



# Life Sciences Report 2019 | 2020

Biotech | Pharma | Medtech | Digital Health  
in Berlin-Brandenburg



## The 2020s: The German Capital Region enters a new decade of healthcare innovation

The future of life sciences and medicine is uncertain. We were in the mid of intensive debates about how we can offer patients the most individual treatments through data and whether artificial intelligence might redefine the job profile of physicians forever, when the coronavirus pandemic hit the world. Thus we took a wider look in the future to answer the question of the state of innovation of our healthcare region. With today's Life Science Report 2020 we can confidently state: The German Capital Region is ready and will be an even more important life science hub in the future.

The acceleration of innovation cycles in the global healthcare economy is apparent. The German capital region – already a world leader in areas such as digital health – is undergoing a pathbreaking transformation process throughout all areas of life sciences that is mostly shaped by developing cutting edge technologies, concentrating synergy effects between its highly established research infrastructure and ensuring a frictionless knowledge transfer.

The unique concentration and networking opportunities of science, clinics and business have long been recognized as one of the regions biggest strengths. That is why recent growth in digital therapies, additive manufacturing, genome therapies and of course the development of artificial intelligence are emerging from larger as well as smaller companies and academic spin-offs.

Berlin-Brandenburg based life sciences companies are responding to new and emerging markets by continuing to strategically invest in expansion and innovation to further modernize their products and production processes. Investments that not only strengthen their international competitiveness but show a common interest to develop the life sciences region as a whole.

Naturally when we are addressing the big challenges that are ahead of the industry and research we have to factor in the radical change of the health consumer behavior. Patients are better informed about their genetic profile, the diseases they have and might have, and the availability of healthcare treatments. In the German health capital region we have a tradition in bringing together industry, care provider and the “quantified self patient” to work on better solutions that meet the expectations of patients in terms of potential treatments at a time, place and cost convenient to the individual.

In our new Life Sciences Report you will find a comprehensive overview how Berlin-Brandenburg is developing towards those challenges both to be competitive as an international location and ensuring the highest standard of modern healthcare for its population.

We are convinced that those who are most successful in global healthcare industries are those who succeed in finding the best partners in order to turn new knowledge into innovation. We are committed to support our partners and further expand the region internationally to become the leading center for healthcare industries and life sciences – for 2020 and beyond.



**Dr. Kai Bindseil**

Cluster Manager HealthCapital Berlin-Brandenburg  
Berlin Partner for Business and Technology

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**Dr. Martin Hirsch**

*Ada Health GmbH, Co-founder & Chief Scientific Advisor*

“We cannot accept the fact that people living with a rare disease often wait six years for the correct diagnosis. Artificial intelligence gives us the opportunity to change this and make a fundamental difference to the lives of millions of people worldwide.”

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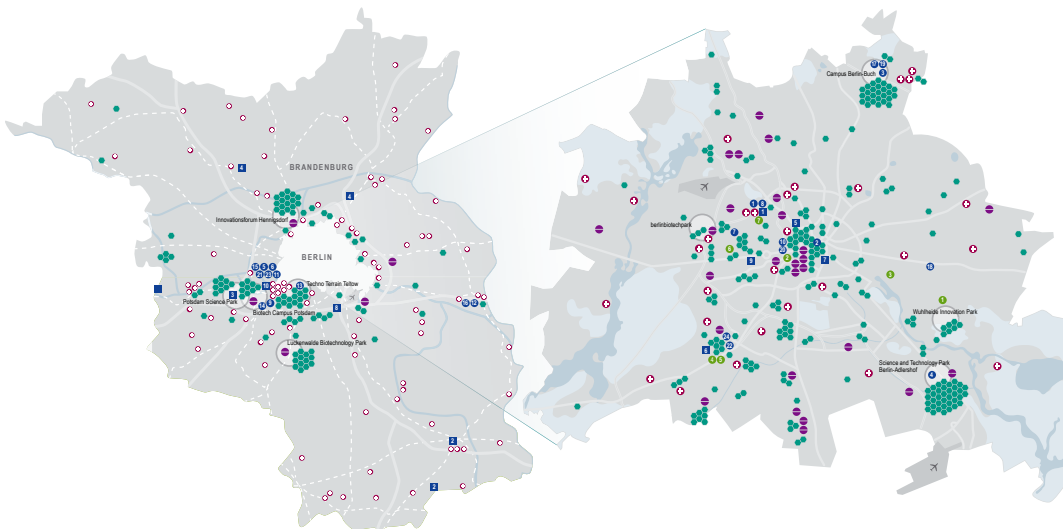


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## Key technologies that will transform the healthcare market

In the German capital region leading companies, renowned scientists, innovative startups and first-class hospitals work together to develop new technologies for a better patient and clinical outcome. At the interface between life sciences and IT developments disruptive technologies such as artificial intelligence, augmented reality, 3D printing, gene and cell therapies will pave the way for transformation in the healthcare market.

### The Allstar: Artificial Intelligence

The innovative power of the German capital region in the area of AI is not only noticeable in the high-profile areas of business intelligence and process management, but is also demonstrated by a significant number of healthcare startups and research institutions. They are pushing the boundaries of traditional healthcare with AI solutions from all different angles which could also break new ground on the international stage. The Berlin AI Venture Studio **Merantix** has developed with its Vara Healthcare project an MDD-certified deep learning technology for the radiological detection of breast cancer, which is aimed to facilitating the work of doctors. One of the most successful startups in the field of AI-based health apps is **Ada Health**. Ada is a global health company founded by doctors, scientists, and industry pioneers to create new possibilities for personal health. Ada's core system connects medical knowledge with intelligent technology to help all people actively manage their health and medical professionals to deliver effective care. For this purpose, Ada collaborates with leading health systems and global non-profit organisations.

Cooperation between different players is a key factor by the development of AI-based technologies. The Hungarian company **turbine** was founded to enable researchers to more effectively plan and develop life saving therapies before carrying out time consuming and costly biological experiments. As part of **Bayer's G4A Accelerator** and in close cooperation with the pharmaceutical giant an AI software solution was developed in Berlin which predicts how a cancer will respond to treatment while helping to develop new medicines. There is also a very strong research landscape in the field of AI in the German capital region. At **Charité – Universitätsmedizin Berlin** currently more than 20 research groups are working to improve treatment and care in the health sector with the help of AI in cooperation with other research institutes such as the **Technische Universität Berlin (TU Berlin)**, the **Max Delbrück Center for**

**Molecular Medicine (MDC)**, the **Humboldt Universität zu Berlin (HU Berlin)**, the **Freie Universität Berlin (FU Berlin)**, the **Hochschule für Technik und Wirtschaft Berlin (HTW)**, the **German Research Center for Artificial Intelligence (DFKI)** and several **Fraunhofer Institutes**.

### The Craftsmen: Additive Manufacturing and 3D Bioprinting

The healthcare sector is one of the most exciting segments for the development and penetration of 3D printing; In the future, customized prosthetics, implants and probably whole organs could be developed by using these techniques. For an interface between awareness, concrete development processes and legislation, the network **Medical goes Additive** has recently been founded in Berlin. It offers a knowledge and transfer platform for its partners in the field of additive manufacturing for the healthcare market as well as the networking with international players. A similar emerging trend that created promising new companies is 3D bioprinting of human tissue and cells. **denovoMATRIX** offers modular, biomimetic coatings for cell culture plastic ware that can be tailored to recreate a large variety of extracellular matrices (ECM) for any adherent cell culture while **Cellbricks** bioprinting produces and distributes bioprinters for printing mini organs and living tissue. The spin-off startup from the Technische Universität Berlin has developed its own 3D printer and specially adapted bioinks, which are used to produce functional placenta and liver models.

## The Precision Worker: ATMPs

Advanced Therapy Medicinal Product: These include gene therapies, somatic cell therapies and biotechnologically engineered tissue products designed to enable individualized, targeted treatment. In the field of regenerative medicine, cell therapy or gene therapy, innovative therapy and product concepts with drugs for advanced therapies are the focus of interest, spurred on by considerable research successes. **The Berlin Center for Advanced Therapies (BeCAT)** is pursuing a new research concept for the development and application of innovative therapy and product approaches. A state-of-the-art research structure is being set up at the Charité location **Virchow-Klinikum** for this purpose. The aim of the research is to integrate novel therapy concepts more quickly into clinical everyday life and thus increase the chances of patients being cured. Only half an hour away on the campus Buch, **T-Knife**, a spin-off from the **Max Delbrück Center for Molecular Medicine**, develops therapies that can fight cancer with the help of the patient's immune system. Over many years, Prof. Thomas Blankenstein's research team has succeeded in genetically modifying human T-cells so that their receptors can specifically detect and destroy certain tumour cells. With the help of this patented technology, the first T-cell receptor gene therapy is to be realized in Germany.

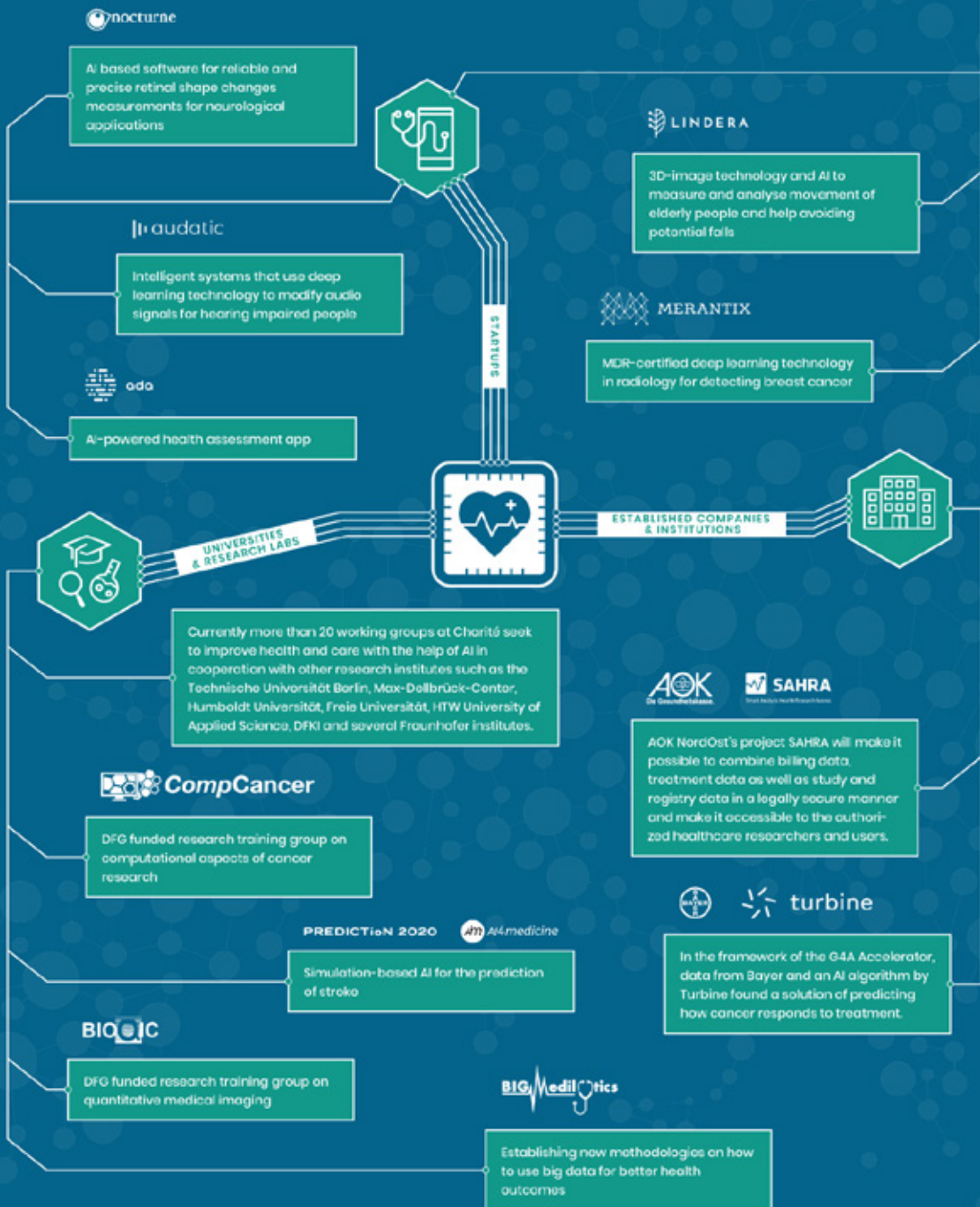
## The Prodigy: CRISPR-Cas9

**Prof. Emmanuelle Charpentier**, who created the basis for CRISPR-Cas9 with her findings in the field of RNA-mediated regulation, is working in the capital region as the founding director at the **Max Planck Unit for the Science of Pathogens**. In the field of gene therapy, the CRISPR-Cas9 gene scissors raise high hopes of being able to treat hereditary diseases at the molecular biological level. Scientists of the **Charité - Universitätsmedizin Berlin** have already investigated reactions of the human immune system to CRISPR-Cas9 in 2018 and found that humans have broad immunity to the Cas9 protein. The industry side is betting on novel cell therapies as well, for example in the treatment of diseases such as Parkinson's disease or heart failure. **Bluerock Therapeutics**, the Boston based subsidiary of **Bayer**, is working on novel therapies based on so-called induced pluripotent stem cells (iPSC). These stem cells can be specifically differentiated into cell types, which could then be used for regenerative therapies against a variety of diseases.



## #ai\_health In Berlin

Berlin features a wealth of medical AI-applications. 10% of all AI companies in the city are working on intelligent healthcare solutions and use artificial intelligence for diagnostics, health apps, therapy and data analysis.





## Biomedicine: Drug Discovery and Development – Potential, Deals and Milestones

In industrialized and emerging countries, diseases of civilization and multiple diseases are increasing, which can be favorably treated by targeted drug therapies. Both non-communicable chronic diseases and infectious diseases are increasingly threatening our health and posing major challenges for the healthcare system. There is a high global demand for new, innovative active ingredients for effective and safe drugs. Research into innovative active substances and the development of drugs make a decisive contribution to medical progress. Numerous companies and academic institutions of modern biomedicine in the Berlin-Brandenburg region are meeting this challenge for the development of innovative drugs.

In addition to the development of innovative cancer therapies and new immunotherapy concepts on proprietary technology platforms, companies in the region are increasingly using digital technologies, the key to personalized medicine.

### New Drugs

The Berlin-Brandenburg region is home to more than 20 biotech companies involved in the development of new drugs. The entire product pipeline covers all phases, from pre-clinical development and Phase I to Phase III. Many companies develop their products on the basis of proprietary platform technologies in order to secure a significant competitive advantage. Different strategies, be it on the basis of novel mRNA constructs, monoclonal antibodies or new first-in-class small molecules, are pursued.

For example **Pantherna Therapeutics GmbH**, a life science startup located in Hennigsdorf, develops a novel pharmaceutical agent preventing the formation of edema and lung tissue injury over the course of ARDS (Acute Respiratory Distress Syndrome). ARDS is a life-threatening condition characterized by widespread and excessive inflammation in lung tissue. Currently, ARDS has a mortality rate of 30-45%, whereas survivors are often unable to work for several months or years. So far, no pharmacological therapy is available. The startup presents a proprietary, innovative technology platform for the development of novel mRNA therapeutics.

Another one, **OMEICOS Therapeutics GmbH**, a Berlin-based biopharmaceutical company developing first-in-class small molecule therapeutics for the prevention and treatment of cardiovascular and ophthalmic diseases, closed a EUR 17 million Series C financing round. The proceeds from this round will finance a Phase II study on OMT-28

in maintenance of sinus rhythm after electrical cardioversion in patients with persistent atrial fibrillation. Additionally, OMEICOS will continue to drive the expansion of its pipeline into novel indications including ophthalmology, led by its US-based subsidiary OMEICOS Ophthalmics.

**Adrenomed AG** was able to raise 24 million euros in venture capital in a series D-round. The capital will be used for a clinical development program of the main product Adre-cizumab. The monoclonal first-in-class antibody is currently being tested in a Phase II clinical trial in patients with early septic shock and elevated adrenomedullin plasma concentration.

**AudioCure Pharma**, dedicated to the development of drug treatments for hearing disorders with a high unmet medical need, receives EMA orphan drug designation for the treatment of sudden sensorineural hearing loss (SSNHL). AudioCure's lead compound may be of significant benefit for patients suffering with the rare and chronically debilitating disease of sudden sensorineural hearing loss (SSNHL).

**Berlin Cures AG** started a phase IIa trial for its  $\beta$ 1-adrenoceptor autoantibody ( $\beta$ 1-AAb) neutralizing ssDNA product BC 007.  $\beta$ 1-AAbs have been identified as a relevant pathogenic cause of heart failure. BC 007 is now being tested as the first causative drug for patients with  $\beta$ 1-AAb associated heart failure. The company is based on the idea of binding autoantibodies with a highly specific aptamer.

### Service Provider

Many service providers in the area of drug discovery and development are located in the Berlin-Brandenburg region. The companies cover the entire spectrum, from specific research tools for pre-clinical studies and technology platforms for drug discovery and screening new drugs to

optimizing lead compounds, active drug transport technologies and drug formulation. Here are a few examples of successful deals and achieved milestones.

**3B Pharmaceuticals GmbH (3BP)**, a private Berlin based biotechnology company closed a multi-year collaboration in the field of peptide-led drug discovery with Boehringer Ingelheim. Under the agreement, 3BP will employ its high-diversity peptide library and hit identification technology on a set of molecular disease targets nominated by Boehringer Ingelheim. Hit compounds identified will be further optimized and jointly characterized by both companies.

As one of the top five non-clinical CROs worldwide, Citox-lab signs an investment and partnership deal with the Berlin located **Experimental Pharmacology and Oncology Berlin-Buch GmbH (EPO)**. This investment in EPO, specialized in the pre-clinical assessment of new anticancer drugs, will benefit from many synergies with preclinical safety and biomarkers services. More than one hundred large pharma and biotech companies from Europe, Asia and North America have already used EPO's services.

**ProBioGen AG**, a premier service and technology provider for complex therapeutic antibodies and glycoproteins, closed a services and license agreement with Abcuro, Inc. Pursuing a new generation of immune modulatory biotherapeutics, Abcuro has developed a new first-in-class antibody for autoimmunity and oncology indications. Under the agreement, ProBioGen will conduct the full service package from cell line development using its CHO.RiGH™ expression platform over process development until GMP manufacturing. This was the fourth deal in 2019.

Berlin-based chemistry-for-healthcare enterprise **Belyntic GmbH** has developed a novel manufacturing technology for pharmaceutically relevant biomolecules, especially chemically synthesized peptides. Belyntic's proprietary PEC technology is based on innovative chemical linker molecules that enable an efficient and yet new way of purification and modification. This facilitates parallel purification for higher reliability in drug discovery as well as the manufacturing of more complex and therefore more targeted pharmaceutical ingredients, e.g. for personalized medicine. Biotech and pharma companies can make use of this novel approach by selecting Belyntic's kit products or setting up a joint development project. Belyntic is a spin-off from Humboldt-University of Berlin, having started its R&D activities in 2016 and is now backed by a financing from Investitionsbank Berlin (IBB) and Germany's most active early stage investor, High-Tech Gründerfonds (HTGF).

## Academic Research

The development of new biomedical treatments is the main focus of today's global biotechnology research. The capital region reflects this in its enormous pool of resources for everything from basic research, the development of new active substances to translational development and treatments. More than 24 universities and unique non-university research institutions with life sciences programs – including Max Planck and Fraunhofer-Gesellschaft institutes, the Helmholtz Association and the Leibniz Association as well as Europe's largest university clinic, Charité – Universitätsmedizin Berlin – make the German capital region one of the world's leading life sciences locations.

The **Max Delbrück Center for Molecular Medicine (MDC)** alone currently has 1,600 employees and visiting scientists. In recent years, MDC has developed into an internationally recognized research institution. It is the only research center from Germany among the world's top 20 institutes for molecular biology and genetics. The MDC is at the forefront of developing and applying the latest technologies, including single-cell analysis, RNA and DNA sequencing and multidimensional OMICS technologies. Such new technical developments often provide the decisive impetus for scientific breakthroughs.

In close proximity to MDC, the **Leibniz-Institut für Molekulare Pharmakologie (FMP)** is located on Campus Berlin-Buch. With more than 270 employees, FMP conducts basic research in molecular pharmacology with the goal of identifying new bioactive molecules and characterizing their interaction with their biological targets in cells or organisms. The FMP hosts the central open access technology platform of **EU-OPENSREEN**, the ChemBioNet and the Helmholtz-Initiative in Drug Research, the Screening Unit. The Unit serves for systematic screening of large compounds or genome-wide RNAi libraries with state-of-the-art equipment like automated microscopes and microfluidic systems within EU, BMBF, DFG and regionally funded academic networks.

**Charité – Universitätsmedizin Berlin** is one of the largest university clinics in Europe. Here, doctors and scientists research, heal and teach at the highest international level. Over 4,500 scientists are involved in countless projects, task forces and partnerships with top-level biomedical research in the Charité – Universitätsmedizin medical faculty. They focus on the translational synergy between experimental, molecularbiology-related basic research with patient-oriented, clinical applications.



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**Dr. Karen Uhlmann**

OMEICOS Therapeutics GmbH, Founder and Director Legal Corporate & Operations

“We founded OMEICOS Therapeutics 2013 on the base of research results, generated at the Max-Delbrück-Center for Molecular Medicine in Berlin-Buch. As pioneers in the field of synthetic omega-3 epoxyeicosanoid analogs, we are developing small molecules for cardiovascular and ophthalmic indications. Our lead candidate OMT-28 is currently tested in a clinical phase IIa/b trial with patients, suffering from atrial fibrillation. Soon, we plan to start also a clinical trial in an ophthalmic indication. We have raised 37 million EURO VC and public grant money so far and always were confident that Berlin is the right place to found and grow the company. Important ingredients for success are here: a vibrant innovative environment with well educated people, an excellent research and clinical landscape and with our premises at Campus Berlin-Buch, we have good and flexible access to lab and office facilities.”

MDC and Charité – Universitätsmedizin Berlin pool their strengths in the **Berlin Institute of Health (BIH)**. The guiding principle is translational research combined with systems medicine’s interdisciplinary approach to bridge the gap between basic research and clinical application.

Also as a common structure established by the MDC and the Charité Medical Faculty, the **ECRC (Experimental and Clinical Research Center)** integrates a critical mass of committed clinicians/scientists and translational researchers in the research-driven environment on the MDC Campus in Berlin-Buch and offers excellent opportunities for education in translational research and the development of clinician scientist careers.

## Networks

The **Network for Pharma Solutions, NetPhaSol**, launched in May 2017, is a cooperation network focussing on drug discovery and development. It serves as a platform for research, development and marketing of new products, technologies and services in drug development. The primary focus are the first value chain stages of a drug development cycle – however, further development stages are not excluded and welcome. Currently NetPhaSol has more than 50 members of companies and research institutions.

The **glyconet Berlin Brandenburg** is the network of scientists and entrepreneurs in glycobiology and glycobiotechnology, located in the capital region Berlin Brandenburg. The professional network facilitates the identification of project partners, supports interdisciplinary collaborations between scientists and entrepreneurs, and represents interests towards political decision-makers in Germany.

## Partnering with Pfizer Worldwide R & D



[www.pfizer.de](http://www.pfizer.de)



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## Pharma Industry: A shared approach to grow through investing

The pharmaceutical industry in Berlin-Brandenburg employs around 11,000 people in the capital region. Many companies have invested in their locations in recent years, others have established a branch office in Berlin or Brandenburg. Moreover the networking with research, biotechnology and startups and the degree of digitization is increasing more and more.

Global corporations such as **Bayer**, **BERLIN-CHEMIE**, **Bausch Health** and **B. Braun** have been active in Berlin-Brandenburg for many years. In 2000 **Sanofi**, **Pfizer Germany** since 2008, **Shire** and **Takeda** and smaller units of **Astra Zeneca**, **Boehringer Ingelheim**, **AbbVie** and **Novartis** were established – some of them with an additional focus on digital health in Berlin. In addition, more than 20 medium-sized and small pharmaceutical companies have headquarters, production sites and marketing and sales units in the region, both long-time such as **Dr. Kade**, **Klosterfrau** or **Dentinox**, as well as newcomers, such as **Riemser Pharma** or **Hevert**.

The industry benefits from the excellent scientific environment, the clinical research landscape, the proximity to decision-makers in the healthcare sector and the high availability of well-trained specialists. With many biotechnology companies and contract manufacturers such as **Aristo Pharma** or **Spreewälder Arzneimittel**, other important partners for the pharmaceutical industry are represented in the region. More and more global players and medium-sized companies are settling here in order to benefit from these location advantages.

In recent years, Berlin has also become an increasingly interesting startup hub for the pharmaceutical industry. In the near future, many companies will not only gain a foothold in the pharmaceutical sector, but also in neighbouring sectors such as medical devices, diagnostics and data management. Berlin is home both to the global headquarters of the phar-

maceuticals division of **Bayer AG** and its largest research location with pharmaceutical production. The division's strategy is focused on innovative treatment options for diseases with urgent medical need. The successful realisation of such a portfolio lies with product supply, i.e. pharmaceutical production, which is being expanded and aligned to include technology platforms. This requires investments in structures and technologies to enable quick reactions to market requirements while taking into account supply and competitiveness and meet the growing demands for quality and security. Bayer plans to set up a centre of excellence for the manufacture of chemically and biologically-based, aseptic liquid, and freeze-dried medication at its Berlin site at a cost of about €100 million. The most modern technologies developed together with external partner companies will be used for highly automated production with highly digitalised production support and innovative, robotic dispensing.

For Berlin-Brandenburg as one of the leading research locations, the particular innovative strength of the pharmaceutical industry pays off twice over. Cooperation between pharmaceutical companies, clinics and scientific institutes guarantees patients state-of-the-art, high-quality healthcare and innovations by pharmaceutical companies create and secure sustainable jobs in the region.

Furthermore the current investments and activities of the local pharmaceutical industry can be seen as proof of the



Stefan Oelrich

Board Member, Bayer AG, and Head of the Pharmaceuticals Division

“It is our goal to bring innovative drugs onto the market that will significantly improve the quality of life for patients,” Stefan Oelrich, Board Member, Bayer AG, and Head of the Pharmaceuticals Division commented when the project launched in September 2019. “The new investment is a clear commitment to our centre of innovation in Berlin. With strong research and the intelligent combination of new technologies in production, we can get innovative ideas for medicines faster to the market and thus to the patient from our base in Berlin.”

attractiveness of the location and a commitment of the companies to the capital region. They range from close cooperation with regional biotech startups, cooperation with the scientific community to expansion of locations to settlement.

In last years, **BERLIN-CHEMIE** has invested more than € 80 million in the expansion of its headquarter in Berlin-Adlershof and has established itself as an important player in the region by organising the renowned Congress for healthcare networkers.

Large parts of **Sanofi's** marketing and sales teams work from Berlin. Sanofi and the Charité/Berlin Institute of Health (BIH) have several joint research projects underway, investigation treatments for various conditions. Among other things, Sanofi has been funding five BIH projects since 2018 through its iAward Europe program. These are intended to move innovative academic research more quickly to the clinical phase. In addition, Sanofi maintains numerous collaborations with partners in the HealthCapital, including long-term strategic partnerships with the Medicine and Health Congress and the World Health Summit. At Sanofi, digitalisation is taking place across the entire value chain. A new cooperation with Google also shows the relevance of cross-sector cooperation. Together with Google, Sanofi will be setting up a virtual innovation laboratory, using data technologies to better understand diseases and gain insights into patients. At its free health exhibition at the Sanofi Showroom on Potsdamer Platz, visitors of all ages are invited to explore the human body interactively and have fun while learning about the topic of health.

After the acquisition of Shire in January 2019, **Takeda** has become the leader in rare diseases. With more than 1,200 employees at Takeda's headquarters in Berlin (including the former Shire local headquarter) and its manufacturing plant in Oranienburg the company has a strong footprint in the Berlin-Brandenburg region and is a proud partner for its stakeholders in the healthcare system. Takeda has been

investing € 100 million into new facilities at Oranienburg to expand its production capacity. The inauguration of the new production unit was accompanied by Chancellor Angela Merkel in June 2017, and through this expansion 180 new jobs have been created.

**B. Braun Melsungen** has three locations and a total of over 1,000 employees in Berlin: with a competence centre for the production of sterile injection solutions in vials and glass and plastic ampoules, a competence centre for products for the treatment of vascular diseases that develops, manufactures, and markets cardiac catheters, stents and vascular implants, as well as the Aesculap Academy. Around €100 million in current and planned investments in its Berlin production facilities illustrate B. Braun's commitment to the capital.

**Pfizer** has its German headquarters in Berlin since 2008. Peter Albiez, Chairman of the Management Board, is the committed spokesman for HealthCapital and closely associated with the cluster community. Since 2014, Pfizer has been active in the region with the Pfizer Healthcare Hub Berlin in order to develop digital solutions through cooperation. The hub is the point of contact for startups - for example with the "Startup Sprechstunde", which takes place several times a year.

**DR. KADE** is also showing its ties to Berlin with extensive investments. On the one hand, the company moved into its new administrative headquarters in the Ullsteinhaus and used the space freed up at the company's headquarters also in Tempelhof-Schöneberg to expand its production facilities. The Berlin based company with more than 130 years of history has added additional products to its portfolio through recent acquisitions and has also demonstrated an eye for innovation by investing in Berlin's startups.

These current examples are only a selection of activities of the pharmaceutical industry in Berlin-Brandenburg. They illustrate how much trust big pharma has in the capital region of Germany.



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**Dr Fabrizio Guidi**  
CEO of Sanofi in Germany

"Sanofi has deliberately located its headquarters for Germany in Berlin. What makes the Berlin-Brandenburg region particularly strong for Sanofi and the healthcare sector is the unique concentration and networking of politics, associations, science, clinics, industrial healthcare, and startups. Political decision-makers and many top researchers are located here. If you want to participate, you need to be here on the ground."



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## Better Diagnostics for Better Therapy

Precise diagnostics are crucial for the successful treatment of diseases. A fast and accurate diagnosis can save both time and money, improve quality of life and even save lives. Currently, a strict distinction is often made between *in vivo*-, *in vitro*- and digital diagnostics. A dissolution of this taxonomy by merging diagnostic data from different sources as well as the integration of further data, e.g. generated by wearables or other non-invasive hardware, has the potential to make future diagnoses more accurate and holistic. In addition, AI-supported approaches could support healthcare professionals in making diagnostic decisions.

In the German capital region, a large number of scientific institutions, startups, small, medium-sized and large companies concentrate on the fields of diagnostics and digital medicine. Thus, the region offers an excellent ecosystem to work on modern diagnostics in a comprehensive way and to develop new products and services around it.

### 1. Systems biology: understanding all determinants of human health and disease

At the beginning of every disease there are changes in individual cells. Although, many processes in individual cells are well known but the complexity and interaction of these processes especially in one united cell structure is poorly understood. The analysis of single cells will help to explain the development of diseases of individual organs or entire organ systems and to be able to develop promising therapies.

Today, with current diagnostics diseases are diagnosed using biomarkers at a late – sometimes too late – stage. Therefore a much more therapeutically effective approach would be an early diagnosis, even before the first symptoms appear. Although there are already many interesting approaches in the field of tumour diagnostics, slowly progressing diseases such as diabetes or Alzheimer's are equally important. With those indications the first changes occur not only years but sometimes decades before the first symptoms appear.

With this in mind, systems medicine is becoming increasingly relevant – an interdisciplinary research field, combining different disciplines such as biology, mathematics and computer science in order to analyse and integrate the various OMICS data (e.g. genome, proteome, metabolome, microbiome) using high-throughput technologies and their bioinformatic evaluation.

More than a dozen excellent research institutions in the Berlin-Brandenburg region are researching the processes at the cellular level in order to better understand diseases and establish new biomarkers.

By now almost old hat: the genome. But this is where the translation of results into clinical application is most advanced.

The **Max Planck Institute for Molecular Genetics (MPI-MG)** in Berlin Dahlem is one of the most renowned institutes in genome research. Prof. Vingron's research group "Regulation of Transcription" develops methods and tools for transcription factor-based and epigenetic gene regulation and identifies regulatory effects of mutations by genomic sequence analysis. The MPI-MG has given rise to several innovative companies that transfer the findings from basic research into health care. **Alacris Theranostics GmbH** can use the ModCell platform to individually predict the mode of action of selected therapies. **The Dahlem Centre for Genome Research and Medical Systems Biology** examines how individualised therapies can be realised.

The **Berlin Institute of Health (BIH)**, also concentrates in its Core Facilities on the investigation of genome profiles of clinical samples. In addition, with its separate Core Facilities Proteomics and Metabolomics, it is a competent partner for joint R&D projects.

Increasingly interesting to investigate interactions and define new biomarkers for diseases: the metabolome

This is no longer limited to plants and their products of metabolism. Although Prof. Wilmitzer's department at the **Max Planck Institute for Molecular Plant Physiology (MPI-MP)** has a major focus on this field, the Potsdam Golm Science Park is home to young companies such as

**metaSysX GmbH**, which are also dedicated to the metabolite analysis in the human field.

Very complex, still little understood but nevertheless meaningful: the glycome

Sugars not only play a major role in food intake and energy production. The modification of cells and proteins with sugar residues is essential for many biological processes in the body. A change in these sugar residues can be accompanied by the progression of various diseases. The group of Prof. Véronique Blanchard at the Charité - Universitätsmedizin Berlin was able to identify an entire glycome panel in the area of ovarian carcinoma, which gives an indication of this disease at an early stage. Prof. Seeberger's Department of Biomolecular Systems at the Max Planck Institute for Colloids and Interfaces is connected worldwide and a leader in the field of glycobiology.

A trend topic with scientific substance: the microbiome

The human body is colonized by more microorganisms than the actually amount of cells it contains. The role of these microorganisms is only partially understood and it is becoming increasingly clear that they have an influence not only on digestion, but also on the immune system and the occurrence of various diseases. **The Charité - Universitätsmedizin** Berlin is dedicated to this topic e.g. in the **Institute for Microbiology and Infection Immunology**. The group of Prof. Marcus Frohme at the TH Wildau is also doing research in this area which has already led to a spin-off: **Biomes NGS GmbH** offers an analysis of the intestinal flora and gives recommendations on how a disturbed intestinal flora can be regenerated.

**MDC – Max Delbrück Center for Molecular Medicine (MDC)** is also dedicated to this topic. The Sofia Forslund working group investigates host microbiome factors in heart disease. In order to get closer to the goal of a high-precision,

quantitative understanding of host-microbiome interaction, data obtained using high-throughput methods from human hosts and microbiomes are analyzed. Metadata on disease development, diet and lifestyle are also taken into account.

## 2. Bioinformatics: collecting and analyzing all data available

Large amounts of data have to be generated, but also evaluated. Bioinformatics has become an integral part of modern medicine and provides the basis for the modelling and simulation of complex systems. In the future, this will enable better and faster diagnostics, the development and application of targeted therapies and the prediction of outcomes. Bioinformatics uses "OMICS" data, which are generated at an unprecedented speed and increasingly cost-effectively using high-throughput Next Generation Sequencing (NGS) methods, and combines them with other data sources – for example imaging methods. Various computer tools are used to interpret gene expression patterns, identify mutations and describe the relationship between the data and therapeutic success.

With its screening unit, the **Leibniz-Forschungsinstitut für Molekulare Pharmakologie (FMP)** offers scientists and SMEs access to high-throughput technologies, especially in the field of cancer medicine, whereby the IP can remain with the client or project partner.

The large amount of data generated has only a value for further research if it is combined with a "smart" analysis and evaluation. In the Berlin-Brandenburg region are many research institutions and companies that offer exactly this analysis. The advantage here is to combine data from different sources. In the MODAL research campus, a platform between the Zuse-Institut Berlin (ZIB), the Free University of Berlin and twelve companies, the application of various mathematical models is intended to address challenges in information-based medicine.



© Pablo Castagnola / MDC

"Science is just beginning to understand how our health is influenced by the microbiome – the ecosystem of bacteria in our intestinal tract. These microorganisms are involved in processes that affect the entire body. They help digest food, render pathogens harmless, produce signaling molecules, and can activate immune cells. Some appear to promote health, while others can harm it. Precisely the expertise I need for my work – connecting the microbiome to cardiovascular diseases – is here in Berlin."

**Dr. Sofia Forslund**

Group Leader „Host-microbiome factors in cardiovascular disease“, Max Delbrück Center for Molecular Medicine (MDC)



© Pablo Casagrola / MDC

**Prof. Nikolaus Rajewsky**  
Scientific Director Berlin Institute for Medical Systems Biology (BIMSB)

“The interdisciplinary spirit of the BIMSB is reflected in the international initiative Life-Time that is co-coordinated together with Geneviève Almouzni at the Institut Curie. With high-profile scientific, industrial and political partners and supporters all across Europe, LifeTime is a large-scale research initiative with the mission to revolutionise healthcare by tracking, understanding and targeting cells during disease. To achieve this, it is currently developing a roadmap that will lay out a strategy to integrate breakthrough technologies such as single cell omics including advanced imaging, Artificial Intelligence and Machine Learning as well as personalised disease models such as organoids and how it can be implemented in Europe.”

A hotspot for (bio-)medical informatics is the **Hasso-Plattner-Institute (HPI), Digital Health Center** in Potsdam. The Digital Health Center brings together individuals from health sciences, human sciences, data sciences, digital engineering and society with a shared goal to improve health and wellbeing. The research group “Digital Health – Machine Learning”, headed by Prof. Christoph Lippert, works on Machine Learning and Artificial Intelligence algorithms and novel applications in medicine. They develop models to detect disease patterns in images and molecular data and statistical models for the quantitative analysis of large cohorts. Technical advances in imaging and DNA sequencing enable diagnosis of disease earlier and more accurate than ever. Innovative use of data promises to revolutionize clinical practice and to turn medicine into a data science.

To view the individual OMICS areas not isolated from each other, but to understand them in their entirety, is the goal of future research and will give new impulses for innovative developments. At **BIMSB – The Berlin Institute for Medical Systems Biology** – high-throughput technologies, mathematics, bioinformatics, molecular biology and engineering sciences can be combined to describe entire

systems and develop new, personalized therapies for various diseases. This involves understanding the processes in a single cell and their effects on entire organs, organ systems, organisms and, ultimately, entire species. In order to address this topic comprehensively and also to think beyond the region, national and international expertise will be bundled in the so called **LifeTime consortium**. But the research at **BIMSB** is not exclusively to this consortium. Prof. Ohlers group for example is working in basic research with computer-based approaches to understand the biology of gene regulation in eukaryotic organisms. The long-term goal of the group is to investigate regulatory networks that allow cells to perform different functions despite having the same genome.

### 3. Simulation: replacing the human organism

The human organism and the complexity of diseases can only be understood if both are thought of in terms of networks for which prevention, diagnostics and therapy are interlinked like cogwheels. To achieve this, new technologies are constantly being applied to develop medical models based on human examples. A major player in this field



© Philipp Arnold

**Prof. Andreas Thiel** Charité – Universitätsmedizin Berlin, **Prof. Roland Lauster** Technische Universität Berlin

“With our new research building ‘Simulated Human,’ – the expertise of the Charité and the TU Berlin is combined and focuses the simulated human being as an experimental model. For example, we can cultivate individual cancer cells from a biopsy on the organ-on-a-chip technology and test the effects and efficiency of various new therapies. The special feature of our centre will also be the public presentation on the lower two floors.”

will be the new research building **Si-M – “Der simulierte Mensch”**. The Si-M combines the scientific expertise of the Charité-Universitätsmedizin Berlin and the Technische Universität Berlin (TU) for the long-term renunciation of animal testing in medical research. In return, the initiators Prof. Andreas Thiel and Prof. Roland Lauster received financial support from the federal government and the state of Berlin. Si-M thus sees itself as a fundamentally experimental project that does not adhere to tried and tested procedures, but breaks new ground. The simulation of human physiology on the basis of organoid technology and bioinformatic methods serves to establish a realistic model for the development of efficient forms of therapy.

In addition to the close cooperation between the project partners, the public communication of theoretical and experimental progress plays an important role in the new research building. Therefore, communication with the public is given a fixed place in the imposing Theatron in the middle of the building, while the thematic orientation is reflected in the allocation of the different floors (“subcellular level”, “cell” as well as “tissue and organs”). The principle of exchange will be extended into scientific practice as the architectural design of the offices and laboratories guarantees all scientists open access to all resources and thus unites the two institutions Charité and TU Berlin as equal partners. But the simulation of the human being is not limited to preclinical drug-testing or evaluation of treatment options. Simulations are also becoming more and more interesting in the field of medical technology: e.g. in the calculation of radiation exposure in imaging techniques made by **PhantomX**.

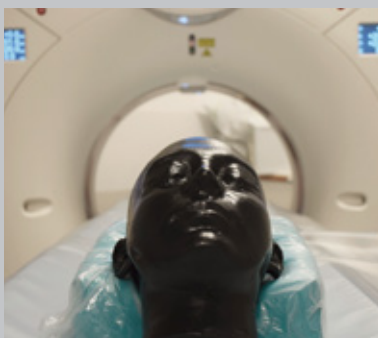
#### 4. Digital diagnostics: detecting disease with software

Incorrect, unstructured and incomplete data – these are some of the unpleasant qualities historically associated with the field of digital diagnostics.

However, a series of trends we are observing are currently impacting the success of digital diagnostics. To name just a few determinants, faster computing, an increasing consumer demand for prevention and better non-invasive consumer technology available like for example the single-channel ECG included in wearables and devices.

But what exactly means digital diagnostics? Digital diagnostics include data capture in almost any possible scenario inside and outside the hospital setting and the subsequent analysis of the data. Data can include a great variety of resources ranging from *in-vivo* and *in-vitro* data, to medical best practice, patient records and real-time monitoring. On a professional medical level, automated assessment of the data can provide clinicians with decision support. On a consumer level, digital diagnostics can empower patients to understand their own health status and possibility even next steps to take, such as consulting a physician. Most consumer-oriented digital diagnostic solutions use mobile phones and the built-in sensors.

The Berlin-based company **Ada Health** has developed two apps: one for consumers and one for physicians. The consumer app helps citizens to report symptoms, matches



© PhantomX GmbH

#### PhantomX – Patient Phantoms for Radiology and Radiotherapy

PhantomX is a world market-leading manufacturer of highly realistic phantoms for simulation of patient radiation exposure in medicine. The unique technology of PhantomX addresses an unmet need for patient simulation in X-ray and computed tomography imaging and radiation therapy. Realistic patient phantoms enable clinically relevant development, testing, optimization and quality assurance of diagnostic and therapeutic systems and software (including artificial intelligence based tools). They provide novel opportunities to accelerate developments, reduce clinical trials and improve

patient radiation exposure and diagnostics. In radiation therapy, dose exposure of individual patient can be verified and optimized with patient specific phantoms before the patient gets treated. Target customers of PhantomX are clinics, patients, manufacturers, researchers, authorities. PhantomX is a spin-off from the Institute of Radiology and works closely with the Charité – Universitätsmedizin Berlin.



Dr. Martin Hirsch

Ada Health GmbH, Co-founder & Chief Scientific Advisor

“We cannot accept the fact that people living with a rare disease often wait six years for the correct diagnosis. Artificial intelligence gives us the opportunity to change this and make a fundamental difference to the lives of millions of people worldwide.”

them with symptoms of patients of similar age and gender, and reports the statistical likelihood that the patient has a certain condition. Particularly in the field of rare diseases, Ada's pioneering artificial intelligence supports doctors in their clinical decision-making for timely and accurate detection.

The startups **Merantix Healthcare** and **mediaire** are two examples of how artificial intelligence applied on medical images can provide accurate and fast diagnostics. But radiology is not the only possible medical discipline that holds great potential for digital diagnostics. A range of research groups at **Charité – Universitätsmedizin Berlin** and the **BIH – Berlin Institute of Health** develop solutions for digital diagnostics in pathology, neurology, oncology and many more.

A prototype of a computer model has been developed by the team of Prof. Dr. Dietmar Frey from Charité - Universitätsmedizin Berlin. Using this digital diagnostic procedure, they aim to create a first approach to stroke prognosis that is specifically tailored to each individual patient. In addition, the simulation software can assist in the determination of the optimal individual therapy for stroke prevention. On the basis of patient-related MRI or CT images of the brain as well as different blood pressure values, the software simulates how cerebral blood circulation behaves for a range of blood pressures. The system then quantifies the risk of stroke on a scale of one to five and compares different various options. Finally, the treating physician is provided with a personalised result report containing a range of blood circulation scenarios and therapy options, and which recommends the optimal treatment method for the stroke patient.

## 5. Medical Imaging: extending the function of traditional radiology systems

In addition to determining vital signs, diagnostic imaging is an essential diagnostic element conducted using computer tomography (CT), magnetic resonance imaging (MRI)

and ultrasounds. The use of contrast agents can improve imaging, and nuclear medical methods, such as positron emission tomography (PET) and single-photon emission computed tomography (SPECT), are increasingly gaining importance. Combining these with existing CT and MRI methods in a single device (MR-PET) is the technology of the future.

More than 130 hospitals in Berlin and Brandenburg have a full range of equipment for large-scale diagnostic imaging at their disposal. With the **Institute of Radiology**, the **University Outpatient Clinic for Radiology** and the **Institute of Nuclear Medicine**, the Charité, is also home to one of the largest radiology centers in Europe. Furthermore, the researchers can count on the **MRI Core Lab Berlin** as a cardiovascular image analysis center for scientific research investigations in clinical trials with imaging endpoints. At the lab dedicated cardiac MRI scanners with 1.5 and 3.0 Tesla allow researchers to simultaneously acquire cMRIs using the MRI Core Lab function.

A key feature of medical imaging in the German capital region is the close collaboration between scientists who conduct fundamental research in the fields of physics, biochemistry, bioinformatics and medicine, science, and industry. The **Berlin Ultrahigh Field Facility** (B.U.F.F.) has been implemented on the Campus Berlin-Buch as an integral part of the ECRC. B.U.F.F. is equipped with a 3.0 Tesla and a 7.0 Tesla whole-body human MR scanner and a 9.4 Tesla animal MR system. B.U.F.F. provides the infrastructure for projects of an interdisciplinary imaging consortium with scientists and clinicians from the **Max Delbrück Center for Molecular Medicine, Charité - Universitätsmedizin Berlin**, the **Physikalisch-Technische Bundesanstalt (PTB)** and the **Leibniz-Forschungsinstitut für Molekulare Pharmakologie (FMP)**.

## Building Today a Healthier Tomorrow

Smart4Health is a project of the European Union (EU) with the aim to empower EU citizens with an interoperable and exchangeable electronic health record (EHR) that enables them to actively manage their health data throughout the EU and beyond, advancing their health and wellbeing. The key objective of the project is to place the citizen in the centre of the management of their health-related data, which can contain diagnoses, treatments, medication plans, and fitness data. The citizen is thus empowered with the possibility to share their health data securely with anybody (e.g. clinicians, medical centres, health care providers, family members) both nationally and internationally, as well as to donate their data for research activities. Thus, Smart4Health will fill a gap in EU eHealth and personalized health initiatives.



© HPI

The Smart4Health consortium consists of 17 partners within the EU from medical, social and technical sciences, and industry and a partner from the US. Prof Dr. Erwin Böttinger, Head of the Digital Health Center at the Hasso Plattner Institute (HPI) in Potsdam, is the scientific coordinator of the consortium. The Smart4Health project started in January 2019 and is funded through the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 826117 with a maximum of € 21.8 million over 50 months. For more information, please visit: [www.smart4health.eu](http://www.smart4health.eu)

### Alternative contrast agents and patient-friendly imaging devices

Innovation in imaging hardware and contrast agents has advanced at a much slower pace than innovation in medical image analysis over the last years. This is only partially related to a lack of research, but rather to difficulties in finding contrast agents that are specific enough to meet a medical need and broad enough to target a large range of

patients. **Bayer** is a major player in the field with more than 20 years of excellent research in molecular MRI. However, several companies and research groups are working hard to develop new contrast agents that can be used as alternatives to iodine, gadolinium or fludeoxyglucose (FDG). This is an important research topic for the German capital region and many regional partners are contributing to the **VSOP project**.

## VSOP – MRI contrast agents based on iron-nanoparticles

The VSOP project combines two important fields of modern medicine: the development of nano medicine and molecular imaging. The objective of the project "Research and development of a MRI contrast agent based on iron oxide nanoparticles (VSOP)" is the development and testing of contrast agents for vascular diagnostics in magnetic resonance imaging (MRI) in patients with reduced renal function and simultaneous cardiovascular diseases. In such patients, the use of contrast media containing iodine or gadolinium should be avoided as far as possible, as this can cause undesirable effects and health damage. The iron oxide nanoparticles developed in the project are tested for their tolerability, in addition to their efficacy for vascular diagnostics, in order to ensure that there is no risk to human health. The results of the project are part of the pre-clinical development as a prerequisite and basis for the clinical development of the product.

Project partners include the radiology department of Charité – Universitätsmedizin Berlin, InnoRa GmbH, Chiracon GmbH, IMTR GmbH, Physikalisch-Technische Bundesanstalt PTB and b.e. imaging GmbH.



Berliner Ultrahochfeld-MR-Anlage at ECRC

With regard to innovation in medical imaging devices, a similar innovation bottleneck can be observed. Few new devices from the capital region have entered the market recently. The Berlin-based company **Xiralite** for example has developed a fluorescence optical imaging (FOI) hardware that provides a differential diagnosis of arthritis of the hands.

#### Algorithms providing a differentiated diagnosis

Medical image analysis is a broad branch of the image processing field, and it conveys all kind of measurements or operations on the image in order to extract some useful information or prepare the image for an upcoming task. Automation of any of the image analysis tasks is of high importance since it saves time and effort and makes the image analysis tasks easier and simpler to perform. Deep learning is used in many image analysis tasks such as detection, classification and segmentation and it has shown very promising results in terms of accuracy and efficiency.

A focus of the **DFG graduate programme BIOQIC** is the classification and segmentation of prostate cancer zones and lesions. Deep learning is a great tool to automate any manual stage in the diagnostic procedure. The approach uses a convolutional neural network, which requires only the coordinates of the lesion, and then the network will do the rest of the analysis on multiple MR sequences auto-

matically. Segmentation in medical imaging is also a very tedious and time-consuming task; it requires segmentation in a slice-wise manner and highlighting all the relevant pixels for the task. Deep convolutional neural networks have shown great capabilities in this field and what requires minutes or hours to be done manually, the networks can do in matter of seconds. The research shows that deep learning not only does reduce the time and make the image analysis procedure more time efficient, but also can reach a level of performance that is very close or equal to the one achieved by the experienced radiologist and maybe in the near future it will go beyond this level.

## 6. Showcase oncology: targeted therapies through better understanding

Cancer medicine is the best example of how broad basic research leads to a comprehensive understanding of a disease. While a few decades ago the only option for treating a tumour was radiation, surgery and subsequent chemotherapy, today not only these methods are far more precise and associated with fewer side effects. Novel cell therapies are an additional way to combat the second leading cause of death in Germany.

However, this progress has only been made possible by elucidating basic mechanisms and the implementation of the results in clinical routine as well as in diagnostic and therapeutic products. The realization that there is not only one type of cancer and that the cells within a tumor have different potentials to form metastases leads increasingly to the fact that the patients have to be divided into smaller groups for a precisely fitting treatment: the way to stratification of patients and personalized medicine.

The Berlin-Brandenburg region is home to a large number of companies and research institutions active in this field. The **CCCC - Charité Comprehensive Cancer Center** is the central point of contact in Berlin for the diagnosis and treatment of tumors. The **Alacris Theranostics GmbH** uses its technologies CMTA (Comprehensive Molecular Tumor Analysis) and ModCell™ to optimize the therapy for each individual patient.

In many innovative projects the basics are further researched and new ways for diagnostics and therapy are being explored. In 2019, the Wachstums Kern (Innovative Regional Growth Core) **“PraeMedBio - precision medicine through biomarker-based diagnostics”** was launched in Senftenberg. A modular and fully automatic analysis system (PRÆMED.BIO-Scan) is to be developed and constructed in a network of several companies and research institutions. It will integrate all necessary hard-



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“The core competence of the PRÆMED.BIO alliance results from more than twenty years of activity of most partners along the entire value chain for medical diagnostics: measuring instrument construction, development of new diagnostic parameters, development, validation/certification, production and distribution of diagnostic multiplex tests, production of consumables as well as clinical routine diagnostics. The know-how of the partners leads to the core competence “Digital Fluorescence”, which is complemented by system automation and clinical expertise in tumor diagnostics.”

**Prof. Dirk Roggenbuck**

General Manager / CEO, Medipan / GA Generic Assays GmbH

ware modules, record and evaluate all measured values on the basis of digital fluorescence. In line with this platform, the development of test systems for the PRÆMED.BIO scan for the characterization of head, neck and rectal carcinomas will be promoted and coordinated with the hardware components for optimized diagnostics. This also includes the validation of different biomarkers for these oncological questions and the clinical testing of the entire system.

Another important contribution to tumour research will be made by the DFG Research Training Group **CompCancer**, which was launched in 2019 by the Charité, Humboldt-Universität zu Berlin, BIH, MDC and MPI MG institutions. CompCancer is a PhD programme that focusses on computational aspects of cancer research. Contemporary cancer research generates enormous data sets characterising tumours at unprecedented molecular details. To integrate and interpret these new layers of data, computational methods are becoming central to cancer research. Increasingly, computational methods are also required for clinical oncology, as more and more patients are receiving therapies based on integrated molecular profiles.

The goal of CompCancer is to develop and apply computational methods on relevant questions of current cancer research and thereby train the next generation of compu-

tational oncologists. CompCancer focusses on research on personalized and advanced therapies, tumor heterogeneity and therapy resistance. These areas are addressed with contemporary methods including single cell methods, mathematical modelling, integration of multi-omics data and complex IT systems.

“To beat cancer with it’s own weapons” is the future trend in the fight against cancer. Since cancer cells are impressively able to hide from the immune system, it has not been included in the therapy for a long time. Today, however, the situation is different. Several promising approaches are being pursued in the field of immunotherapies. CAR-T cell therapy, which has been approved for leukaemia in the European Union since August 2018, is the pioneer in this type of therapy. Researchers in Berlin and Brandenburg also use genetic engineering methods to modify autologous cells of the immune system in such a way that they are able to recognise and combat cancer cells. Spin-off projects such as **Captain-T-Cell** or **T-Knife** at the MDC are dedicated to new T-cell receptor technologies in order to fighting cancer with activated, tumor-specific T-cells. On the other hand, **AmpliVak Immunotherapy GmbH**, a spin-off of the **RKI - Robert Koch Institute**, is pursuing the development of a cancer vaccine. The dendritic cells are equipped with a special technology with the tumor antigen, which is then



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“AmpliVAK is developing a special vaccine technology for loading dendritic cells in vivo with tumor antigenes. The resulting T-killer cell response is then amplified 100-500 times in the patient’s body so that the cancer cells can be fought very efficiently. With these therapeutic vaccines, we hope to achieve a long-standing goal in immunotherapy against cancer. The capital region, with its excellent network of research institutions, clinics and companies, offers a perfect opportunity to test and further develop our technology in clinical studies”.

**Prof. Richard KroczeK**

CEO, Amplivak Immunotherapy GmbH



presented to the immune cells. These then fight and eliminate the cancer cells.

Last but not least there is the clinical application: The **Charité Comprehensive Cancer Center (CCCC)** organizes and coordinates cooperation in the field of tumor medicine among the various Charité Centres, the interdisciplinary tumor outpatient departments, the specialist disciplines and the Berlin research institutions. The CCCC pursues comprehensive precision medicine. Molecular tumor diagnostics and interdisciplinary therapy are available at the Charité Comprehensive Cancer Center as well as the best technical equipment and numerous clinical studies with new drugs and treatment principles.

## 7. A regional roadmap from diagnostics to therapy

Every treatment begins with a precise diagnosis. The search for new biomarkers and their transfer into clinical routine will make it easier to diagnose and treat diseases in the future. The subdivision of the disease into different subtypes and the associated stratification of patients offers the potential for personalized therapy and rapid recovery. However, this is only possible if results from basic research are quickly translated into innovative products and applied in clinical practice.

### The entire value chain

The development of innovative medical solutions covers the four areas of basic research, technology development, clinical validation and industrial development. The German capital region is well positioned to handle these areas, providing the entire value chain from basic scientific research to production and marketing. The many research facilities, hospitals, and biomedical and pharmaceutical companies in the region provide advantages for everyone involved in the value chain.

### Basic research

Development starts with consolidating knowledge on biomarkers as indicators for biological and pathogenic processes. As already mentioned, a hot spot for medical research in the capital region is the **Berlin Institute of Health (BIH)**, which connects medical research by the Charité – Universitätsmedizin Berlin and basic research from the Max Delbrück Center for Molecular Medicine (MDC) to strengthen translational research. By doing so, the systems medicine approach of the BIH combines biomarker research at a genomic and proteomic level with clinical patient data for specific indication areas.

Beside the BIH there are a lot more institutions where the basics of various diseases are being researched. In addition

to five universities, the region also has several universities of applied sciences and research institutions of the **Max Planck Society**, the **Helmholtz Association** and the **Fraunhofer Society** that are involved in the search for new biomarkers and the development of new therapies.

With the **Charité - Universitätsmedizin Berlin**, the largest university hospital in Europe is located in the region. Besides the treatment of patients a lot of research is being done to get insights in the basics of health and disease. With the Brandenburg Medical School “Theodor Fontane”, Brandenburg has had its own medical education since 2014, basic research and its translation into the clinic are also pursued.

### Technology development

Berlin-Brandenburg holds a strong position in developing solutions for next generation *in vitro*-diagnostics like sensor-actor molecules and autonomous biosensors, as well as genome, proteome and glycan-based multiplex analytics. The majority of IvD are performed in highly automated and advanced hospital laboratories, but in recent years, many more have been developed for point-of-care testing (POCT). As these test procedures are very fast, the application will increase. Currently, the greatest challenge in the field is miniaturizing analytic devices. The **Fraunhofer Institute for Cell Therapy and Immunology IZI-Berlin-Brandenburg** in Potsdam-Golm is developing an *in-vitro* diagnostics (IvD) platform consisting of the cartridge the size of a credit card (lab on-a-chip) and a base station. At the **TH Wildau** a lot of work is done in the area of biosensorics. And with the research groups of the **Brandenburg University of Technology (BTU)**, Senftenberg is a hot spot for multiparameter analysis.

### Transfer into innovative products

Beside scientific institutions, more than 200 regional small and medium sized companies are also focused on innovative technology developments. In joint cooperation projects, findings from basic and applied research are translated into innovative products. Innovative and knowledge-based companies benefit from the region's first class research landscape.

**Medipan's** AKLIDES® platform technology is one example of successful cooperation between science and industry. It is worldwide the first fully automated system for standardized immunofluorescence imaging and data processing. The AKLIDES® system is used in the field of immunology, especially for immunofluorescence tests.

With their proprietary non-contact dispensing technologies, **SCIENION AG** can print capture molecules onto any surface. Additionally, they own a unique single-cell isola-



© BCRT

**Prof. Petra Reinke**

*Director, Member of the Steering Committee & Lead Scientist, Head of Research and Development (R&D), Berlin Center for Advanced Therapies, Charité – Universitätsmedizin Berlin*

“The new BeCAT research building implements a new research concept and, thanks to the good infrastructure of medical institutions in Berlin, enables the translation of scientific research, technological development and clinical application testing of ATMPs. The research initiative RESTORE will also advance research in the field of ATMPs throughout Europe and will help making our vision of healing patients instead of treating them become a little more reality.”

tion and dispensing technology – opening up new dimensions for cell line development and single cell sequencing. Partnerships play an important role in their activities, the relationships to the scientific, academic and business communities are very strong.

#### **Transfer into clinics**

With the Charité – Universitätsmedizin Berlin, one of Europe’s largest university hospitals with more than 35,000 beds and a wide spectrum of outstanding basic research, the region offers broad access to a patient collective of urban and rural population of about 180 ethnicities for implementing clinical trials to validate biomarkers.

The **Charité Research Organisation** allows researchers to access a large group of patients in the German capital region for clinical trials. It provides the capabilities and collaborations that modern translational, experimental and exploratory clinical development groups are looking for.

**Labor Berlin**, one of the largest clinical laboratories in Europe, combines the expertise of the Charité and Vivantes laboratories and offers complete solutions for any type of laboratory diagnostics for the diagnostics industry.

With the new **BeCAT research building - Berlin Center for Advanced Therapies** – another state-of-the-art center is being built at the Charité Campus Virchow, which covers everything from basic research and technology development research to clinical trials. Numerous research groups from different fields are working on new therapeutic options, e.g. the development of cell-based products for endogenous regeneration, tissue engineering, gene therapeutics and immunotherapeutics as tumour therapy for diseases with high clinical demand. The BeCAT also includes a GMP laboratory unit to enable the production of all ATMP classes. Prof. Petra Reinke was appointed founding director of the center. She and her team of researchers are working on new therapeutic approaches for incipient and chronically manifested renal insufficiency. Prof. Igor Sauer is working on improving the de- and re-cellularisation of the liver as part of the **NeoOrgan** project in order to prevent tissue rejection as far as possible in the future. For BeCAT, additional new cell-based approaches with pro-regenerative and anti-inflammatory capacity for improved regeneration after partial liver resection are being developed. Prof. Petra Reinke and Prof. Hans-Dieter Volk from the BCRT coordinate the innovation project **RESTORE**, which is funded by the Horizon 2020 program. It supports the development and application of novel therapies and pursues the goal of transferring these novel therapies into everyday life. However, **RESTORE** is not only about research and development of these technologies, but also about education and training of different expert groups.

# RESTORE

Health by Advanced Therapies


Advanced therapies are one of the most recent and significant advances in medicine. They include gene and cell therapies and tissue-engineering approaches to not only treat disease symptoms, but to potentially provide a cure for otherwise incurable chronic diseases.

A growing number of these advanced therapies are now reaching patients, transforming not just the lives of people afflicted with chronic diseases, but the lives of their families too. However, to make these innovative therapeutic strategies available to millions of patients, there are multiple challenges to overcome, from conceptual and technical hurdles through to special manufacturing issues and new payment models.


We at **RESTORE** want to make these treatments options available to patients as a standard of care across Europe. We believe that Europe provides an optimal scientific ecosystem for such a large and concerted interdisciplinary effort, with excellent science, sound infrastructure and diverse funding opportunities.

**RESTORE** is a network of over 300 research institutes, companies, consortia and non-profit organizations from Europe and beyond, which is managed by ten European partners and coordinated by the BCRT and BeCAT in Berlin. We are working on the "Advanced Therapies Roadmap for Horizon Europe" to make the vision of bringing Advanced Therapies to patients around the world a reality, and to build a European infrastructure to support and enable this vision.

For more information,  
for to get involved, you can follow us on

 [twitter.com/RESTOREhorizon](https://twitter.com/RESTOREhorizon)

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[www.restore-horizon.eu](http://www.restore-horizon.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820292.



**BIH Regeneration**  
BIH Center for Regenerative Therapies (BCRT)



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## Medical Technology and Digital Health: Providing modern therapies and devices

The medical technology and digital health sector is a strong pillar of the healthcare industry in the German capital region. Berlin-Brandenburg is home to more than 330 medical technology companies – including global market leaders, SMEs and startups. Over the last two years the Berlin and Brandenburg medical device community has been marked by technological trends, which we can also observe on a global level: biologisation, personalisation and digitisation. These trends will affect greatly how we provide and experience therapy and care in the future. Patient journeys will be optimised as we attain better medical care by reducing treatment errors.

### Innovative materials for medical devices and implants

Beside the field of prosthetics and orthopedics, innovative materials are essential for the development of medical devices and therapies. Special materials and surfaces can reduce the sticking of germs, promote the growth of completely new cell cultures and can also be used for targeted drug delivery. For these reasons, material sciences play an important role in the Berlin-Brandenburg life sciences region.

Infections in hospitals and antibiotic resistances are currently topics of high public interest. Infections can also occur during trauma procedures. So-called surgical site infections (SSI) are associated with the implementation of implants in the body and can lead to complications in patient care and thus to enormous costs for global health care systems.

The innovative Berlin-based medical device company **aap** has developed an answer to this huge challenge in trauma which could be a real game-changer. The company coats trauma implants as plates and screws with an innovative antibacterial silver layer with infection-reducing properties. As there are no considerable resistances against silver, the technology could also protect against the particular problematic multiresistant germs, thereby delivering a solution without antibiotics. Furthermore, the application of aap's silver coating technology is not only restricted to trauma: it can also be used in other areas of orthopaedics as well as in cardiology, dentistry or medical instruments.

Treating severe heart failure using ventricular assist devices (VAD) is clinically very complex. Despite considerable progress in recent years, the treatment is still associated with complications. For example, thromboembolic events, in other words, the formation of blood clots leading to cerebral infarction, may occur as a result of a parallel

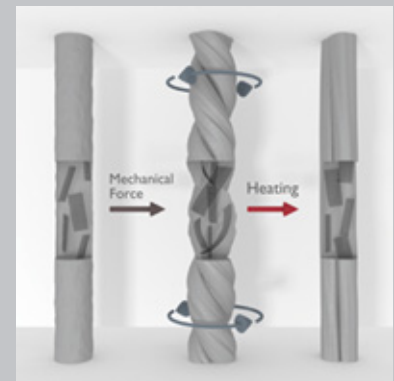
implanted mechanical blood pump largely taking-over the pumping function of the natural heart. The company **Berlin Heart** from Berlin is breaking new ground in the possible minimisation or even prevention of this. A new type of surface coating for the blood-conveying components of the VAD is being researched in the project "**GlycoVAD**". This coating is designed to prevent the activation of the patient's coagulation system following contact of the blood with the foreign surface of the blood pump. The special coating masks the foreign surface so that this is not recognised as foreign by the blood and therefore, does not trigger an immune response. Established coatings, for example those based on heparin, are not able to do this. The coating technology, test specimens, the experimental equipment and testing procedures required for evaluation are being researched and developed under the direction of Berlin Heart GmbH in collaboration with the **Institute for Chemistry and Biochemistry, Freie Universität Berlin**, and the **Biofluid Mechanics Laboratory, Charité – Universitätsmedizin Berlin**. The project is sponsored by the Federal Ministry of Education and Research (BMBF).

Surface coating also influences whether cells can adhere, and whether an assay functions. The **Fraunhofer Institute for Applied Polymer Research (IAP)** in Potsdam Golm is a specialist in this field, and researches and develops new biosystems, colloidal structures and bio-hybrid materials. The core areas include biomaterials, hydrogels, and new products for the pharmaceutical, medical and cosmetic industries. At the same time, the Fraunhofer IAP offers solutions on both a laboratory and industrial scale.

The surface coating is very significant in tissue engineering, as scaffolds form the initial structure for future heart, kidney and liver transplants. Prof. Georg N. Duda from **Berlin-Brandenburg Center for Regenerative Therapies (BCRT)** is concerned with the endogenous regeneration of muscles and bones. *In vivo* experiments provide knowledge of endogenous processes, which can subsequently be used

## Wireless microengine made from a twisted fibre

Researchers from the **Helmholtz-Zentrum Geesthacht (HZG)**, Institute of Biomaterial Science in Teltow (Brandenburg) and the University of Bordeaux developed highly efficient, micro-sized motor-cum-energy storage system. The **'microengine' is made from polymeric micro-fibres**, which are stiff at room temperature. When heated, the fibres become elastic and can be twisted – like a model aeroplane powered by a rubber band. Unlike the elastic band, however, when the fibres are cooled, they remain twisted until the microengine is re-heated. The energy stored when the fibres were twisted is released, the movable end begins to turn and the 'microfiber motor' can propel objects.



Source: HZG / Oliver Gould

With their easy-to-build motor, the two research teams in Bordeaux and Teltow fill a gap in the market, as for many applications, an electric motor is too weak, too large, insufficiently robust, and requires electricity and control cables. In the micro-fibre motor, the energy density is 60 times greater than in natural skeletal muscles.

to imitate *in vivo* situations using 3D biomaterials combined with the cultivation of primary cells in bioreactors.

## Optimise medical procedures with AI, VR/AR, robotics and 3D imaging

Digital technologies have a disruptive impact on medical and surgical care. Artificial intelligence, robotics, and augmented reality will play significant roles in conjunction with clinical applications. The German capital region offers a high concentration of research expertise in life sciences, photonics and informatic sciences as well as a strong and high innovative startup and AI ecosystem. This is a crucial precondition for developing highly innovative products and procedures such as robotics in surgery.

Minimal-invasive surgery, the technology of small incisions, was first developed in the 1980s with the aim to avoid

large wounds and to enable fast patient recovery and mobilisation. Since then, minimal invasive surgery has become the gold standard for many surgical fields, most importantly laparoscopy and otorhinolaryngology. **W.O.M. WORLD OF MEDICINE** is a Berlin-based global leader in those particular applications of minimal-invasive medicine.

Before artificial intelligence can be introduced into operating rooms (OR) at scale, operating rooms need to be digitised. Health IT specialists need to collect, warehouse and dashboard data and insights in a machine-learning-ready form. This is exactly where the Berlin-based company **caresyntax** started its journey in 2013, having introduced end-to-end IoT solutions to nearly 2000 hospitals worldwide touching all types of data streams from electronic medical records to radiology and laparoscopic videos, among others.

Caresyntax is convinced that artificial intelligence will have a very special role in operating rooms as a sounding board



© Peter Rigaut

**Björn von Siemens**  
Co-founder, caresyntax

“Berlin offers access to world-class medical institutions, leading technical universities, and a vibrant start-up ecosystem. It is this three-pronged combination that makes Berlin the ideal hub for supporting caresyntax on its mission to transform the more than 300 million surgeries each year.”

for surgical teams all the way up to the C-suite to promote safety, quality and efficiency in surgery. Specifically, they are bringing peri-operative clinical decision support solutions online for all operating room stakeholders who benefit from how, for example, certain techniques or drugs can lead to a variety of clinical outcomes for a given patient profile, and plan, control and execute across the surgical continuum accordingly leveraging big data and deep learning.

Digitization in the operating room, however, presents some challenges that need to be addressed. According to Marc Kraft, professor of medical technology at the TU Berlin, the “high demands on data security and data protection are good examples. In the context of artificial intelligence applications, it is necessary to discuss the possible loss of know-how among users with their natural intelligence, which is then used less frequently. If methods of machine learning are used, the traceability of results must be guaranteed and process validation is mandatory. If an optimization is carried out with digitally supported operating room process documentation, this can also be perceived as patronizing and leading to further consolidation of work processes. Digital manufacturing processes can fundamentally change the value chains and the role distributions of actors”.

As illustrated above, minimally invasive surgery with endoscopes has become the medical standard. It promises a fast and complication-free healing. However, the limited field of view, also called keyhole surgery, and the navigation and orientation outside of it pose great challenges to technology and surgeon.

Several groups of researchers in the capital region are developing solutions for mixed or virtual reality. The growing number of projects in virtual surgery is facilitated by the strong presence of clinicians, software specialists, gaming industry and designers.

In 2019, the former excellence cluster Image Knowledge Gestaltung hosted by Humboldt-Universität zu Berlin, transformed into the new excellence cluster **Matters of Activity. Image Space Material** by the Berlin University Alliance. Prof. Igor M. Sauer is one of the Principal Investigators at Matters of Activity – Image Space Material. Together with his team at the **Charité – Universitätsmedizin Berlin** and the **Humboldt-Universität zu Berlin**, he is working on extended reality (XR) solutions for preoperative surgical planning in visceral surgery as well as for the analysis and design in tissue engineering. In his work, Prof. Sauer has investigated the impact of mixed reality in the operation room (OR). His group showed transparent displays which can fundamentally change the concept of intra-operative imaging and interaction in the OR. While standard computer monitors generally relegate viewers to a static and

passive position, mixed reality applications display patient-related information directly in the surgeon’s field of view. Seen through a transparent head-mounted display, medical data overlays and annotates the surgeon’s vision with anatomical information by synchronising with the scale and position of the patient in real time. As this eliminates the offset between image and patient, surgeons do not need to continuously switch back and forth between screen and surgical site in order to view information, resulting in improved hand-eye coordination and spatial awareness. Furthermore, the research group investigates the impact of the transformation of human anatomy and physiology into computable material. As a result of converting e.g. soft tissue into geometric shapes, the manipulation of anatomy can be translated into algorithmic problems. Cutting tissue is then not only based on virtual datasets but can be executed by robotic systems that anticipate decisions, restrict actions and augment the surgeon’s point of view. Within the cluster Matters of Activity the group evaluates new practices of robot-assisted cutting including new human-computer interfaces that can improve the limitation of access to physical space.

**The Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute (HHI)**, is also currently running several projects funded by the Federal Ministry of Education and Research (BMBF) in the field of digital surgery. The project **COMPASS**, which has launched in September 2018, aims to develop a cooperative immersive assistance system for minimally invasive surgery, which improves intraoperative surgical navigation and optimizes the surgical workflow.

The COMPASS system is intended to recognize the navigation process of the surgeon through comprehensible, immersive visualization and interaction, to navigate the surgeon in an anticipatory manner and to accompany him through the surgical procedure. Images of a 3D endoscope are used to create an anatomical map of the patient. On this, distinctive anatomical regions, risk structures, directional guidelines and information on the surgical steps are entered and adjusted according to the endoscope position. The surgeon navigates through the patient’s body and interacts with the surgical navigation system to receive information. The procedures are being developed with clinical research partners in Leipzig (Innovation Center Computer Assisted Surgery – ICCAS) and Munich (Research group MITI - Minimally Invasive Interdisciplinary Therapeutic Intervention) for sinus surgery and laparoscopy. Overall, eight partners from the fields of research and industry contribute to the results.

Another innovative project at HHI is the project **MultiARC**. The focus of MultiARC combines multispectral imaging, 3D-measurement and true-to-scale augmentation of clinical images in the field of surgical microscopy. The hybrid



© ICCAS, Fotograf: Swen Reichhold

COMPASS im OP

multimodal 3D scene analysis uses different wavelengths to highlight tissue structures like tumors, bones, fat or even high-risk structures like the facial nerve. This processed and highlighted spectral tissue information is then combined with metric 3D information to allow a high qualitative intraoperative decision-making process for the best patient outcome.

Digital therapeutics offered by startups like **Fosanis**, **Selfapy** or **Newsenselab** often employ strategies rooted in cognitive behavioural therapy. Interesting is the fact that we see more and more digital products where the software or a hardware-software solution provides the entire therapy. Particularly in the field of mental and neurological disorders, or rehabilitation, hardware-software solutions have a huge potential to support the cure process.

In the field of neurology, the Israeli-German startup **Tech InnoSphere** develops an AI-powered brain-stimulation medical device, for personalized effective and safe

treatment of cognitive disorders. The first target indication of Innosphere is ADHD. The Innosphere patented electrodes and AF-RNS™ technology, provide accurate and effective stimulation to specific brain regions.

In the field of mental disorders, **neomento**, a spin-off from the German Center for Neurodegenerative Diseases, is currently developing a virtual reality-based therapy software. Mental disorders, such as anxiety disorders are effectively treated with *in vivo* exposure therapy, in which patients are repeatedly exposed to fear-provoking situations in real-life. However, patients often have to wait before treatment becomes available and exposure is rarely applied with the necessary intensity due to resource limitations. Also, objective measurement of treatment efficacy and dynamic adjustment of therapeutic scenarios are hardly possible.

Neomento develops virtual scenarios, for so called in vitro exposure therapy. The interdisciplinary team combines



© Christoph Neumann

**Dr. Hans Dietl**  
Science Officer, Ottobock

“Digitization changes our business significantly: it allows us to produce customized products through digital techniques. That applies to the entire care process. From determining the needs of the patient, to 3D scanning his or her body, up to producing individualized prostheses with computer-aided design software and additive manufacturing solutions. Then there’s the growing field of digital support services: when the patient has received a new prosthesis, we will be able to communicate with the device via IoT or cloud solutions. We can then still optimize and calibrate. Everything is beginning to be and eventually will be digital.”





Neomento class room in virtuo exposure

latest virtual reality and enhancing technologies (eye tracking, measurement of heart rate and skin conductance) with own scientific findings and expertise to create cutting-edge therapy solutions for psychotherapists. The products are developed and validated in close cooperation with renowned clinics and research institutions such as the Charité - Universitätsmedizin Berlin and the University Clinic in Düsseldorf.

Also, in medical fields where strong medication plans are currently the gold standard of treatment, such as chronic pain, digital therapy is gaining importance. The project “**VIRST**” run by the working group “**Age and Technology**” of **Charité** aims to complement back pain therapy using virtual reality. The goal is to combine the physiotherapeutic and the psychotherapeutic approach and to supplement a purely drug therapy in a multimodal pain therapy concept.

The target group of the project are elderly with chronic pain whose quality of life can be improved by a VR exergame.



Pain therapy with the help of virtual reality

Running from 2018 until 2020, the project also includes the project partners **Cocomore AG** (consortium leader), **German Research Center for Artificial Intelligence (DFKI), Berlin**, and **metricminds GmbH & Co. KG** and has received funding within the KMU-innovative programme of the federal government.

Another project of the working group is called “**BewARe**”. The aim of the project is the development of a sensor-supported movement and mobility training for seniors with hypertension based on an intelligent augmented reality system. The exergame includes gamification approaches to increase motivation, change behaviour and strengthen resilience and persistence. The consortium consists of further partners: **Ascora GmbH**, **Art+Com AG** and **Beuth University of Applied Sciences Berlin**. The project runs until 2021.



Mobility training for seniors with hypertension

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## Partner für wachstumsorientierte Medizintechnik-Unternehmen



Es gibt Entwicklungsschritte in Unternehmen, da sind verlässliche Partner gefragt. Und zwar solche, die auch die strategischen Ziele des Unternehmens mittragen und denen der langfristige und nachhaltige Unternehmenserfolg ein Anliegen ist.

#### UNIQA Insurance Group

Mit über einer Million Versicherten ist UNIQA nicht nur klarer Marktführer im Bereich der privaten Krankenversicherung in Österreich, sondern ist auch an einigen Privatspitälern beteiligt. So zählt insbesondere auch die PremiQaMed-Gruppe als Betreiberin privater Gesundheitseinrichtungen, in denen jährlich rund 95.000 Patienten behandelt werden, seit Jahrzehnten zum Konzern. In Kooperation mit PremiQaMed, baut das Versicherungsunternehmen nun sein Beteiligungsportfolio im Bereich Gesundheit weiter aus. Dabei will UNIQA vor allem wachstums- und ertragsorientierten mittelständischen Unternehmen im Gesundheitsbereich zur Seite stehen (www.uniquahealthinvestat).

Gerade der Mittelstand als Basis unserer Wirtschaft steht oft vor strategischen Weichenstellungen, die zusätzliches Eigenkapital eines stabilen und langfristig orientierten Mitgesellschafters erfordern. Zu solchen eigenkapitalintensiven Situationen zählen beispielsweise die Erschließung neuer Märkte, eine Anlageinves-

tion, die Auszahlung eines Mitgesellschafters oder die Ablösung einer Fremdfinanzierung. Die spezifischen Herausforderungen der Medizintechnikbranche, wie etwa die gestiegenen regulatorischen Anforderungen durch die MDR bzw. IVDR oder die fortschreitende Digitalisierung können gemeinsam mit einem bonitätsstarken Partner als Chance verstanden werden.

#### Eine langfristige Beziehung

UNIQA ist genau hier zur Stelle und bringt neben Eigenkapital auch umfassendes Know-how im Gesundheitsmarkt mit. Mit Zugang zu einem internationalen Netzwerk an Experten bietet die UNIQA Gruppe auch einen nichtmonetären Mehrwert: Wissen um medizinische Produkte, um ärztliche Leistungskriterien, Usancen des Tagesgeschäfts, Kostenerstattungen, bis hin zu Zertifizierungs- und Qualitätskriterien. UNIQA versteht die Stärken und Schwächen, Chancen und Risiken. Das operative Tagesgeschäft bleibt dabei in der alleinigen Verantwortung des Mehrheitsgesellschafters bzw. des Managements.

Ebenso wie das Versicherungsgeschäft ist das Beteiligungsgeschäft auf eine langfristige, vertrauensvolle Zusammenarbeit ausgerichtet.



Pharmaceutical



34



10,921



Biotech



255



6,265



Medtech &  
Digital Health



332



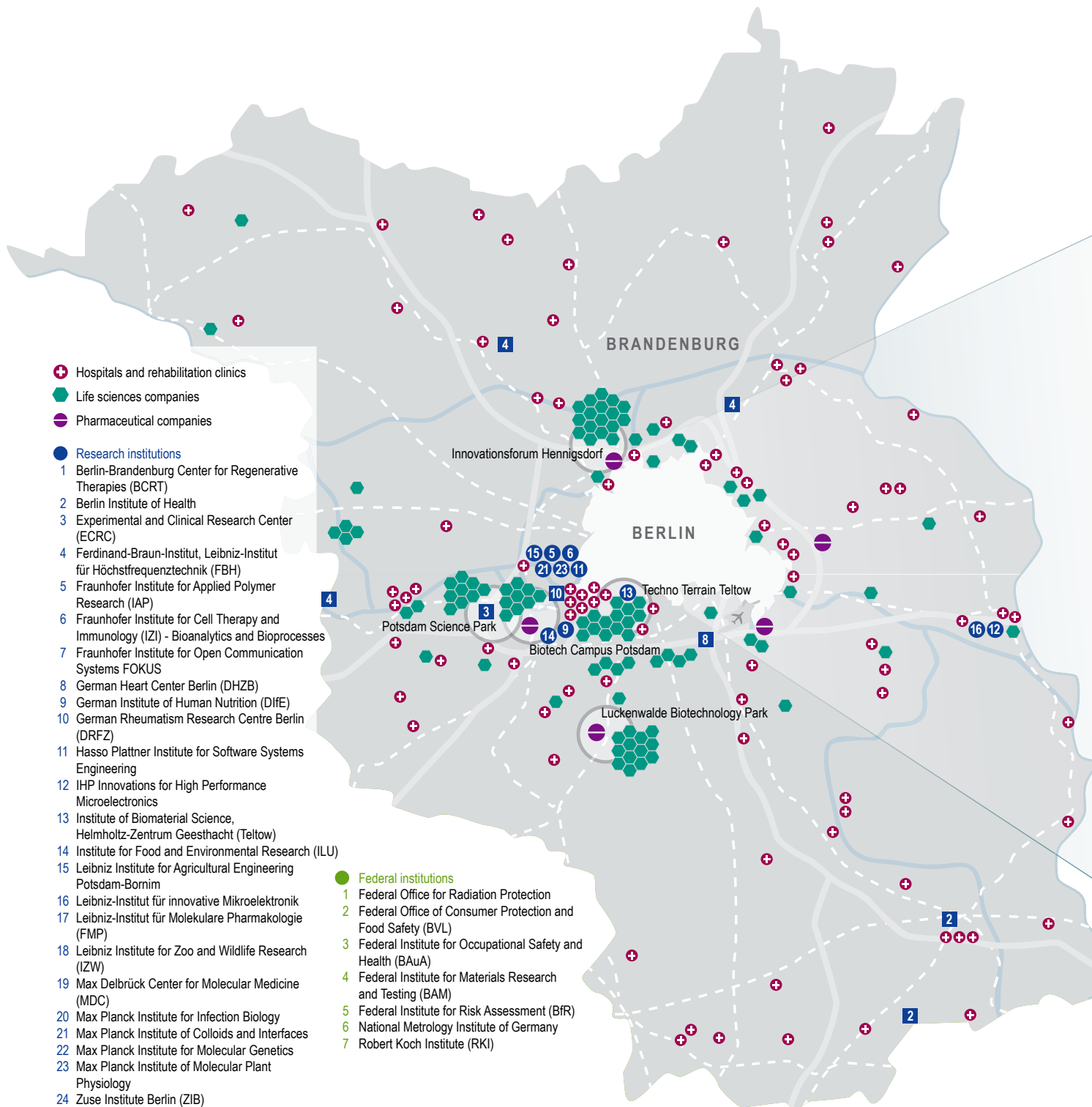
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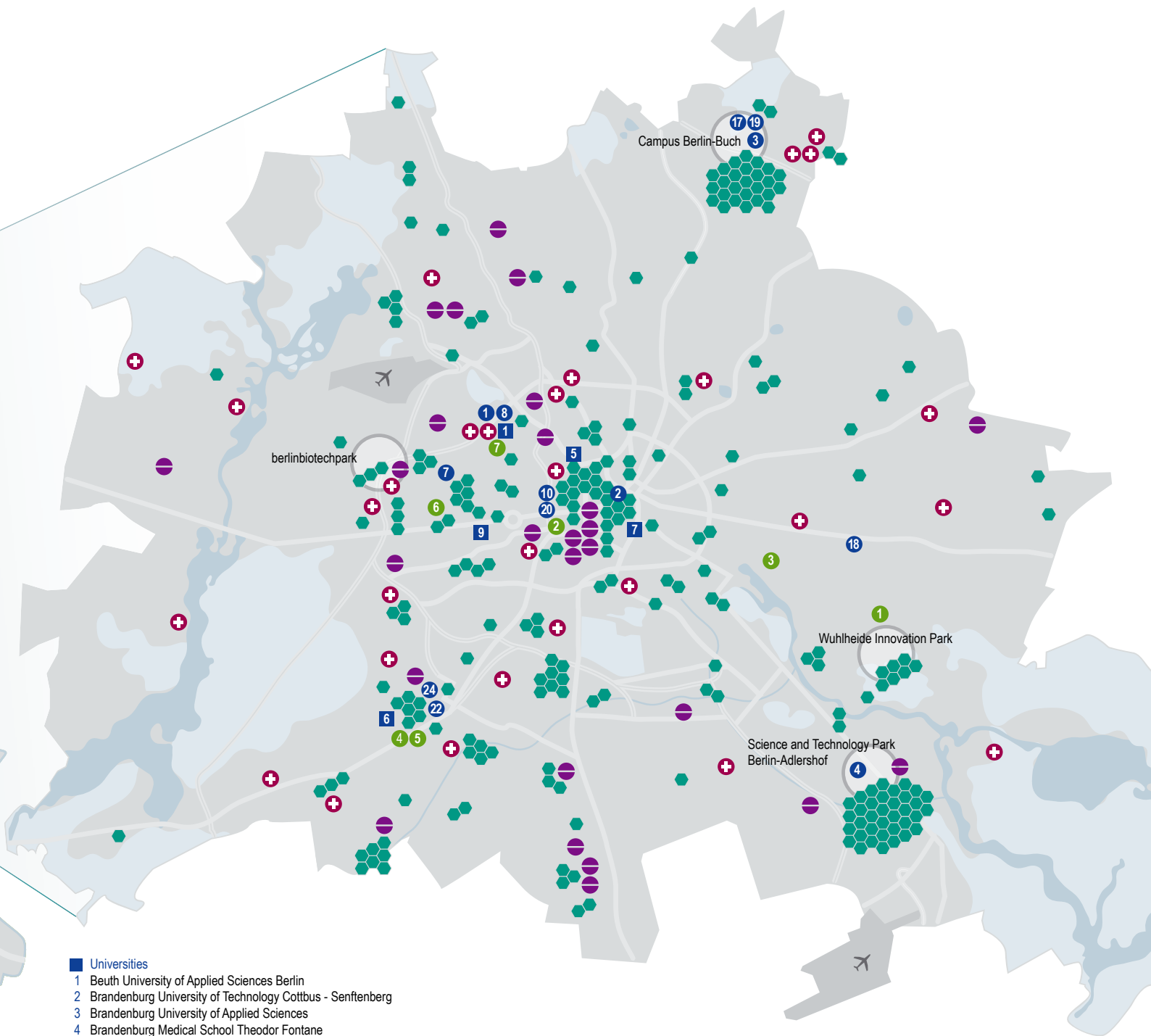
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**621 Companies**

**31,614 Employees**

# Hotspots of Healthcare Industries in Berlin-Brandenburg





- Universities
- 1 Beuth University of Applied Sciences Berlin
- 2 Brandenburg University of Technology Cottbus - Senftenberg
- 3 Brandenburg University of Applied Sciences
- 4 Brandenburg Medical School Theodor Fontane
- 5 Charité - Universitätsmedizin Berlin
- 6 Freie Universität Berlin
- 7 Humboldt-Universität zu Berlin
- 8 Technical University of Applied Sciences Wildau
- 9 Technische Universität Berlin
- 10 University of Potsdam

## Excellent Conditions for Innovation and Growth

For many companies that have come to the German capital region or were founded here, the outstanding academic and scientific landscape and the dynamic startup community is a decisive factor for success. The region features short paths to establishing partnerships between industry, startups, clinics, and academic research in various ways.

The German capital region is home to over 40 renowned scientific institutions, including the **Charité – Universitätsmedizin Berlin**, the **Robert Koch Institute**, the **Max Delbrück Center for Molecular Medicine of the Helmholtz Association (MDC)**, the **German Heart Center Berlin**, and other well-known **Fraunhofer**, **Helmholtz**, **Leibniz** and **Max Planck Institutes**. The Charité is one of the largest university hospitals in Europe. More than 4,200 researchers and doctors there carry out research, teach, and treat patients at the cutting edge of international medicine.

The **Berlin Institute of Health (BIH)** combines the strengths of Charité – Universitätsmedizin Berlin and Max Delbrück Center for Molecular Medicine (MDC) with the aim to translate scientific discoveries from the lab into clinical research and into medical applications – and vice versa. To ensure better predictive medicine and new therapies, the BIH's approach to research is based on systems medicine, encompassing methods to analyse the dynamic interactions of molecules, cells, tissues and organs as well as physiological and psychosocial factors.

Cooperation is a key driver for better research and better therapies. This is also shown by another leading institution in the capital region: the **German Heart Center Berlin**. As one of the nation's leading hospitals, the German Heart

Center Berlin has been treating the entire spectrum of cardiac, thoracic and vascular diseases and offering artificial heart implants and heart and lung transplants since 1986. Its success story will continue in the next years as part of a joint venture with the Charité to establish the most modern heart centre in Europe. Prof. Dr. Volkmar Falk, Medical Director of the German Heart Center Berlin, remarks: "Modern heart medicine can only succeed with highly specialised and interdisciplinary treatment teams. The University Heart Center Berlin being created jointly by the German Heart Center Berlin and the Charité will strengthen Berlin's reputation as a location for the very best in cardiac medicine in close cooperation with partners from Vivantes and other medtech companies in our region."

The **Hasso Plattner Institut Potsdam** is an internationally renowned institution paving the way for the digital transformation, including in the healthcare field. The **HPI Digital Health Center (DHC)** brings together individuals from health sciences, human sciences, data sciences, digital engineering and broader society with the shared goal of empowering patients and transforming healthcare with innovative digital health solutions. The main focus areas of the research are personalized medicine, connected healthcare and machine learning.



© Olga Sheshukova

Dr. Anika Bockisch

Managing Director Network Bio-PAT (e.V.)

"We support the cooperation between SME and research institutions in the field of PAT in bioprocesses to enhance inter- and transdisciplinary research and the development of innovative technologies by stimulating joint research activities. This strengthens the market position and innovation power of SMEs and increases their visibility. Bio-PAT aims to exploit the high potential of the Berlin-Brandenburg area for innovative biotechnology companies by bundling existing expertise in different fields."





Dr. Ilias Tsimpoulis  
Managing Director German, Doctolib

“Our long-term vision is to contribute to improving our healthcare system by building the hospitals and practices of the future. With our software solution, we offer patients easier and faster access to healthcare and improve the daily working life and efficiency of medical facilities. Our headquarters based in Paris and Berlin, offer an excellent starting point, geographically, with a view to the innovative environment for the development of digital service offerings for modern healthcare.”

## Strong networks and technology parks creating the medicine of the future

Berlin and Brandenburg is home to a number of knowledge transfer and translation centres working on a variety of topics and technologies in the life sciences. These include the **Berlin-Brandenburg Center for Regenerative Therapies (BCRT)**, the **Experimental and Clinical Research Center (ECRC)**, and the screening unit at the **Leibniz-Forschungsinstitut für Molekulare Pharmakologie (FMP)**.

Having industry, science and clinical care providers in close proximity to each other and working together as partners as it is the case in Berlin and Brandenburg is an ideal way to advance tomorrow's top technologies and patient-oriented services. The two states offer excellent infrastructure and straightforward services that make effective networking possible. For example, there are eight technology parks in the region that are active in the life sciences, including Germany's largest biotech park at **Campus Berlin-Buch**, Europe's leading technology park at **Berlin-Adlershof**, and the **Potsdam Science Park**.

The **Gesundheitscampus Brandenburg** includes an inter-university network of the supporting universities (**University of Potsdam**, **Brandenburg University of Technology** and the **Theodor Fontane Brandenburg Medical School**), non-university research institutions, and additional universities in the state, as well as clinics, health insurance companies, associations, and other businesses.

The German capital region features a number of networks working on specific topics that allow stakeholders along the entire value chain to collaborate. These include **Network Bio-PAT**, **DiagnostikNet Berlin-Brandenburg**, **glyconet Berlin-Brandenburg** and **NetPhaSol**.

## The place to be for startups and investors

The German capital region is increasingly becoming attractive to international investors, who have discovered the startup climate in and around Berlin to be a valuable location for investment. The EY Startup-Barometer (January 2020) once again named Berlin the hotspot of the German startup scene for 2019: with 262 financing rounds, startups in the German capital benefited from 37% of all financing rounds recorded in Germany. In the healthcare sector, startups from Berlin raised €229 million, the highest inflow of capital in Germany. **Doctolib**, headquartered in Paris and Berlin, raised the most capital last year at €150 million.

In addition to private equity, there exist several public financing programmes at the federal and regional levels in Germany. For example, the two regional banks of Berlin (IBB) and Brandenburg (ILB), with their funding programmes and their holding companies **IBB Beteiligungsgesellschaft** and **ILB Beteiligungsgesellschaft**, play an important role in financing. They provide startups with the grant money or share capital they need and supplementing these funds with commitments from private investors or even providing initial access to such investors.

Over 60 incubators and accelerators in the capital region offer founders and startups a leg up in developing their ideas and networking with other stakeholders. Established companies are increasingly choosing to work with startups in their own units, such as **Bayer's CoLaborator** and **Pfizer's Healthcare Hub Berlin**.

The combination of entrepreneurial spirit and established industry as well as the extensive networking between science and industry provide an extraordinary infrastructure for innovation and company growth in Berlin and Brandenburg.



# HealthCapital

BERLIN BRANDENBURG

## Joint cluster management for a strong healthcare region

The management team for the HealthCapital Berlin-Brandenburg Cluster at Berlin Partner for Business and Technology and Brandenburg Economic Development Corporation (WFBB) is driving networking, technology transfer and supporting regional companies and international corporations interested in relocating their business, research or development to the German capital region. Peter Albiez, country manager of Pfizer Germany, is the cluster's spokesperson.

For more information about the cluster HealthCapital Berlin-Brandenburg: [www.healthcapital.de/](http://www.healthcapital.de/) or send an email to [info@healthcapital.de](mailto:info@healthcapital.de)

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HealthCapital Cluster Manager (Berlin)  
Dr Kai Uwe Bindseil

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HealthCapital Cluster Manager (Brandenburg)  
Florian Schlehofer

## Healthcare Industries Cluster Berlin-Brandenburg

### HealthCapital

**> 21,000** Companies

**≈ 380,000** Employees

**≈ 27 billion** Euros in revenue

**≈ 34** Pharmaceutical companies with

**≈ 10,900** Employees

**≈ 255** Biotech companies with

**≈ 6,200** Employees

**≈ 332** Medtech companies with

**≈ 14,400** Employees

**> 130** Hospitals with

**> 35,000** Beds

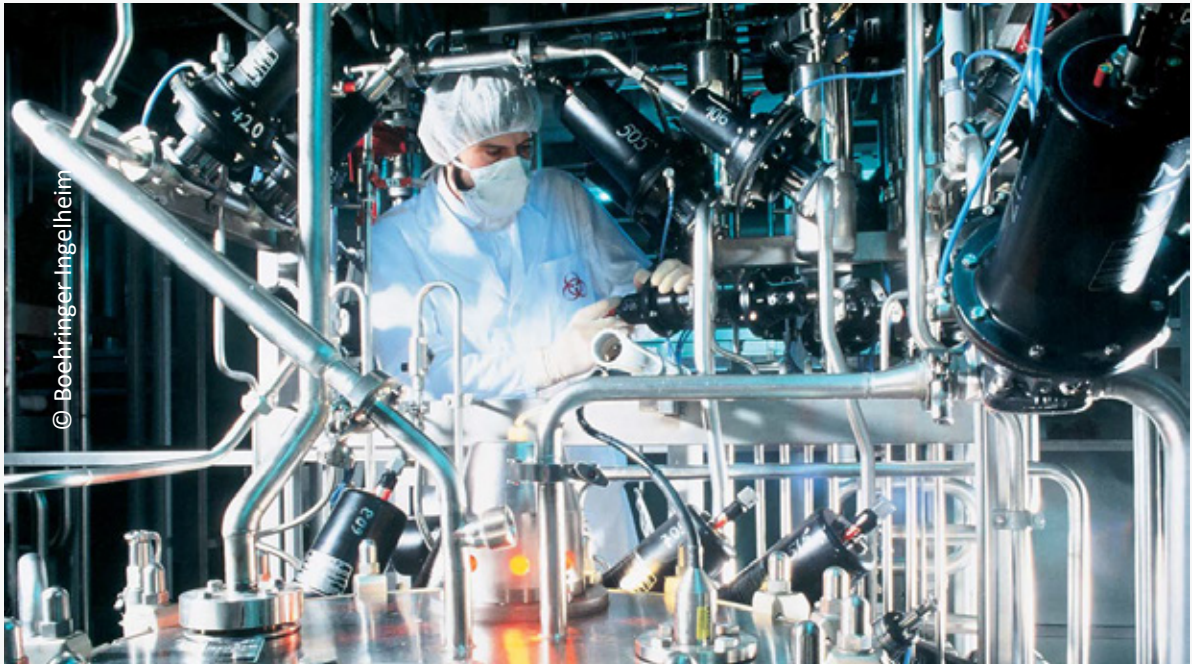
### Largest university hospital in Europe:

Charité - Universitätsmedizin Berlin

**8** Technology parks focusing on life sciences

**≈ 40** Large research facilities and institutions of higher learning focusing on life science

**≈ 170** Health-related programs of study



vfa bio represents the biotech interests within the German Association of Research-Based Pharmaceutical Companies (vfa). vfa campaigns for the interests of 45 worldwide leading pharmaceutical companies in the fields of health, research and economy.

vfa bio seeks to exploit the therapeutic and economic potential of biotechnology to make Germany the leading biotech location in Europe.

**Medical biotechnology is our topic. Consequently, we primarily deal with**

- Medical progress provided by biopharmaceuticals – relevance, benefit and value for patients, physicians and society as a whole
- Access to biopharmaceuticals for patients
- Business location Germany and regulatory and economic framework for research, development and production of biopharmaceuticals
- Quality-assured use of biopharmaceuticals – original products and biosimilars
- Orphan Drugs (drugs for people with rare diseases)
- Advanced therapies such as gene and cell therapies and tissue engineering products

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<b>Contract Manufacturers</b> . . . . .	<b>6</b>
<b>Contract Research Organisations</b> . . . . .	<b>7</b>
<b>Biotech Companies</b> . . . . .	<b>9</b>
<b>Medtech and Digital Health Companies</b> . . . . .	<b>30</b>

By scanning the QR Code you will find an overview of more than 600 player of industries, startups and research institutions in the HealthCapital region Berlin-Brandenburg.



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**HealthCapital**  
BERLIN BRANDENBURG

## Our aim: your success!

The German capital region is one of the leading life sciences and healthcare industries centers in the world. At the interfaces of business, science and clinics, the HealthCapital cluster management supports networking and the technology transfer and helps companies interested in relocating to the region. Berlin Partner for Business and Technology and the Economic Development Agency Brandenburg (WFBB) are responsible for managing the cluster.

Our aim is to provide comprehensive support to companies and scientific institutions interested in inward investment or further development in the capital region.

We are ready to assist you with:

- **Company startup**
- **Location search**
- **Funding and financing**
- **Technology transfer and R&D partnerships**
- **Cooperating in networks**
- **Employee recruiting, programs designed to retain skilled specialists and qualification**
- **International market development**

Reach out and contact us!  
[www.healthcapital.de](http://www.healthcapital.de)



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Economic Development Agency | **Brandenburg**

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