Roadmap for research infrastructure

Faculty of Medicine
University of Bergen

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Innhold

1. BACKGROUND

Medical research requires advanced and timely infrastructure. Research infrastructure of high quality is necessary for excellent research and innovation, and therefore research infrastructure is prioritized by the Faculty of Medicine (MED). Our infrastructure is used by researchers from several faculties and contributes to the positioning of UiB, to the recruitment of researchers, and is crucial for collaboration with the best international environments. Furthermore, timely infrastructure inspires our young research talents and students to pursue research careers. The faculty collaborates closely with local partners, especially Helse Bergen and Helse Vest, to offer researchers in the region the best possible infrastructure. It is an important principle for the faculty that all infrastructure should be made available in the best possible way, and that we should contribute to the research community with timely infrastructure. See also the faculty's strategy for research infrastructure.

2. ORGANIZATION OF RESEARCH INFRASTRUCTURE AT THE FACULTY OF MEDICINE

Research infrastructure at the Faculty of Medicine is largely gathered in core facilities. A core facility can be described as a platform with advanced scientific infrastructure and competence, which has a relatively broad user group, and which contributes to researchers being able to answer complex biological or medical questions. The core facilities are also of strategic importance for national and international cooperation, recruitment of researchers and for teaching. An important goal of organizing in core facilities is also that infrastructure is made visible and accessible to researchers. It is important to emphasize that the core facilities at MED have users from several different faculties. Within UiB, the core facilities are especially used by researchers from MED, the Faculty of Mathematics and Natural Sciences and the Faculty of Psychology. We also have national and international users, and regionally, the collaboration with Helse Bergen is especially important for the operation and development of the core facilities. The faculty carried out a process in the period 2010-2011 that resulted in most of the larger and advanced research infrastructure being organized in core facilities. The idea of core facilities at MED arose as a result of grants from the Research Council's FUGE program for infrastructure, and the establishment of the first three core facilities (MIC, PROBE and Genomics) began as early as 2003. The scheme was adopted by the faculty board and meant that to obtain status as a core facility, the infrastructures must serve relevant user environments at the entire faculty and the entire UiB and have clear guidelines for organizing operations and services.

The core facilities were further required to develop long-term plans for academic upgrades and financing as well as daily operations and equipment renewals, and it was decided that the core facilities should be anchored and operated by an institute on behalf of the community. Appropriate operation of the core facilities presupposes that they are prioritized in relation to resource use at the institutes. The scheme with core facilities was evaluated by the faculty in 2017-2018. The working group concluded that the core facilities function as intended, that they are important for the research activity at MED and elsewhere in Bergen, and that the leaders of the core facilities show great interest in ensuring that the units function well. The working group developed principles for core facilities at MED (see box 1; The report can be read in its entirety here: The working group's report).

The faculty has its own committee for core facilities that advises the faculty management and the institutes in matters concerning the core facilities and other advanced infrastructure. The committee for core facilities was established as part of the follow-up from the review of the core facilities in 2017-2018. The committee shall work to ensure that the core facilities function as efficiently as possible and promote research at the faculty. The committee is an advisory body for the faculty and institute management in matters concerning the core facilities and other large infrastructure at the faculty, with the intention that competence and infrastructure in the core facilities benefit researchers at UiB, Helse Bergen and other actors in the best possible way. The committee shall ensure that academic development, organization and operation are well taken care of in infrastructure announcements and be involved in the development of the faculty's strategy for infrastructure.

1. A core facility at MED consists of a platform of especially scientific equipment and/or relevant infrastructure and competence that has a broad user group and that helps researchers answer complex biological or medical questions.
2. A core facility shall make the resources in the unit equally available for user environments at UiB, Helse Bergen and other users.
3. A MED core facility is anchored and operated on behalf of the community by one institute. The institute leader thus becomes financially responsible and overall leader for the core facility on behalf of the entire faculty. This must happen in collaboration with the faculty management.
4. The leader of the core facility shall be scientifically employed and conduct their own research and development.
5. Technical staff with relevant high competence shall be linked to the core facilities.
6. Necessary administrative support shall be linked to the core facilities.
7. The core facility shall have a professional steering group.
8. A customized operating model shall be developed for each core facility.
9. The core facilities at MED shall use a common booking/invoicing system.

Boks 1: Principles for core facilities at MED.

3. THE FUNCTION OF THE ROADMAP

The roadmap for research infrastructure at MED is a dynamic document, and it will be necessary to update the roadmap to ensure flexibility and adaptability as the research landscape changes. Such an update is particularly relevant in relation to large announcements, such as the Research Council's infrastructure announcements.

The roadmap for research infrastructure at the Faculty of Medicine aims to:

- Show the faculty's long-term strategy and priorities when it comes to research infrastructure for researchers at UiB.
- Make the faculty's infrastructure visible and accessible to internal and external users.
- Make the resource needs for research infrastructure in medical research visible to internal management and external actors.
- Stimulate regional and national cooperation on infrastructure.
- Clarify that the faculty will maintain and develop the scheme with core facilities.
- Be a tool for the faculty to achieve positioning and financing in announcements of infrastructure funds and in national and European infrastructure networks.

4. DESCRIPTION OF RESEARCH INFRASTRUCTURE AT THE FACULTY OF MEDICINE

Core Facility at MED

There are eight core facilities at MED, distributed across four institutes. Below are brief descriptions of the core facilities. More information can be found on this website: Core facilities at the Faculty of Medicine

Core Facility at the Department of Biomedicine

Biophysics, Structural Biology, and Screening: BiSS is a core facility for biophysics, structural biology and screening. For biophysics, different techniques are present for characterization of proteins and biomolecular interactions. Structural biology is fundamental for an understanding of biochemical processes, and crystallography will in collaboration with modeling, experimental biomedicine and artificial intelligence be crucial for a molecular understanding of life processes and disease development, and personalized medicine. The faculty has a goal of developing this infrastructure through national cooperation by establishing a platform for cryo-EM (cryogenic electron microscopy). BiSS is a member of the national infrastructures NORCRYST and NOR-OPENSCREEN funded by the Research Council of Norway, as well as EU-OPENSCREEN. The staff offers user guidance, project planning and pilot service projects.

Molecular Imaging Center (MIC) is a core facility for advanced cell, tissue and small animal imaging, and also offers preparation for transmission microscopy and paraffin cutting. Highly qualified scientific and technical staff provide guidance to users and assist in the planning of experiments. Understanding intracellular processes is crucial for the basic research in almost all branches of life science, including health research, marine research, agricultural research and biotechnology. Imaging of experimental animal models is important for Norwegian biomedical translational research, i.e. research that bridges the gap from basic research to practical use in personalized patient care. MIC is organized in a national network within imaging (Nor-BioImaging) and is one of five partners in NALMIN; Norwegian Advanced Light Microscopy Imaging Network and one of four partners in NORMOLIM; Norwegian Molecular Imaging Infrastructure. NORMOLIM is also a node in the ESFRI project EuroBioImaging, where MIC's small animal unit is one of three sub-nodes in Norway. In addition, MIC hosts Single-molecule localization microscopy acquired through the NORBRAIN network where the Neuroscience research group is a partner.

Proteomics Unit: PROBE (Proteomic Unit at the University of Bergen) is research and service based core facility for mass spectrometric (MS) analysis of proteins. Clinical proteomics identifies and quantifies disease-associated proteins and possible biomarkers and is crucial for the understanding of disease processes and patient care, and thus for personalized medicine. The field is rapidly developing, and new highly sensitive and accurate mass spectrometers will

be crucial for research and innovation in many different fields such as food, aquaculture, biomedicine and clinical research. PROBE is equipped with advanced instrumentation for sample preparation of biological samples for mass spectrometric analysis. PROBE is one of six NAPI (National Network of Advanced Proteomics Infrastructure) nodes in Norway that offer nationally coordinated research front expertise on equal terms to all Norwegian research environments within the field of proteomics.

Core facility at the Department of Global Public Health and Primary Care

Biostatistics and Data Analysis (BIOS) offers biostatistical support to researchers. The majority of the users belong to the Faculty of Medicine at UiB, but BIOS is also available for researchers at other institutions, e.g. Helse Bergen and other universities and colleges. BIOS consists of highly qualified statisticians and bioinformaticians with especially high competence in the preparation and analysis of registry data, genetic and other biobank-based data and heavier data sets from clinical and epidemiological studies.

Core facility at the Department of Clinical Medicine

The Laboratory of Animal Facility: is a resource for activities that involve research with animals. The department is accredited by AAALAC International. The staff performs daily care and supervision of the animals both before and during experiments. The core facility can house both small rodents, such as rats and mice, and larger mammals such as pigs. The department also offers professional advice in connection with planning, administration and progression of breeding projects and veterinary service services in connection with all types of animal studies. The facility also offers veterinary services that include training, planning and/or performing surgery, anesthesia and analgesia. The animal department is responsible for conducting courses in laboratory animal science and facilitates surgical training for Haukeland Hospital.

Core facility at the Department of Clinical Science

Flow cytometri: is a technology that measures and analyzes the optical properties of single particles, such as cells, bacteria, micro beads, yeast, nuclei and picoplankton. In medical research, the method is used to analyze and sort cells based on properties such as size, shape and expression of specific proteins on the cell surface. This method plays an important role in personalized medicine especially in immunological and hematological diseases, and the method is used for diagnosis, monitoring of treatment response and development of cell-based therapies. The core facility has recently been upgraded with equipment that enables 3D images of tissue structure at the cellular level, a method that is increasingly demanded by researchers and that is important for future personalized diagnosis and treatment. The core facility Flow is currently a supplier for the infrastructure network EATRIS in a Horizon Europe funded project (canSERV).

Genomics core facility performs service assignments for local and national users within a wide range of sequence-based genome analyses, such as whole genome sequencing, exome sequencing, RNA sequencing, ChIP-seq, metagenome sequencing etc., including quality control and temporary data storage. The platform also offers expert advice on experimental design and bioinformatic data analysis. Sequencing of DNA and RNA is crucial for understanding genetic causes of disease. Gene sequencing is important for personalized diagnosis and treatment, and also for predictive medicine. GCF is organized in close collaboration with the Laboratory Clinic, Helse Bergen. GCF is a partner in the Norwegian Consortium for Sequencing and Personalized Medicine (NorSeq), which has received infrastructure funds from the Research Council. The service activities are also supported by the Trond Mohn Foundation.

Research Unit for Health Surveys: Research Unit for Health Surveys (FHU/RUHS) is a core facility that assists researchers in conducting clinical studies on healthy people and patients who do not need hospital facilities, with a main focus on collecting raw data through physical visits and/or decentralized clinical studies. The studies can be population-based, vaccine studies, nutrition studies, research in relation to primary health care, etc. The list is not exhaustive, and it is possible to perform other research at FHU after dialogue between the parties. FHU was established as a national infrastructure in line with the allocation from the Trond Mohn Foundation. The unit is run through close collaboration with Helse Bergen and complements the clinical research posts.

Core Facility for Metabolomics is an open platform for measuring small molecular substances, where qualified scientific and technical staff perform analyses and provide guidance to users. Metabolomics involves studies of metabolic profiles in biological systems, such as cells, tissues or biological fluids such as blood or urine. Metabolites are a result of cell activity (metabolism), which is often altered by disease. The composition of metabolites will vary from patient to patient, and metabolic analyses are therefore important for personalized diagnosis and treatment. The core facility at the faculty is quite limited in the analyses offered, and there is currently no national infrastructure that covers a wide range of metabolic analyses (from single cells to whole animals). It is a priority task for the faculty to build up and further develop the core facility for metabolomics over time.

Research infrastructure at MED that is not organized as a core facility

The nanoplatform at the Department of Clinical Dentistry performs biological and physico-chemical analyses related to nanosafety, for safer and more sustainable development of nanomaterials and nanomedicines. The NanoSafety and NanoMedicine group has been pioneering in the development of impedance- and electrochemical-based methods for reliable assessment of biological effects of nanomaterials. The infrastructure can test effects of nanomaterials in biological models and thus contributes to reduction/replacement of animal experiments. The effects are monitored in real time by using microfluidic impedance-based chips and live microscopy. The group collaborates closely with the nano-Bergen platform at UiB, Department of Physics - Nanophysics group, and Department of Chemistry at UiB. The group is also responsible for nanosafety in the Research School for training the next generation of micro- and nanotechnology researchers in Norway (TNNN), funded by NFR.

Infrastructure related to tissue regeneration: This infrastructure at the Department of Clinical Dentistry has equipment and expertise to repair or regenerate damaged tissue and organs. The infrastructure is based on an interdisciplinary collaboration between researchers, clinicians, and bioengineers, and is in close collaboration with UiB and Helse Bergen, as well as national and international partners. The infrastructure is part of the Bergen stem cell consortium, and also contributes to the coordination of preclinical and clinical research projects.

NorBrain: Since 2019, researchers at the Department of Biomedicine (Neuroscience, Neural Networks) have been included as partners in the NorBrain consortium (NTNU, UiO, UiB) and have established a total of three laboratories for advanced structural and functional microscopy, especially aimed at exploring the central nervous system and functional mechanisms at the molecular, subcellular, cell and network level, through an infrastructure grant from the Research Council of Norway. NorBrain3 is organized in three laboratories and enables, among other things, super-resolution microscopy with localization and tracking of protein molecules, structural and functional imaging of single neurons and neural networks in intact tissue, and

imaging of protein-protein interactions in intact tissue. In addition to use in neuroscientific research, the three laboratories will be of significant interest for other research fields, e.g. work with iPSCs within translational research. Specific methods that are established in the new laboratories have clear relevance for the development of personalized medicine. The first laboratory has been in full operation since spring 2021. The other two laboratories are almost finished and will be available (for qualified users) from around the turn of the year 2023-24.

PraksisNett (The Norwegian Primary Care Research Network). PraksisNett is an infrastructure that facilitates researchers to conduct good clinical studies in Norwegian general practice. PraksisNett is a national initiative from general medical research environments at the partner institutions. The consortium consists of the University of Bergen (UiB), UiT - Norway's Arctic University, the Norwegian University of Science and Technology (NTNU), NORCE - Norwegian Research Centre AS, the University of Oslo (UiO) and the National Center for e-health research (NSE). The infrastructure is led from the Department of Global Health and Social Medicine at UiB. A total of 92 general practice practices and almost 500 general practitioners from all parts of Norway are affiliated with the infrastructure.

5. THE FACULTY'S AMBITIONS AND PRIORITIES

The faculty is dependent on continuous updating of infrastructure and related competence to conduct research at a high level and to succeed in the competition for external funds. Timely research infrastructure is also important for positioning UiB and MED, and for recruiting good employees and partners. Medical research today is characterized by the generation of large amounts of data, and the faculty sees that there is an urgent need for infrastructures that ensure safe storage, handling and sharing of, and analysis of different types of data. This applies not least to sensitive personal data including health data. The faculty will contribute to ensuring that the international FAIR principles (findable, accessible, interoperable and reusable) are maintained at UiB and nationally, in line with the recommendations from the data infrastructure committee, 2022[1].

The scheme with organization of infrastructure in core facilities as described above, works very well and will continue at the faculty. In addition to making the infrastructure visible and accessible to all researchers at UiB and in Helse Bergen and more, the scheme allows transparent ordering and payment solutions that are important for planning operation and maintenance, as well as priorities in relation to new acquisitions. An important priority for the faculty is to constantly work for the development of the core facilities' competence and equipment park. The faculty invests significant funds annually in operation, maintenance, upgrading and new purchases of research infrastructure. The leaders of the core facilities, and also researchers in general at the faculty, participate in announcements of infrastructure funds and contribute on behalf of UiB to national and international infrastructure networks.

In order for the core facilities to offer good services, dedicated technical staff who can perform advanced analyzes and guide the clients are required. Maintaining the cutting-edge competence is crucial for the infrastructure to be operated in an appropriate manner. A typical technical employee at large infrastructure is highly educated and often with solid own research experience, and targeted measures will be required to retain this group of employees.

In connection with the Research Council's work on revising the national roadmap for infrastructure (2022-2023), the faculty organized an extensive input round in the spring of 2022

[1] data infrastructure committee

where the institutes reported their needs and priorities for infrastructure in the coming years. These inputs have laid a good foundation for the design of the faculty's future plans and ambitions regarding infrastructure. We have also recently revised the strategy for infrastructure after a thorough discussion with the institutes and core facilities. This work also forms the basis for the roadmap. In addition, we link up to UiB's strategy documents[2], national strategies such as Long-term plan for research and higher education [3], Revised strategy for personalized medicine[4], and to the Research Council's revised roadmap for infrastructure [5].

Priority areas for infrastructure at MED

a) Personalized medicine

Personalized medicine (precision medicine) is a national and international priority area within medical research, prevention, diagnosis and treatment of diseases, as highlighted in the Long-term Plan for Research and Higher Education and in the National Strategy for Personalized Medicine. Together with clinical trials, medical basic research and infrastructures for biotechnological methods and digital tools are crucial for further development of the field of personalized medicine and for personalized medicine to become part of the health service.

The recently revised national roadmap for research infrastructure is clear that further development of infrastructure for personalized medicine will become increasingly important to meet the requirements and expectations for what the health service should offer of diagnostics and treatment. The national roadmap also emphasizes the importance of Norway investing in infrastructure that enables systems medicine research on genomes, biomolecules, cells, tissues and organs to realize personalized medicine in the future. Such infrastructure is based on biotechnological and biochemical methods and includes, among other things, structural biology and all established 'omics' technologies. In addition, clinical-digital tools will play an essential role in the future. Biotechnological infrastructure is thus also crucial for conducting large studies in medical research, so that we get a coherent understanding from biomolecules to clinical treatment and public health.

The faculty has over a long-time developed infrastructure for advanced biotechnological methods through the core facilities. It is also important to note that the biotechnological methods offered through our core facilities are relevant for many disciplines within life science.

The following core facilities at MED are particularly relevant for personalized medicine:

- PROBE; Proteomics Unit
- BiSS; Biophysics, Structural Biology, and Screening
- MIC; Molecular Imaging Center
- Genomics core facility
- Flow Cytometry
- Core facility for Metabolomics
- Animal department

[2] UiB's strategy documents
[3] Long-term plan for research and higher education
[4] Revised strategy for personalized medicine
[5] Norwegian Roadmap for Research Infrastructure 2023

Biobanks: Biological material from patients and healthy people is collected in biobanks, and is invaluable material in medical research, also for the development of personalized medicine. Very many researchers at MED use material from biobanks in their research, from basic medical to epidemiological research. The faculty is a partner in the national infrastructure Biobank Norway (BBN), where Helse Bergen is the coordinating unit in Bergen. BBN is a national infrastructure that has over time developed into a very important infrastructure for development and coordination of human biobank resources in Norway. The close contact that has been established through BBN across hospitals and UH sector is unique and very valuable. MED supports further development of BBN. Helse Bergen is working for a national biobank for human brain tissue in Norway, and establishment of Norwegian brain biobank. The faculty has supported this initiative through input to the Research Council's national roadmap.

The faculty prioritizes further development of infrastructure for personalized medicine in the future, and this is also evident in the sketches that have been sent from the faculty to the Research Council's infrastructure announcement in June 2023 (see table 1). Most of the submitted sketches concern partnerships, while two sketches concern national infrastructures that the faculty will coordinate. One of the sketches coordinated by MED falls under personalized medicine and concerns cryogenic electron microscopy (cryo-EM) which is a state-of-the-art method for determining structures of macromolecules and molecular complexes at the atomic level. Cryo-EM is not yet established in Norway but is necessary to get in place in Norway for us to be competitive in structural biology.

b) Data infrastructure

Use of artificial intelligence (AI) will in the future become a natural part of medical treatment, and will be a necessary tool to integrate data generated through 'omics' technologies, health registers, biobanks, systems biology, imaging technologies and structure determinations. The faculty supports the development of solutions to meet a large and unmet need for processing of health data, so that real access to health data is ensured, and with flexible and dynamic solutions that meet the needs of research. This is a national need that requires national solutions. Good systems for health data are also crucial for the development of AI in medical research and health services. The faculty is part of UiB AI, and collaborates with Helse Bergen to coordinate, develop and finance research in medical AI in Bergen.

The faculty asks UiB to support existing local and national data infrastructures, and infrastructures that are developed and planned to handle and exploit large amounts of data. It is important that sensitive data is made available in secure systems, which allow secure analyzes according to the researchers' needs and which facilitate national and international cooperation. Relevant infrastructures are SAFE, ELIXIR and Sigma2. In addition, the faculty supports the national infrastructure BioBankNorge which is coordinated from NTNU and where UiB is a partner. Further development of BioBankNorge is now planned with a focus on data services secure access and use of health data linked to this infrastructure. The faculty also wants to build up a competence for precision-medical statistics.

c) Materials – nanotechnology – nanosafety

Research and innovation in medicine and health depend on access to basic research infrastructures also within other disciplines, such as material science and nanotechnology. Nanotechnology is especially mentioned in the Long-term Plan for Research and Higher Education as an important enabling technology in the years to come, and with this also follows a focus on unwanted effects of nanotechnology. In the national roadmap for infrastructure, the importance of nanotechnology for research and innovations in many disciplines, including health, sea, food and environment, is emphasized. At the faculty, we have in recent years developed infrastructure related to nanotechnology, and in this year's sketch round to the Research Council's infrastructure announcement, we submitted an initiative from the Department of Clinical Dentistry on nanosafety related to health and environment. At the

national level, there are currently no integrated infrastructures available that provide the necessary knowledge and competence across several scientific fields that are needed to conduct harmonized research in nanosafety (see table 1).

d) Public health and primary care

Public health and primary health care Better public health and research and development of municipal health services are a prioritized political goal in the Long-term Plan for Research and Higher Education. Through strong research environments within community medicine, MED has an established and good cooperation with municipalities in Western Norway, and especially with Bergen municipality. We have especially two research infrastructures aimed at public health; PraksisNett and the core facility Research Unit for Health Surveys. At the same time, we are building up infrastructure related to research in the Center for Age and Nursing Home Medicine (SEFAS).

PraksisNett was established in 2018 through self-financing and support through the Infrastructure Program, and it was listed as a separate item in the state budget for 2023. PraksisNett today consists of 92 GP offices with a total of 481 GPs and their around 500,000 list patients. The network thus comprises around 9% of the country's GPs and a corresponding proportion of the population. The GP offices are the health service's largest arena for diagnostics and treatment, but the clinical research lags significantly behind the specialist health service. National strategy documents announce increased focus on research-based service development in the public sector. This will require permanent arrangements to support such research - i.e. an infrastructure like PraksisNett. The faculty supports further development of PraksisNett together with partners, so that the infrastructure can be further developed to include a larger proportion of the GPs, as well as other parts of the primary health service, such as emergency room, nursing home and physiotherapy and dental health service. We thus support the sketch of further development that was sent to the Research Council's announcement in June, with NORCE as coordinator.

Research Unit for Health Surveys (FHU) is a unique infrastructure in Norway that fills a very important task in public health surveys and clinical trials. FHU assists research groups in different academic environments with conducting different types of studies on voluntary participants, and the unit is run through close cooperation with Helse Bergen, and complements the clinical research posts. This is a unit where the infrastructure first and foremost lies in professional competence and personnel resources, as well as facilities such as premises, parking and accessibility, in addition to electronic programs for decentralized studies and to a lesser extent in the equipment park. Planning and conducting clinical trials in accordance with current privacy rules and good clinical trial practice is very resource-intensive for each research group to maintain. Such competence is necessary for high-quality research and is made easily available to everyone through FHU. Investment and further development of this in the future is highly relevant.

Quality of life for the elderly - Center for Age and Nursing Home Medicine (SEFAS). One of the most pressing challenges in our society is care and treatment for the growing group of elderly people with chronic, complex diseases including neurological disorders such as dementia and Parkinson's disease. The Health Commission report supports an increased need to support elderly people with chronic and complex diseases to live safely and independently at home with good quality of life, and thus support their relatives and health services in the municipalities. With the patients follows extensive data information on, among other things, diseases, treatment and care needs and future resource needs in primary and specialist health service. Potentially, some of the needs can be covered with welfare technology. Today, it is little investigated whether digitalization, smart housing and related AI contribute to increased quality of life and health economic gain. The faculty is now building up a digital plug-and-play mobile platform (ALIVE) that collects selected technologies for use at home. This infrastructure will be able to answer questions related to which digital solutions actually provide increased quality of life for patients and relatives, and which also provide health economic benefits.

The Faculty's roadmap in relation to the Research Council's announcement Funds for research infrastructure of national importance autimn 2023

In June 20203, the Research Council's board adopted the Norwegian roadmap for research infrastructure 2023[6]. This roadmap has been put in place after extensive input rounds from Norwegian institutions, where also MED and UiB have contributed. At the same time, the Research Council has announced funds for research infrastructure of national importance with a sketch deadline in June 2023, and a deadline for full application in November 2023. It is clearly stated in the national roadmap that it is prioritized for the allocation in the announcement, and it is also clearly stated that the roadmap is linked to national strategies, and especially to the Long-term Plan for Research and Higher Education.

MED started in the winter of 2023 a process to get an overview of which initiatives were planned among researchers at the faculty. Table 1 shows an overview of infrastructure sketches that were sent to the Research Council in June 2023. The faculty is coordinator for two ordinary applications (project no. 347070 and 347057, table 1), and for two pre-projects (Table 2). For the other sketches, the faculty participates as a partner, and for the majority of the sketches, it concerns the continuation of infrastructures that are already partially financed through the infrastructure program. A few of the partner applications concern new initiatives for national infrastructure (project no. 347017 and 346926, table 1). All the sketches describe infrastructure within areas that are prioritized in the national roadmap for infrastructure, and central national plans and strategies, such as the Long-term Plan for Research and Higher Education and Strategy for Personalized Medicine.

Of the two infrastructures that are planned to be coordinated by the faculty, one project falls under Life Science and Health (Cryo-EM, table 1) and the other under Technology and Natural Science (NanoSafety, table 1). There is an expressed national need for these infrastructures, and the faculty is aware of the obligations that follow operation, maintenance and development of a national research infrastructure. It should be mentioned that the faculty today does not coordinate any national infrastructures. As a leading medical faculty in Norway, we would like to take on the role of coordinator and contribute to the national infrastructure effort. Below follows a closer description of the two national infrastructures planned to be coordinated from MED.

1) Cryoelectron microscopy (Cryo-EM) is a method that makes it possible to determine structures of large and flexible biomolecules and their complexes. Previous methods for determining structure (X-ray crystallography and NMR) are based on the molecules having a rigid structure, which allows them to be crystallized, or are relatively small in size. Structure determination using cryo-EM has therefore become an indispensable tool in life science to understand how complex biomolecules interact in life processes and development of disease. The researchers behind the method were awarded the Nobel Prize in Chemistry in 2017, and cryo-EM is now established at many research institutions, also in Sweden, Denmark and Finland. Norway currently lacks infrastructure for biological cryo-EM, and research that requires the method is exported abroad or not carried out at all. This weakens Norwegian life science research and makes Norwegian researchers less attractive as partners and less competitive in announcements of external funds. In addition, it weakens Norway's opportunities to recruit good researchers to life science research.

[6] Norwegian Roadmap for Research Infrastructure 2023

We propose to establish a Norwegian cryo-EM infrastructure (CryoNOR) with the main node at UiB (Department of Biomedicine, MED). With CryoNOR, cryo-EM will become an integrated part of Norwegian science from structural biology to cell biology, marine biology, nanoscience, molecular evolution and medical science. CryoNOR will open up new opportunities for collaboration, promote curiosity-driven and applied science and help Norway to remain a leader in science. When it comes to active research, publications and collaboration within the field, UiB has the leading research environment in Norway for cryo-EM, and UiB is thus the natural host for the infrastructure. The need for CryoNOR is well anchored in Norwegian institutions, and the academic environments agree that based on professional expertise, UiB is the natural choice to coordinate the platform.

2) NanoSafety (Nano4S). It is expected that nanotechnology will contribute to innovations in most areas of society, such as energy and environment, sea, agriculture, food and health. As an example, nanotechnology was crucial for the development of lipid nanoparticle-based Covid-19 vaccines. At the same time, it is crucial to avoid unwanted effects on health, environment and society. The purpose of the platform for nanosafety (Nano4S) is that it should be a national resource for the development of safe and sustainable design of nanomaterials and nanomedicines. A similar infrastructure does not exist in Norway today, although the need is great. Not only research environments, but also state authorities, business and other developers need such a platform.
   Nanotechnology is highlighted as an important area for further research and for the development of business, both in the Long-term Plan for Research and Higher Education and in the Research Council's national roadmap for research infrastructure. Funding for Nano4S was also applied for in the previous national infrastructure announcement from the Research Council from the same research environment from the Department of Clinical Dentistry, which will now apply again. The basic idea was very well received by the evaluators in the previous round, and the project was evaluated to excellent on all points in the scientific evaluation, and also received very good evaluation for the more administrative parts of the project (four A, and three B). Partners on the project are in addition to UiB, SINTEF Industry, SINTEF Ocean, STAMI (state working environment institute), NILU (Climate and Environment Institute) and NMBU. This consortium will together integrate central competence areas and deliver a "one-stop-shop" for holistic, integrated and user-adapted services: advice, support, testing (physical-chemicals, exposure, toxicity), hazard and risk assessment, education, training and communication. The partners are at the forefront of national and international NanoSafety research and have collaborated in national and EU projects. The environment at UiB that coordinates the project has extensive experience with coordination of large projects.

Ranking	Project number	The project title of the project	Department	Coordinator/ Partner	Partners
A	347070	National Platform for NanoSafty	Department of Clinical Dentistry	C	**UiB** SINTEF Ocean, SINTEF Industry, NILU, STAMI, NMBU
A	347057	Norwegian National Cryo-EM Infrastructure (CryoNOR)	Department of Biomedicine	C	**UiB**, UiT
A	346926	BBI - The Norwegian Brain Bank Initiative	Department of Clinical Medicine	P	**Helse Bergen,** UiB, OUS, St.Olavs, SUS, AHUS
A	347226	Biobank Norway 5 – a national data infrastructure	Department of global health and primary care	P	**NTNU**, UiB, UiO, UiT, FHI, Dir. for e-helse, Kreftreg., St. Olavs hospital, OUS, Helse SØ, Helse Vest, Helse Nord
A	346974	National network of Advanced Proteomics Infrastructure phase 2(NAPI2)	Department of Biomedicine	P	**UiO**, UiB, OUS, NTNU, NMBU, UiT
A	347017	NorMet – Norwegian Infrastructure for Metabolomics	Department of Biomedicine	P	**NTNU**, UiO, UiB, UiT, NMBU, UiS, OUS, UNN, SUS, SINTEF
A	346982	NOR-Openscreen II – The Norwegian node of EUOPENSCREEN ERIC	Department of Biomedicine	P	**UiO**, UiB, UiT, Sintef
A	347034	NorSeq II – National Consortium for DNA Sequencing	Department of Clinical Science	P	**OUS,** UiB, UiO, HUS, NTNU, St. Olavs hospital, UiT, UNN
A	346283	Norwegian Brain Initiative (NORBRAIN) – a large-scale infrastructure for 21st century neuroscience: Stage 4	Department of Biomedicine	P	**NTNU,** UiO, UiB
A	347059	Norwegian Molecular Imaging Infrastructure - 2 (NORMOLIM)	Department of Biomedicine	P	**NTNÙ,** UiB, UiO og UiT
A	346956	The Norwegian Emergency Primary Care Research Network	Department of global health and primary care	P	**NORCE,** UiB, UiO, NTNU, UiT, UNN
B	347114	Integrated Norwegian infrastructure for microphysiological systems including organoids and organ-on-chip systems (NOR-MPS)	Department of Clinical Science	P	**UiO**, UiB, OsloMet, SINTEF

Table 1: Overview of applications for INFRASTRUCTURE 2023

Ranking	Project number	The project title of the project	Department	Coordinator /Partner	Partners
A	347141	Norwegian Platform for Bioprinting and Cell Production for Tissue Engineering & Personalized Medicine (NorPrintLab)	Department of Clinical Dentistry	K	**UiB**, UiO, RISE PFI AS (Trondheim), Helse Bergen
A	347036	Preparedness platform for health crises research and management (PrepHealth platform)	Department of global health and primary care	C	**UiB**, Sikt, FHI, Helse Vest, RAYVN - Crisis Management Software

Table 2: Overview of pre-project applications INFRASTRUCTURE 2023

6. OVERVIEW OF CONNECTION TO NATIONAL AND INTERNATIONAL INFRASTRUCTURES

Several of the faculty's core facilities participate in national and international (EU) infrastructure networks. Such participation gives our researchers additional access to advanced technology, and better conditions for participating in larger research projects and establishing national and international cooperation. This is again important for competence development at UiB and for recruiting good researchers. Membership fees are generally high in the EU-based networks, and there is a general frustration among the core facilities, and at the faculty in general, that continuation of membership after initial support from the Research Council must be covered by user payment to the infrastructure, or at the institute/faculty. Therefore, a cost-benefit assessment of membership must always be made, which is also expressed in the revised national roadmap[7]. It is unfortunate that academic environments fall outside international networks due to challenges with paying membership fees. This affects not only research opportunities and network building, but will also probably reduce Norwegian researchers' chances of getting through in calls in Horizon Europe. The faculty asks UiB management to consider the importance of membership in the European infrastructure networks, and invite dialogue with the faculties on the matter.

Here is an overview of MED's membership in national and international research infrastructures:

- ELIXIR (EMBL)
- NorSeq (National consortium for sequencing and personalized medicine)
- NorCryst (Norwegian Macromolecular Crystallography Consortium)
- PraksisNett (The Norwegian Primary Care Research Network)
- NAPI (National network of Advanced Proteomics)
- NOR-OPENSCREEN (The Norwegian EU-OPENSCREEN)
- Biobank Norway (a national biobank research infrastructure)
- NORBRAIN (Norwegian Brain Initiative)
- NORMOLIM (Norwegian Molecular Imaging Infrastructure)
- HRR (Health Registries for Research)

[7] Norwegian Roadmap for Research Infrastructure 2023