BIOMX
A Unique Microbiome Company with Substantial Market Potential
NYSE: PHGE
BiomX – Uniquely Positioned To Uncover Significant Market Opportunity

Exchange: NYSE  Ticker: PHGE

CHAC and BiomX Business Combination Agreement

Chardan Healthcare Acquisition Corp. (NYSE: CHAC, “PHGE”), a special purpose acquisition company (“SPAC”) sponsored by affiliates of Chardan Capital Markets LLC (“Chardan”), and BiomX Ltd. (“BiomX”) entered into a business combination merger agreement on 17 July 2019 to create a publicly listed microbiome company under ticker PHGE focused on developing both natural and engineered phage therapies. The merger was completed on 28 October 2019.

BiomX Business Overview

BiomX is a microbiome company that develops customized phage therapies aimed to treat chronic diseases, including inflammatory bowel disease (IBD) and colorectal-cancer (CRC), as well as acne that affects the skin appearance, which present significant market potentials.

BiomX treats the microbiome as a therapeutic target, a very distinctive perspective than many other microbiome companies. BiomX also approaches phage differently, where the Company uses the customized phage therapy to target and eradicate harmful bacteria associated with the chronic diseases, contrary to the “additive” approach commonly adopted by other companies where “good” bacteria is added to treat diseases.

With the Company’s mission to develop precision medicines in the microbiome sector to treat chronic diseases, BiomX applies its cutting-edge, proprietary computational platforms and synthetic-biology technology enabled solutions to discover and validate proprietary bacterial targets, as well as to compose customized cocktail containing multiple phage types to effectively counter those harmful bacterial targets.

Microbiome – A promising field for new drug discovery

Microbiome is found an assuring tool to predict the existence and state of a wide range of chronic diseases, as well as displays the potential to predict responses to specific IBD therapeutics and immune-oncology.

The composition of bacteria has been linked to various chronic health conditions, such as gastrointestinal disorders, obesity, allergies and even cancer. The microbiome has demonstrated to be effective in predicting the existence and stage/state in IBD, colorectal cancer, liver and cardiovascular diseases, and is being used to develop new medicines aimed at treating these chronic diseases. Overall, microbiome presents a new, exciting and fast-emerging field with plentiful opportunities for new drugs discovery.

1 BiomX's company press release
Once BiomX uses its sophisticated technology to identify and validate a pathogenic bacteria in the microbiome specific to a certain disease, the Company then develops customized phage therapies to target and destroy the specific bacteria, aiming to restore the microbiome back to a healthy condition.

**Steps required to effectively develop Phage Therapies**

As illustrated by the diagram, developing phage therapies starts with phage hunting. Hunting for the best suited phage is the required first step to effectuate a phage therapy cultivation, which requires the use of a wide range of clinical and environmental phage-containing samples, to be processed against a range of bacterial hosts to automatically extract prophage.

The logical next step is to use advanced synthetic biology for phage engineering, or SynBio, which involves expanding host range, converting lysogenic into lytic, and incorporating payload to eradicate a wider array of bacterial strains, as well as to overcome bacterial resistance, if necessary.

The final step is to customize the phage “cocktail” through multi-dimensional optimization, both in-vitro and in-vivo, to achieve best activity. These dimensions include host range, biofilm, receptor analysis, resistance, toxic genes, and manufacturing.

**BiomX – Uniquely Positioned to Uncover Significant Market Opportunities**

I. **Proprietary Technology Coupled With Internal Manufacturing & Engineering Capabilities**

Through partnership and exclusive licensing, BiomX garners a proprietary phage discovery platform and synthetic biology technology.

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2 BiomX’s company website
BiomX uses its robust phage-hunting platform to target unique bacteria, and has the capacity to revise/adjust the new phages using synthetic biology to form more effective phage cocktail. Customizing phage is a disruptive technology enabling BiomX to discover new drugs targeting to treat chronical diseases, which comes with significant market potential.

Additionally, BiomX has the in-house manufacturing and other engineering capacity to support its clinical trials. Having control over this important component has proved highly advantageous for BiomX over its competitors.

**Proprietary Biomarker Discovery Platform - Xmarker**

BiomX has devised a robust platform for discovering new phages to target unique bacteria.

The Company’s XMarker is the first-of-its-kind platform that incorporates a metagenomics-based approach to help uncover predictive microbial genomic signatures, which are then further processed into its proprietary, microbiome-based biomarkers. BiomX uses its XMarker platform to develop classifiers of high sensitivity and specificity, empowered by ultra-high resolution DNA analysis, high-scale cloud computing resource and AI technology.

**Target and Validation of Bacteria**

BiomX can gain access to the candidate bacteria targets through academia/industry licensing. The Company can then apply its proprietary computational platform to go through a robust validation process for these candidates, entailing the analysis of patient cohorts, in-vitro, ex-vivo and animal validation models.

The patient cohort analysis involves the collection of microbiome sample, from both the patients and healthy people globally. Once the sample collection is done, the Company will then appraise, revalidate and analyze multiple parameters to advance valid targets to phage discovery, with the ultimate goal to produce phage cocktail that targets and destroys harmful bacteria in chronic diseases.

Additionally, as bacteria is typically resistant to phage therapy, a multi-phage cocktail is then used to counteract such resistance by attacking the target bacteria from different angles, to potentially improve the therapeutic effect.

**II. Strong Product Pipeline To Catalyze BiomX Market Potential:**

BiomX has a fairly strong pipeline of microbiome-focused phage therapeutics and diagnostics products. In early 2019, BiomX raised $32 million in Series B financing, primarily to be used for the advancement of leading IBD and acne programs to the clinic, Ness Xiaon, Israel.

There are four initial programs - Acne, IBD, PSC and CRC to catalyze its business over the next 2 years³.

- Acne (BX001) - to initiate a phase I study in healthy volunteers, and mild-to-moderate acne subjects in 4Q2019, expecting to report results in phase I acne study in 1Q2020, and to initiate a phase II trial in acne in 2Q2020;
- IBD (BX002) - expected to initiate a phase I study in healthy volunteers and IBD patients in 1H2020, and to report topline results of phase I trial in IBD in 2H2020;
- PSC (BX003) - expected to initiate a phase I/II study in PSC in 2021

³ BiomX company website.
Current stages and expected implementation timeline of pipelines

<table>
<thead>
<tr>
<th>Product Candidates</th>
<th>Phage discovery</th>
<th>Preclinical</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Partners</th>
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<tbody>
<tr>
<td>Acne • BX001</td>
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<td>IBD • BX002</td>
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<td>PSC • BX003</td>
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<td>Colorectal cancer</td>
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<th>Biomarker discovery</th>
<th>Validation</th>
<th>Development</th>
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<tr>
<td>IBD (responder/ non-responder)</td>
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1H19  2H19  1H20  2H20  1H21  2H21

**BX001 – A product candidate for treating acne-prone skin**

Partners with the Global Cosmetics Company, BX001 is the Company’s topically administered product candidate, catered to improve the appearance of acne-prone skin. By targeting the bacteria associated with acne, BX001’s customized phage cocktail is expected to help control skin microflora. Specifically, BX001 is evidenced to be only active on antibiotic resistant P. acnes strains, but not targeting other bacteria on the skin. BX001 is also able to penetrate the biofilms, which is a matrix that would be otherwise inaccessible to antibiotics substance.

**BX002 – A product candidate for treating Inflammatory Bowel Disease (IBD)**

BX002 is BiomX’s revolutionary product candidate for treating IBD. Its customized phage cocktail is aimed to eradicate the Company’s proprietary bacterial targets, that are specifically linked to the onset of IBD and proved to be pro-inflammatory. BX002 targets a possible underlying cause for IBD, compared to the existing medications that only offer symptomatic relief without curing the disease.

**BX003 – A product candidate for treating Primary Sclerosing Cholangitis (PSC)**

PSC is a rare progressive liver disorder. Currently there is no FDA-approved treatment for PSC, given its rarity progressive liver disorder. The inflammation and fibrosis within the bile ducts could result in cholestasis condition, in that the bile flow from the liver is often interrupted. There are about 70% of PSC patients also have IBD. The high overlap in patients with both
diseases suggests the strong linkage between microbiomes in both diseases, and that the microbiome used to treat IBD could also be influential in developing new drug intended to treat PSC.

BiomX is developing a customized phage cocktail, BX003, to fight against specific strains of Klebsiella pneumoniae (Kp) isolated from the PSC patient’s gut microbiome. These bacteria targets could potentially affect progression of the disease, according to the report by Professor Takanori Kanai of Keio University School of Medicine, published in *Nature Microbiology* ([https://www.nature.com/articles/s41564-018-0333-1](https://www.nature.com/articles/s41564-018-0333-1))

**Colorectal Cancer (CRC) - Harnessing Synthetic Biology**

Colorectal cancer is the third most commonly diagnosed cancer in both men and women. There are growing evidences showing that the bacteria resided within tumors normally helps promote tumor growth, while also adds to the resistance to cancer therapeutics.

Continuing discoveries have also shown that Fusobacterium nucleatum (Fn) bacteria has been playing an active role in promoting resistance to cancer therapeutics\(^4\). This is providing an exciting opportunity in combining conventional therapeutics with a customized, counter-Fn phage cocktail to better treat for CRC patients.

BiomX has accordingly focused its CRC program on developing customized phage cocktails, aiming at eradicating the Fn bacteria, evidently enriched in colorectal cancer (CRC), by utilizing a synthetic biology approach to optimize the identified natural phages, such as killing the target bacteria, or expanding a host range of phage by allowing them to eradicate a wider array of bacterial strains aimed to suppress or overcome bacterial resistance to phage. These approaches have been developed by one of the Company’s scientific founders, Prof. Timothy K. Lu of MIT, who has published extensively on phage engineering.

### III. World-Class Partnerships and Strategic Investor Base

BiomX has strong partnerships and investments from the big pharma companies, including partnering with a global cosmetics company to develop BX001 for treating acne, and with Johnson-Johnson (JNJ) for microbiome analysis. The company’s technology is also validated by the equity investments made by both JNJ and Takeda (TYO:4502). Together with the world-class partners and investors, BiomX is gearing up to bring life-changing phage therapies to the market.

**Investor Profile – Life Science & Strategic**

![Investor Profile - Life Science & Strategic](image)

*Source: BiomX company website*

### IV. Partnership Enabling Exclusive Access To Technology & Targets

Through the strategic partnership, BiomX has proprietary access to targets in IBD and PSC, on top of exclusive access to Target discovery and validation platform technology.

*Exclusive access to technologies* - BiomX exclusively licensed two proprietary technologies developed at the Weizmann Institute of Science, Israel., including 1). access to phage discovery systems as the basis of the Microbiome Modulation platform, as well as in-vitro and in-vivo validation capabilities, and 2). access to the target bacteria discovery platform for identification of target bacteria and bacteria genes of complex microbiomes.

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Exclusive access to Novel targets - BiomX has exclusively sub-licensed from JSR Corporation a set of bacterial targets for the development and commercialization of phage therapies for IBD, and the Company is now advancing its IBD product - BX002, a phage composition customized to specifically target and eradicate these IBD associated pro-inflammatory gut bacteria.

Additionally, BiomX collaborates with the leading global cosmetic company in its phage therapy in Acne. BiomX collaborated with Johnson & Johnson Innovation for microbiome-based biomarkers discovery targeting to treat IBD, and licensed Novel Targets from Japan’s JSR Corp for liver disease phage therapy program.

Collaborative IBD drug development with JNJ - BiomX utilizes its XMarker microbiome-based biomarker discovery platform to stratify responders and non-responders to inflammatory bowel (IBD) disease therapeutics. XMarker applies a unique metagenomics-based approach to decipher full microbial genomic signatures that can be further developed into predictive biomarkers, to be used for key J&J IB drug development in diagnostics.

Collaborative development in intermediate drug formulation with Takeda - By collaborating with Takeda, BiomX is developing formulations for manufacturing intermediates, and for the final form to be administered of its phage therapies. The cooperation has found that the intermediate drug formulation enables cost-efficient long term storage and shipping condition, with virtually no loss in phage activity over extended periods of time.

V. A Mission Focused Leadership Team – Company Executives, Scientific Founders & Advisors

BiomX has a missioned focused leadership team encompassing the executive team, life-science focused scientific founders and advisors. The Company’s proprietary technologies in phage-therapies are steered by the cutting-edge research from the Company’s heavyweight scientific founders and advisors.

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<th>Management Team</th>
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<tbody>
<tr>
<td>Jonathan Solomon</td>
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<tr>
<td>Assaf Oron</td>
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<td>Sailaja Puttagunta, MD</td>
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<td>Sigal Fattal†</td>
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<tr>
<th>Scientific Founders</th>
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<tr>
<td>Prof. Rotem Sorek</td>
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<td>Prof. Eran Elinav</td>
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Source: BiomX company introduction ppt, September 2019
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