Theme 1: Big Data in Biomedicin

1. **'Big Data Centre for Environment and Health', DKK 60 million**

   Main applicant: Clive Sabel, Professor, Department of Environmental Science, Aarhus University

   Co-applicants:
   Ole Hertel, Professor, Department of Public Health, Aarhus University

   Torben Sigsgaard, Professor, Department of Public Health, Aarhus University

   Carsten Bøcker Pedersen, Professor, Department of Economics, Aarhus University

   Brief description:
   Exposure to many environmental factors is damaging our health, but is illness a result of individual cases of high-risk exposure that can damage health or the result of slow accumulation throughout life? And is the effect boosted by the combination of environmental factors? These are some of the questions that the Big Data Centre for Environment and Health wants to answer. In recent years, the big data revolution in registries of pharmaceutical, environmental and demographic factors and the opportunity to collect data from personal sensors and social media provide unique potential for understanding the complex interactions between polluting substances and people's health.

2. **'Big life-course data analytics for understanding disease initiation and progression in diabetes and its complications', DKK 60 million**

   Main applicant: Søren Brunak, Professor, Novo Nordisk Foundation Center for Protein Research, University of Copenhagen

   Co-applicants:
   Henrik Ullum, Professor, Department of Clinical Medicine, Rigshospitalet, Copenhagen

   Laust Hvas Mortensen, Associate Professor, Department of Public Health, University of Copenhagen

   Ewan Birney, Director, European Bioinformatics Institute (EMBL-EBI), United Kingdom

   Brief description:
   The project uses big data thinking to study all diseases at once, and especially in which order hundreds of diseases occur in a lifelong perspective. This includes large quantities of data from healthy individuals, such as from blood donors in Denmark and abroad who have consented to their data being analysed. The project focuses especially on diabetes and on understanding the transition from health to disease and the many alternative patient pathways that can lead to diabetes. The research will contribute to creating a knowledge base for new types of personal treatment and, in purely technical terms. will also create new more secure frameworks for storing health data and data analysis. The infrastructure may then be used at hospitals to improve the treatment of individual patients.

3. **'Harnessing the Power of Big Data to Address the Societal Challenge of Aging', DKK 60 million**

Main applicant: Rudi Westendorp, Professor, Department of Public Health, University of Copenhagen

Co-applicants:
Niels Ploug, Associate Professor, Department of Economics, University of Copenhagen

Thomas Kirkwood, Professor, Department of Cellular and Molecular Medicine, University of Copenhagen

Lene Juel Rasmussen, Professor, Department of Cellular and Molecular Medicine, University of Copenhagen

Brief description:
The continuous increase in life expectancy and the numbers of years we spend with illness cause profound upheaval to all of us. Age is the most important risk factor for most chronic disorders, including diabetes, cancer and dementia, but it is not well understood why that is so. I will bring together a group of excellent researchers with various types of expertise to make the best out of the exceptional data on health and disease that are stored within Denmark's official registries. Within a tight legal and ethical framework, we will use modern computer-assisted analyses to better understand the aging process and learn how to interfere in the underlying biomolecular processes. The purpose of our work is to prevent and delay infirmity in old age, to shape personalized therapies and to live healthier for longer.

Theme 2: Design and engineering of biological molecules and systems

1. **'Center for Advanced Microbiome Therapeutics', DKK 60 million**

   Main applicant: Morten Sommer, Professor, Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark

   Co-applicants:
   Fredrik Bäckhed, Professor, Novo Nordisk Foundation Center for Basic Metabolic Research, University of Copenhagen

   Max Nieuwdorp, Professor, Faculty of Medicine, University of Amsterdam, Netherlands

   Tine Rask Licht, Professor, National Food Institute, Technical University of Denmark

   Brief description:
   Bacteria are naturally present in the human body and affect our health both positively and negatively. Despite their potential roles as targets for treating various diseases, manufacturing targeted medicine is still a major challenge. The purpose of the project is to use the latest developments in synthetic biology to solve this problem. In particular, synthetic biology tools will be developed to construct a new form of cell-based medicine that will be capable of capturing signals from the human body and begin to produce relevant therapeutic molecules. If we succeed, we expect that this approach can be used widely to treat numerous diseases, including cancer, high blood pressure and metabolic diseases.

2. **'Center for Multifunctional Biomolecular Drug Design (CEMBID)', DKK 60 million**

Main applicant: Kurt Gothelf, Professor, Department of Chemistry, Aarhus University

Co-applicants:
Jørgen Kjems, Professor, Interdisciplinary Nanoscience Center, Aarhus University

Ken Howard, Associate Professor, Interdisciplinary Nanoscience Center, Aarhus University

Tony Lahoutte, Professor, Department of Nuclear Medicine, University Hospital Brussels and Vrije University Brussels, Belgium

Brief description:
Most drugs used today have only one activation mechanism, and manufacturing drugs with several functions is both difficult and expensive. The aim of the project is to carry out research on new drugs with several activation mechanisms. We will develop methods to construct modules of various proteins and small molecules that can be simply and effectively combined into multifunctional drugs. This will pave the way for new types of drugs that are both more effective, have fewer side-effects and can be tailored to individual patients.

3. **'Center for Geometrically Engineered Cellular Systems', DKK 60 million**

Main applicant: Dimitrios Stamou, Professor, Department of Chemistry, University of Copenhagen

Co-applicants:
Jay T. Groves, Professor, College of Chemistry, University of California, Berkeley, United States

Orion Weiner, Professor, Cardiovascular Research Institute, School of Medicine, University of California, San Francisco, United States

Brief description:
Life on our planet emerged through the evolution of cells endowed with the ability to metabolize energy, grow, adapt and ultimately reproduce. Cells are composed of molecules positioned in complex arrangements that are critically important for life. Here we propose to engineer these geometrical arrangements, using novel nanotechnologies and optogenetic methods, in order to achieve new levels of synthetic control over the behaviour and function of molecular systems and living cells. Our work will focus on geometrical engineering of 1) T-cells for cancer immunotherapy and 2) the most common target of all drugs in the market today (G protein coupled receptors).