BIO STOCK

COMPANY ANALYSIS

IDOGEN

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ANALYTICAL SUMMARY

IDOGEN

Swedish biotech company Idogen AB is developing a cell therapy platform that has the potential to transform the treatment of autoimmune diseases and transplant rejection. A key component of the cell therapy is the novel tolerogenic vaccine – which involves transforming the patient's own white blood cells into tolerogenic cells to discourage the immune system from attacking certain objects. Idogen has obtained traction in the last year with recruitment of new team members, positive study results, obtaining orphan drug status in Europe and recent approvals of its second patent family. In development, Idogen achieved positive results from a proof-of-concept study where human dendritic cells were converted to tolerogenic cells for the treatment of hemophilia A with antibodies. Also, through a collaboration with Oxford University, the company achieved positive results in an arthritic model with zebularine's follow up molecules – indicating that the company's technology could be extended to other indications and molecules. With its target set on hemophilia A, Idogen is expected to conduct its first trials in humans during next year for hemophilia A.

Idogen's lead product involves using the patient's own blood, the generic substance, zebularine, and the disease specific antigen. Idogen initially intends to focus the development towards patients with hemophilia A who have developed intolerance towards first-line treatment, namely coagulation factor VIII (FVIII) replacement therapy, followed by renal transplantation. Hemophilia A is a genetic blood disease that is characterized by frequency of bleeding. As a pioneer in treating hemophilic patients with a tolerogenic vaccine, Idogen could satisfy the unmet clinical need of a patient group that cannot be treated with the standard of care today. This could entitle opportunities for collaborations and partnerships as Idogen's product could grow the market for many of the big players in this space that market FVIII replacement therapy to hemophilia patients.

Today, treatment costs are high for hemophilia patients that have developed an intolerance against the standard of care. This speaks in favor of higher prices, which alongside the potential market benefits of Orphan Drug Designation (ODD) and developing a Pediatric Investigation Plan (PIP) weigh high. Although the market of hemophilia A is challenged by larger competitors armed with gene therapies, Biostock's analysis on deals in this space found several deals in the three digit million dollar range for preclinical stage treatments, thus indicating a large perceived value by large players in this space. Another challenge is that autologous cell therapy requires the use of the patient's own blood, which could be a costly process with high demands due to strict production regulations and potential needs to invest in cell therapy clinics to enable access to patients. However, since Idogen's aim is to obtain verification in humans for this indication and later expand toward bigger indications, this strategy could be a foot in the door to enter the clinic.

BioStock has analyzed deal values and market caps to see how Idogen compares. Many of the deals have upfront payments that exceed Idogen's current market value. Interestingly, another cell therapy company with two pre-clinical projects is valued at roughly twice as Idogen's current market cap. Perhaps this could be indicative of a future value when Idogen has established development within renal transplantation. Internationally, cell- and gene-based therapies belong to a space with high investment interest and BioStock believes that it's just a matter of time until this trend reaches Scandinavian investors.

Important catalysts for investors to watch

- Production of zebularine and tolerogenic vaccine for clinical studies. Expected Q3 2017.
- Completion of preclinical studies in hemophilia A. Expected in 2018.
- Start of Phase I/IIa study in hemophilia A with antibodies. Expected in 2018.

ABOUT THE COMPANY

Background

Idogen AB is a Swedish biotech company listed on AktieTorget, Sweden. The company thrives in the development of cell therapy through tolerogenic vaccines as a novel treatment for hemophilia A, organ rejection after transplantation and autoimmune diseases. The cell therapy concept is based on using the patient's own dendritic cells from their blood, the substance zebularine and the specific antigen to reprogram the body's own immune system towards said specific antigen. These dendritic cells are then transferred back to the patient to create immune tolerance to the antigen without affecting the rest of the immune system. This was discovered by Prof. Leif G. Salford, Prof. Hans-Olov Sjögren, Porf. Bengt Widegren and Prof. Bertil Persson at Lund University and led to the formation of the company in 2008.

The company is currently in pre-clinical phase and it is developing a platform technology that has the potential to be applied for the treatment of a range of diseases by making small changes to the existing technology. Thus, Idogen's strategy is to initially focus in the development of a tolerogenic vaccine for patients with hemophilia A that have developed antibodies using regular treatment (concentrated factor VIII) parallely with renal transplantation towards the market. Hemophilia A is a genetic condition caused by a lack of or defective factor VIII (FVIII), a clotting protein, thus resulting in increased bleeding. Although the most common treatment is to supply the patient with concentrate FVIII, many patients develop antibodies/inhibitors, which are proteins from the immune system that neutralizes and discards the supplied FVIII from the body. As a result, many hemophilia patients are left with limited or no treatment options.

In addition to the large unmet clinical need, Idogen is strategically pursuing such indication because hemophilia A has a well-defined antigen, meaning that there is an opportunity to develop a successful treatment for this patient group. Idogen has ODD in Europe and potential to obtain PIP, PRIME (in Europe) and accelerated approval by the FDA, thus Idogen's ambition to develop the treatment for this indication to the market on their own would not be a far-fetched idea. Part of the strategy is also to strengthen the IP portfolio with patents of additional compounds found to act similarly to zebularine (user patents) to secure future licensing agreements. The strategic alternative is to build competences and skills and to establish a future facility in Sweden for a production plant.

Idogen recently announced that the company wll pursue renal transplantation as an additional indication. Patients with renal transplantation, similarily to other organ transplantation, require life long treatment with immunosuppressive drugs. The effect of this type of drugs result in the partial suppression of the immune system with an increased risk of developing serious infections or cancer. Therefore, Idogen's tolerogenic vaccine has the potential to decrease the need of immunosuppressive drugs and to improve transplant survival.

Strategic direction

Idogen is a company that is developing a technology platform of tolerogenic vaccines to treat a range of diseases. Idogen's strategy is to develop the tolerogenic vaccine towards hemophilia A and renal transplantation. The rationale behind the choice of hemophilia A patients who have developed resistance against first-line FVIII replacement therapy is multifactorial. This is a well characterized disease antigen, recruitment of this group of patients is straight forward and there are regulatory

"Idogen's vision is to develop the world's first tolerogenic vaccine. It programs the immune system to tolerate defined molecules instead of activating our immune system. The treatment method is very interesting for the managment of autoimmune diseases and transplant rejection.

Lars Hedbys, CEO Idogen

ABOUT THE COMPANY

advantages from the obatined ODD and potentially obtaining PIP, PRIME (in Europe) and accelerated approval from the FDA. Thus, strategically speaking, hemophilia A is a suitable indication to obtain verification in humans that indicates that the technology platform works and potentially attracting other actors to license different parts of the technology platform. Additionally, Idogen would like to cater this group of hemophilia A patients who have an urgent medical need and are left with limited or no treatment options.

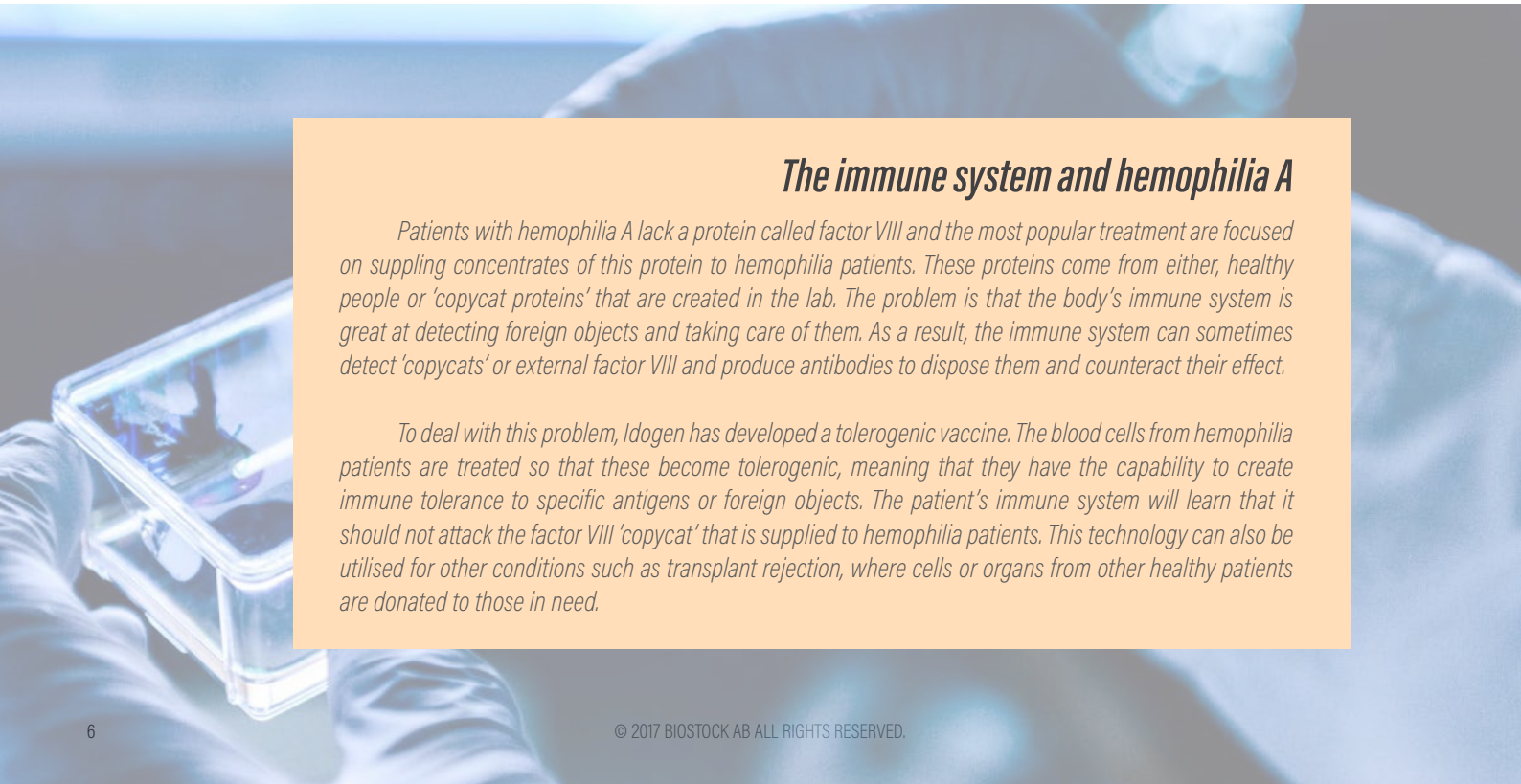
Parallel to Phase I/IIa and the following Phase IIb study for hemophilia A, Idogen will perform preclinical work and start a Phase I/IIa in 2019 for renal transplantation. Due to the nature of this type of therapy, it would also be possible that Idogen could start selling their tolerogenic vaccine in hemophilia A and renal transplantation already in 2020 and 2022, respectively.

Strategic collaborations

Idogen is advantageously located in Lund where it is close to the premises of Medicon Village and Lund University. In April 2017, Idogen announced that it entered into a collaboration with Medicon Village to independently produce the tolerogenic vaccine in its premises. This location eases the access to use Medicon Village's clean room for GMP manufacturing of cell therapy products for future clinical trials and also allows Idogen to form part of the collaboration between Xintela, Medicon Village, the Faculty of Medicine at Lund University and Skåne Region to create a new center for cell and gene therapy.

In order to produce one of the key active ingredients of the toletogenic vaccine, Idogen announced in November 2016, a collaboration with Advinus Therapeutics, a global contract research organization to produce zebularine for preclinical and clinical studies under GMP standards.

Since June 2016, Idogen started a collaboration with Richard Williams' research team at the Kennedy Institute of Rheumatology of the University of Oxford. The institution and Dr. Williams are renowned for their competence in research of inflammatory diseases and their reputation in the development of TNF-alpha inhibitors, the most successful therapeutic drug for many autoimmune diseases. Dr. William and his team are very knowledgeable in the field as they have conducted fundamental research on the rheumatoid arthritis (RA) and IDO1 enzyme (zebularine increases the expression of this enzyme). Additionally, they have previously studied zebularine in an arthritic model. Therefore, this collaboration was ideal to study zebularine follow-up molecules in a research model of RA. The results demonstrated that these molecules significantly reduce clinical symptoms of RA and the effect continues sometime after stopping the treatment. Thus, these positive results could provide Idogen the opportunity to expand or license out their technology for the RA indication to potential partners. Additionally, William's position in Idogen's scientific advisory board will be essential if Idogen decides to pursue RA as an additional indication in the future.



The immune system and hemophilia A

Patients with hemophilia A lack a protein called factor VIII and the most popular treatment are focused on suppling concentrates of this protein to hemophilia patients. These proteins come from either, healthy people or 'copycat proteins' that are created in the lab. The problem is that the body's immune system is great at detecting foreign objects and taking care of them. As a result, the immune system can sometimes detect 'copycats' or external factor VIII and produce antibodies to dispose them and counteract their effect.

To deal with this problem, Idogen has developed a tolerogenic vaccine. The blood cells from hemophilia patients are treated so that these become tolerogenic, meaning that they have the capability to create immune tolerance to specific antigens or foreign objects. The patient's immune system will learn that it should not attack the factor VIII 'copycat' that is supplied to hemophilia patients. This technology can also be utilised for other conditions such as transplant rejection, where cells or organs from other healthy patients are donated to those in need.

DEVELOPMENT PROGRAMS

Technology platform

Idogen develops a novel treatment platform for anti-drug antibodies, autoimmune diseases and transplant rejection that consist of a tolerogenic vaccine. This type of vaccine is different compared to traditional vaccines as it comprises of taking the patient's white blood cells (dendritic cells), treating them ex-vivo with zebularine (or compounds with similar effect) in the presence of the specific antigen and injecting them back to the patient to reprogram the immune system to tolerate these specific antigens. The purpose of treating these immune cells is to teach the immune system to recognize specific antigens or foreign objects, and allow them to tolerate and inhibit the attack to that specific antigen. In connection to this, treatment of dendritic cells in vitro is performed using zebularine (or follow-up molecules) which increases an enzyme called IDO1 in the dendritic cells. The increased expression of IDO1 is key in controlling the dendritic cells from reacting against a specific antigen during its presence. In short, the technology teaches the immune system to recognize a specific antigen as something normal or part of the body and to impede an immune attack against it. Thus, the above-mentioned technology platform has the potential to be applied to a range of diseases by making small changes to the technology i.e. changing the disease specific antigen.

Lead molecule and follow-ups

Zebularine is the lead molecule that Idogen is using to develop the tolerogenic vaccine towards hemophilia A. The company has also found four additional substances that have the ability to up-regulate the IDO1 enzyme through somewhat different mechanisms of action. So far, two of zebuline's follow up molecules have proven to work through the collaboration with Oxford University. Idogen's plan is to strengthen their patent portfolio, use these molecules for disease specific tolerogenic vaccines, fence competition and/or license out this part of the technology platform. These molecules also serve as a reinforced strategy in case zebularine does not work as expected.

Technology platform

To date, Idogen is in a pre-clinical program and has a technology platform for tolerogenic vaccines. The company's strategy is to first develop a tolerogenic vaccine for patients with hemophilia A that have developed antibodies towards FVIII therapy. In parallel to the first Phase I/IIa trial in hemophilia A, Idogen plans to pursue peclinical work and then Phase I/IIa in renal transplantation.

Currently, around 38 560 children in US, Japan and major European countries have hemophilia A. From these patients, 60% of them have severe hemophilia and 30% of these users develop antibodies under this treatment. This means that about 6 941 patients are left with limited or no treatments and could benefit from Idogen's treatment once its verified.

Through an animal model of hemophilia A, Idogen was able to demonstrate that their technology reduces the occurrence of FVIII antibodies and provides a lasting effect. As of September 2016, Idogen announced a breakthrough in their development as the company successfully reprogrammed human dendritic cells to tolerogenic dendritic cells in a proof of concept study. Along with these positive results and the outcome of the scientific advice meeting with the Medical Product Agency (MPA) regarding their design of their first in human clinical study, CEO Lars Hedbys and his team should be able to take Idogen to clinical phase in 2018. Idogen expects to start a combination of a Phase I and Phase IIa trial for hemophilia A in 2018. Therefore, the next step in the pre-clinical development are safety studies and the production of GMP quality zebularine (a component of the vaccine) for pre-clinical and clinical studies. The later will be executed in collaboration with Advinus Therapeutics. Additionally, Idogen has ODD for hemophilia A in Europe, which entitles advice in regulatory aspects and clinical development from the EMA/MPA.

So far, the company has obtained proof of principle in a rat model of transplantation for diabetes type-1 in 2013. The study demonstrated that diabetic rats that received insulin producing cell transplant from another foreign tribe had significant delay or prevention of rejection towards transplanted cells. This provided some evidence that by using Idogen's treatment concept, the immune system could be reprogrammed to avoid attacking the transplanted cells or even organs. In 2016, Idogen obtained proof of principle in a preclinical model of rheumatoid arthritis (RA) done in collaboration with Richard Williams' research team from the University of Oxford. Previously, the team proved that zebularine could inhibit RA in a preclinical model and through this collaboration Williams and his team were able to prove that two follow-up molecules of zebularine could significantly reduce the clinical symptoms of RA.

Kidney transplantation

The same method and technology platform that is currently being used within hemophilia A may be used for development in additional indications. This was confirmed in May as Idogen announced that new experimental data had led to a decision to pursue kidney transplantation as a parallel track to its lead hemophilia A program. Idogen has announced that its technology may possibly offer a way to reduce the need for patients to take immunosuppressants and that it may improve survival in transplant patients. These are undisputable clinical needs and Idogen's contribution is thought to be well received by both patients and physicians.

ASSET PORTFOLIO

IP portfolio

Idogen has a patent portfolio with seven patent families where two of these patent families are granted in different regions. From the pending patents, one is a PCT application that has entered national phases in EU, US, Canada and Japan. The remaining patent applications relate to new substances that increase expression of enzyme IDO1, similarily to zebularine, and are expected to enter PCT stage during this year.

Exclusivity

In addition to the granted patent families, Idogen obtained ODD for hemophilia A in January 2017. This is an attractive route of commercialization as in addition to the appealing market exclusivity, Idogen will be able to benefit from shorter development time, government incentives, high approval rates in ODD, higher pricing, faster uptake, increased market share and lower marketing costs. Idogen could also be eligible for longer protection by making a Pediatric Investigation Plan as hemophilia A is a pediatric condition. This could potentially grant Idogen further market exclusivity and protection.

Patent portfolio

Product	Description	Regions granted (estimated expiry)
Zebularine	**The use of Zebularine for the treatment of autoimmune or immune rejection of transplants.** WO/2008/147283 - Consists of zebularine, analogues or salts for the manufacturing of a medicament that can increase the amount of IDO production to reduce the immunological tolerance in a method to treat mammals.	Europe (2028)
Tolerogenic vaccine	**A composition comprising at least two compounds which induces indolamine 2,3-dioxygenase (IDO), for the treatment of an autoimmune disorder or suffering from immune rejection of organs** WO/2012087234A1 - Consists of a composition comprising at least two compounds, each of which induces IDO. Some patents were recently granted or had a 'Notice of Allowance' issued. The patent is pending in Canada	Japan, Europe and US (2031)
Method of treatment	**Novel treatment method** WO 2016146842 A1 – Consists of a method of treatment comprising ex-vivo treatment of antigen presenting cells from the mammal with an agent which induces IDO in said antigen presenting cells in the presence of a drug or fragment that induces an immune reaction in the mammal. Afterwards, said cells are transferred back to the mammal, thus establishing immune tolerance.	(2036)

Orphan drug designation portfolio

Opportunity	Exclusivity time
Orphan Drug Designation (ODD)	10 years in Europe/Japan 7 years in US
Pediatric Investigation Plan (PIP)	6 months SPC and 2 years on top of the market exclusivity from ODD in Europe

FINANCIALS

53 million SEK

maximum target for current share issue

1.09 million SEK

estimated burn-rate per month, in 2017

226 million SEK

maximum target if full suscription of share issue and full exercise of warrants

Financial summary

At this early development phase, Idogen is still financed by its shareholders. According to the company's quarterly report from January to March 2017, no revenues from sales were reported. Costs for development and upkeep during the first quarter totaled to 3.28 million SEK (72% external costs and 28% in personnel), resulting in an estimated burn rate of 1.09 million SEK per month while liquid assets equaled to 15.2 million SEK. Idogen's Board of Directors recently proposed prior to the Annual General Meeting the right issue of units of shares and two series of warrants. The target for the current share issue is between 42 million (min) and 53 million SEK (max). If full suscription and full exercise of the warrants are obtained, in the two step process, between 122 million (min) and 226 million SEK (max) may be added to Idogen after issue cost in 2018-2019. Moreover, Idogen recently announced that the company had been awarded about 2.9 million EUR from Horizon2020 through the EU Framework Program for Reseach and Innovation for the development of the tolerogenic vaccine in hemophilia A.

Summary of comprehensive income (Q1, 2017 report)

[kSEK]	Jan-Mar, 2017	Jan-Mar, 2016	2016	2015
Net sales & operating income				
Other external expenses	-2 349	-2 071-	-9 928-	-8 029
Personnel costs	-927	-657	-2 707	-1 973
Profit from financial items	-2	-2	-16	3
RESULTS	**-3 277**	**-2 689**	**-12 599**	**-9 658**

Summary of balance sheet (Q1, 2017 report)

[kSEK]	Mar 31, 2017	Mar 31, 2016	Dec 31, 2016	Dec 31, 2015
ASSETS				
Intangible assets	*1 856*	*1 224*	*1 803*	*1 142*
TOTAL NON-CURRENT ASSETS	*1 856*	*1 224*	*1 803*	*1 142*
Customer and other receivables	*477*	*310*	*363*	*595*
Cash and bank balances	*14 959*	*9 174*	*18 502*	*11 542*
TOTAL CURRENT ASSETS	*17 292*	*10 708*	*20 668*	*13 279*
EQUITY AND LIABILITIES				
	Jan-Mar, 2017	Jan-Mar, 2016	Jan-Dec, 2016	Jan-Dec, 2015
Total equity	*14 563*	*9 479*	*18 597*	*12 168*
Short-term debt	*2 729*	*1 229*	*2 072*	*1 111*
TOTAL EQUITY AND LIABILITIES	**17 292**	**10 708**	**20 668**	*13 279*

BOARD OF DIRECTORS

AGNETA EDBERG
CHAIRMAN OF THE BOARD

Has over 20 years of experience from leading positions at Mylan, Swedish Pharmaceutical Insurance Association, Pfizer, Pharmacia and J&J. She is also in the board of Immunicum.

ULF BLOM
BOARD MEMBER

oard member since 2014.
Medical and clinical research director with responsibility also for regulatory affairs, safety and quality management at Novo Nordisk Scandinavia AB.

LEIF G. SALFORD
BOARD MEMBER

Founder and board member since 2008. Vice dean at the medical faculty at Lund University, and professor and physician in obstetrics and gynecology at Lund University.

KARIN HOOGENDOORN
BOARD MEMBER

Experience in drug production and special regulations in cell based treatments. She has had leading roles related to CMC in Immunicum AB, Novartis AG and Janssen Biologics.

CHRISTINA HERDER
BOARD MEMBER

Has over 20 years of experience in early stage pharmaceuticals and busines development. She is CEO of Modus Therapeutics and board member in PCI Biotech Holding ASA.

Shareholders

Since June 2015, Idogen AB is listed on AktieTorget and trades under the ticker IDOGEN. The share capital is 855 581.21 SEK, divided between 12 222 589 shares (quotient value of 0.07 SEK). The largest shareholders in Idogen are HCN Group AB with 9.9% ownership followed by Ventac Holding (Cyprus) Ltd with 6.6 % ownership, Leif-Göran Salford with 6.0% ownership, Olov Sjögren with 5.6% ownership and Tipajumanica AB with 5.3% ownership. Each share of the company entitles one vote and have equal rights to dividends and any surplus on liquidation.

The commitment and belief in the company is reflected in many member of the management team and board of directors as some of them have purchased shares within the company (e.g. current CEO, CFO and chairman). Ventac Holdings (Cyprus) Ltd is one of the largest shareholders and also one of the founders of Idogen. Ventac Holding's business model revolves around the development of life science companies. In January 2007, the holding company sold 100 000 shares to free up capital to invest in new projects.

OPERATIONAL TEAM

Ph.D LARS HEBDYS
CEO

Experience in senior and executive roles in the life science industry.

DENNIS HENRIKSEN Ph.D.
CTO

Management, research and development and implementation of cGMP.

M.Sc INGVAR KARLSSON
CFO

Financial experience as CFO and controller in several big companies

NEIL THOMAS Ph.D.
CBO

Company formation, fund-raising, IP management, business development, licensing and technology exploitation.

Ph.D ANETTE SUNDSTEDT
CSO

Research and development, research in immunological tolerance and immunotherapy for autoimmune diseases.

STEVEN GLAZER M.D
CMO

Clinical drug development and industrial experience in hemophilia, transplantation and diabetes.

Management team

Idogen has a competent and experienced team that keeps growing as the company is approaching to clinical development. The company is led by CEO and co-founder, Lars Hedbys. He has over 20 years of experience in management and executive roles in public and private life science companies. Among these roles was Vice President and Site General Manager in Astra Zeneca. Additionally, Lars Hedbys has co-founded several international pharmaceutical companies and he is a board member in several biotech and medtech companies, of which whom he is currently board member of RhoVac. Accompanying Lars Hedbys is an experienced management team composed of Ingvar Karlsson, Anette Sundstedt, Dennis Henriksen, Neil Thomas and Steven Glazer. Ingvar Karlsson, M.Sc., CFO, oversees the financial operations and has previously held multiple positions as CFO in Lekolar Group and Doro AB, where the latest company was listed in the NASDAQ OMX Nordic Exchange Small Cap List in Stockholm. Anette Sundstedt, Ph.D., CSO, has over 15 years of experience in R&D in the pharmaceutical industry, thus entitling her the position of CSO. Some of her previous roles include senior researcher and project manager at Active Biotech AB and leader of a research group on immunological tolerance at Lund University. Dennis Henriksen, Ph.D., CTO, has over 20 years of managerial experience in small and medium sized biotech companies, vast experience in the development and implementation of cGMP, along with the involvement of R&D programs in the fields of arthritic diseases, inflammatory and autoimmune and cancer. He previously worked as Vice President of BioNebraska Inc. Following, Neil Thomas, Ph.D., CBO, has the main role of IP strategy, evaluating projects in cell therapy and immune tolerance as well as potential out-licensing opportunities due to his extensive experience in fund-raising, IP portfolio management, business development, licensing and technology exploitation. His previous roles include Director of Business Development & IP at Genetrix and Director of IP & Technology at Roche spin-out, Bioxell. Finally, it has been recently announced that the latest addition to the team is Steven Glazer, M.D., as Chief Medical Officer. His competence will be crucial for the upcoming clinical trials, specially because he has previously worked as Medical Director at Novo Nordisk where he was responsible for NovoSeven, the main current treatment for hemophilia patients who have developed antibodies towards FVIII.

MARKET OPPORTUNITY

Hemophilia A

This disease is a rare genetic disorder resulting from deficiency or defective factor VIII (FVIII), a clotting protein. As a result, the blood doesnt't clot properly which occasionally causes prolonged bleeding in the patient. This disease affects mainly young males where onset of hemophilia occurs when affected infants start to walk. Although minor external cuts are not of a big concern, internal bleedings in joints, muscles, and soft tissue can lead to inflammation and pain. Furthermore, repeated bleeding could lead to long term damage of such tissues.

The prevalence is of hemophilia A about 1 in 5 000 births while the annual incidence is of 1 in 12 000 births. Today, most patients that obtain appropriate treatment will go on to live a full and productive life. However, the most life-threatening complications for hemophilia patients is the risk (10%) of having an intracranial bleeding or bleeding into the soft tissue around vital areas e.g. airways. The mortality rate for hemophilia patients compared to healthy males is twice as high, while in the most severe cases, the mortality rate is 4 – 6 times higher.

Disease characteristics

Hemophilia A almost always affects males due to the association of an inherited X-linked recessive pattern. Thus, most female carriers of this genetic mutation do not experience any signs or symptoms, however about 10% of females with the genetic mutation experience symptoms such as abnormal bleeding after an injury or surgery. The signs and symptoms of hemophilia include bruising susceptibility, joint hemorrhage, osteoarthritis, persistent bleeding after trauma, prolonged partial thromboplastin time, reduced FVIII activity and X-linked recessive inheritance.

The severity of the clinical manifestation depends on the following degree of factor VIII deficiency or defectiveness:

Disease severity

Biological activity	Degree of FVIII deficiency	Frequency (% of cases)	Manifestations/Symptoms
< 1%	Severe	60%	Frequent spontaneous and abnormal bleeding from minor injuries, surgery or tooth extraction
1 – 5%	Moderately severe	15%	Abnormal bleeding from minor injuries, surgery and tooth extraction
6 – 40%	Mild	25%	Some abnormal bleeding from minor injuries, surgery and tooth extraction

MARKET OPPORTUNITY

Hemophilia A competitors

There is limited or no treatment options for patients with hemophilia A who develop antibodies against FVIII therapy. Based on an assessment of competitors to Idogen's tolerogenic vaccine in the hemophilia A area, it was found that gene therapy would be the closest competitor that would also treat this group of patients (table below). However, it is worth mentioning that gene therapy has the competitive advantage of potentially being a curative treatment, whereas Idogen's tolerogenic vaccine will be applicable for patients receiving FVIII therapy that have developed antibodies to this treatment. Thus, in this particular case, the tolerogenic vaccine will not be a curative treatment for hemophilia A, but instead a complement to FVIII therapy with antibodies. The story would be different for other indications as it could potentially become a curative treatment for a range of autoimmune diseases and organ transplantation (where the immune system fails to recognize endogenic objects). Based on this assessment, it was identified that there are several programs/companies that are focused on developing coagulation FVIII gene therapy and the companies that have come the furthest are shown in the table below.

Stem cell platform competitors

As Idogen is identified as a company developing a platform technology for tolerogenic vaccines to a range of indications, similar platform technologies were assessed (Table below). Thus, it was identified that Avrobio and Angiocrine Bioscience are developing stem cell therapy platform that involves taking the patient's blood, reprogramming cells and injecting them back to the patient in different indications.

Selected hemophilia A competitors in clinical development

Therapy type	Development stage	Target patients	Company	Reference
Coagulation FVIII gene therapy	Phase II	Severe hemophilia A	Sangamo Therapeutics	SB525
Coagulation FVIII gene therapy	Phase II	Severe hemophilia A	BioMarin Pharmaceutical	BMN270
Coagulation FVIII gene therapy	Phase II	Hemophilia A	Spark Therapeutics Inc	SPK8011

Selected stem cell therapy platform competitors

Technology platform	Development stage	Indications	Company	Reference
Stem cell therapy platform	Preclinical	Oncology, endocrine, metabolic and genetic disorders	Avrobio	AVR01, AVR02, AVRRD02
Stem cell therapy platform	Phase II	Hematology malignancies, sickle cell anemia, respiratory, tendon surgery, genetic disorders	Angiocrine Bioscience	E-CEL PEC, E-CEL TEC, E-CEL UVEC

Other competitors

Moreover, it may be noted that there may be additional ways to achieve tolerance in patients for different antigens. One example is the pre-clinical peer, Toleranzia, that develops a tailor-made protein molecule consisting of three parts, a targeting part, a disease specific part and a tolerance-inducing part. Toleranzia's primary indication is myasthenia gravis, while its therapy has been evaluated for diabetes type 1, rheumatoid arthritis, and multiple sclerosis. Like Idogen, Toleranzia is listed on AktieTorget but currently - following a massive decline this past fall – is at a lower market cap.

MARKET OPPORTUNITY

Market dynamics

According to market analysts, the global market of hemophilia A was valued at $6.1 billion USD in 2015 with an expected growth at CAGR of 5.6%. It is dominated by clotting factors which constitute more than 77% of the market, this being $4.3 billion USD. An explanation to their dominance is that the World Federation of Hemophilia's treatment guidelines from 2012 recommended clotting factor, mainly those derived from recombinant or viral-inactivated serums, as the primary treatment due to safety reasons. A current overview of the market trends indicates that there is a continuous increase of approvals for extended FVIII therapies with lower dosing frequencies. However, with the rising burden of unmet clinical needs for curative treatments, gene therapy is expected to be the next innovation in this market. Already today, it was identified that medium and large sized companies, Sangamo Therapeutics, Spark Therapeutics and BioMarin Phamaceutical, are developing coagulation FVIII gene therapy in Phase II clinical trials.

Market potential

The diagnosed prevalent cases of hemophilia A in the US, Japan, France, Germany, Italy, Spain, and UK in 2017 is expected to be around 38 610 patients. Severe hemophilia A constitutes to 60% of all cases, this would correspond to 23 166 patients. Furthermore, Idogen's treatment is targeted to those patients who have developed antibodies toward FVIII replacement therapy, this constitutes 30% of the population (6 950 patients). Today, this population undergoes 11 months of tolerogenic treatment with high amounts of FVIII therapy as a treatment. According to Idogen, the cost for this is close to $150 000. Since this treatment has a 45-80% success rate, at least 20-55% patients will be left without options and presumably a high willingness to test Idogen's therapy in its clinical trials.

BioStock believes that Idogen's therapy may have the potential to be used in the majority of the severe hemophilia A cases as an alternative to immune tolerance induction by high dose of FVIII treatment. By further estimating that the therapy may achieve a peak market share of 10-30% of these 23 166 cases that are treated once every third year, about 800-2 300 annual treatments may be sold. With a treatment price of $50 000 – 150 000 per administration (i.e. every third year), this translates to an opportunity of $40 million – 345 million per year. With the $150 000 price tag, this opportunity would be on the higher end. It should further be noted that the market opportunity for Idogen will be even larger if the technology is applied in additional, larger indications such as organ transplant rejection and/or RA.

Comparable deals

To find relevant comparable deals, Idogen's characteristics of being in early phase and developing a potential solution towards antibodies in hemophilia A were considered. In 2014, Bayer HealthCare and Dimension Therapeutics created a partnership collaboration to develop and commercialize a novel gene therapy for the treatment of hemophilia A. The agreement resulted in Dimension Therapeutics receiving an upfront payment of $20 million and milestone payments of up to $232 million. In this partnered collaboration, Dimension Therapeutics will be mostly responsible for preclinical and phase I/II studies, while Bayer Healthcare will be responsible of phase III studies, regulatory submissions and the commercialization of the product.

Bayer HealthCare partnered with Dimension Therapeutics around a novel gene therapy for the treatment of hemophilia A, in a deal involving an upfront payment of $20 million and milestone payments of up to $232 million .

In May 2017, Pfizer and Sangamo Therapeutics partnered up where Pfizer obtained an exclusive worldwide license to four programs of gene therapy, including the previously mentioned SB525 candidate from Sangamo Therapeutics. The deal resulted in an upfront payment of $70 million and up to $475 million in milestone payments, where $300 million is only corresponding to SB525's milestone payments.

Other comparable deals in the hemophilia A space provide a glimpse of the possible outcomes from a fruitful collaboration. For example, the partnership between Lipoxen (Xenetic Biosciences) and Baxter International for blood clotting factors in pre-clinical phase resulted in a total deal value of $115 million. Another comparable deal was the collaboration between Nektar Therapeutics and Baxter International for longer-acting forms of blood clotting factors. The deal resulted in a total deal value of $128 million, where $84 million was for the development of the early phase PEGylated clotting factors towards hemophilia A and the rest for hemophilia B. The multiple

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deals made by Baxter International demonstrates that this company is eager to establish partnerships with biotech companies to access and develop assets in this space.

Potential partners

Shire is the global leading company in the hemophilia market. The expansion of its dominance was seen from the recent $32 billion USD merge with Baxalta, a spin-off from Baxter International. Before the merge, over 40% of Baxalta's revenue corresponded to the sales of Recombinate, Advate, Hemofil, Rixubis, and Obizur (many of these are FVIII concentrate). Thus, Shire could be a potential partner as it could benefit from having Idogen's therapeutic treatment as a complement to FVIII therapy for those patients who have developed antibodies. The possibility is even higher as news from late May 2017 confirmed that the development program from Baxalta and Xenetic Biosciences (SHP656), for a long lasting drug for hemophilia A, failed.

Similarily, recent news from the Swiss giant, Roche, regarding a patient's death in a phase III trials evaluating emicizumab in patients with hemophilia has raised safety concerns in such promising candidate. Despite the top-line results released in December by the company (promising data of decreased bleedings), Roche might have to cover ground and expand their portfolio beyond emicizumab if the company intends to join the competitive hemophilia market.

Another potential partner is Novo Nordisk, as sources from March 2017, indicate that Novo Nordisk is considering the buyout of Global Blood Therapeutics to boost its blood disorder business. Although the company aims to focus more on diabetes and obesity, the strategy to strengthen the pipeline is to in-license early stage project and work with external academic collaborators. Similarly, to Shire's case, Idogen's tolerogenic vaccine to treat against FVIII antibodies could become a complement to Novo Nordisk's and other companies' portfolio of FVIII therapy.

Comparable companies

As mentioned previously, there are no direct competitors to Idogen working in the same indication. Therefore, a market cap benchmark assessment was based on public companies that were developing cell therapy, gene therapy or a treatment involving immune-tolerance mainly in the hematology area, followed by RA and diabetes. The market caps ranged from $22 million to $320 million USD, where the company with closest market cap is BioRestorative Therapies as it is a small company that has two development programs in the preclinical stage. While there are many differences between the companies, it may be assumed that this table provides an indication on how investors could value Idogen based on their assets, clinical space and technology.

International comparison of market caps

Company	HQ	Drug portfolio: no. of assets, indications, and highest development phase	Rationale for inclusion as comparable company	Market cap (May 23, 2017)	Stock market
Endonovo Therapeutics	US	1 asset, indication, Pre-clinical	Pre-clinical, GvHD cell therapy in graft-vs-host disease	$14.4 million	OTCMKTS
BioRestorative Therapies	US	2 assets, 2 indications, Pre-clinical	Pre-clinical, stem cell therapy in genetic disorders	$20 million	OTCMKTS
Adverum Biotechnology	US	11 assets, 7 indications, Pre-clinical	Pre-clinical, cell therapy for rare genetic diseases	$117 million	NASDAQ
Tigenix	Belgium	7 assets, 7 indications, Pending approval	Phase II cell therapy for RA	$197 million	NASDAQ
Abeona Therapeutics	US	26 assets, 21 indications, Marketed	Preclinical, gene therapy for hematology	$246 million	NASDAQ
Selecta Bioscience	US	12 assets, 10 indications, Phase II	Preclinical, gene therapy vaccine for Type I diabetes	$258 million	NASDAQ
Sangamo Therapeutics	US	10 assets, 15 indications, Phase II	Phase II, gene therapy for hemophilia A	$536 million	NASDAQ

CONCLUDING REMARKS

Lars Hedbys and his team have been driving Idogen smoothly since it became publicly traded in 2015. The team's commitment and confidence in the company is portrayed not only through the progress of the company but also from some of the managers and board member who have invested in the company. The traction of the company is well reflected by continuous positive news from the company; these include approvals in different territories for the second patent family, proof of concept in human cells with the tolerogenic vaccine, positive results in an RA model, approval of ODD in Europe and more.

Idogen recently decided to produce the tolerogenic vaccine on its own. The production of the tolerogenic vaccine requires a clean room, which is accessible through an agreement with Medicon Village. While this will create unique competence, it could potentially limit the economies of scale offered through outsourcing. GMP production and creation of a new cell therapy center could drive hefty costs but may create know-how that increases the value of a future deal. Such know-how and competence would be important to facilitate future tech-transfer and/or potential licensing deals for the upscaling of Idogen's commercial product in other geographical areas.

It is unclear how long Idogen intends to develop its lead candidate before striking a deal. According to CEO Lars Hedbys, it may be realistic for Idogen to develop the tolerogenic vaccine for hemophilia A with antibodies all the way to the market if necessary as there are incentives from ODD, potential PIP, PRIME and accelerated approval by the FDA and from the company's technical standpoint. However, Idogen's beach head market is very small and the company is expected to face competition from gene therapy, a potential curative solution for hemophilic patients with or without antibodies. Nevertheless, this move aims to establish a proof of concept and bullish investors are likely to be attracted by its platform technology that may be used for multiple indications.

Idogen is operating in an interesting space where many large players and investors have been making large bets on CAR-T technologies and multiple gene therapies. BioStock's analysis of comparable market caps and deal values clearly indicate that a positive outcome for Idogen would price its shares at higher values than its current market cap. Overall, Idogen has a very promising technology platform where its different components can be licensed out as indication specific assets or as a trade-sale technology platform deal. If the company succeeds in proving that the technology can be used for autoimmune diseases or transplant rejection, it would make a large step forward in therapeutic development of future cures.

Important catalysts for investors to watch

- Production of zebularine and tolerogenic vaccine for clinical studies. Expected Q3 2017.
- Completion of preclinical studies in hemophilia A. Expected in 2018.
- Start of Phase I/IIa study in hemophilia A with antibodies. Expected in 2018.

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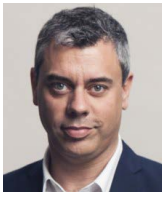

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