Drug pipeline 2Q17

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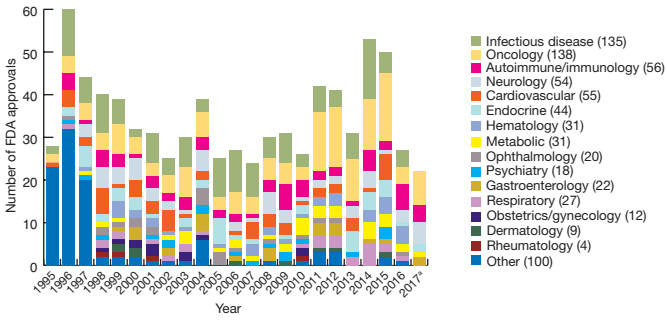
FDA approvals continue the upward trend noted in the first quarter, with the registration of the first deuterated compound, a new small-molecule drug for amyotrophic lateral sclerosis (ALS) and accelerated approval of Imfinzi, a checkpoint inhibitor for use in bladder cancer. A slew of drugs gained breakthrough therapy designation (**Supplementary Table 1**). The first approved gene therapy Glybera was axed for economic reasons; two biosimilars ran into trouble at the FDA.

Historic US regulatory approvals by lead indication



[a]2017 partial year from January 1 to June 30, 2017. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com)

Notable upcoming catalysts (3Q17)

Drug/company	Indication	Drug information
Nerlynx (neratinib maleate)/Puma Biotechnology	Breast cancer	7/21/2017 FDA PDUFA date for this irreversible multi-tyrosine kinase inhibitor of ERB4/HER4, epidermal growth factor receptor (EGFR) and HER-2/neu
Idhifa (enasidenib)/ Celgene	Acute myelogenous leukemia	8/30/2017 FDA PDUFA date for the first isocitrate dehydrogenase 2 inhibitor
Sirukumab/Johnson & Johnson	Rheumatoid arthritis	9/22/2017 FDA PDUFA date for this fully human mAb against interleukin (IL)-6
CTL019 (tisagenlecleucel-t)/Novartis	Acute lymphocytic leukemia	7/12/2017 and 9/21/2017 FDA Advisory meeting and FDA PDUFA date for this autologous engineered chimeric antigen receptor (CAR) T cell therapy against CD-19
Translarna/PTC Therapeutics	Duchenne muscular dystrophy	9/28/2017 FDA advisory meeting for this small molecule that increases ribosome read-through at stop codons

FDA, US Food and Drug Administration; PDUFA, Prescription Drug User Fee Act; mAb, monoclonal antibody. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com)

Notable setbacks (2Q17)

Drug/company	Indication	Summary
Baricitinib/Eli Lilly	Rheumatoid arthritis	4/14/2017 FDA sent a complete response letter for this small-molecule inhibitor specific for STAT/JAK 1 and 2 owing to insufficient data on dosage and safety
Glybera (alipogene tiparvovec)/ uniQure	Lipoprotein lipase deficiency	4/20/2017 Company announced that it will not renew marketing authorization from the EMA for its adeno-associated virus-delivered LPL gene due to economic considerations
Xilonix/XBiotech	Colorectal cancer	5/18/2017 EMA CHMP panel issues negative opinion on this natural IgG4/kappa anti-IL-1 mAb autoantibody clone due to lack of improvement in body mass or weight gain, and an increased risk of infection
Adlumiz (anamorelin)/ Helsinn Healthcare	Cachexia/ weight loss	5/18/2017 CHMP panel issues negative opinion on this oral, synthetic, small-molecule ghrelin mimetic owing to marginal effect on body mass/quality of life
Biosimilar Pegfilgrastim/Coherus	Neutropenia/ leukopenia	6/12/2017 FDA sent a complete response letter with a request for a revised immunoassay and more details on manufacturing.
Biosimilar Retacrit/ The Galencia Group	Anemia from renal failure, dialysis-dependent	6/22/2017 FDA sent a complete response letter for this Epogen biosimilar due to issues at the manufacturing plant unrelated to Epogen manufacture.

FDA, US Food and Drug Administration; mAb, monoclonal antibody; EMA, European Medicines Agency; CHMP, The Committee for Medicinal Products for Human Use. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com)

Notable approvals (2Q17)[a]

Drug/company	Indication	Drug information
Alunbrig (brigatinib)/ Takeda	Non-small cell lung cancer (NSCLC)	4/28/2017 FDA granted accelerated approval for this small-molecule anaplastic lymphoma kinase (ALK) inhibitor for patients with the ALK-L1196 mutation
Imfinzi (durvalumab)/ AstraZeneca	Bladder cancer	5/1/2017 FDA granted accelerated approval for this human IgG1 monoclonal antibody (mAb) against B7-H1, blocking interactions between B7-H1 and programmed death (PD)-1 or CD80 (B7-1).
Bavencio (avelumab)/ Merck KGaA	Bladder cancer	5/17/2017 FDA granted accelerated (conditional) approval for a fully human IgG1 antiPD-L1 mAb
Austedo (deutetrabenazine)/Teva	Huntington's disease	4/17/2017 FDA granted accelerated approval for this first deuterated-substituted tetrabenazine
Brineura (cerliponase alfa)/BioMarin	Neuronal ceroid lipofuscinosis	4/27/2017 and 6/1/2017 FDA and EMA approved this enzyme replacement for tripeptidyl peptidase-1
Rydapt (midostaurin)/ Novartis	Acute myelogenous leukemia and mastocytosis	4/28/2017 FDA approved this small-molecule inhibitor of fms-like tyrosine kinase 3, vascular endothelial growth factor receptor (VEGFR), platelet-derived growth factor receptor (PDGFR), protein kinase C, and KIT/c-KIT
Radicava (edaravone)/ Mitsubishi	Amyotrophic lateral sclerosis	5/5/2017 FDA approved this small-molecule noran-tipyrine free-radical scavenger
Rebinyn (PEG-rFIX)/ Novo Nordisk	Hemophilia B	5/31/2017 and 6/6/2017 FDA and EMA approved this glyco-PEGylated derivative of recombinant Factor IX

[a]A list of breakthrough drugs is provided in **Supplementary Table 1**. FDA, US Food and Drug Administration; mAb, monoclonal antibody; EMA, European Medicines Agency. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com)

Notable clinical trial results (2Q17)

Drug/company	Indication	Summary
AMG 334 (erenumab)/Amgen	Migraine and other headaches	6/27/2017 In phase 3 randomized placebo-controlled trial of IgG2 mAb to calcitonin gene-related peptide receptor, patients had fewer migraines and used less migraine medication at all doses relative to placebo. (*Lancet* **16**, 425–434, 2017)
Epidiolex (cannabidiol)/GW Pharmaceuticals	Dravet syndrome (epilepsy)	5/24/2017 Phase 3 randomized trial of 120 children with uncontrolled seizures found median frequency of seizures decreased from 12/month to 6/month with cannabidiol compared with placebo. (*N. Engl. J. Med.* **376**, 2011–2020, 2017)
Benralizumab/ AstraZeneca	Asthma	5/22/2017 In randomized placebo-controlled trial, patients receiving humanized, recombinant, afucosylated IgG1κ mAb against alpha subunit of IL-5R were fourfold less likely to require steroids than those receiving placebo. (*N. Engl. J. Med.* **376**, 2448–2458, 2017)
RT002 (daxibotulinumtoxinA)/Revance Therapeutics	Wrinkles	6/15/2017 In phase 2 randomized double-blind trial of Botox formulated with a lyophilized straight-chain peptide of lysines containing HIV Tat domain or the protein transduction domain of Antennapedia, patients had greater response rate and duration compared with Botox (*Dermatol. Surg.* doi:10.1097/DSS.0000000000001206, 2017)

mAb, monoclonal antibody. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com) FDA, US Food and Drug Administration; mAb, monoclonal antibody; EMA, European Medicines Agency; CHMP, The Committee for Medicinal Products for Human Use. Source: BioMedTracker, a service of Sagient Research (http://www.biomedtracker.com)

Note: Any Supplementary Information and Source Data files are available in the online version of the paper.

Laura DeFrancesco is Senior Editor at Nature Biotechnology.