***The Articulate Biolubricant*:** A next-generation, cartilage-protecting viscosupplement providing significantly longer pain relief compared to existing and in-development osteoarthritis joint injections

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Articulate Biosciences' mission is to develop and deliver long-lasting pain relief and restoration of mobility to sufferers of osteoarthritis in the human and veterinary medical fields. Through deep understanding of patient and clinician needs, combined with innovative breakthroughs in medical device technology, Articulate Biosciences strives to bring back quality of life by eliminating chronic joint pain.

Company Description

Articulate Biosciences is a pre-seed medical device startup, spun out from technology developed at Boston University. The company's lead product candidate is a Class III medical device (a viscosupplement) for injection into osteoarthritic knee, hip, and finger joints. Articulate Biosciences is seeking rapid growth to execute the preclinical studies required for entry into the veterinary medical device market, followed by a pilot clinical trial to support approval in humans in US and foreign markets.

Clinical Need: Osteoarthritis (OA)

OA affects 27M individuals in the US (projected >40M by 2030), and in the veterinary field, 60% of all equine lameness is related to OA. OA may be treated by viscosupplementation—injection of viscous solutions of hyaluronic acid, the body's own cartilage-protective biopolymer. However, hyaluronic acid viscosupplements provide minimal clinical benefit, as they are rapidly enzymatically degraded, do not reside within the joint for more than several days (reimbursement regulations only allow re-injection every six months), and have not been demonstrated to protect cartilage from wear. Of the 6M US patients who are currently candidates for viscosupplementation, only 1.2M are receiving viscosupplement injections due to existing treatments' ineffectiveness. Half of all US adults with knee OA will eventually undergo a total knee replacement, equating to 700k knee replacements per year (projected 3.5M by 2030). Moreover, about 1.5M of the 4M adults currently living with a replaced knee are 50-69 years old—relatively young, suggesting a likelihood for costly and risky revision surgery within their lifetime. The Articulate Biolubricant aims to slow OA progression to delay or obviate knee replacement.

Viscosupplementation reinvented

The Articulate Biolubricant's composition is completely different from existing supplements: a synthetic, **non-hyaluronic-acid** polymer, lasting significantly longer within the joint than competitors.

Next-generation Supplement: *The Articulate Biolubricant*

Competitive advantage. Articulate's innovative product is an improved viscosupplement: a proprietary, synthetic (non-hyaluronic-acid), biocompatible polymer providing pain relief and protection of cartilage from degeneration. In contrast to hyaluronic acid's susceptibility to degradation (thus short residence in the joint), a synthetic yet biomimetic polymer—used in FDA-approved stents, contact lenses, and surgical meshes—is the Articulate Biolubricant's primary component. The product has a **4-month residence time** in rodent knees in vivo, with eventual renal clearance and no accumulation within the body. The polymer is not enzymatically degraded, is thermally stable (can be autoclaved), and **significantly protects cartilage from wear** ex vivo. Furthermore, our product will be the first to treat small synovial joints such as finger and ankle joints, and it can be injected through a significantly smaller needle than existing viscosupplements, greatly increasing patient acceptance.

In-development competition. There are several other synthetic cartilage protectants in development; our 4-month residence time is the Articulate Biolubricant's distinguishing feature, as the in-development competitors have not demonstrated comparable extended residence time on the order of several months.

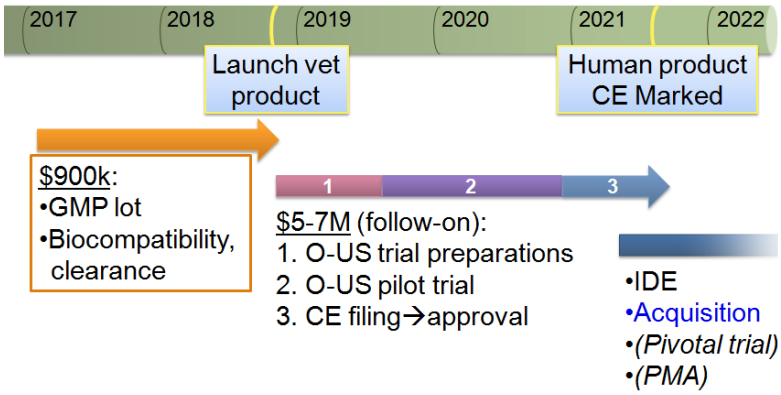
Market Opportunity

Human viscosupplements have global sales of $2B annually ($900M US, $700M Japan, remainder predominantly Europe). Only about 20% of the population eligible for viscosupplementation is receiving such treatment. The potential market is experiencing rapid growth, as there is an increased aging population as well as more athletes (human and equine) suffering joint injury. Moreover, the 2013 guidelines from the American Academy of Orthopedic Surgeons cease to recommend hyaluronic acid viscosupplementation, creating a void in the market that our non-hyaluronic-acid product will fill. The equine market is $100M, representing an earlier sector for revenue-generation during ongoing development.

Strategy and Exit Plan

Articulate Biosciences' strategy is to complete preclinical testing and demonstrate efficacy in a clinical trial. Concurrent with first establishing veterinary sales (**2018**), CE Marking in Europe for humans will be sought (**2021**), followed by IDE granting (Class III device) (**2022**). The likely exit for investors will be acquisition prior to pivotal trial initiation by a larger company with a sales force targeting primary care, orthopedics, physiatry, sports medicine, rheumatology, and geriatrics.

IP surrounding the Articulate Biolubricant's composition and method of manufacture was filed in November 2014 (priority date November 2013) and applications entered major relevant national stage jurisdictions in May 2016 (US, EPO, and Japan). Articulate Biosciences, led by the product's inventors, is obtaining the exclusive worldwide technology license from Boston University.



Articulate Biosciences' projected development milestones.

Funds Raised and Anticipated Need

Articulate Biosciences has funded development via federal and private research grants which have supported ex vivo testing and in vivo rodent studies. A Phase I SBIR grant ($200k) is pending. We will seek a seed round of $900k during 2017 to fund complete development of an equine viscosupplement and one cGMP batch of product to commence sales in approximately 18 months. This development includes engineering and actual cGMP runs, ISO 10993 biocompatibility and biodistribution/clearance testing on final specification-locked product, and consulting regarding product labeling and liability. Following demonstration of early sales growth via distributors and efficacy in treating larger numbers of horses, follow-on funding ($5-7M) will be sought to obtain CE Marking. Much of the veterinary product development will support CE filing in order to maximize early funding, with veterinary product revenue (beginning in 2018) being used to offset expenditures of the human product's development.

Partnering and Investment Opportunity

Articulate Biosciences is seeking collaborative development partners or investment to complete preclinical testing, enter the veterinary market, gain CE Marking, and apply for an IDE with the FDA.

Team

Founders:	Benjamin Cooper, PhD, CEO & Director of Research – Biomaterials chemist leading product development. Deep expertise in polymer chemistry and cartilage treatment evaluation. Co-inventor of lead technology.
	Mark Grinstaff, PhD, CTO – Distinguished Professor of Translational Research (Boston University), prolific inventor, and co-inventor of lead technology. Six medical device startups, with four products in clinical use.
Clinical advisors:	Brian Snyder, MD, PhD – Orthopedic Surgeon, Beth Israel and Boston Children's Hospitals, Harvard Medical School. One prior orthopedic device startup, with one product in clinical use.
	Laurie Goodrich, DVM, PhD – Professor in Equine Surgery and Lameness. Experienced in novel OA viscosupplement evaluation at world-renowned equine orthopedic facility at Colorado State University.
Scientific advisors:	Andy Carter, PhD – Former CTO (Anika Therapeutics). Responsible for viscosupplement (MONOVISC) development through clinical trials. Scientific, business development, and regulatory affairs experience.
	Robert Miller, PhD – Former Sr. Director and VP of R&D (Genzyme). Responsible for development of Synvisc-ONE and other hyaluronic acid biomaterials. Chemistry, engineering, and osteoarthritis expertise.
	Elliott Gruskin, PhD – Former World Wide President of Biomaterials (DePuy Synthes). Managed orthopedic biomaterial development from concept through approval, supervising R&D team of 200 personnel.
Regulatory advisors:	Lee S. Simon, MD – Former FDA Division Director and clinical rheumatologist. Direct participation in viscosupplement (Synvisc-One) regulatory examination. 10+ years consulting medical device development.

Dr. Cooper has participated on behalf of Articulate in the BU Questrom School of Business Startup Accelerator, Brandeis University Hassenfeld Innovation Center Lean LaunchPad Program, and four Boston-area showcase events.

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