HEALTHCARE RESEARCH

Non-Independent Research
MiFID II Exempt
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23 July 2020

Stock Data

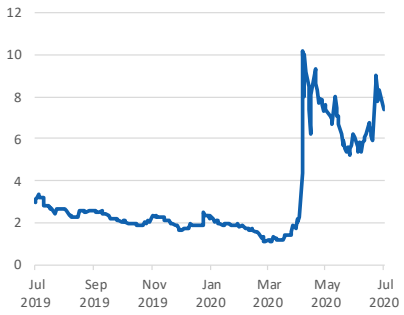
Ticker	HEMO.L
Share Price:	7.35p
Market Cap:	£31.9m

Source: London Stock Exchange (prior trading day's close)

Company Description:

Preclinical stage biotechnology company focused on the development of novel therapies for blood diseases.

Share Price Chart (p)



Source: Bloomberg Terminal

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Hemogenyx Pharmaceuticals plc*

LSE: HEMO.L ***CORP**

The pipeline continues to grow

Key points

- **CAR-T therapy** offers a new treatment modality for treating blood cancers which is complementary to the Group's CDX bi-specific antibody program. The HEMO-CAR platform has shown *in vivo* anticancer activity and may be an attractive cancer treatment without the toxic side-effects of chemotherapy.

- **COVID-19 opportunity:** Hemogenyx has initiated a project focused on developing a neutralising antibody treatment against SARS-CoV-2, the causative virus of COVID-19. We would expect significant interest in the candidate if preclinical data shows a therapeutic effect against the virus.

- **CDX platform:** The collaboration with an unnamed major biopharma (GlobalCo) regarding the CDX antibody platform is nearing its conclusion. Upon completion, GlobalCo has three months to decide to in-license the program. If GlobalCo does not exercise its licensing option, Hemogenyx will have 3 months to negotiate its own license. Hemogenyx is confident that whichever scenario is undertaken, the Group is in a position to progress the CDX program towards clinical trials.

- **Agreement with Eli Lilly:** In June 2020, Hemogenyx struck a Biological Investigation and Material Supply Agreement with Eli Lilly and Co. The agreement is focused on the discovery and validation of novel materials for the treatment of lupus, an autoimmune disease. Hemogenyx will grant Lilly a research license for anything jointly developed under the agreement, as well as an option for an exclusive worldwide license to commercialise jointly developed materials. The agreement highlights the continued ability of the Group to strike agreements with large biopharma companies across its asset pipeline.

- **Placing to raise £2.5m** provided additional capital to progress multiple opportunities, including the COVID-19 and CAR-T programmes.

Peer-group review

We have updated the peer group of ex-UK development-stage companies published in the Initiation note (August 2019). Table 1 highlights companies with operations which focus on developing treatments for blood diseases, a core area for Hemogenyx. The average market capitalisation of the peer-group is **£242m**, over 7-fold higher than that of Hemogenyx (Table 1). We also compared the market capitalisation of Hemogenyx to drug developers with phase 2 assets or earlier which are listed on AIM or the LSE standard-list (Table 2). Hemogenyx's current market capitalisation is well below that of the peer-group average of c.**£97.9m**. Although at a preclinical stage, Hemogenyx has a strong pipeline of assets in development, including a COVID-19 program, as well as multiple collaboration agreements and we believe this review highlights the upside potential for the Group.

Table 1: Peer-group analysis of blood disease specialists

Name	Ticker	Mkt Cap (£m)	Lead asset stage	Lead Candidate	Lead indication
Average		**242.0**			
Hemogenyx Pharmaceuticals Pl	HEMO LN	31.2	Preclinical	CDX Ab	AML and conditioning
Actinium Pharmaceuticals Inc	ATNM US	168.6	Phase 3	Iomab-B CD45	BMT conditioning step
Aptose Biosciences Inc	APS CN	354.5	Phase 1	APTO-253	AML & MDS
Bellicum Pharmaceuticals Inc	BLCM US	30.3	Phase 2/3	Rivo-cel	BMT
Cellectis	ALCLS FP	570.3	Phase 1	UCART19	ALL
Gamida Cell Ltd	GMDA US	175.2	Phase 3	Omiducel	BMT transplant stage
Kiadis Pharma Nv	KDS NA	74.5	Phase 2	K-NK002	BMT
Magenta Therapeutics Inc	MGTA US	294.7	Phase 2	MGTA-456	BMT transplant stage
Molecular Templates Inc	MTEM US	479.0	Phase 2	MT-3724	B-Cell lymphoma

Source: Bloomberg; Company websites

Table 2: Peer-group analysis of AIM or LSE Standard-listed companies at Phase 2 or earlier

Name	Ticker	Mkt Cap (£m)	Lead asset stage
Average		**97.9**	
Hemogenyx Pharmaceuticals	HEMO LN	31.2	Preclinical
C4x Discovery Holdings	C4XD LN	17.0	Preclinical
Sareum Holdings	SAR LN	25.2	Phase 2
Avacta Group	AVCT LN	335.1	Preclinical
Okyo Pharma	OKYO LN	68.9	Preclinical
Redx Pharma	REDX LN	48.8	Phase 1
Tiziana Life Sciences	TILS LN	270.4	Phase 2
E-Therapeutics	ETX LN	49.4	Preclinical
Scancell	SCP LN	31.8	Phase 1/2
N4 Pharma	N4P LN	7.5	Preclinical
Evgen Pharma	EVG LN	14.9	Phase 2
Synairgen	SNG LN	275.0	Phase 2

Source: Bloomberg; Company websites

Placing to raise £2.5m

In May 2020, Hemogenyx conducted a placing to raise £2.5m (gross) through the placing of 35,714,286 shares at 7p/share.

March 2020 Placing

Placing	
Existing shares	397,253,969
Placing shares	35,714,286
Enlarged share capital	432,968,255
Placing price (p)	7
Placing proceeds (£)	2,500,000

Source: Company announcements

Proposed use of funds

The funds aim to support the Group's COVID-19 project, which includes the discovery and development of neutralising antibodies against the virus, as well as to progress the Group's CAR-T cell therapy program for blood cancer. The Company previously demonstrated in mouse models that HEMO-CAR-T was able to programme human T lymphocytes, a form of immune cell to identify and destroy acute myeloid leukaemia (AML) cells, an aggressive form of blood cancer.

Intended use of funds

Placing	Funds (US$)
COVID-19 program Discovery and ApbHC discovery platform validation	750,000
CAR-T IND-enabling studies	1,600,000
Working Capital	500,000
Total	**2,850,000**

Source: Hemogenyx plc

Neutralising Antibodies against SARS-COV-2

Although Hemogenyx has been primarily focused on developing therapies for blood diseases, the Group has outlined a new project to use its Advanced peripheral blood Hematopoietic Chimera (ApbHC), a proprietary mouse model system, to develop potential treatments against SARS-CoV-2, the causative agent of COVID-19.

The Group's ApbHC mouse model uniquely exhibits components of a near fully functional human immune system. It was originally developed for in-house testing of Hemogenyx's drug candidates but has since been generating significant interest from industry as an *in vivo* platform for disease modelling and drug development.

In 2019, the Group announced a potential biodefense application of the ApbHC mice, as they were shown to be able to recreate a variety of human antibodies which existed in the donor of blood cells used to make ApbHC. In the future, such antibodies could possibly be quickly produced to neutralise emerging natural and artificially created pathogens (bioweapons). Based on this work, and with the onset of the COVID-19 pandemic, the Group commenced a programme to use ApbHC mice to discover human antibodies which have neutralising potential against SARS-CoV-2.

Neutralising antibodies are immune proteins produced by B-lymphocytes, an immune cell type. The antibodies can target a specific region of the virus and interfere with one of its functions, such as binding to a host cell, to reduce infectivity.

Coronaviruses, including the SARS-CoV-2 virus, have proteins on their surface called spike proteins (S protein), which are used to bind to host cells. Many neutralising therapy candidates for COVID-19 aim to target the S protein in order to block its ability to interact with the host cell, thus 'neutralising' the virus.

Method of neutralising antibodies production

To generate neutralising antibodies specific to SARS-CoV-2, Hemogenyx first needs to develop mice which have a humanised immune system. To do this, the Group is isolating cells from blood samples of COVID-19 survivors and transplanting them into immune-compromised mice. The rationale for using COVID-19 survivors' blood (convalescent blood) is that, having previously been exposed to SARS-CoV-2 and successfully eliminated the infection, these patients' blood samples should contain immune cells which produce effective neutralising antibodies against the virus. Once this step is complete, the resultant mouse should have a humanised immune system with functional B-cells which are producing human anti-SARS-CoV-2 antibodies with neutralising properties.

The mouse, humanised using convalescent blood, will then be challenged with a portion of SARS-CoV-2 virus to expand a population of B cells producing neutralizing antibodies. These cells will then be isolated and sequenced to identify the sequence of neutralizing antibodies for further testing, validation and development.

Advantages over conventional techniques

Hemogenyx's AbpHC platform has been designed to overcome some of the limitations associated with current techniques of antibody discovery which should enable the generation of a diverse pool of human neutralising antibody candidates.

Conventional methods of producing human neutralising antibodies involve the isolation of cells directly from human COVID-19 survivors, followed by further B-lymphocyte isolation and antibody expression and identification. This approach is thought to result in a low diversity of anti-SARS-CoV-2 antibodies.

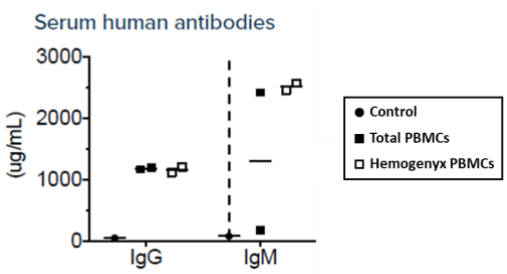
By using a humanised mouse model, further direct challenge with an antigen of interest such as portions of SARS-CoV-2 is possible. This "re-infection" is thought to stimulate the immune system to amplify the number of antibody-producing B cells and potentially produce a highly diverse pool of humanised neutralising antibody candidates for selection.

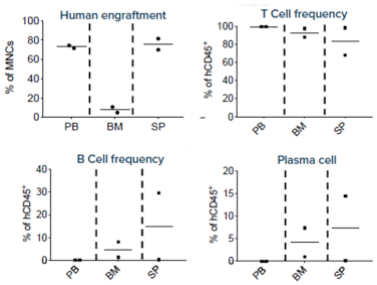
Mouse model approach

Hemogenyx has performed studies with ApbHC mice which suggest that the platform overcomes some of the limitations observed in conventional mouse model systems. Hemogenyx's mouse model exhibits a higher level of similarity to portions of the human immune system and has been shown to generate human blood cell lineages such as T-lymphocytes and B- lymphocytes. These cell lines have been shown to be functional and B- lymphocytes can generate human antibodies and T- lymphocytes can generate cytokines upon *in vitro* stimulation. By using a humanised immune system, antibodies produced in AbpHC mice are fully human and hence have a reduced risk of rejection by the patient's immune system when administered as a future therapeutic.

Hemogenyx also has a novel method of processing human blood prior to transplantation into mice which can reduce the risk of Graft vs Host Disease (GvHD) developing and thereby support successful engraftment and immune system development. GvHD is a condition which often occurs in a recipient (mice or human), whereby the transplanted immune cells attack the host, causing morbidities and mortalities. The ApbHC mice also survive much longer than current known models, which may be an attractive feature for future manufacturing scale-up.

AbpHC mice have human blood cells which are able to produce human antibodies





***IgG**: Immuglobulin G; **IgM**: Immuglobulin M; (forms of antibodies); **PB**: Peripheral Blood; **BM**: Bone marrow; **SP**: Bone Marrow Side Population*

Source: Hemogenyx

Current landscape for COVID-19 neutralising antibodies

Neutralising antibody treatment is seen as a promising form of therapy for COVID-19 and there are a number of groups, alongside Hemogenyx, looking to develop treatments. **Regeneron Pharmaceuticals** is using its own mouse model system, VelocImmune®, to isolate virus-neutralising antibodies. In June 2020, the company began testing of a treatment, known as REGN-COV2, in Phase 1 trials in both hospitalised and non-hospitalised COVID-19 patients. REGN-COV2 consists of two neutralising Abs which both non-competitively target the S protein. Their rationale of using a 'cocktail' treatment compared to a single therapeutic approach is to maintain efficacy in the scenario that the virus mutates to escape treatment.

In May 2020, **Amgen** and **Adaptive Biotechnologies** partnered to develop a neutralising Ab based on the identification of tens of thousands of naturally occurring antibodies from COVID-19 survivors. The project is using Adaptive's high throughput B-lymphocyte receptor screening platform to identify antibodies which bind to the SARS-CoV-2 from blood samples of COVID-19 survivors. No specific target has been disclosed. **Vir Biotechnology** struck a collaboration agreement with **GSK** to expedite development of two neutralising Ab candidates, VIR-7831 and VIR-7832 which are expected to enter the clinic in H220. The molecules target a region of the SARS-CoV-2 S protein that is shared with SARS-CoV-1 (the causative virus of SARS). The fact this region is conserved may make it more difficult for the virus to escape treatment through mutations in this region.

Eli Lilly and **Abcellera** struck their own collaboration in March 2020, and in June 2020 announced the initiation of a Phase 1 study testing LY-CoV555, a neutralising Ab targeting the S protein in hospitalised COVID-19 patients. In May, Abcellera closed a $105m series round which included investment from OrbiMed and Eli Lilly. **AstraZeneca** has performed preclinical screening of over 1,500 candidates and in June 2020 announced it has licensed 6 neutralising Ab candidates from **Vanderbilt University**, USA. AZ is looking to select two candidates which bind to different parts of the S protein for entry into the clinic by the end of August 2020.

Selected neutralising antibody treatments

Company	Product candidate	Stage
CSL Behring | Sab Biotherapeutics	SAB-185	Preclinical (Phase 1 planned for 'summer 2020')
Regeneron	REGN-COV2	Adaptive Phase 1/2/3 trials began in June 2020
Eli Lilly | Abcellera	LY-CoV555	Phase 1/2 trials began in June 2020
Celltrion	CT-P59	Phase 1 trial began in July 2020
Amgen |Adaptive Biotechnologies	undisclosed	Preclinical
Systimmune	SI-F019	Preclinical (Phase 1 planned by end of 2020)
AstraZeneca | Vanderbilt University	undisclosed	Preclinical (Phase 1 planned for August 2020)
Atreca |BeiGene	undisclosed	Preclinical (Phase 1 planned in H121)
GSK | Vir Biotechnology	VIR-7831/VIR-7832	Preclinical (Phase 2 planned for July 2020)

Source: Company websites/The Milken Institute

COVID-19 prognostic test: Cytokine biomarker

Hemogenyx has also initiated a pilot study to investigate the underlying mechanisms behind the observed variance of symptoms between COVID-19 patients, which can range from asymptomatic to life-threatening. If this study is successful, the Group aims to develop and commercialise a test which could stratify patients into different risk categories to help guide therapeutic management.

The pilot study has been designed to investigate a certain group of cytokines taken from COVID-19 survivor blood samples and assess if there is a relationship between disease severity and cytokine levels. Cytokines are small proteins which are involved in communication between cells of the immune system. Higher levels of certain cytokines such as TNF-alpha and Interferon, can have pro- and anti-inflammatory effects and are commonly seen in infections.

An issue with using cytokine-based biomarkers is that there is known to be a high degree of variance in cytokine production between individuals. It is therefore difficult to establish "normal vs abnormal" cytokine profile cut-offs which are consistent across patient populations. However, should a reliable cytokine test be developed, it would significantly support clinical management of patients and guide therapy choice.

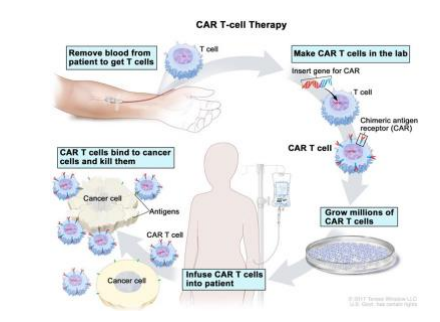
CAR-T development programme

Current treatment of blood cancers relies on chemo-/radiotherapy followed by bone marrow transplantation. However, these treatments can be high-risk with harmful side-effects. The development of immunotherapies, such as checkpoint inhibitors, are becoming more established modes of treatments for many cancer types. Rather than directly targeting tumours, immunotherapies prompt the patient immune system to respond to the cancer. They have been shown to produce durable anti-tumour responses which has resulted in long-term remissions without the toxic side effects seen in chemo-/radiotherapy.

What is CAR-T

Chimeric antigen receptor (CAR) is an immunotherapy which involves the reprogramming of T-cells, a form of immune cell, to recognise and attack a specific target, such as a cancerous cell. CAR-T therapy involves removing T-cells from the patient and genetically modifying them to express a CAR on the cell surface. The CAR is designed to recognise specific antigens expressed on the surface of the target cell. Once the CAR-T cell has been generated, the cell population is expanded and infused back into the patient. Antigen recognition by the CAR triggers the T-cell to attack the cancer cell and also releases cytokines which can trigger a potent immune response including T-cell proliferation. CAR-T cells have also been shown to circulate in a patient's bloodstream months after administration, which may help guard against cancer recurrence and lead to longer-term remission.

Autologous CAR-T process



Source: US National Cancer Institute

Hemogenyx's product: HEMO-CAR-T

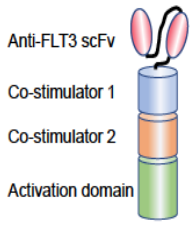
Hemogenyx, is developing a CAR-T cell therapy for the treatment of acute myeloid leukaemia (AML). AML is an aggressive form of blood cancer with a five-year event-free survival rate of c.20% in adults and up to c.70% in children. Standard of care consists of intensive chemo-/radiotherapy and bone marrow transplantation.

Hemogenyx's HEMO-CAR platform, could provide an alternative treatment against AML, without the toxic side-effects of chemotherapy.

HEMO CAR-T Progress so far

Hemogenyx has constructed a proprietary Chimeric Antigen Receptor, HEMO-CAR. The HEMO-CAR targets FLT3 (fms-like tyrosine kinase 3), a receptor protein which is highly expressed on the surface of AML cells. In January 2020, the Group demonstrated *in vitro* that HEMO-CAR was able to programme human T cells (i.e. convert them into HEMO-CAR-T cells) to identify and destroy human AML-derived cells. In February 2020, the Group replicated these findings *in vivo* using mouse models for AML.

HEMO-CAR Structure



Source: Hemogenyx

The ability for HEMO-CAR-T to successfully identify and eliminate human AML-derived cells *in vivo* represents an important milestone in the-preclinical development of the technology. With funds from the recent placing, Hemogenyx is looking to progress development of the HEMO-CAR-T into Investigational New Drug (IND)-enabling studies, which include animal pharmacology/toxicology trials, preparations for manufacturing and the establishment of clinical protocols. An IND application is the request for permission from the FDA to initiate human studies of a new drug.

Switch enables tuneable CAR-T to mitigate safety issues

CAR-T therapies have shown impressive anticancer effects; however, the potency of CAR-T can lead to life threatening side-effects such as a damaging inflammatory response known as cytokine release syndrome (CRS) and neurotoxicity. CRS was thought to be the cause of three patient deaths in Kite Pharma's Yescarta marketing approval trials, and in 2017, Juno Therapeutics saw five patients die of brain swelling, known as cerebral edema, in a trial testing JCAR015, a CAR-T against relapsed/refractory acute lymphoblastic leukaemia. To mitigate against this risk, Hemogenyx aims to introduce and test a safety switch within the HEMO-CAR-T therapy. The switch aims to enable clinicians to modulate the activity of HEMO-CAR-T cells in order to increase the safety profile of the potential treatment. Companies such as Bellicum Pharmaceuticals have designed a CAR-T therapy which is only active when a small molecule, rimiducid, is also administered to the patient. This enables clinicians to alter the CAR-T activity by modulating the dosage of rimiducid.

Peer Group and deal activity

CAR-T remains a nascent field and there are currently only two CAR T-cell therapies which have received US FDA approval, both in 2017. Novartis' Kymriah (tisagenlecleucel), was approved for the treatment of B-cell acute lymphoblastic leukaemia. Kymriah was shown to have an overall remission rate of 83% within three months of treatment. Yescarta (axicabtagene ciloleucel), developed by Kite Pharma (bought by Gilead for $12b) received approval for relapsed/refractory acute lymphoblastic leukaemia. Yescarta was shown to have a remission rate of 58% at 24 months. FY19 sales of Yescarta were $456m, whilst Kymriah brought in $278m in sales in 2019. An issue which has impacted sales of these approved therapies is their high-price, costing c.$400k for a course. This cost is partially due to the complex nature of manufacturing CAR-T therapies on a patient-by-patient basis. As such, multiple one-size-fits-all approaches are currently in development to address this issue. The eventual development of an off-the-shelf product should reduce costs associated with CAR-T and drive clinical adoption.

Although there are only two approved CAR-T therapies, there is considerable interest in the sector with multiple agreements being struck at different stages of development. Should HEMO-CAR-T generate positive data in IND-enabling studies, this should put the Group in a good position to initiate discussions with potential partners. The Group has proven experience in striking agreements at a preclinical stage. This has been demonstrated by the agreement with GlobalCo regarding the CDX antibody program as well as the Orgenesis and Janssen agreements regarding the AbpHC mouse model system.

Selected CAR-T deals

Year	Company	Company	Deal type	Upfront	Biodollars	Lead asset stage at time of deal
2013	Celgene	bluebird bio	Collaboration & License Agreement	undisclosed	$225m/product in potential option fees and milestones.	Phase 1
2014	Pfizer	Cellectis	Collaboration & License Agreement	$80m	$185m/product in potential option fees and milestones.	Preclinical
2015	Astellas Pharma	Bellicum	Collaboration & License Agreement	undisclosed	undisclosed	Preclinical
2015	Gilead	Kite	Acquisition	$11.9b	undisclosed	BLA under review
2017	Gilead	Cell Design Labs	Acquisition	$567m	$322m	Preclinical
2017	Bluebird Bio	TC BioPharm	Collaboration & License Agreement	$16m	undisclosed	Preclinical
2017	J&J - Janssen Biotech	Legend Biotech	Collaboration & License Agreement	$350m	undisclosed	under review by China Food and Drug Administration (CFDA)
2020	J&J - Janssen Biotech	Fate Therapeutics	Collaboration & License Agreement	$50m	up to $1.8b in milestones	Phase 1
2020 (amended)	BMS	bluebird bio	Collaboration & License Agreement	$200m	undisclosed	BLA under review
2020 (amended)	Servier	Cellectis	License Agreement	$28m	$410m	Phase 1
2018	Celgene	Juno Therapeutics	Acquisition	$9b	undisclosed	Phase 1
2019	Allogene	Notch	Collaboration and license agreement	$10m	$283m	Preclinical

Source: Company websites

Selected CAR-T therapies

Company	Product	Target	Indication	Phase
Gilead Sciences	Yescarta (axicabtagene ciloleucel)	autologous anti-CD19 CAR T	r/r ALL	US/EU Approval
Novartis	Kymriah (tisagenlecleucel)	autologous anti-CD19 CAR T	r/r ALL	US/EU Approval
Bristol-Myers Squibb	Liso-cel (Lisocabtagene maraleucel)	allogenic anti-CD19 CAR T	B-cell lymphoma	BLA under review by FDA
Allogene Therapeutics	ALLO-501	allogenic anti-CD19 CAR T	B-cell lymphoma	Phase 1
Crispr Therapeutics	CTX120	allogenic anti-BCMA CAR T	r/r MM	Phase 1
Cellectis/Servier	UCART19	allogenic anti-CD19 CAR T	B-cell lymphoma	Phase 1
Autolus	AUTO1	allogenic anti-CD19 CAR T	r/r B-ALL	Phase 1/2
J&J	JNJ-4528	allogenic anti-BCMA CAR T	r/r MM	Phase 1b/2
BMS/Bluebird bio	ide-cel (idecabtagene vicleucel)	allogenic anti-BCMA CAR T	r/r MM	Phase 2

Source: Company websites; r/r: relapsed/refractory; ALL: Acute Lymphoblastic Leukaemia; MM: Multiple Myeloma

General Update

The recent initiation of a COVID-19 project and the rapid development of the CAR-T programme highlight the ability of Hemogenyx to expand its pipeline into areas of unmet need. Alongside these developments, the Group continues to make progress across its existing asset pipeline of treatments including its CDX antibody programme, for which the Company is concluding discussions with an unnamed multinational biopharmaceutical company (GlobalCo), which could result in a significant licencing agreement.

Development agreement with GlobalCo nearing completion

Hemogenyx's lead asset is a bispecific antibody-based immunotherapy known as a CDX antibody (CDX Ab). CDX Abs aims to redirect the patient's own immune cells to selectively target blood stem cells and certain types of blood cancer. CDX could be used as a direct therapy to eliminate diseased cells or to clear unwanted blood stem cells prior to a bone marrow transplant.

In May 2018, Hemogenyx struck a development agreement with GlobalCo regarding its CDX Abs. Hemogenyx is receiving technical support from GlobalCo with Hemogenyx granting the partner the option of an exclusive worldwide licence to commercialise its CDX Abs. The partnership has resulted in the generation of CDX Ab variants which appear to be of clinical grade and the collaboration agreement was expected to complete in April 2020. However, due to the ongoing Covid-19 pandemic's impact on GlobalCo's operation, the agreement is being extended by three months to properly complete the work required.

The outcome of this agreement is that Hemogenyx will either license a CDX Ab to GlobalCo or will in-license GlobalCo's improvements to the asset on favourable terms. The result of these discussions is difficult to predict, however, should the partner license the CDX Ab product we would expect Hemogenyx to receive a substantial upfront payment and then for GlobalCo to finance and manage the rest of the development programme. We would also expect Hemogenyx to secure significant future milestone and royalty payments.

Agreement with Eli Lilly provides additional potential for licencing agreements

In June 2020, Hemogenyx struck a Biological Investigation and Material Supply Agreement with Eli Lilly and Co ("Lilly"). As part of the agreement, Lilly is supplying Hemogenyx with material and confidential information for use in R&D work aimed at the discovery and validation of novel materials for the treatment of systemic lupus erythematosus (Lupus), an autoimmune disease. Hemogenyx will grant Lilly a research license for anything jointly developed under the agreement, as well as an option for an exclusive worldwide license to commercialise jointly developed materials.

Humanised mouse model

Aside from the COVID-19 neutralising antibody project, Hemogenyx is continuing to develop its humanised mouse model platform for in-house testing as well as a commercial tool for biopharma companies. Immugenyx, LLC, the subsidiary developing the model, has multiple ongoing collaborations in place including ones with Johnson & Johnson, Orgenesis and an unnamed major biopharma company (GlobalCo). These projects not only demonstrate the interest in the Group's platform but should provide the Company with an immediate revenue stream as it progresses its other assets into the clinic.

The Group is using its mouse model as a platform to discover and develop a cell-based treatment of systemic lupus erythematosus (SLE aka lupus). Individuals affected by the disease exhibit increased mortality and a lower quality of life when compared to the general population. There are a limited number of treatment options for Lupus, leading to considerable interest in developing new treatments.

In 2011, GSK received US approval for Benlysta, an antibody treatment thought to have been the first treatment approved for SLE in the past 60 years. GSK reported £613m in sales for FY19, up 30%y/y. AstraZeneca is looking to file for regulatory approval of its antibody therapy for SLE, anifrolumab, after Phase 3 results in 2019. In June 2020, AbbVie acquired the rights to ALPN-101, a Phase 2 ready SLE candidate from Alpine Immune Sciences. Alpine received a $60m upfront payment and up to $805m in conditional milestones.

Selected collaboration agreements

Agreement	Partner/Date	Key Terms
Biological Investigation and Material Supply Agreement for the Development of New Treatments for Autoimmune Diseases	Eli Lilly June 2020	Lilly to supply Hemogenyx with certain materials to perform research and development activities aimed at the discovery and validation of novel material to be used for the treatment of SLE Under the Agreement, the Company will grant Lilly a research license for anything jointly developed under the Agreement, as well as an option for an exclusive worldwide license to commercially exploit jointly developed Materials.
Research Agreement to develop humanized mice as a tool for drug development and testing	GlobalCo October 2019	Immugenyx to grant an unnamed global pharmaceutical company (GlobalCo) a worldwide, non-exclusive, royalty-free licence to any know-how and any patent(s) and patent application(s) arising from the Agreement. Immugenyx will also grant to GlobalCo an option to an exclusive licence of patent(s) or patent application(s) arising from the Agreement. GlobalCo to pay US$75,000 to Immugenyx for the research it conducts
Collaboration, License and Investment by Orgenesis	Orgenesis October 2018	In October 2018, two of the Group's subsidiaries received investment via a convertible loan facility from Orgenesis, a US biotechnology company. Immugenyx LLC, developing the AbpHC mouse model, received $1m on a pre-money valuation of US$8m whilst Hemogenyx-Cell SPRL, developing the Hu-PHEC cell therapy, received $1m on a pre-money valuation of US$12m. In return for these investments, Orgenesis is receiving a non-exclusive global licence to commercialise and market the subsidiaries' technology, with each subsidiary receiving a 12% royalty on net revenues generated from the technology. Also, Orgenesis has an option to invest additional funds into the subsidiaries, between US$0.5m and US$1m, in the three years following the start of the agreement.
Collaboration agreement for the development of a model of systemic lupus erythematosus	Janssen October 2018	Hemogenyx partnered with Janssen LLC, a subsidiary of Johnson & Johnson. The collaboration aims to develop a model of human lupus using the AbpHC mouse model which can be used to understand mechanisms of the disease and to develop new treatments. This collaboration is expected to generate an undisclosed amount of revenue.
Development agreement for CDX antibodies development	GlobalCo May 2018	Hemogenyx has granted an unnamed leading biopharmaceutical company (GlobalCo) a research license for anything jointly developed under the agreement and an option for an exclusive worldwide license to commercially exploit CDX antibodies which will be jointly developed under the Agreement. Hemogenyx will receive on a cost-free basis technical support, access to advanced methods of discovering, developing and engineering antibodies, and certain IP which is expected to assist the successful preclinical development of the Hemogenyx's lead candidate bi-specific CDX antibodies.

Source: Hemogenyx plc

Hu-PHEC

The Group continues to progress development of its Hu-PHEC cell therapy candidate into clinical trials via Hemogenyx-Cell SPRL, a wholly owned subsidiary established in Belgium in April 2019. The subsidiary is looking to strike a partnership with a Belgian-based partner to support the further development of Hu-PHEC, which could involve the construction of a cell bank.

Intellectual property update

Hemogenyx continues to extend its patent portfolio to provide adequate protection from competition. In February 2020, the Group received approval by the US Patent and Trademark Office for a patent related to the Group's Hu-PHEC cell therapy. The patent, entitled *Post-Natal Hemogenic Endothelial Cells and their isolation and use* covers a method of isolation and identification of Hu-PHEC cells, as well as methods to utilise the cells to regenerate the blood system in a patient. In July 2019, the Company filed a new patent application regarding the CDX Ab, with a composition of matter patent application expected to be filed upon the completion of the development agreement with GlobalCo.

Financials

Income Statement (£)

Fiscal Year	2016A	2017A	2018A	2019A
Fiscal Period end date	31/12/2016	31/12/2017	31/12/2018	31/12/2019
Revenue	-	-	-	
Administrative expenses	**(447,152)**	**(837,060)**	(1,630,222)	(1,589,407)
Depreciation Expense	(11,870)	(33,614)	(51,805)	(94,726)
Operating profit/EBIT	**(459,022)**	**(870,674)**	**(1,682,027)**	**(1,684,133)**
Other income	-	101,138	91,357	213,126
Finance costs	(11,817)	(10,741)	4,374	14,191
Finance costs	-	(1,631,020)	(1,779)	(31,328)
Profit before tax	**(470,839)**	**(2,411,297)**	**(1,588,075)**	**(1,488,144)**
Income tax credit (expense)	-	49,698	43,751	35,000
Profit after tax	**(470,839)**	**(2,361,599)**	**(1,544,324)**	**(1,453,144)**
Translation of foreign operations	26,526	(36,652)	51,031	16,176
Comprehensive income/(loss) to the year	**(444,313)**	**(2,398,251)**	**(1,493,293)**	**(1,436,968)**
Weighted average number of ordinary shares in issue	145,166,853	260,270,699	360,125,230	360,719,748
EPS (£)	**(0.00)**	**(0.01)**	**(0.43)**	**(0.40)**

Source: Company financial reports

Cash flow (£)

Fiscal Year	2016A	2017A	2018A	2019A
Fiscal Period end date	31/12/2016	31/12/2017	31/12/2018	31/12/2019
EBIT	**(470,839)**	**(2,361,599)**	**(1,544,324)**	**(1,453,144)**
Depreciation & Amortisation	11,870	33,614	51,805	94,726
EBITDA	**(458,969)**	**(2,327,985)**	**(1,492,519)**	**(1,358,418)**
Share based payments	-	35,492	309,322	122,487
Change in trade and other payables	9,507	7,637	(98,670)	(17,880)
Change in trade and other receivables	(163,209)	86,260	(19,266)	16,056
Change in prepayments	-	-	-	-
Working capital movements	(153,702)	93,897	(117,936)	(1,824)
Operating CF	**(612,671)**	**(2,198,596)**	**(1,301,133)**	**(1,237,755)**
Interest	12,035	10,462	1,773	31,328
Capex	(188,785)	(64,257)	(24,589)	(11,918)
Tax	-	-	-	-
FCF	**(789,421)**	**(2,252,391)**	**(1,323,949)**	**(1,218,345)**
Acquisitions/Disposals	-	-	-	-
Cash acquired on acquisition	-	1,098,640	-	-
Working capital changes applicable to pre-acquisition retained earnings	-	(1,145)	-	-
Share issues/reverse acquisition	754,914	1,616,129	-	-
Debt movements	-	(399,422)	1,180,908	(39,393)
Reverse Acquisition Expense	-	1,631,020	-	-
Other non cash items	60,358	105,000	-	-
Change in cash	**25,851**	**1,797,831**	**(143,041)**	**(1,257,738)**
FX effect on cash	13,982	(8,399)	28,814	(6,011)
Cash at beginning of period	47,390	87,223	1,876,655	1,762,428
Cash at end of period	**87,223**	**1,876,655**	**1,762,428**	**498,679**

Source: Company financial reports

Balance sheet (£)

Fiscal Year	2016A	2017A	2018A	2019A
Fiscal Period end date	31/12/2016	31/12/2017	31/12/2018	31/12/2019
PPE	175,797	191,578	173,943	123,922
Right of use asset	-	-	-	109,442
Intangible assets	281,577	257,525	272,753	262,050
Non-current assets	**457,374**	**449,103**	**446,696**	**495,414**
Trade and other receivables	162,059	69,784	90,475	55,804
Cash and cash equivalents	87,223	1,876,655	1,762,428	498,679
Current assets	**249,282**	**1,946,439**	**1,852,903**	**554,483**
TOTAL ASSETS	**706,656**	**2,395,542**	**2,299,599**	**1,049,897**
Called up share capital	1,010,849	3,600,514	3,601,762	3,612,429
Share premium	-	7,341,056	7,340,267	7,699,789
Other reserves	-	369,147	620,059	399,229
Reverse asset acquisition reserve		(6,157,894)	(6,157,894)	(6,157,894)
Foreign currency translation reserve	22,668	(13,984)	37,047	53,223
Retained Earnings	(645,383)	(3,006,982)	(4,482,075)	(5,953,294)
Total equity	**388,134**	**2,131,857**	**959,166**	**(349,035)**
Trade and other payables	16,687	7,333	167,607	141,677
Accruals and deferred income	-	256,353	-	39,896
Current borrowings	38,489	-	-	-
Current liabilities	**55,176**	**263,686**	**167,607**	**181,573**
Lease liabilities				73,192
Non-current Borrowings	263,346	-	1,172,826	1,144,167
Non-Current liabilities	**263,346**	**-**	**1,172,826**	**1,217,359**
TOTAL LIABILITIES	**318,522**	**263,686**	**1,340,433**	**1,398,932**
TOTAL EQUITY + LIABILITIES	**706,656**	**2,395,543**	**2,299,599**	**1,049,897**

Source: Company financial reports

Disclaimer: Non-independent research

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Recommendations are based on a 12-month time horizon as follows:

Buy - Expected return >15%

Hold - Expected return range -15% to +15%

Sell - Expected return < 15%