, found on pre-B and mature-B lymphocytes. Not found on hematopoietic stem cells, pro-B-cells, or normal plasma cells. The Fc domain of rituximab recruits immune effector functions to mediate B-cell lysis. Rituxan is detected in the serum for up to six months after therapy.	Non-Hodgkin's lymphoma; chronic lymphocytic leukemia; rheumatoid arthritis in combination with methotrexate in adults failing one or more TNF antagonist therapies	Autoimmune mediated blistering diseases (e.g., pemphigus vulgaris, bullous pemphigoid); lupus; Sjogren's syndrome; antibody-mediated vasculitis (e.g., cryoglobulinemia); dermatomyositis; other antibody-mediated autoimmune disorders	Rheumatoid arthritis dosing: two IV infusions of 1000 mg separated by two weeks every 24 weeks or based on clinical evaluation but no more often than every 16 weeks. Administer 100 mg methylprednisolone IV or its equivalent 30 minutes prior to each infusion to reduce incidence and severity of infusion reactions. Also premedicate with acetaminophen and an antihistamine before each infusion.	18 days
IVIG	Not fully elucidated; in PV, perhaps triggers consumption of overexpressed pathological antibodies	Primary humoral immunodeficiency; idiopathic thrombocytopenic purpura; chronic inflammatory demyelinating polyneuropathy	Auto-immune blistering diseases (e.g., pemphigus vulgaris, bullous pemphigoid); erythema multiforme; chronic urticaria; TEN; pyoderma gangrenosum; systemic lupus erythematosus; dermatomyositis; Kawasaki's disease. Approved by Medicare as an indication for PV (one of many instances where insurance coverage drives choice of medication over and above FDA)	2g/kg divided over two to four consecutive days for acute flares – usually 2 to 3 months only. Authors try to get three doses in one week period if patient cannot do consecutive days; no more than 1g/kg/day is a good rule. Have epinephrine at bedside in case of anaphylaxis. Not compatible with saline, so dilute with D5W. Use only 18 gauge needle to penetrate the stopper from the 10mL vial; 16 gauge needles or dispensing pins for the 25mL vials and larger. Infuse at rate of 0.01mL/kg/min for	35 days

				first 30 minutes, then increase to 0.02mL/kg/min in 15 minutes, then increase by 0.02mL/kg/min every 15 minutes to maximum of 0.08mL/kg/min[17]. Store no longer than 6 months at room temperature, 36 months at 2-8^{o}C. In those predisposed to thrombotic events, use the minimum infusion rate practicable.	