

Dealmaking for inflammatory disorders

Recently announced inflammation deals selected by *BioPharma Dealmakers* highlight the approaches companies are taking to target disorders in this area, specifically those affecting the gastrointestinal system.

BioPharma Dealmakers

Diseases in which inflammation has an important role include gastrointestinal disorders such as Crohn's disease, musculoskeletal conditions such as rheumatoid arthritis and skin disorders such as psoriasis. Targeting key inflammatory mediators such as tumor necrosis factor has proved to be a successful broad approach for treating such diseases. To address unmet medical needs in the

area, companies are continuing to search for ways to target other mediators, such as Janus kinases and vascular adhesion protein 1, as well as exploring new types of interventions for particular diseases, such as cell therapies and microbiome-based therapies. This is illustrated by recent deal activity in the inflammation area overall (Table 1) and for gastrointestinal diseases specifically (Table 2).

Table 1: Selected inflammation deals since 2015

Date	Companies	Deal summary
January 2016	Fibrocell Science, Inc.; Intrexon Corporation	Fibrocell has signed an exclusive channel collaboration with Intrexon Corporation to develop genetically modified fibroblasts for the treatment of chronic inflammatory and degenerative diseases of the joint. The agreement will see Fibrocell pay Intrexon a technology access fee of \$10 million to partner its cell-engineering techniques with the Fibrocell fibroblast platform to develop potential candidates.
December 2015	Galapagos NV; Gilead Sciences, Inc.	Galapagos has partnered with Gilead to develop and commercialize the JAK1-selective inhibitor filgotinib for the treatment of inflammatory diseases. Positive phase 2 data have shown the potential of filgotinib as an oral therapy for both rheumatoid arthritis and Crohn's disease. The deal involves an up-front payment of \$725 million from Gilead and up to \$1.35 billion in milestones.
December 2015	Proximagen Ltd. (a wholly owned subsidiary of Upsher-Smith Laboratories); Roche	Proximagen has signed a license agreement with Roche to develop a phase 2 small-molecule VAP1 inhibitor to potentially target inflammatory diseases together. Roche will then conclude late-stage development of the inhibitor.
November 2015	ProThera Biologics; ProMetic Life Sciences Inc.	Through a strategic partnership, ProMetic and ProThera will develop and commercialize plasma-derived IAIP products from ProMetic's platform to treat inflammatory conditions.
June 2015	Carna Biosciences, Inc.; Janssen Biotech Inc. (part of Johnson & Johnson)	Carna Biosciences has collaborated with Janssen Biotech to develop small molecules from one of its kinase-inhibitor programs for inflammatory and autoimmune disorders.
May 2015	Pharmaxis; Boehringer Ingelheim	Boehringer Ingelheim has acquired Pharmaxis' phase 1 anti-inflammatory candidate PXS4728A, a small-molecule VAP1 inhibitor. Boehringer Ingelheim will make an up-front payment of €27 million to Pharmaxis, and will assume all development, regulatory, manufacturing and commercialization responsibilities.
January 2015	X-Chem, Inc.; Janssen Biotech, Inc.	X-Chem has collaborated with Janssen Biotech to discover and develop small-molecule candidates to treat inflammatory diseases. X-Chem will receive an initial up-front payment; however, Janssen has an exclusive option to license the resulting candidates.
January 2015	California Institute for Biomedical Research (Calibr); Bristol-Myers Squibb	Bristol-Myers Squibb has signed a research collaboration with Calibr to develop small-molecule anti-fibrotic treatments. Any compounds successfully developed from the deal will be available for Bristol-Myers Squibb to license and commercialize.

IAIP, inter-alpha inhibitor protein; JAK1, Janus kinase 1; VAP1, vascular adhesion protein 1. Source: BioCentury BCIQ.

Recent activity in gastrointestinal dealmaking

Focusing on inflammatory gastrointestinal disorders specifically, the number of deals in the area over the past four years is shown in **Fig. 1**, and a selection of the gastrointestinal deals in 2015 and 2016 are listed in **Table 2**. The deals illustrate growing interest from a number of companies in exploring therapeutic strategies targeting the human microbiome, catalyzed by advances in the understanding of links between the gut microbiota and specific gastrointestinal disorders such as inflammatory bowel disease. As highlighted in the feature in our September 2015 issue (Manipulating the human microbiome to fight inflammatory disorders), 2014 was a particularly active year for partnerships involving the microbiome, and in 2015 Seventure Partners established a \$130 million fund, Health for Life Capital, dedicated entirely to microbiome-based innovations. In January this year, Ferring Pharmaceuticals partnered with the Karolinska Institute to launch a microbiome research center, and Takeda partnered with Enterome to develop microbiome-based therapies (**Table 2**).

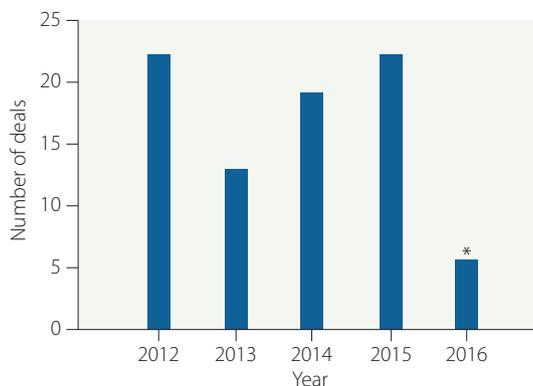


Figure 1: The number of gastrointestinal deals since 2012.

*Data for 2016 are from January to April only. Source: BioCentury BCIQ.

Table 2: Selected gastrointestinal deals since 2015

Date	Companies	Deal summary
January 2016	Karolinska Institute; Ferring Pharmaceuticals	Ferring Pharmaceuticals and the Karolinska Institute will jointly establish a research center to exploit the human microbiome in gastroenterology. The Karolinska Institute already has significant expertise in studying the human microbiome and will lead research, while Ferring will fund the project.
January 2016	enGene, Inc.; Takeda Pharmaceutical Company Ltd.	Takeda has partnered with enGene to develop and commercialize new therapeutics for gastrointestinal diseases. Using its Gene Pill gene delivery platform, enGene will take two targets up to IND-enabling studies, at which point Takeda will have the option to license and develop the candidates further. enGene will receive an initial up-front payment and will be reimbursed for any R&D costs.
January 2016	Enterome Bioscience SA; Takeda Pharmaceutical Company Ltd.	Takeda and Enterome signed a collaboration agreement to develop treatments for gastrointestinal disorders based on microbiome targets. Enterome, a microbiome specialist, will receive an up-front payment and R&D funding to discover potential therapeutics from gut bacteria.
December 2015	Cour Pharmaceutical Development Company, Inc.; Takeda Pharmaceutical Company Ltd.	Takeda and Cour Pharmaceuticals announced a strategic partnership to develop therapies for celiac and other gastrointestinal diseases. Potential compounds will be discovered using Cour's tolerizing immune-modifying nanoparticle platform, for which Takeda will make an up-front payment and additional milestone payments based on successful developments.
June 2015	Numab; Tillotts Pharma AG (part of the Zeria Group)	Tillotts Pharma has signed an exclusive licensing agreement with Numab AG to develop antibody therapies against TNF to treat patients with inflammatory bowel disease.
February 2015	Queen Mary University of London; Takeda Pharmaceutical Company Ltd.	Queen Mary University of London has partnered with Takeda on the discovery of new therapies to treat gastrointestinal disorders. The partnership will focus on understanding gastrointestinal sensory and motor mechanisms behind bowel disorders and gastrointestinal motility disorders.

IND, investigational new drug; TNF, tumor necrosis factor. Source: BioCentury BCIQ.