MULTISCALE INTEGRATED TECHNOLOGY SOLUTIONS, US

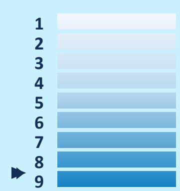
OPTIMIZING STEPS TO PREVENT THE SPREAD OF COVID-19 THROUGH NANOTECHNOLOGY

Challenges

- With the growth of number of Covid-19 cases globally, the adoption of facial mask has been essential. The facial mask which was only in high demand in the healthcare industry has experienced rapid. However, most of the commercialized N95 mask as well as fabric mask requires the additional need of anti-microbial coating in enhancing its application in combating the easily spread virus.
- The Multiscale Integrated Technology Solutions, a startup based in Indianapolis, US, has introduced adoption of copper-based nanoparticles for enhancing the anti-microbial features of fabric masks.

Technology Profile and Technology Readiness Level

- The technology development has been done, keeping in mind the anti-viral potential of the copper nanoparticle. The research was done by the collaboration with the Indiana University–Purdue University Indianapolis (IUPUI),US.
- Multiscale Integrated Technology Solutions has commercialized the nanoparticle.



Benefits

- The technology has been developed for mass production with the existing facilities . The anti-viral potential of the copper nanoparticle has been tested on the corona viruses in laboratory scale and has been adopted as the proof of concepts.

Institute Profile

- The startup has recently received $40,000 pre-seed investment from the Elevate Ventures, US. The company was founded in 2019 mainly focuses on fabricating layers of nanofibers for reinforcing composite materials. However, during the pandemic outbreak, the business shifted toward developing prevention technology.
- A nano 3D texture of the copper nanoparticle was created on the fabric mask using spray coating using roll on roll application system. Hence, there is no need of mask manufacturer to change their production process.

Growth Opportunities Across Industries/ Applications

Enable to optimize the prevention activity in a larger scale through the adoption in the air purification system:

- Apart from the facial masks, the technology is applicable for air filter technology, which enables the anti-viral technology to be adopted for air purification system in the heating, ventilation, and air conditioning (HVAC) of building facilities, such as hospital, residential, and offices. The air purification system enables to reduce the risk of spreading of the viruses.

Healthcare facilities, personal protection equipment (PPE)

Residential area, offices, and manufacturing facilities

UNIVERSITY OF NEBRASKA MEDICAL CENTER, US

NANOFIBER SWAB IMPROVES SARS-COV-2 TEST SENSITIVITY AND DETECTS VIRAL LOAD EVEN AT LOW CONCENTRATION

Challenges

- Currently to carry out COVID-19 test, long cotton or flocked swabs are utilized. These swabs collect the specimen from patients' nose and later the specimens are tested for reverse transcriptase-polymerase chain reaction (RT-PCR) to detect SARS-CoV-2 RNA.
- These swabs don't provide accurate results (false-negative results) during testing when viral load is low at early stage of infection and even is not capable of collecting enough amount of virus to be detectable.
- Considering these challenges, there is a need to develop swabs that can detect the viral load even at low concentration and simultaneously absorbs high amount of viruses.

Technology Profile

- Researchers at University of Nebraska Medical Center (UNMC), US, have developed porous nanofiber swab that can improve SARS-CoV-2 and other biological specimens test sensitivity.
- The research team have utilized electrospinning process to produce layers of nanofibers, which are 1 cm long. Further they have coated the nanofibers swab with thin layer of gelatin and freeze dried it for 20 minutes. Once dried, the swab tips are crosslinked in glutaraldehyde chamber for 24 hours. After crosslinking, nanofiber swabs are bonded to plastic swab sticks and before usage they are sterilized with ethylene oxide.

Technology Readiness Level and Publication

- The prototypes of nanofiber swabs are developed and the research team are partnering with healthcare facilities to commercialize it on an industrial level.
- The research results are published in *Nano Letters* journal on January 28, 2021.
- The research team received financial support from National Institute of General Medical Sciences.

Testing

- The research team when tested the nanofiber swab against commonly used flocked or cotton swabs used for COVID-19 test, showed high level of absorption and release of bacteria, proteins, cells, DNA, and viruses from liquid samples and surfaces.

Growth Opportunities Across Industries/ Applications

The medical sector is likely to benefit the most from the developed nanofiber swab, as it can detect SARS-CoV-2 even at lower concentration:

- The research team prepared the SARS-CoV-2 virus dilution and dipped the nanofiber swab into it and tested it for viral RNA with RT-PCR. The developed nanofiber swab detected the SARS-CoV-2 virus even at a lower concentration (10 times lower concentration) and also it helped to reduce false-negative rate.
- In addition to COVID-19 testing, developed nanofiber swab is also potential in testing foodborne illness and diagnosing biological specimens.

Medical

THE UNIVERSITY OF KANSAS MEDICAL CENTER, US

NANOPARTICLE DRUG DELIVERY SYSTEM INHIBITS TUMOR GROWTH IN PANCREATIC CANCER

Challenges

- The most common medication provided for the pancreatic cancer treatment is gemcitabine, which offers modest improvement in survival rate. Gemcitabine has limited effectiveness in low pH environment and pancreatic cancer also starts developing resistance against this drug. This is ascribed primarily to its ability to get degrade quickly in the body. Other medication extracellular receptor kinase inhibitor (ERKi) doesn't dissolve in water and provide problem in formulation. Additionally, it is also toxic in nature, which can damage other body parts.
- Considering these challenges, there is a need for effective medication that hinders the tumor growth without causing toxic side effects.

Company Profile

- Researchers at The University of Kansas Medical Center, US developed nanoparticle-based drug delivery system that potentially delivers pancreatic cancer drug (gemcitabine) and extracellular receptor kinase inhibitor (ERKi) efficiently without causing harm to other body parts.
- The two drugs are encapsulated in the nanoparticles, which are made up of proprietary polymers. The nanoparticle drug delivery system is designed in such a way that they can release drugs only when they come in contact with low pH environment. Adding ERKi to the gemcitabine and encapsulating in nanoparticle also helped in reducing body sensitivity to gemcitabine.

Technology Readiness Level and Publication

- The nanoparticle drug delivery system is developed on laboratory level and is yet not commercialized.
- The research is jointly conducted with North Dakota State University.
- The research results are published in *Molecular Pharmaceutics* journal on January 4, 2021.

Growth Opportunities Across Industries/ Applications

The medical sector is likely to benefit the most from the nanoparticle drug delivery system as it doesn't cause any toxic side effects:

- Pancreatic ductal adenocarcinoma is one of the most common pancreatic cancer found in the US population. Patients with pancreatic ductal adenocarcinoma have survival rate of 8% and are responsible for 7% of the cancer death in the US. The nanoparticle drug delivery system effectively delivers the drug to the tumor site without causing any toxic side effects. Additionally, the dosage of the drug required for treatment is minimum and it effectively hinders the tumor progression during treatment.

Medical

Future Potential

- The research team is working on other drugs such as taxanes, eribulin, vinorelbine, and ixabepilone with similar polymer nanoparticle system to treat other types of cancers, such as prostate, ovarian, and breast cancer.

ADVANCED TISSUE GENERATION TECHNOLOGY

BIOCHANGE LTD., ISRAEL

BIOCHANGE	
Product/ Technology	Tissue Regeneration
Type of Ownership	Private
Year Founded	2015
Headquarters	Israel
Key Markets	Europe
CEO	Ishay Attar
Investment Stage	NA
Total Funding	NA
Employees	1-10
Frost Radar	Not profiled

BIOCHANGE'S FOCUS & VISION

- BioChange based in Israel is a tissue regeneration company, which has the vision to improve and increase the healthy lifespan of an individual by restoring the tissues that have degenerated with age or restoring the damaged body functions.
- The company's patented technology platform was initially indicated for veterinary science. Treating urinary incontinence, the tissue regeneration technology was used to remodel the urethra.
- In 2017, the company developed its technology for skin tissue regeneration. Further clinical developments proved that the technology can be used for soft tissue augmentation after tumor removal.
- Its tissue regeneration technology called the CellFoam™ technology is used for the repair and growth of the tissue or organ which is damaged by natural degradation due to age or damage due to disease.

TECHNOLOGY ATTRIBUTES

FUNCTIONAL TISSUE GRAFT

CellFoam is an injectable bio-adhesive 3D foam structure, which initially is flowable, but solidifies on reaching the tissue site. This natural material based tissue graft is fully biocompatible and biodegradable. The scaffold stimulates cell growth due to its high cellular adhesion sites.

MEDICAL GRADE BIOMATERIAL

For shape stabilization of the tissue scaffold, a biological cross linker enzyme is used. By using this enzymatic crosslinking of biomaterial gelatin, the need for any chemical cross linker or need for UV light is avoided.

FLEXIBLE TECHNOLOGY

The foam-like tissue scaffold is adhesive, with flexible pore size and rheological properties.

INJECTABLE TISSUE SCAFFOLD FOR AESTHETIC DERMATOLOGY AND RECONSTRUCTIVE SURGERY

TECHNOLOGY ASSESSMENT

- Based on the CellFoam technology by BioChange, the company has developed a dermal regenerative scaffold. This is an injectable filler scaffold that supports fibroblast stimulation and regrowth of tissue. When injected inside the tissue, the 3D structure of Revolette™ provides excellent attachment sites for fibroblasts. This fibroblast rich environment stimulates not just production of new collagen, but also recovery of existing collagen. Its product- BlueStim™ is a dermal biostimulant which helps in correction of facial wrinkles and folds. Revol™ is a body contouring tissue scaffold.

KEY COMPETITORS

- Merz Pharma
- Galderma
- Sinclair Pharma
- Adocia, Paris
- Bellaseno

STRATEGIC ANALYSIS

S – STRENGTHS

- It is a novel soft tissue repair scaffold.
- This injectable solution is a welcome alternative to surgical aesthetic procedures and autologous implants for young and healthy skin.

W – WEAKNESSES

- Long-term efficacy and safety needs to be proven in the clinical studies.

O – OPPORTUNITIES

- Aesthetic dermatology and reconstructive surgery are booming markets. Moreover, the aging population is increasing the demand for these anti-aging solutions, creating great growth opportunities.

T – THREATS

- There are several tissue regeneration technologies and companies emerging, with faster clinical trials in progress. By being the first to market, they will get an advantage and be a challenge to BioChange.

FUTURE PLANS

BioChange is looking at exploring different applications for the tissue regeneration technology. It is collaborating with Università degli Studi di Milano, and BEL (Bioengineering Laboratories) to use CellFoam technology (PulmFoam™ COPD) to tranform the prognosis of chronic obstructive pulmonary disease. The company is also expanding its facility for the clinical stage development of BlueStim™.

ANALYST'S INSIGHTS

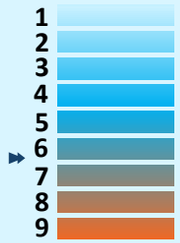
- The novel technology of enzymatic crosslinking of gelatin foam provides an optimal environment for fibroblasts stimulation which helps in new collagen production in scaffold pores.
- This minimally invasive treatment that helps obtain young skin from aged skin has great potential, primarily because of the growing aging population, and the industry trend towards maintaining youthful skin. Aesthetic procedures are also getting less stigmatized nowadays, thus providing a further boost to such technologies.

BIOCHANGE– INVESTOR DASHBOARD

COMMERCIALIZATION READINESS LEVEL

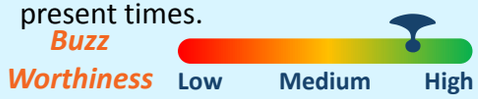
BlueStim™-dermal biostimulant and Revol™-Body contouring is in the preclinical stage. BlueStim is gearing up for clinical studies in 2022-2024, expecting CE approval in 2023 and FDA approval in 2025. Similarly, Revol is expected to file for CE mark in 2024 and FDA in 2026. PulmFoam™ COPD is still in the early research stage.

Expected Time Frame – 4-5 years



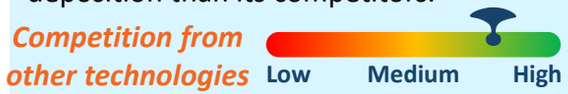
BUZZ WORTHINESS

The proprietary injectable scaffold technology platform for minimally invasive applications helps regenerate the collagen for aging skin, a huge market need in the present times.



TECHNOLOGY COMPETITION LEVEL

There are several competitors' bio-stimulants claiming collagenesis, some are globally approved and some are not. Pathological analysis has revealed that BlueStim shows better collagen deposition than its competitors.



GEOGRAPHY

Global – The company plans for commercialization in both Europe as well as globally, as the unmet needs it is addressing in the industry has a global scope.

APPLICATION

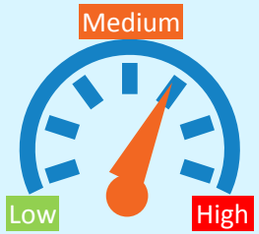
The CellFoam regenerative technology helps in soft tissue regeneration and repair, making it ideal for skin remodeling, and even body contouring.

INVESTOR LENS

- The start-up is supported by Trendlines Israel Fund.
- The company had also received a grant from the EU Horizon 2020 fund.

RISKS

- BioChange is currently in the pre-clinical stage. There are several companies in the clinical stage awaiting approval. Though BlueStim shows better clinical results, it will require significant technology and market disruptiveness to gain high market share.



REVENUE MAGNITUDE POTENTIAL

The tissue regeneration technology is addressing a significantly large market in aesthetic dermatology and reconstructive surgery. The company estimates that dermal filler BlueStim has a market potential of $10 billion. Similarly, the body contouring Revol also has a high market potential of $2.2 billion. Its pipeline PulmFoam for COPD has a market potential of $20 billion.

AI-BASED CELL CULTURE OPTIMIZATION

NUCLEUS BIOLOGICS, US

NUCLEUS BIOLOGICS	
Product/ Technology	Cell Culture Media, AI Platform
Type of Ownership	Private
Year Founded	2016
Headquarters	US
Key Markets	US, New Zealand, Australia
CEO	David Sheehan
Investment Stage	-
Total Funding	$4.8million
Employees	~ 24
Frost Radar	Not profiled

NUCLEUS BIOLOGICS' FOCUS & VISION

- Cell and Gene Therapy is a rapidly growing therapy line. Over the last five years, this area has emerged as a billion dollar therapeutic market. Nucleus Biologics has a strong vision to build a robust precision cell culture platform using AI to optimize solutions for cell and gene therapy development.
- Nucleus Biologics has launched its new platform named NB-AIR™ to help scientists select better cell cultures and formulations suitable for product development. The AI platform scans through peer reviewed papers and recommends the best suitable formulations and helps scientists improve efficiency of the cell and gene therapy in development.
- The company has a previously established product called the NB-Lux which is a custom cell culture media configurator that helps scientist develop a customized culture media that caters to their demands.

TECHNOLOGY ATTRIBUTES

INTEGRATION WITH AI

The AI based platform cell culture media optimization is designed to assist and provide opportunities to scientists directly to formulate their exclusive media.

CULTURE MEDIA OPTIMIZATION

Screening through numerous publication data, the platform allows scientists to work on a cloud-based media configuration that will help in faster and precise media selection.

REDUCTION IN DEVELOPMENT TIME

Time spent for media optimization can be drastically reduced from months to minutes with the help of NB-AIR™.

NUCLEUS BIOLOGICS' PLATFORM ALLOWS DIRECT PARTICIPATION OF SCIENTISTS IN MEDIA EVALUATION FOR CELL THERAPY DEVELOPMENT

TECHNOLOGY ASSESSMENT

Nucleus Biologics has developed advanced technologies to address the bottlenecks in cell and gene therapy with respect to culture media. The media used for cell culture has a significant impact on the quality, growth phase and efficiency. Nucleus Biologics has two unique platforms NB-Lux and NB-AIR™ that are interconnected and are readily available for scientists to optimize their cell culture media. The technology collected information from peer reviewed publications and provides formulas to scientists that can be tested and help to arrive at a precise selection of media.

KEY COMPETITORS

- AxolBio, US
- Caisson Laboratories, US
- Cytiva, US

STRATEGIC ANALYSIS

S – STRENGTHS

- Unique application of AI in media selection and formulation. Altering one component in media preparation can result in changes in therapeutic yields, phenotype, and efficacy.

W – WEAKNESSES

- Less evidence of projected yield and efficacy results from the NB-AIR™ AI based platform.

O – OPPORTUNITIES

- The launch of NB-AIR™ will create a lot of interest by cell and gene therapy developers to adopt a transforming tool in the early stage development of therapy.

T – THREATS

- Improving steps in cell and gene therapy development is of interest to several stakeholders. Hence, it is potentially a high competitive segment.

FUTURE PLANS

The company has recently launched its NB-AIR™ and is ready to stir the NA market with its promising capacity to deliver precision cell culture media creation. There is growing opportunity for R&D development and investment in cell and gene therapy. Nucleus Biologics also focuses on improving this area drastically.

ANALYST'S INSIGHTS

Nucleus Biologics' focus area is niche and rapidly growing. The company has a huge potential to transform existing cell culture media development processes and make them more interactive and scientifically efficient. Implementation of time saving tools to enhance research will help in better productivity and specialized results. NB-AIR™ has these promising features that drive its adoption by cell and gene therapy developers.

NUCLEUS BIOLOGICS – INVESTOR DASHBOARD

COMMERCIALIZATION READINESS LEVEL

With a technology readiness level of 9, Nucleus Biologics is one of the first companies to launch its AI-based platform for precise cell culture media selection in the market. This technology helps identify high yield compounds essential for the media and its effect on the cell culture. The platform allows real-time yield prediction based on cell performance.

Expected Time Frame – 0-2 years

BUZZ WORTHINESS

Cell and Gene therapy is the most prominent and rapidly growing area of therapeutics. Hence solutions to increase efficiency of cell therapy is of high value.

TECHNOLOGY COMPETITION LEVEL

The technology makes use of AI which is implemented in all areas of science to reduce product development time. There are companies making customized media but none are using AI for modifications, resulting in low competition currently.

GEOGRAPHY

Global – Nucleus Biologics is based out of the US and has market presence in Australia and New Zealand.

APPLICATION

- ✓ The customized culture media is available in the range of 2-2,000L for cell and gene therapy.
- ✓ The cloud-based platform can be implemented with ease.

INVESTOR LENS

- Nucleus Biologics generates an overall revenue of $4.8 million.
- In 2019, Nucleus Biologics acquired Primorigen Biosciences.

RISKS

There are several CDMOs and other companies focused on manufacturing cell culture media on a large scale. However, integration with AI and screening through peer reviewed publications for precise selection of media has not been developed by competitors. Hence, competition for this technology remains low at this stage.

REVENUE MAGNITUDE POTENTIAL

Nucleus Biologics is an emerging company with an interesting product pipeline. With its presence across multiple geographical regions and utilization of an AI based platform, the company is expected to witness a rise in revenue and potentially reach the $10 million mark in the next two years.

MICROFLUIDX, LONDON, UK

AUTOMATED CELL MANUFACTURING SYSTEM

Challenges

- Cell processing is often associated with challenges, such as process control, scalability, and high costs for autologous cell and gene therapy.
- Single-use technologies used in cell processing may lead to a low rate of manufacturing of cell therapies.
- An automated and closed technology enabling process development can enhance cell development and manufacturing.

Company Profile and Technology Overview

- MicrofluidX is developing a novel cell processing technology that utilizes microfluidics to solve challenges associated with the bioprocessing of cell and gene therapy.
- The innovative technology does not need re-engineering of the process maintaining the yield, quality, and results.
- The innovative technology solves key issues, such as batch variability, high cost-of-goods, and low scalability.

Technology Profile and Technology Readiness Level

- The novel technology enables process development by running dozens of cell culture conditions in parallel, enabling the scale-up of several billion cells for manufacturing at low costs.
- The company is currently building a working prototype of the technology to generate comparative data between the new technology and conventional single-use technologies.

Funding and Future Work

- MicrofluidX has raised a total amount of £1.4M ($1.92M) since its inception in 2018. UK Innovation & Science Seed Fund is the lead investor of the company.
- The company plans to utilize the funding to further develop its innovative technology and conduct trials.

Growth Opportunities Across Industries/ Applications

The innovative microfluidic-based technology will result in faster manufacturing of cell and gene therapies at lower costs.

- The innovative technology can be an alternative to the conventional single-use technology in bioprocessing which has limitations in scaling up the production.
- The low-cost manufacturing capabilities offered by the innovative technology can help in increasing the adoption of disease modifying therapies for complex diseases.

Faster manufacturing of therapies

Alternative to conventional single-use technologies