

ново
nordisk
fonden

Benefiting people and society

Societal impact

of the Novo Nordisk Foundation

Annual Impact Report
2020







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“Investing in research and development in society contributes to creating knowledge, employment, growth and innovation of products and services to benefit people.”

— Lars Rebien Sørensen

Chairman, Board of Directors, Novo Nordisk Foundation.

Preface

The Novo Nordisk Foundation is an independent Danish foundation with corporate interests which supports scientific, social and humanitarian causes. The Foundation's ambition is to strengthen research in Denmark and the Nordic countries while contributing to international collaboration, knowledge creation and growth to pave the way for societal development and solutions that improve the lives of people and create a sustainable society.

Our 2019–2023 strategy lays out the scope of our activities and how we will support projects in a wide range of fields, such as biomedical science, natural science, biotechnology, humanities, interdisciplinary research, diabetes treatment, innovation, education, outreach as well as social and humanitarian causes.

As a significant contributor to and investor in science and society, we adopt a long-term perspective. Research and investments in companies involve taking risks, and achieving results can take time. We believe that high-quality activities and interdisciplinary approaches create the ideal research environment for great ambition, scientific collaboration and new ideas to flourish. And

such an environment has the potential to foster the greatest breakthroughs and find new sustainable solutions to societal challenges.

This impact report documents the overall contribution to society of our grant-giving activities, alongside the impact on society of the Foundation's commercial activities. The commercial activities are investments in life science companies, capital investments and controlling interest in Novo Nordisk A/S, Novozymes A/S and Novo Holdings A/S.

With respect to the commercial activities, and if not otherwise stated the report focuses on the Novo Group and life science companies with equity investments where Novo Holdings' ownership share ranges between 5% and 100%.

We hope you will enjoy reading this year's impact report.

Mads Krosgaard Thomsen
CEO
Novo Nordisk Foundation

Executive summary

The Novo Nordisk Foundation has two objectives: 1) to provide a stable basis for the commercial and research activities of the companies in the Novo Group; and 2) to support scientific, humanitarian, and social purposes.

The Foundation aims to make contributions that benefit people and society. Our strategy formulates the desired contributions to society for the Foundation across its grant-awarding and commercial activities. We have established an impact framework to analyse, measure and communicate our societal achievements. This year's impact report links our grant-giving and commercial activities in 2020 and those of previous years to scientific achievements and societal outcomes beyond science.

Part I

The report is divided into three parts. Part I of the report describes the monetary flows and the capital stock of the Novo Nordisk Foundation Group¹ and how we contribute to research investments in society. The key insights are:

- Since 2016, we have awarded grants at an amount of DKK 25 billion (€3.5 billion) to society. In 2020 alone, we awarded DKK 5.5 billion (€0.75 billion), and our payouts financed 11% of all Danish public sector research.
- In 2020, the market value of Novo Holdings' ownership of Novo Nordisk A/S and Novozymes A/S was DKK 307 billion (€41 billion), and our investment company, Novo Holdings, had investments of DKK 77 billion (€10.2 billion) in life science companies and capital investments at DKK 73 billion (€10 billion). The Novo Group and Novo Holdings' life science companies financed 18% of Danish private research, and the corporate taxes amount to an estimated 10% of total corporate taxes in Denmark.

Part II

Part II describes the societal impact of our grant-giving activities based on our nine impact principles for the Foundation's contribution to society. Over nine chapters, each devoted to an impact principle, we document our main imprints on society. The key results for each chapter are:

- **We foster the development of research talent**
In 2020, 4,630 people in science have been fully or partly funded by the Foundation, including nearly 2,200 PhD students and postdoctoral fellows.
- **We invest in infrastructure**
Since 2007, the Foundation has awarded DKK 18.5 billion (€2.5 billion) to research, innovation and education infrastructure activities, hospitals, and new independent foundations. Researchers, teachers, medical professionals, children, youths and patients benefit from the infrastructure.
- **We support research collaboration**
Since 2016, 69% of the Foundation-funded journal articles are co-authored with international researchers, 11% with industry researchers and 64% with interdisciplinary research teams. The grant recipients have published more than 10,000 journal articles in collaboration with other researchers.
- **We promote excellent research**
In the period 2016-2019, 21% of the journal articles funded by the Foundation are among the world's top 10% most cited journal articles. By the end of 2020, 3,900 publications were reported from grantees and 90% were published in international peer reviewed scientific journals.

¹ Novo Nordisk Foundation Group consists of the Novo Nordisk Foundation, the Novo Group as well as Novo Holdings A/S' life science and capital investments. The Novo Group comprises the Novo Nordisk A/S, Novozymes A/S and Novo Holdings A/S. Novo Holdings A/S is fully owned by the Foundation.

- **We support development of innovative products and solutions**

Since 2016, 113 medical products and interventions have been developed by grantees, and recipients of Foundation grants reported 138 patent applications or patents. 1,654 journal articles funded by the Foundation are currently cited in patent documents. The share of Foundation-funded research that will eventually be cited in patent documents is approximately 18%.

- **We create jobs and growth**

In 2020, 5,500 jobs were created by the Foundation's grants, which is 3,400 more than in 2016. On top of the jobs created directly by the grants, around 700 jobs were created in spinouts based on Foundation-funded research discoveries and inventions.

- **We support development of healthcare and new medicine**

Of the 47 clinical trials reported by grantees since 2016, 34 are registered on www.clinicaltrials.gov and 22,312 people are enrolled in these trials. In 2020, 26,000 people were treated at the Foundation-funded Steno Diabetes Centers. 21% of 870 Danish and international guidelines within non-communicable diseases published between 2011 and 2020 hold a reference to a Foundation-funded article.

- **We develop world-class education**

In 2020, our school initiatives reached more than 101,000 children, youths, and adults, and our outreach initiatives reached nearly 900,000 people.

- **We empower vulnerable groups in society**

In 2020, the Foundation helped more than 1.1 million people in humanitarian settings. And our social grants supported 30,000 youths achieving a more healthy lifestyle.

Part III

Part III documents the societal impact of our commercial purpose. We have analysed the Novo Group and Novo Holdings' life science portfolio of companies. With focus on our impact principles, the key societal impact through the Novo Group and Novo Holdings' companies are:

- **We promote research collaboration and excellence**

Since 2016, the companies have published more than 3,000 journal articles. 75% (2,371 articles) are published in collaboration with researchers from academia.

- **We support development of innovative products and solutions**

Since 2018, the companies published more than 5,700 patents, and 1,700 patents were granted.

- **We create jobs and economic growth**

In 2020, the Novo Group and Novo Holdings' life science companies had 107,000 employees worldwide. Approximately 25,700 employees were working in Denmark.

- **We support development of healthcare and new medicine**

Since 2016, the companies have registered nearly 500 clinical trials in the US and 61 protected products. 400,000 people have been enrolled in clinical trials.

- **We have empowered people through medicine, technologies and services**

In 2020, nearly 32.8 million people used pharmaceutical products from Novo Holdings' companies. Annually, 40 million people are helped by medical devices.

Our results are based on extensive research and build on analyses of several data sources. We track the activities from our input and assess output, outcome and impact to monitor and analyse the societal impact of the portfolio of activities. We use the reporting of the grant recipients and the companies, alongside other databases. We capture data systematically through our two online data collection and reporting systems, *researchfish*[®] and *Foundgood*, as well as ad-hoc surveys and research. Since all grant recipients report annually, we have data on the full population with no attrition.



Part I

The monetary contribution to society

1. The scale of investments in society

The Novo Nordisk Foundation Group contributes to society in many ways. We award money to support public research for the benefit of people and society. Through the Novo Group, the investments in life science companies and capital investments, the Foundation Group contributes to private sector research and innovation. Both these forms of engagement in society provide jobs, tax revenue in Denmark and abroad and contribute to the creation of income for hundreds of thousands of people. Denmark is the centre of gravity for the Foundation's support, followed by the other Nordic countries. Novo Holdings commercial investments are global. Underpinning all these benefits is the financial resilience and scale of the Foundation Group and its investments, which are covered in this chapter. We outline our legal and commercial structure, before describing the economic scale of our activities.

1.1 The business model

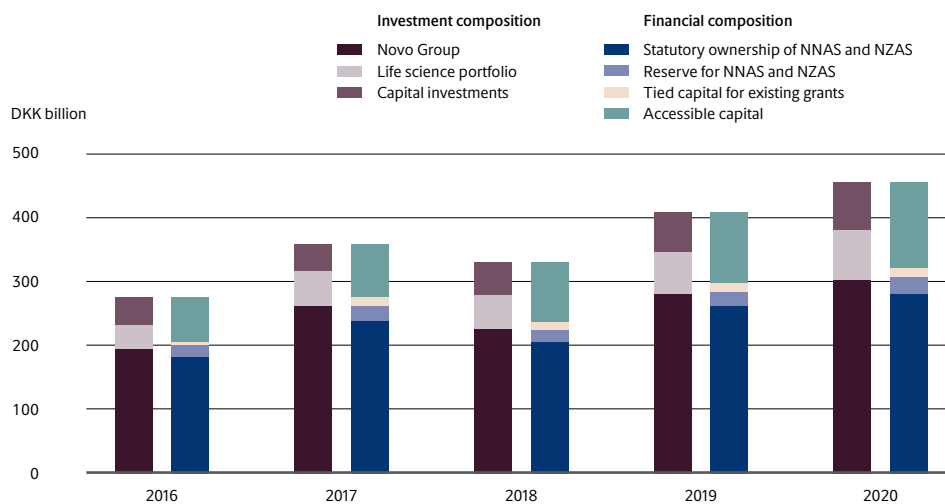
In 2020, the Novo Nordisk Foundation Group owned or invested in more than 137 companies through its wholly owned subsidiary Novo Holdings A/S (NHAS), a holding company and majority shareholder of Novo Nordisk A/S (NNAS) and Novozymes A/S (NZAS). Novo Holdings manages the Foundation's commercial activities, which are primarily within life sciences (Figure 1.1 and Figure 1.5), in addition to receiving dividends from Novo Nordisk and Novozymes and returns on its own commercial and financial investments.

The Foundation receives income from Novo Holdings and awards grants to benefit society. In 2019 and 2020, the Foundation had a net worth of DKK 411 billion and DKK 457 billion, respectively, making it one of the largest financial endowments of any foundation in the world (Figure 1.1). The income and the return on the investments in Novo Holdings was DKK 29 billion in 2020 compared to DKK 26 billion in 2019.

Figure 1.1 shows the composition of the financial endowment of the Foundation (investments in the Novo Group and all investments in life science companies and capital investments) as well as the financial strategy which ensures the necessary accessible capital which forms the basis for the Foundation's grant-giving capacity.

Figure 1.1

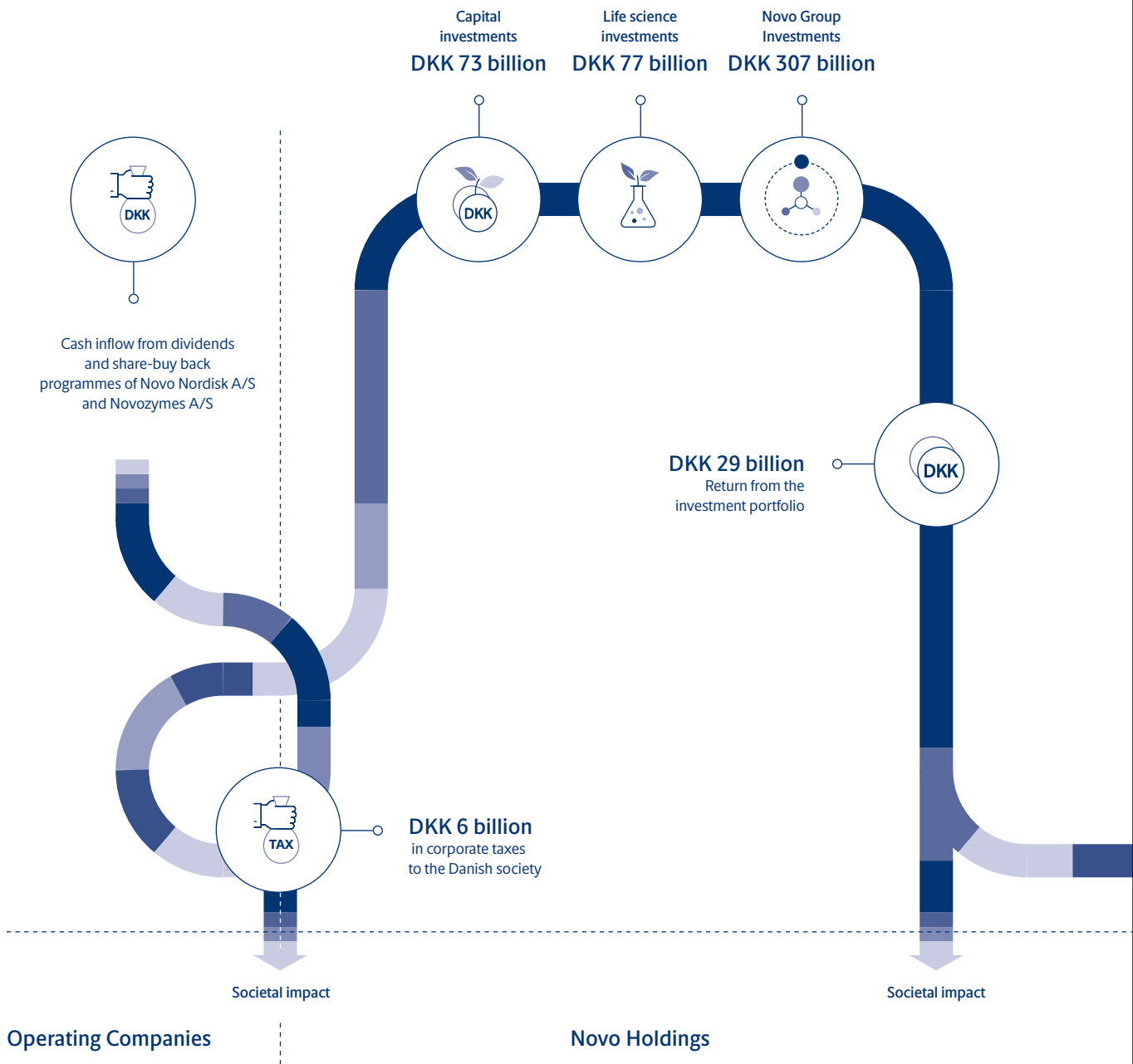
Development in the Foundation's financial endowment, 2016–2020 (DKK billion)



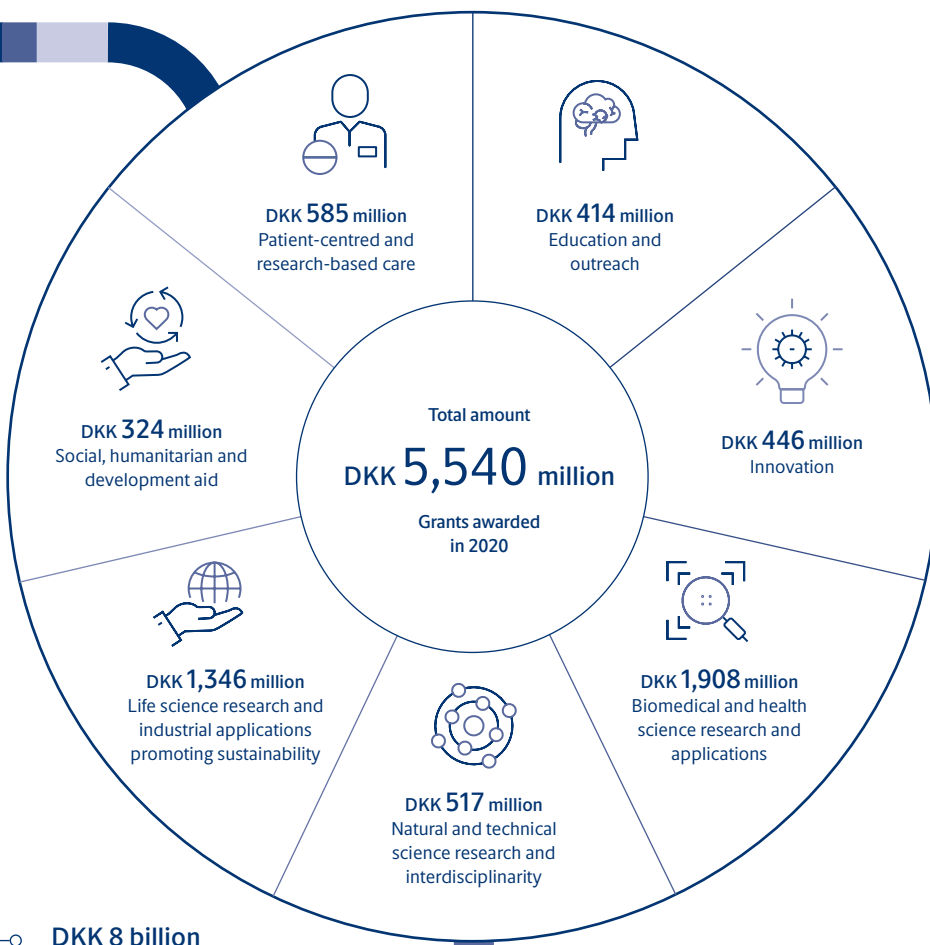
Note: Accessible capital equals total assets minus statutory ownership of and reserves for Novo Nordisk A/S and Novozymes A/S minus grant-giving reserves. The grant payout ambition is 3-5% of 5 year average of accessible capital based on the last two realized years, expected for the current year and forecast for the coming two years.

Source: Novo Nordisk Foundation.

The business model (2020)



Grant-giving decision in 2020



DKK 8 billion
in dividends to the
Novo Nordisk Foundation

Societal impact

Novo Nordisk Foundation

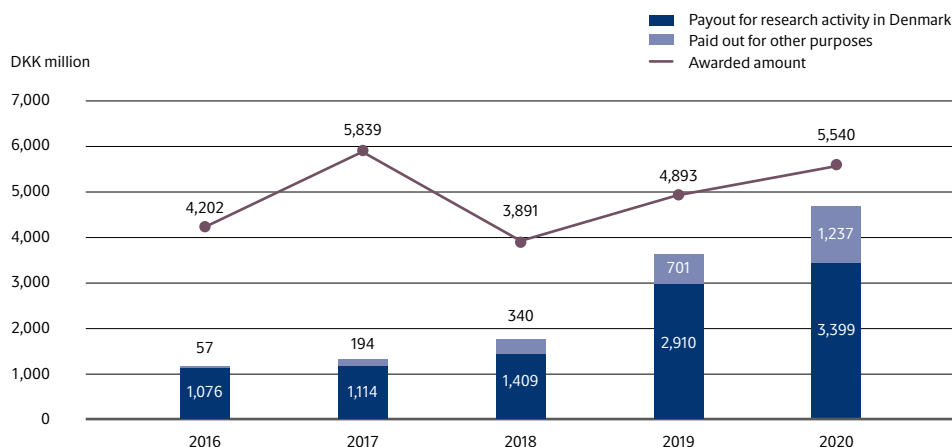
1.2 Grant-giving for scientific and non-scientific purposes

The Foundation awards grants both for scientific purposes and non-scientific purposes. In 2020, the Foundation awarded 754 new grants worth DKK 5,540 million (€745 million), while it paid out DKK 4,636 million (€623 million) on all active grants. This was the highest annual payout in the history of the Foundation and the result of increased annual awarded amounts in previous years (DKK 3.9–5.8 billion per year in 2016–2020).

Figure 1.2 shows the increase in the total grant amount awarded and the fourfold increase in payout (the amount of money paid to grant recipients) since 2016.

Figure 1.2

Grants and payouts from the Novo Nordisk Foundation 2016–2020



Source: Novo Nordisk Foundation.

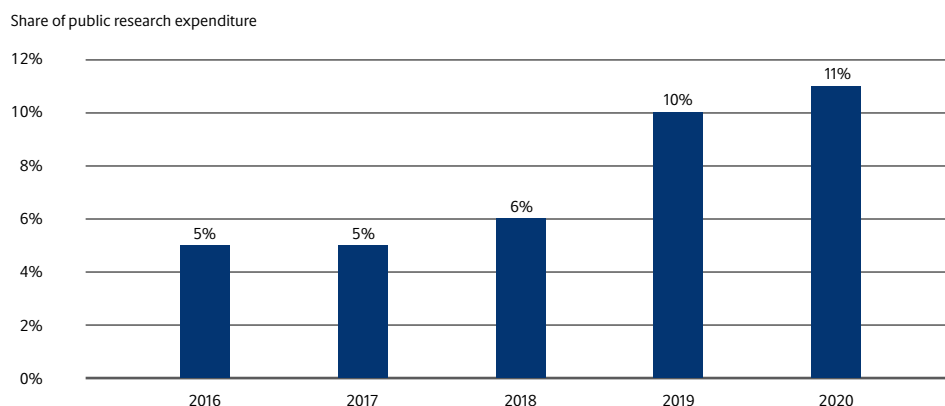
In 2016–2020, 80%–90% of the total payout went directly to financing research in the public sector. In 2020 alone, the direct payments to public sector research activities and research equipment and buildings, mostly at universities and research hospitals, totalled DKK 3.6 billion. Nearly DKK 0.3 billion were paid out for research outside Denmark and DKK 0.5 billion were paid out for Steno Diabetes Centre buildings, leaving nearly DKK 2.9 billion paid out for public research in Denmark.

1.3 Contribution to public research investments in Denmark

The Foundation's use of resources provided by its endowment induce financing of 11% of public sector research funding in Denmark in 2020. We have estimated our contribution to 27% of public research spending in Denmark in 2020 within the biomedical and health sciences, 4% within the natural sciences and engineering/technical sciences and 2% within the humanities (the Foundation funds art and art history research) and social sciences (incl. health economic research).

Figure 1.3

Novo Nordisk Foundation contribution to public research expenditure, 2016–2020



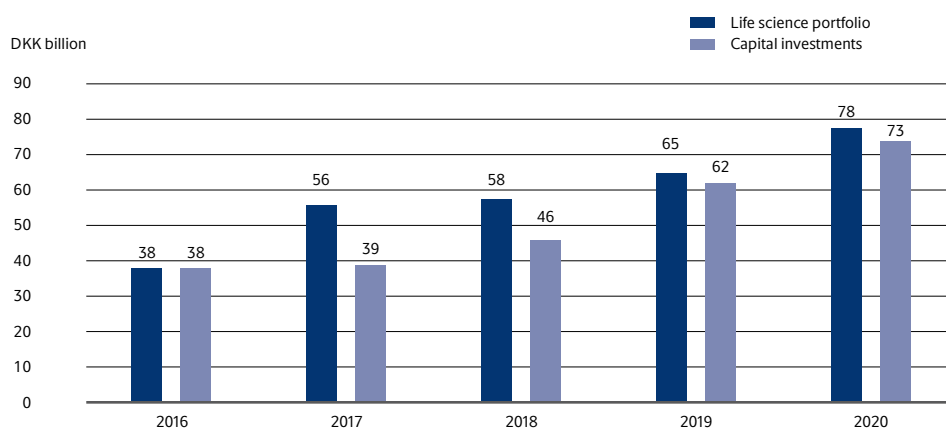
Sources: Statistics Denmark and Novo Nordisk Foundation.

The Foundation is one of many private foundations supporting public research in Denmark. In 2020, the Foundation's funding of public research spending contributed an estimated 0.13% of gross domestic product (GDP), up from 0.05% of GDP in 2016. In comparison, other foundations' and organisations' total share is estimated at 0.07% of GDP in 2020. And EU's share is 0.05% of GDP. The national public budget's funding of public research spending was 0.88% of GDP in 2020.

1.4 Commercial investments and private research investments

This section concerns the value of the Novo Nordisk Foundation Group's portfolio in life science and capital investments managed by its holdings company Novo Holdings A/S. The Group is an active investor in life science companies, providing capital and security for its portfolio companies to perform long-term research and development activities. Figure 1.4 shows the total value of life science investments and capital investments from 2016 to 2020. The total value has increased 100% since 2016. The figure includes all life science investments where Novo Holdings' ownership share ranges between 0% and 100% and all capital investments.

Figure 1.4 The value of Novo Holdings' life science investment portfolio and capital investment portfolio, 2016–2020 (DKK billion)



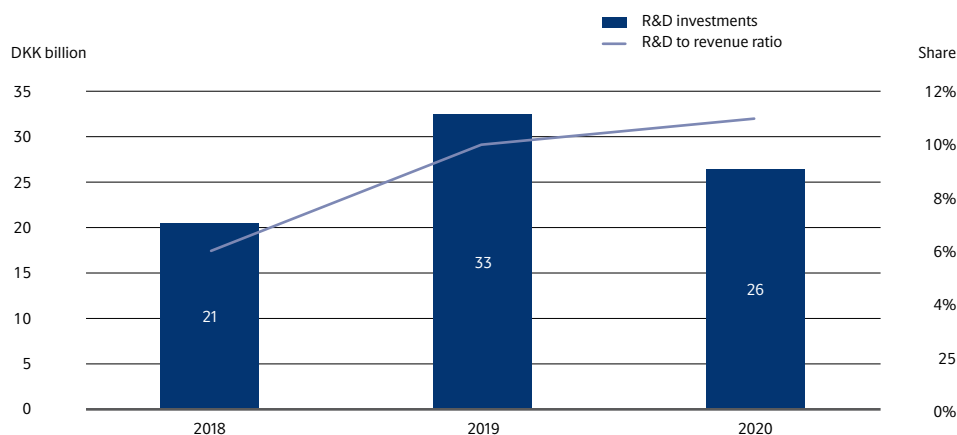
Note: Life science investments exclude Novo Nordisk A/S and Novozymes A/S. This figure includes all life science investments where Novo Holdings' ownership share ranges between 0% and 100% and all capital investments.

Sources: Novo Holdings and Novo Nordisk Foundation.

In 2020, the Novo Group and the Novo Holdings's life science portfolio companies (where Novo Holdings' ownership share ranges between 5% and 100%) invested DKK 26.4 billion (€3.5 billion), in research and development (R&D) worldwide (Figure 1.5). In 2019, DKK 7.5 billion (€1 billion) were spent in the private sector in Denmark, equivalent to 23% of our companies total R&D investments in the world. The R&D share relative to total sales (for the Novo Group and the life science investments where Novo Holdings' ownership share ranges between 5% and 100%) worldwide has increased from 6% in 2018 to 11% in 2020.

Figure 1.5

The Novo Nordisk Foundation Group's investments in private R&D worldwide and the R&D share of total revenue worldwide

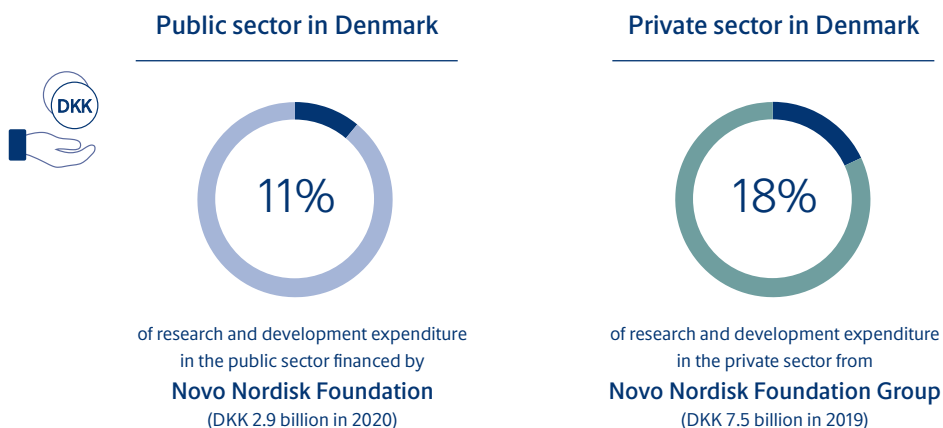


Note: The companies in the figure are the Novo Group and the life science companies where Novo Holdings' ownership share ranges between 5% and 100%. Since all companies have not yet reported R&D expenses for 2020, the 2020 value is expected to be higher.
Sources: Novo Nordisk Foundation and Novo Holdings.

The share of the Novo Nordisk Foundation Group of companies' expenditures in R&D in the private sector in Denmark is estimated at 18% for the year 2019. This corresponds to 0.32% of GDP. The sum of the Novo Nordisk Foundation Group's investments in R&D in the public sector as well as in the private sector is for 2020 estimated at 0.45% of GDP.

Figure 1.6

Novo Nordisk Foundation Groups' financing share of R&D in the public and privat sector (2020)

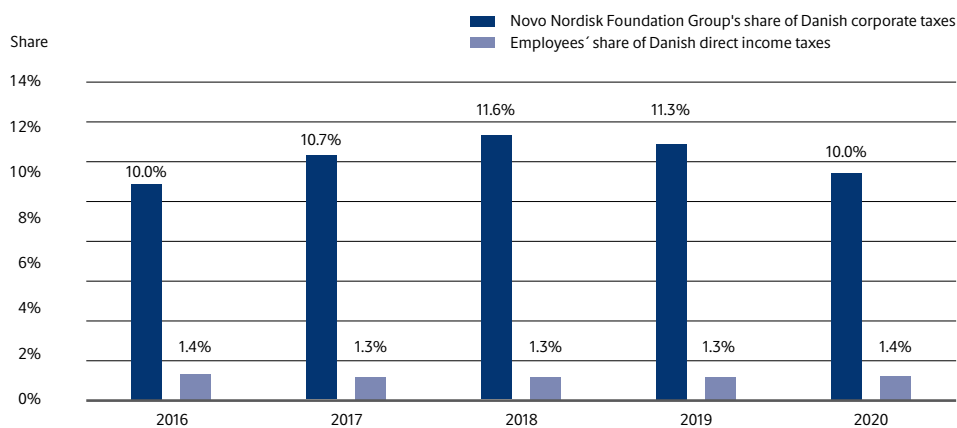


Note: Companies are the Novo Group and the life science companies where Novo Holdings' ownership share ranges between 5% and 100%.
Sources: Statistics Denmark and Novo Nordisk Foundation.

1.5 Tax payments to Danish society

Through its economic activities, the Novo Nordisk Foundation Group contributes to significant tax income. Alone in Denmark, the total annual corporate tax payments from the Group were DKK 6–8 billion in 2016–2020, and between 10% and 12% of Danish corporate taxes were paid by the Group (Figure 1.7). The figure also shows the share of Danish direct income taxes paid by the employees from the Novo Group and the life science companies where Novo Holdings' ownership share ranges between 5% and 100%, varying between 1.3%–1.4% of Danish direct personal income taxes between 2016 and 2020.

Figure 1.7 Share of Danish corporate taxes and direct income taxes paid by the Novo Nordisk Foundation Group and its employees

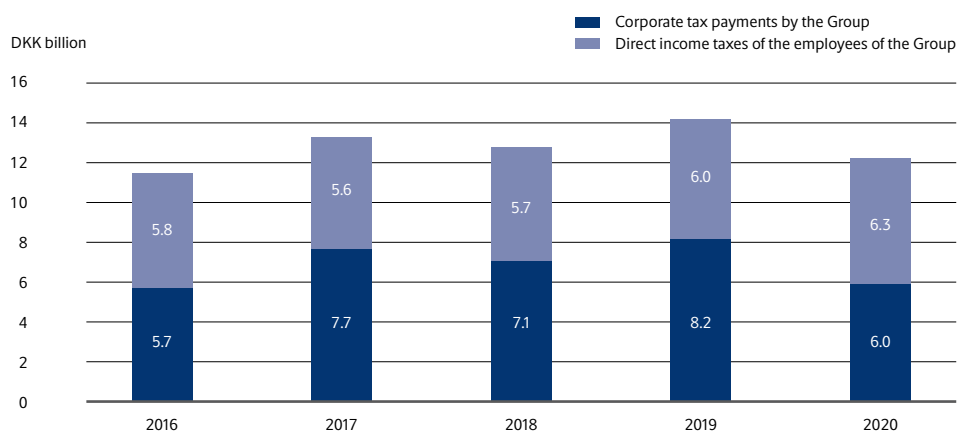


Sources: Novo Holdings, Novo Nordisk Foundation, Statistics Denmark, and Danish Tax Authorities.

The total sum of the Group's corporate taxes and direct taxes of the Novo Group's and the life science companies' employees in Denmark was DKK 12.3 billion (€1.65 billion) in 2020 compared to DKK 11.5 billion (€1.55 billion) in 2016 (Figure 1.8).

Figure 1.8

Total direct tax payments in Denmark for Novo Nordisk Foundation Group and its employees, 2016–2020 (DKK billion)



Sources: Novo Nordisk Foundation and Statistics Denmark.

In addition to the corporate taxes and the direct taxes paid by the Novo Nordisk Foundation Group's employees, the companies and employees also pay indirect taxes. On top of that, the grant-giving activities of the Foundation also generate income taxes via income for people fully or partly paid by Foundation grants (see chapter 7). The Danish society's tax income from the Group's activities will therefore be higher than the estimates in Figure 1.8.



Part II

The societal impact of grant-giving activities

2. Fostering the development of research talent

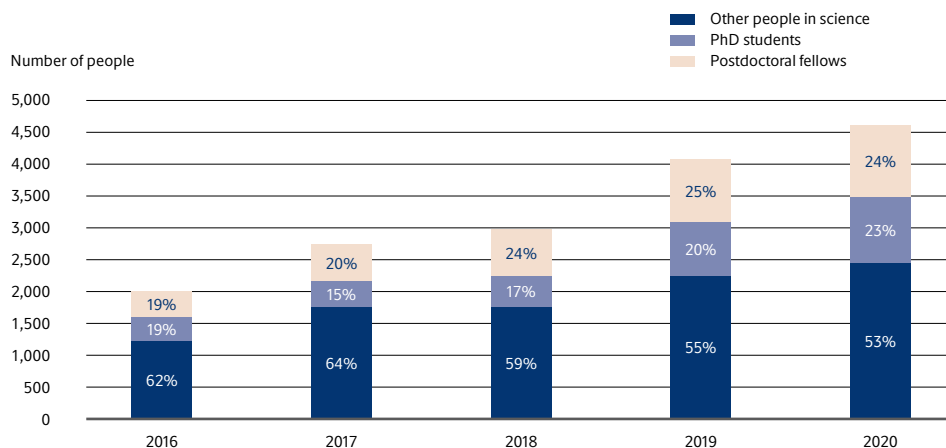
This section describes how the Foundation supports researchers across the entire career path. The Foundation aims to support the development of talents and to help institutions attract talented researchers to Denmark at all career stages.

2.1 People in activities funded by Foundation grants

In 2020, the Foundation fully or partly funded 4,630 people in science or research hospital settings. Figure 2.1 shows the growth among postdoctoral fellows, PhD students, and other grant recipients and scientific team members funded by the Foundation. In 2020, 24% of the people funded were postdoctoral fellows, 23% PhD students and 53% occupied other positions in science.

Figure 2.1

Number of people in science fully or partly funded by the Foundation, 2016–2020



Note: Other people in science includes assistant, associate, and full professors as well as technical and administrative staff.

Sources: Novo Nordisk Foundation/researchfish/impact-of-science.

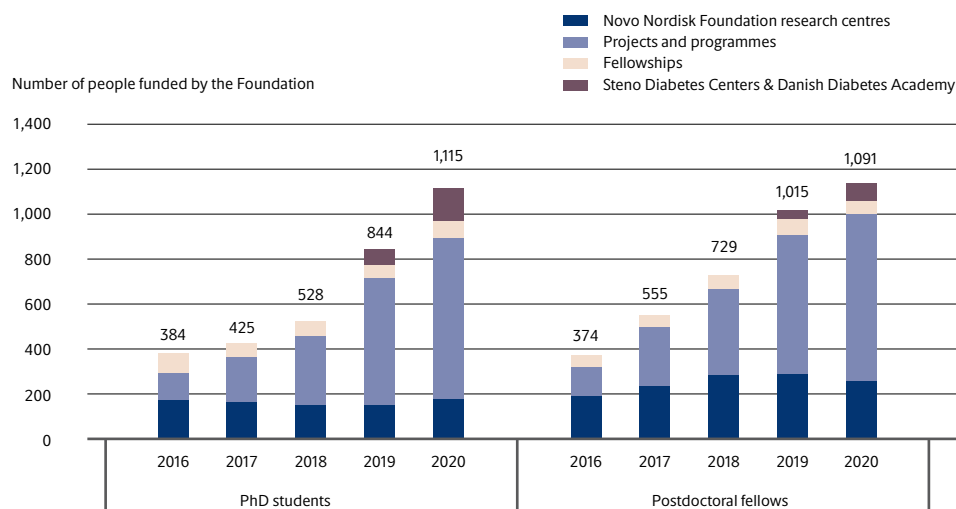
Foundation-funded recruitments of researchers from abroad are substantial. The NNF research centres have recruited 51% of their scientific personnel from outside Denmark. 70% are PhD students and postdoctoral fellows. The Steno Diabetes Centres have recruited 7% of the personnel from abroad. Moreover, the Foundation also attracts research talent to Denmark via e.g. the Foundation's Laureate Research Programme, Young Investigator Programme, and the Copenhagen Bioscience PhD programme for international students. Finally, the research programme grants, investigator grants and research project grants also recruit PhD students and postdoctoral fellows from abroad. Based on Foundation grants, more than 500 PhD students and postdoctoral fellows and approximately 200 professors at different seniority levels funded by Foundation grants in the period 2016-2020 have been recruited from abroad.

2.2 PhD students and postdoctoral fellows

The number of current PhD students and postdoctoral fellows fully or partly funded by Foundation grants has grown to more than 2,200 in 2020. The number has almost tripled since 2016. Figure 2.2 shows a steady increase of PhD students and postdoctoral fellows funded by the Novo Nordisk Foundation research centres, projects and programme grants, fellowship grants, as well as the Steno Diabetes Centers and the Danish Diabetes Academy.

Figure 2.2

PhD students and postdoctoral fellows supported by Foundation grants, 2016–2020



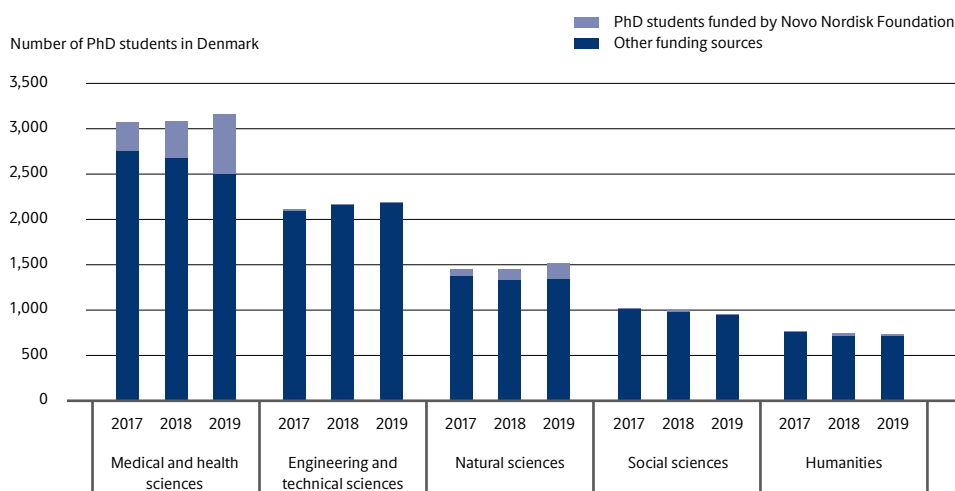
Sources: Novo Nordisk Foundation/researchfish*/impact-of-science.

The Foundation supports research education through a variety of grant instruments, including fellowships at research centres, PhD academies and programmes, and team member-funding of PhD students and postdoctoral fellows through investigator grants and research projects. Further, the Foundation has also occasionally supported individual PhD projects.

Divided on field of science, Figure 2.3 shows the share of PhD students funded by the Foundation and by other sources in the period 2017–2019. During this period, the fraction of PhD students fully or partly supported by the Foundation has increased from 5% in 2017 to 10% in 2019. The increase was particularly fueled by an increase in the number of PhD students within medical and health sciences. Of 3,156 PhD medical and health science students in 2019, 639 or 20% were supported by the Foundation compared to 322 or 10% in 2017.

Figure 2.3

Number of active PhD students in Denmark and active Foundation-funded PhD students within fields of science between 2017–2019



Sources: Novo Nordisk Foundation/researchfish*, Statistics Denmark: www.statbank.dk.

Within humanities, the Foundation supports PhD students within art history research and practice-based research in art and curating. The Foundation supports all PhD students in Denmark (100%) within the field of practice-based research in art. Also, the Foundation supports PhD students through cross-disciplinary research programmes, including the research programme on the socioeconomic impact of sciences and the interdisciplinary synergy programme.

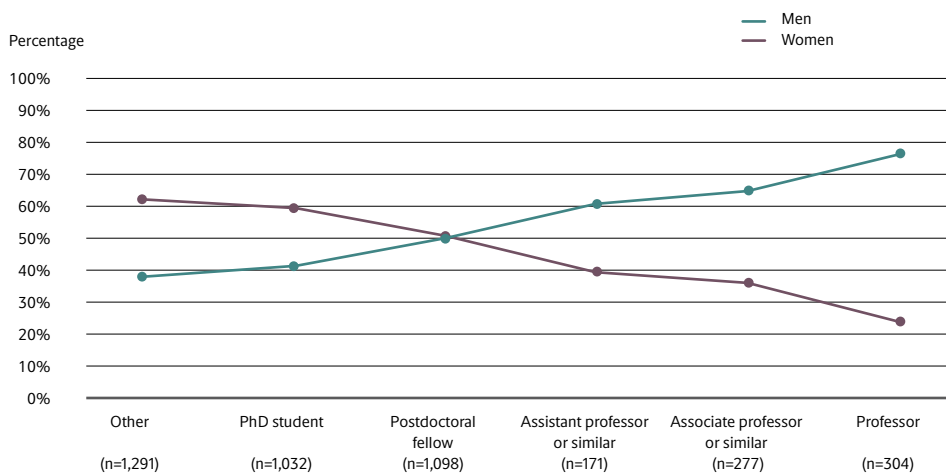


2.3 Gender distribution among researchers supported by the Foundation

Figure 2.4 shows the gender distribution for people in science who were fully or partly funded by the Foundation's grants. In 2020, 52% were men and 48% were women. Compared to 2019, the gender gap has narrowed. In 2019, 56% were men and 44% were women. The proportion of women at the lower seniority levels exceeded 60% but gradually falls as seniority increases, reaching 24% at the professor level. This reflects the situation at the universities in Denmark. The Foundation has adopted a diversity policy that aims to support diversity among grant recipients and to ensure equal opportunities and treatment for all applicants.

Figure 2.4

Gender distribution for people in science supported fully or partly by the Foundation in 2020



Note: The data includes approximately 80% of people partly or fully supported. The remaining 20% was not possible to analyse for gender.

Sources: Novo Nordisk Foundation/Impact-of-Science.

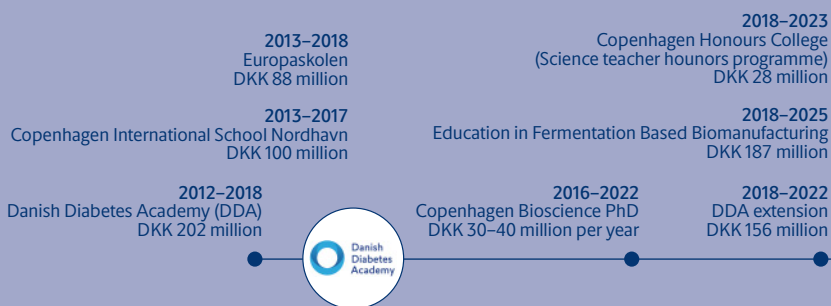
3. Investing in infrastructure

High quality research thrives and high-quality healthcare and education are delivered when researchers, doctors, nurses, healthcare professionals, and teachers have access to high quality infrastructure, including effective organizations, access to the right people, and modern equipment and technologies. Such conditions for success make up infrastructure and are part of a virtuous cycle: high quality infrastructure attracts talented researchers and healthcare professionals providing attractive possibilities and stability. This section shows the many different types of infrastructure initiatives supported by the Novo Nordisk Foundation.

3.1 The Foundation's main infrastructure initiatives

Since 2007, the Novo Nordisk Foundation has continuously funded a wealth of larger initiatives designed to facilitate advancements in education, research, innovation, and healthcare for the benefit of society. In 2007–2020, the Foundation has awarded DKK 18.5 billion (€2.5 billion) to infrastructure initiatives. Figure 3.1 gives a comprehensive overview of major initiatives directed towards STEM education, the health sector and the public research community.

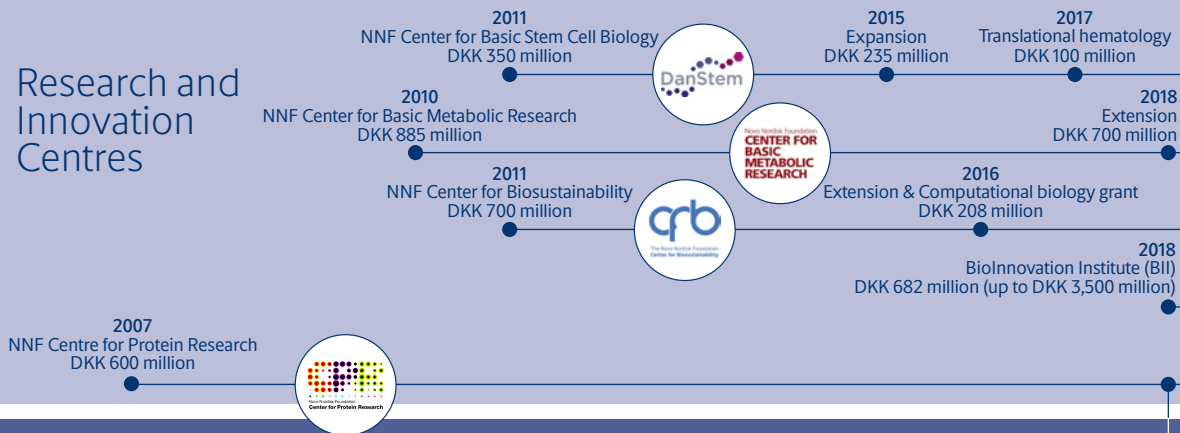
Education



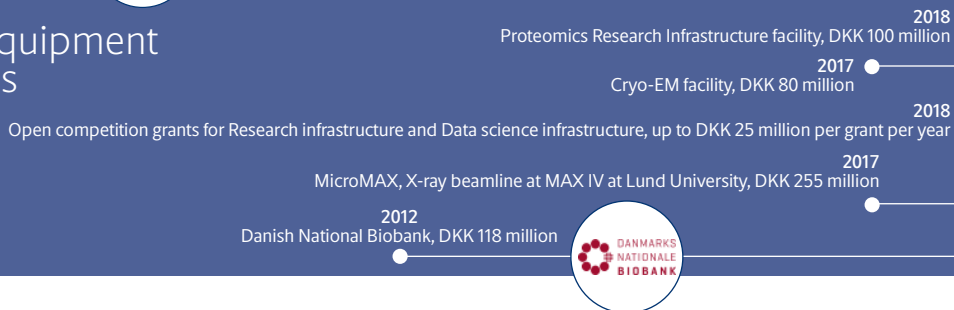
The health sector



Research and Innovation Centres

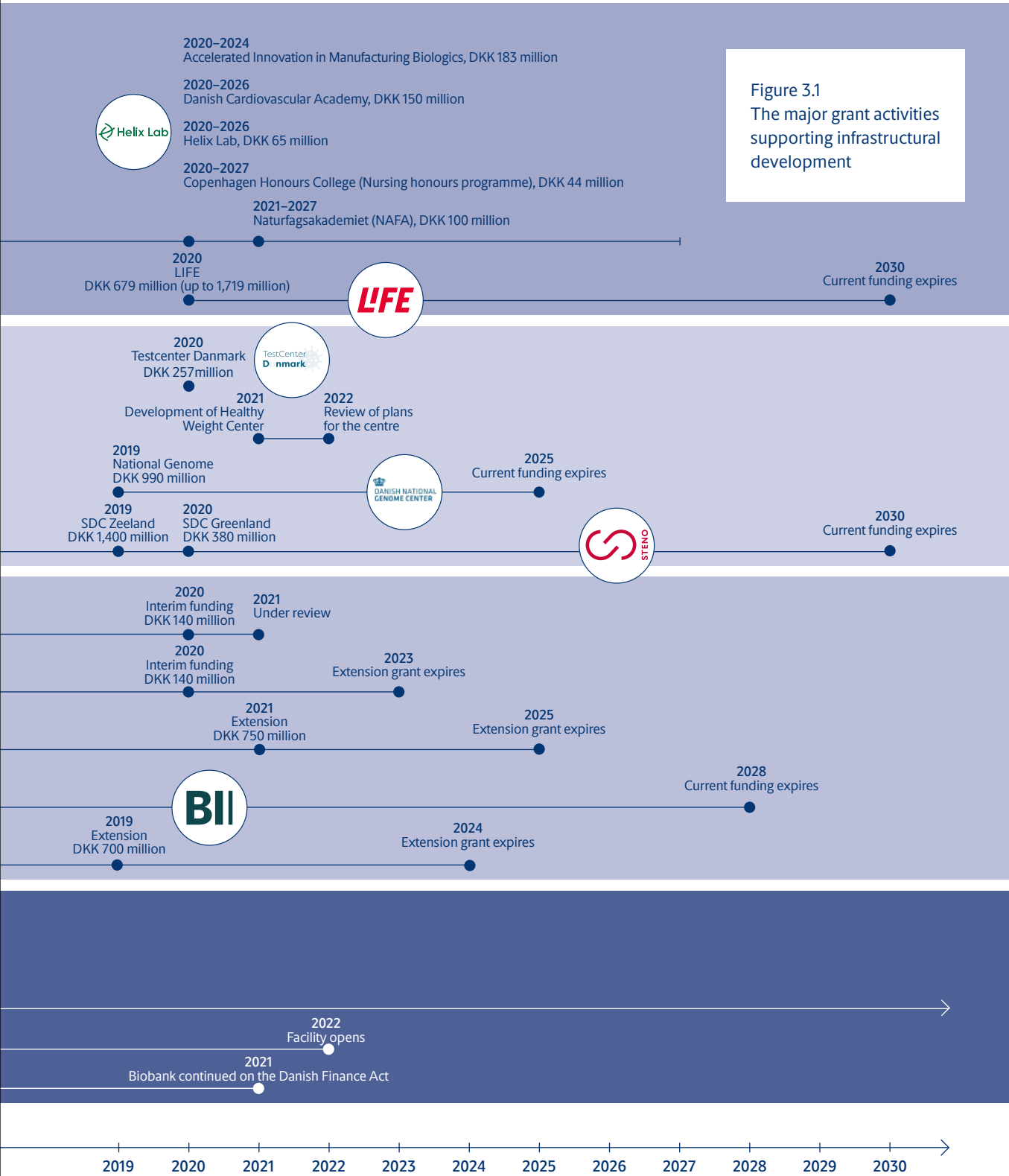


Research equipment and facilities



2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Figure 3.1
The major grant activities supporting infrastructural development



Source: Novo Nordisk Foundation.

3.2 Infrastructure support for education

This section focuses on the Foundation's education-centred grants. Figure 3.2 provides an overview of our education infrastructure grants and shows selected results.

The Foundation sees education as a critical factor at all stages of life and supports the education system in many ways, from pre-school to life-long learning programmes. The Foundation's biggest single initiative is the LIFE Foundation, which works to stimulate STEM curiosity in children from pre-school to youth education. To improve the quality of science teaching the Foundation supports a selective bachelor's honours programme for new science teachers ("Copenhagen Honors College for Science Teachers") and a professional development programme, Naturfagsakademiet ("The Natural Science Academy"), for natural science teachers both at university colleges and in primary schools.

The Foundation also supports the education of professionals in the healthcare sector, specialists in industry, and public researchers. The Copenhagen Honours College for Nurses initiative offers an honours degree specializing in elderly care for talented nursing students. Apart from nurturing talent, this programme also aims to increase the prestige in specializing in healthcare for the elderly.

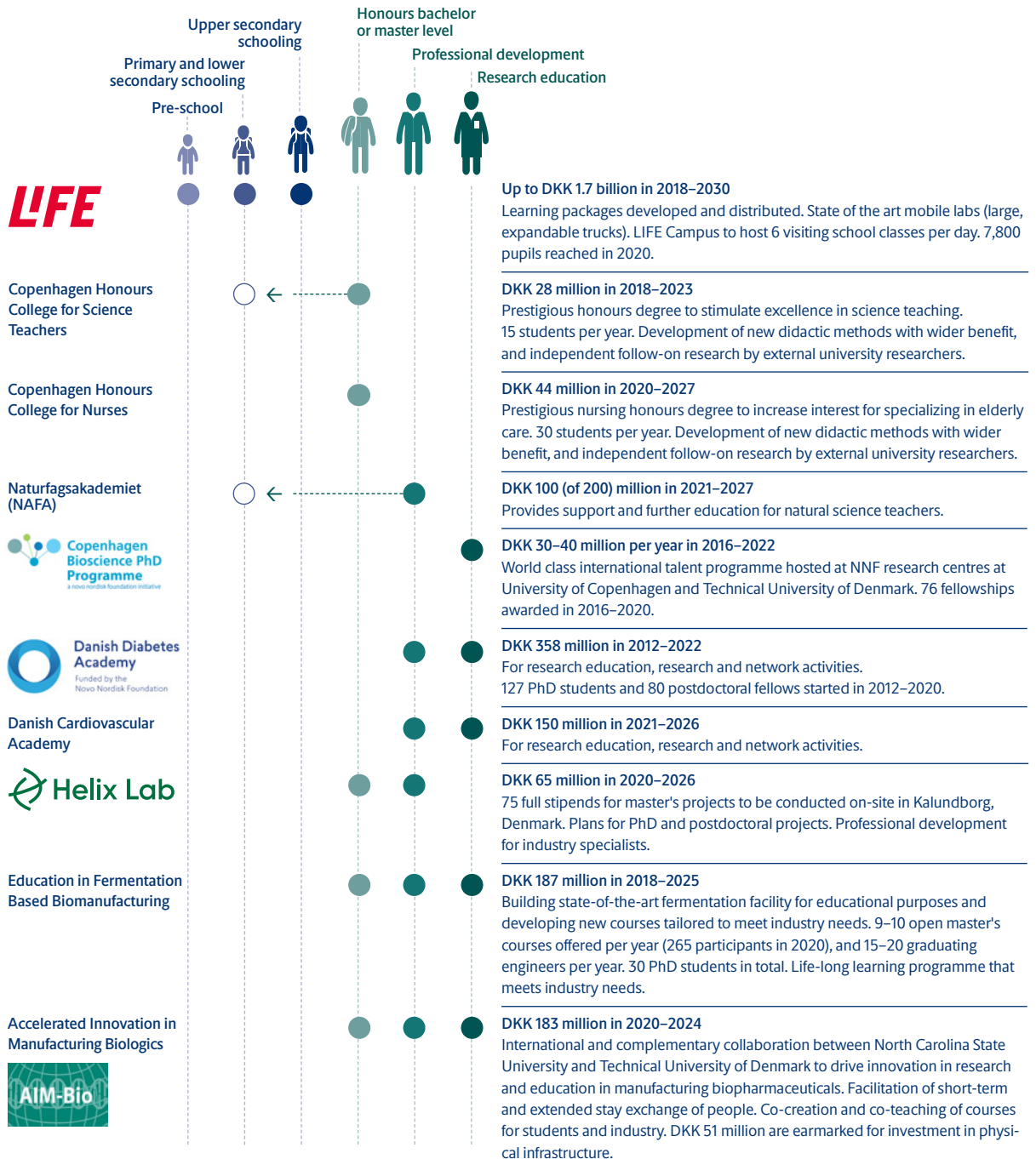
The Foundation supports specialist educational programmes at the earliest stages of a researcher's career such as the Danish Diabetes Academy, the Cardiovascular Disease Academy, the Danish Data Science Academy and the Copenhagen Bioscience PhD programme.

The Foundation has also invested in the following three higher education-centred programmes in biomanufacturing:

- The Helix Lab situated in the bioindustrial cluster in the proximity of Kalundborg offers collaborative opportunities between public research institutions and local biomanufacturing companies. In 2022–2026, this will include full stipends for Danish and international master's students to work in the Helix Lab.
- The Education in Fermentation Based Biomanufacturing initiative at the Technical University of Denmark offers research-based expert education at Masters-, PhD-, and professional level. Students will have access to a state-of-the art facility prioritized for education.
- The AIM-Bio (Accelerating Innovation in Manufacturing Biologics) project is an international and complementary collaboration between two global frontrunners in biotechnological research, North Carolina State University and Technical University of Denmark. A central element is the exchange of courses and people ranging from students to faculty.

Figure 3.2

Infrastructure support for education distributed across target groups or gateways to target groups



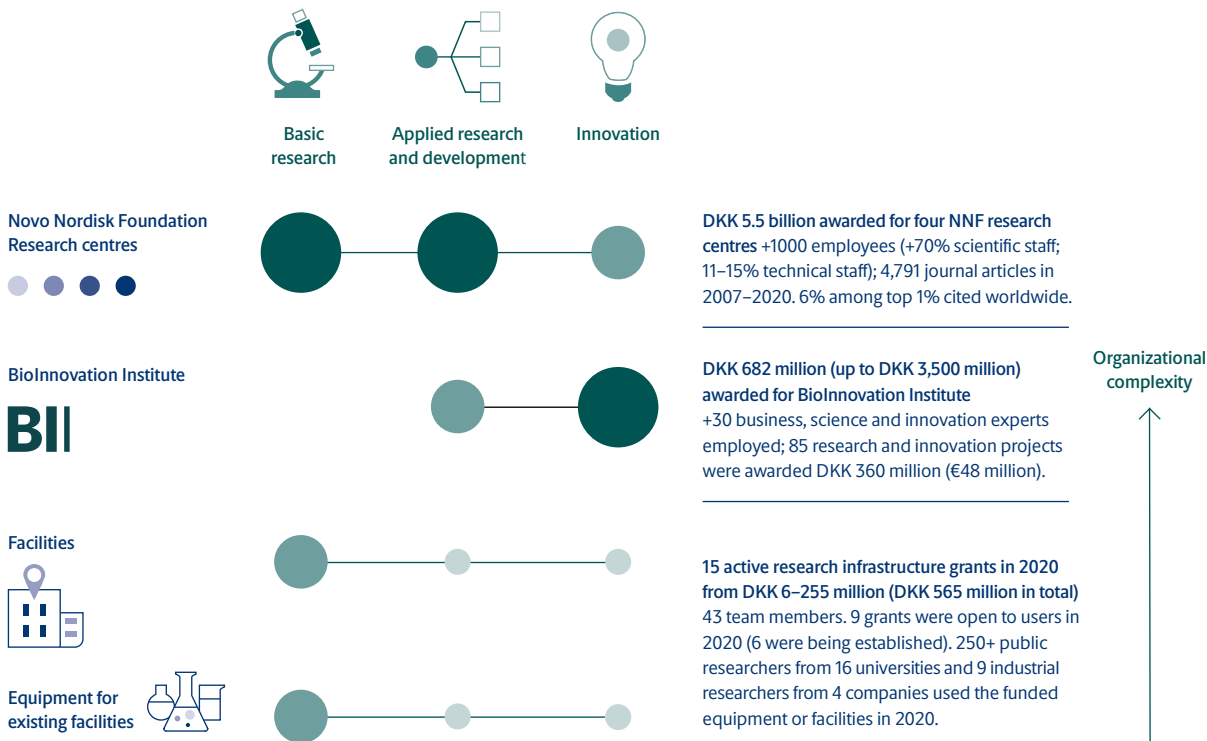
Sources: Novo Nordisk Foundation/researchfish*/FoundGood/Impact-of-Science and grant recipients

3.3 Research and innovation infrastructure

To support Danish research and innovation, the Foundation has supported research centres, the BioInnovation Institute (BII Foundation), and research equipment and facilities (Figure 3.3).

The first research centre was the NNF Centre for Protein Research established in 2007. This was followed by NNF Center for Stem Cell Research (2010), NNF Center for Basic Metabolic Research (2010), and NNF Center for Biosustainability (2012), comprising a total investment of DKK 5.5 billion in core funding for all four centres from 2007–2025.

Figure 3.3 Research infrastructure and focal areas of support



Source: Novo Nordisk Foundation/researchfish*/Infrastructure Reporting/Impact-of-Science.

In addition to establishing the four research centres, the Foundation has also supported facilities embedded in other organizations in the Copenhagen Bioscience Cluster: the Danish National Biobank at Statens Serum Institut, the Cryo-EM and the Proteomics Research Infrastructure at University of Copenhagen, and MicroMax at the large scale facility Max IV in Lund, Sweden. These facilities make up more than DKK 500 million in total grants. The Foundation also has an open competition programme for research infrastructure grants that awards six grants of up to DKK 25 million each for purchasing and installing state-of-the-art equipment, labs, biobanks etc.

BII Foundation was established in 2018 with the aim of creating innovative solutions which can be commercialized in the Nordic countries. BII Foundation became an independent foundation in December 2020.

3.4 Health sector infrastructure

Since 2016, the Foundation has awarded DKK 8.6 billion to Danish healthcare infrastructure. Figure 3.4 shows the results in 2020 from these public-private partnership initiatives.

TestCenter Denmark was established in first half of 2020 to meet the need for national testing arising from the global threat of COVID-19, illustrating the Foundation's ability to react rapidly and provide its support to urgent national needs. It has already had an impact on public health by providing free and timely access to COVID-19 testing for the general population.

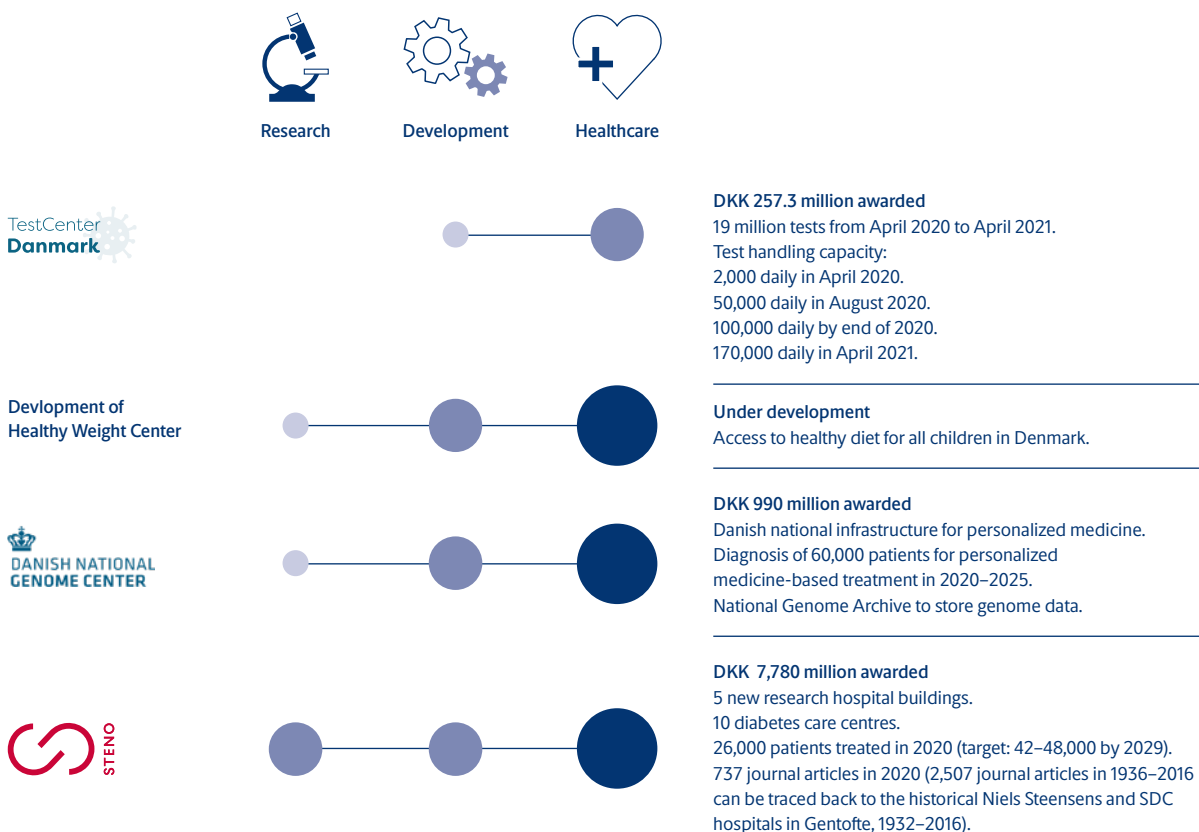
The Foundation's support to establishment of TestCenter Denmark and Novo Nordisk A/S contribution by lending its expertise on developing and scaling tests, reporting and test infrastructure had a swift impact on the nationwide test capacity. From April 2020 to August 2020, TestCenter Denmark increased its capacity from 2,000 per day to 50,000 per day, and by April 2021 to 170,000. Nineteen million tests have been performed from April 2020 to April 2021.

The five new regional Steno Diabetes Centers in Denmark were inaugurated between 2017–2019 with the building of five research hospitals. The Steno Diabetes Center in Greenland were supported in 2020 with DKK 382 million to strengthen the initiatives throughout Greenland over the next 10 years. Of the DKK 7.4 billion in total funding provided until 2030, DKK 2.25 billion are earmarked for buildings. The initiative will contribute to ensuring equal access to world-class diabetes treatment all across Denmark. 26,000 patients were treated in 2020. The centres also perform research, engage target groups and families, and teach professionals to deliver the best diabetes care.

Understanding and responding to how genetic variations in people affect effective treatment makes genome-based diagnosis a gateway to personalized medicine. The Foundation supports the scale-up of whole genome sequencing in Denmark. DKK 990 million has been awarded to The National Genome Center under the Ministry of Health. It was inaugurated in 2020. The ambition is to whole-genome sequence 60,000 human samples over a period of 4½ years. The sequenced genome data will be provided to clinicians via an interpretation platform, including a Personalized Medicine Knowledge Base to organize and distribute knowledge, to help clinicians with diagnosis and treatment decisions.

As well as working to improve diabetes treatment, the Foundation is keen to reduce the incidence of the disease. A major contributor to diabetes is obesity, which also results in cardiovascular and other lifestyle diseases. The continuing increase in obesity in the world population is a major challenge to public health and national healthcare budgets. The correlation of adult and childhood obesity, alongside other research, suggests that the origins of obesity are to be found early in childhood. This has led the Foundation to sponsor the development of a Healthy Weight Center understand and combat the early stages of obesity among children in Denmark. The aim is to provide children with the tools and opportunities necessary to maintain a healthy weight. Solving this complex task requires an investment in resources to work with families and follow their experience of child obesity to learn what works and what does not work.

Figure 3.4 Public-Private Partnership grants for healthcare in Denmark



Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science.

4. Supporting research collaboration

This section details the collaborative nature of the research supported by the Foundation. Collaboration transcends national borders and can involve both public and private researchers and collaboration between disciplines (interdisciplinary collaboration). Our data shows that researchers supported by the Foundation consistently have more international collaboration and more industry collaboration than other researchers in Denmark. In addition to this, the share of interdisciplinary co-authorship in Foundation-funded articles is high.

4.1 National and international collaboration in academia

The share of Foundation-funded journal articles which have been co-authored with international researchers is 69% for the period 2016–2020. In comparison, the share of international co-authorship among all Danish articles published between 2015 and 2018 (latest year with data available) was 59% (www.leidenranking.com). The 69% share of Foundation-funded articles with international co-authorship is also higher than what was reported for the period 2014–2017, which was 61%. Going further back, the share was approximately 50% for the period 2007–2012.

Table 4.1 Number of Foundation-funded journal articles with co-authorships, 2016–2020

Academic co-authorship	Number of journal articles	% of journal articles
With international research institutions	7,249	69%
With other national research institutions	3,208	31%
Total	10,457	100%
Co-authorship with industry	1,157	11%

Note: The articles categorized as 'co-authored' in Dimensions include: 1) articles co-authored with researchers from two or more national academic research institutions only, and 2) articles co-authored with researchers from international, academic research institutions.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science, Digital Science Dimensions and DAMVAD Analytics.

4.2 Research collaboration with industry

Collaboration across national boundaries is often seen as a measure of success in research publication. Similarly, co-authorship between academic researchers and those based in industry points towards collaborations that may move new knowledge into commercial application. Of the Foundation-supported journal articles published by grant recipients between 2016 and 2020, 11% (1,157 articles) were co-authored with industrial researchers. Table 4.2 breaks down the fields of research for these articles co-authored by Foundation-supported researchers and industry: 57% of these articles concerned medical and health sciences, while 33% were in the biological sciences.

Table 4.2 Distribution of Foundation-funded journal articles by field of research for all journal articles and for journal articles co-authored by industrial researchers, 2016–2020

Field of research	Share of all journal articles	Share of journal articles co-authored with industrial researchers
Medical and Health Sciences	58%	57%
Biological Sciences	32%	33%
Chemical Sciences	3%	2%
Engineering & Technology (jointly)	2%	2%
Other fields of research	5%	6%

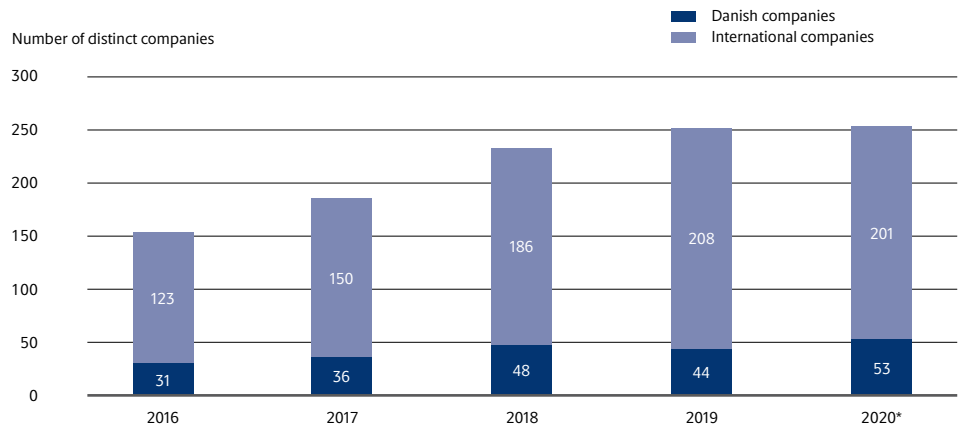
Note: Digital Science Dimensions classifies articles according to field of research (based on the Australian and New Zealand Standard Research Classification (ANZSRC) and is widely compatible with OECD Field of Science at the two-digit level). Multiple classifications per article can occur – multiply classified articles are fractionally counted, so totals add to 100%.

Sources: Novo Nordisk Foundation/Impact-of-Science, Digital Science Dimensions and DAMVAD Analytics 2020.

The number of journal articles co-published with industrial researchers has increased from 2016 to 2020. Similarly, the number of different companies co-publishing with grant recipients has also increased from 152 in 2016 to 254 in 2020 (Figure 4.1). Figure 4.2 shows that this growth has largely come through co-publication with international companies. The majority (80%) of companies are international and the distribution remains largely the same between 2016 and 2020.

Figure 4.1

Number of companies contributing to the Foundation-funded journal articles.

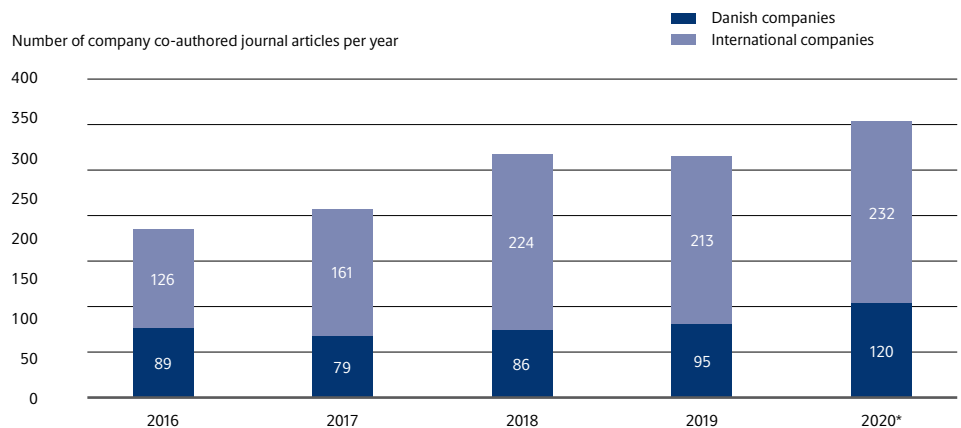


Note: *) Preliminary estimate. The actual figure is likely to be higher, since every year in January grant recipients also report publications, they have previously omitted.

Sources: Novo Nordisk Foundation/Impact-of-Science and DAMVAD Analytics.

Figure 4.2

Number of journal articles co-authored with company-affiliated researchers distributed by origin of the company.

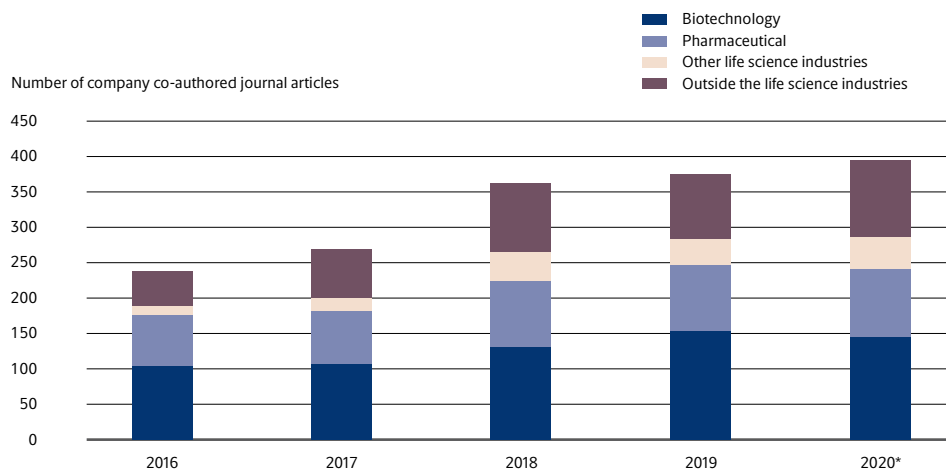


Note: *) Preliminary estimate. The actual figure is likely to be higher, since every year in January grant recipients also report publications, they have previously omitted.

Sources: Novo Nordisk Foundation/Impact-of-Science and DAMVAD Analytics.

Figure 4.3 shows the distribution of the Foundation-funded, company co-authored journal articles across industry sectors. In 2020, the share of articles co-authored with researchers from the life science industry was 73%. Half of the life science industry-academia articles was co-authored with industry researchers from biotechnology companies and one third from pharmaceutical companies.

Figure 4.3 Number of company co-authored journal articles



Note: *) Preliminary estimate. The actual figure is likely to be higher, since every year in January grant recipients also report publications, they have previously omitted.

Sources: Novo Nordisk Foundation and DAMVAD Analytics.

4.3 Interdisciplinary collaboration on journal articles

Similar to international collaboration and collaboration with industry, collaboration between disciplines is often valuable. By examining co-authors' background, journal articles can be classified as monodisciplinary or interdisciplinary. Interdisciplinary collaboration can be between relatively closely related disciplines or across a wider spectrum of science. The two levels of interdisciplinarity used here are based on 1) the researchers finely grained academic specializations, such as endocrinology, microbiology, genetics, physiology, biotechnology or bioinformatics, and 2) the higher level of OECD fields of science, like medical and health sciences, natural sciences, engineering and technology, or social sciences and humanities.

Across a random sample of 20% of the funded journal articles for each year between 2016 and 2020, 95% have authors from more than one area of academic specialization, and 64% of the articles are published by authors from 2–4 fields of science.

Our analysis of the output from our interdisciplinary grant instruments confirms that they contribute to more interdisciplinary research collaboration: 87% of the journal articles funded by our interdisciplinary research grants are published by authors from 2–4 fields of science, compared to 64% for all types of research grants.

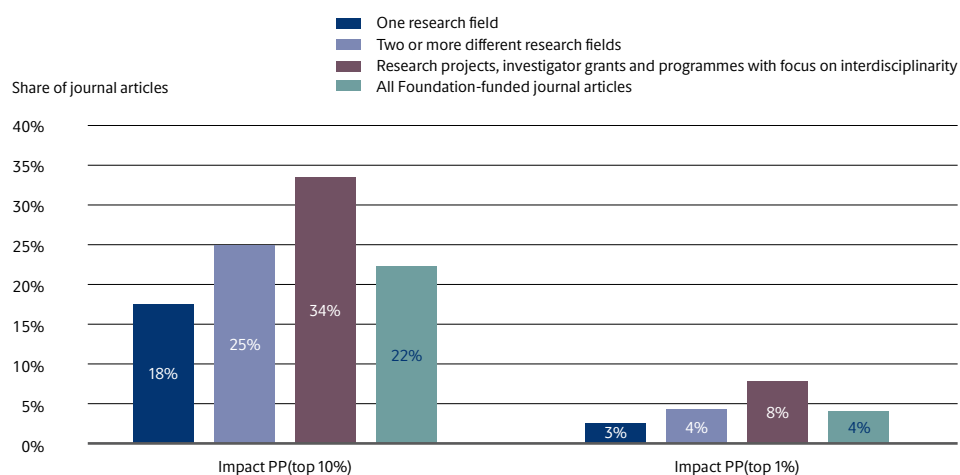
Citation impact of interdisciplinary co-authorship

One indicator for quality of the articles by Foundation-funded researchers is that they are consistently overrepresented in the top 1% and top 10% most cited publications (as detailed in Chapter 5, section 3). The scientific literature (e.g. Lin Zhang, et al, *On the relationship between interdisciplinarity and impact: Distinct effects on academic and broader impact, Research Evaluation, 2021*) suggests that a greater diversity of disciplines involved in a research project, and by extension in an article, increases the likelihood of it achieving novel research findings and being highly cited research.

Looking at Foundation-funded journal articles confirms that articles with authors from more than one research field are likely to be more highly cited, although all subsets of publications from Foundation-funded researchers are overrepresented in the proportion of publications within top 1% (PP(top1%)) and top 10% (PP(top10%)) most cited journal articles (Figure 4.4). Journal articles co-authored within two or more different research fields have a higher probability (4% and 25% respectively) of being among the top 1% or 10% most cited. And finally, for journal articles published in conjunction with research projects, investigator grants and programmes with focus on interdisciplinarity, the results confirm the hypothesis that a higher degree of interdisciplinarity gives a higher probability of producing articles that are among the most cited in their field. Figure 4.4 shows a PP(top 1%) and PP(top 10%) of 8% and 34%, respectively.

Figure 4.4

Share of journal articles in top 1% and 10% of most frequently cited journal articles in the world, 2016–2019, by number of fields of science and for all Foundation-funded articles



Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science, Incites/Clarivate Analytics and DAMVAD Analytics.

5. Promoting excellent research

This section reports on the quantity and quality of research supported by the Foundation. It demonstrates that researchers consistently produce high quality research – even as the breadth and scale of the research supported continues to grow.

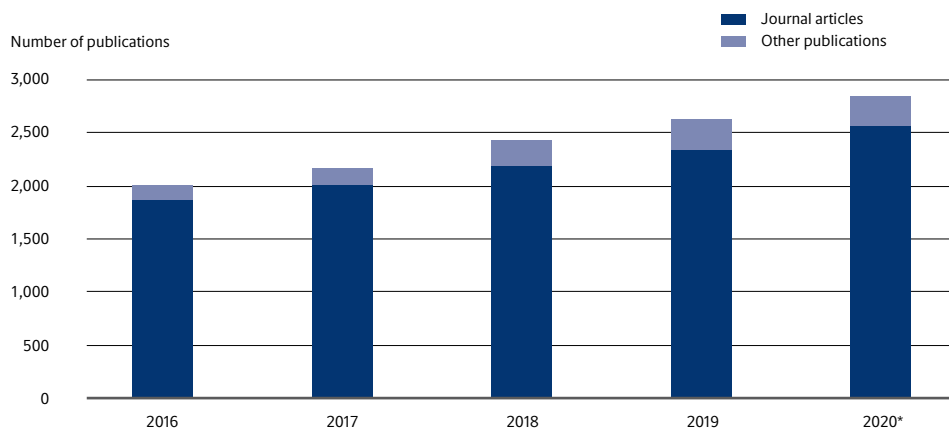
5.1 Foundation-funded research published in journal articles

In 2020, grant recipients published 2,841 publications supported by the Foundation's funding of which 2,559 were journal articles. Because the recipients of Foundation grants typically obtain additional funding, and multiple authors contribute to a publication, most publications are supported by more than one funder or more than one funding instrument of the Foundation.

In 2016–2020, about 90% of all Foundation-supported publications were journal articles (research articles and reviews) and the remaining 10% were made up of a variety of other publications including policy papers, technical reports, letters, books, and book chapters (Figure 5.1).

Figure 5.1

Total number of publications published by recipients of Foundation grants, 2016–2020



Note: *) Preliminary estimate. The actual figure is likely to be higher, since every year in January grant recipients also report publications they have previously omitted.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Clarivate Analytics/Dimensions.

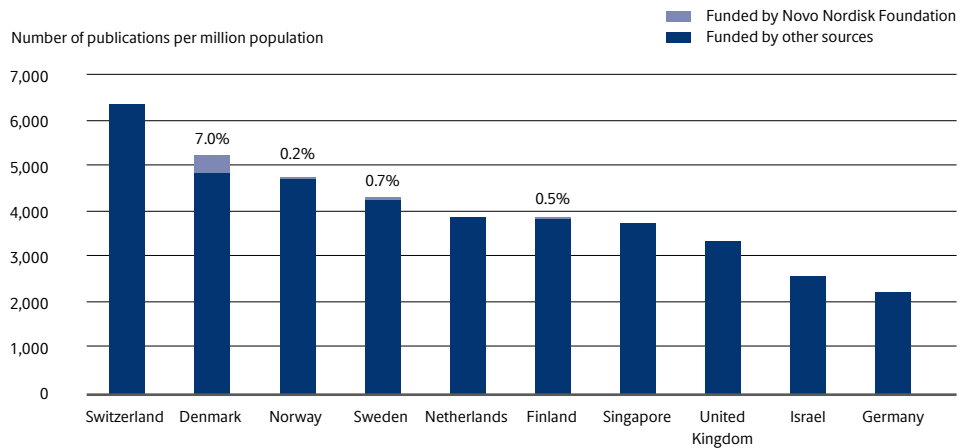


5.2 The contribution of Foundation-funded journal articles across countries

Researchers in Denmark publish more journal articles per million population than researchers in most other countries except in Switzerland (Figure 5.2). Recipients of Foundation grants contributed 7% of this total (346 articles per million population). This is an increase of 0.6 percentage points compared to 2019. With a delay in grantees' reporting, the share is expected to be higher next year.

Figure 5.2

Number of journal articles per million population in selected countries, 2020, and the Foundation-funded share of journal articles in the Nordic countries



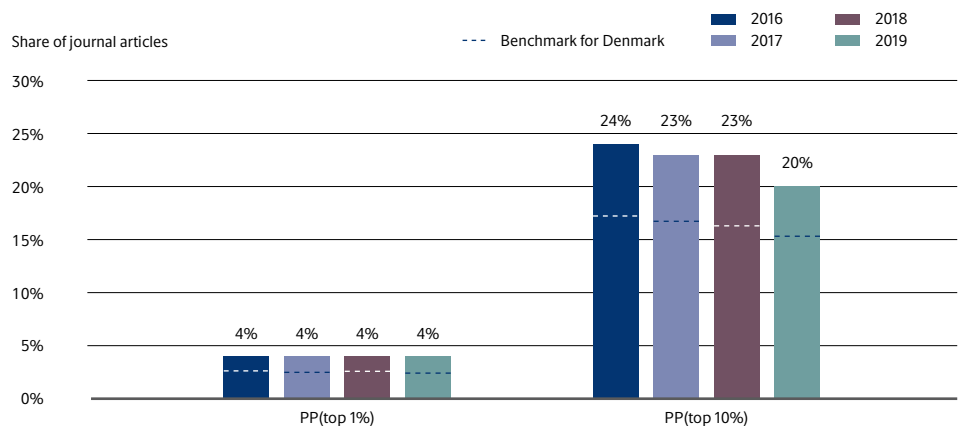
Sources: Novo Nordisk Foundation/Impact-of-Science, US Census Bureau and Clarivate Analytics/Dimensions.

5.3 Overall citation impact of grantees' journal articles

Foundation-funded journal articles have high citation impact, mirroring that knowledge from Foundation-funded research is disseminated and used within academic research. The numbers of journal articles among the world's top 1% and top 10% most cited within their field have increased substantially in recent years. Tracking the share of Foundation-funded journal articles among the 1% and 10% most frequently cited journal articles illustrates that while an increasing number of articles has been produced over the years, Foundation-funded research maintains a steady fraction (4%) of the top 1% of global research, and 21% of the journal articles (1,313 articles) are among the top 10% most frequently cited in 2018–2019. For comparison, the overall Danish citation impact is about five percentage points lower, corresponding to 16% for the same period.

Figure 5.3

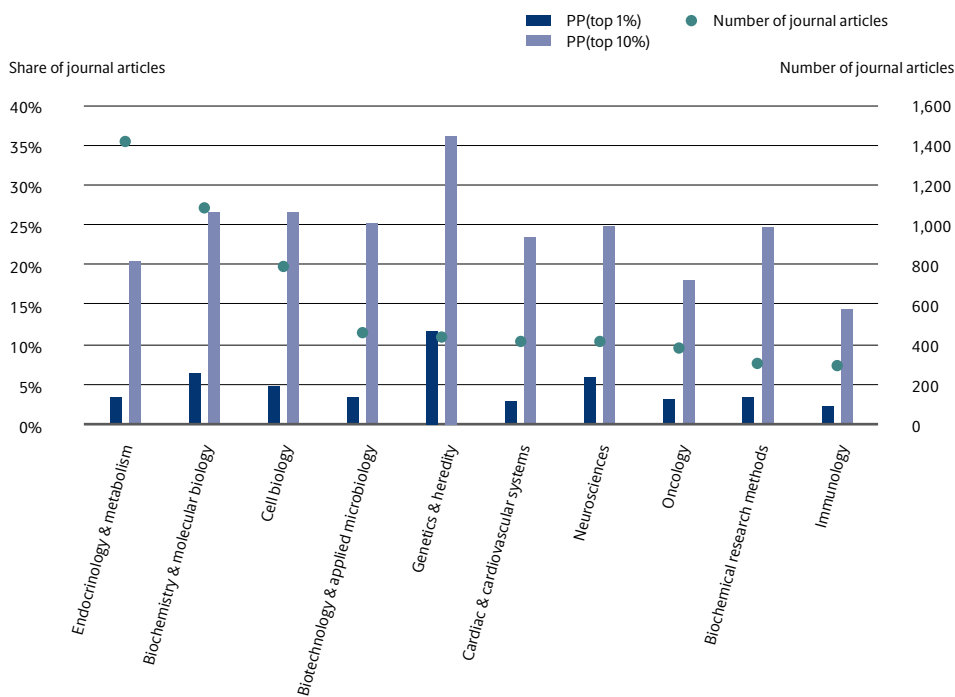
Share of journal articles by Foundation grant recipients among the top 1% and 10% most frequently cited journal articles in the world, 2016–2019.



Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Incites/Clarivate Analytics/Dimensions.

More than half of the Foundation-funded journal articles are in medical and health sciences. Figure 5.4 shows the distribution of articles published 2016–2019 across the sub-fields Web of Science categories of medical and health sciences. The dots show the volume of publications, illustrating that most journal articles are published within endocrinology and metabolism (1,410 articles). The bars show that the endocrinology and metabolism articles have a citation impact score of 2.1 times the world average within this field, while the area genetics & heredity has the highest citation impact score, with 3.6 times the world average within this field. The figure shows the 10 fields in which the Foundation funds the most research and in all fields the research has above average citation impact.

Figure 5.4 The number of journal articles and citation impact for the 10 journal subject categories in which the largest amount of Foundation-funded research is published, 2016–2019



Note: The 10 most frequently used Web of Science subject categories are sorted according to the number of Foundation-funded articles, descending from the left to the right. An article may count in more than one subject category.

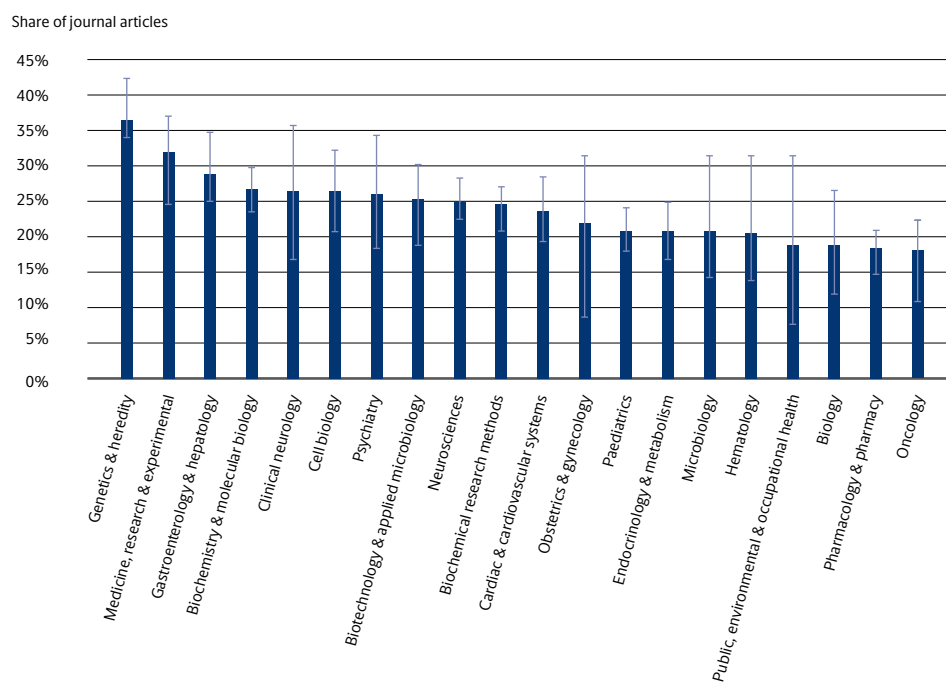
Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Clarivate Analytics/Incites.

Looking beyond the 10 core fields, Foundation-funded research continues to outperform global research. Figure 5.5 shows the fraction of Foundation-funded research in the top 10% globally across the 20 areas most strongly represented in the Foundation's portfolio. The error bars show the variation from year to year in the fraction of research in the top 10%, illustrating that nearly all areas are as consistently strong.

In the period 2016–2019, the share of Foundation-funded journal articles in the research area Endocrinology & Metabolism was 13%, compared to a share of 18% in the period 2013–2017. This shows the broadening of the scope of the support for research of the Foundation. Payouts have increased six-fold since 2013, but the volume of Foundation-funded journal articles within Endocrinology & Metabolism remains unaffected, and for all subject categories, even though some variation in citation impact occurs in the years 2016–2019, citation impact remains relatively stable and high.

Figure 5.5

Citation impact for the 20 journal subject categories in which the largest amount of Foundation-funded research is published, showing percentage of articles in top 10% most frequently cited in the world – PP(top 10%), 2016–2019, with maximum and minimum deviation in PP(top 10% for the period

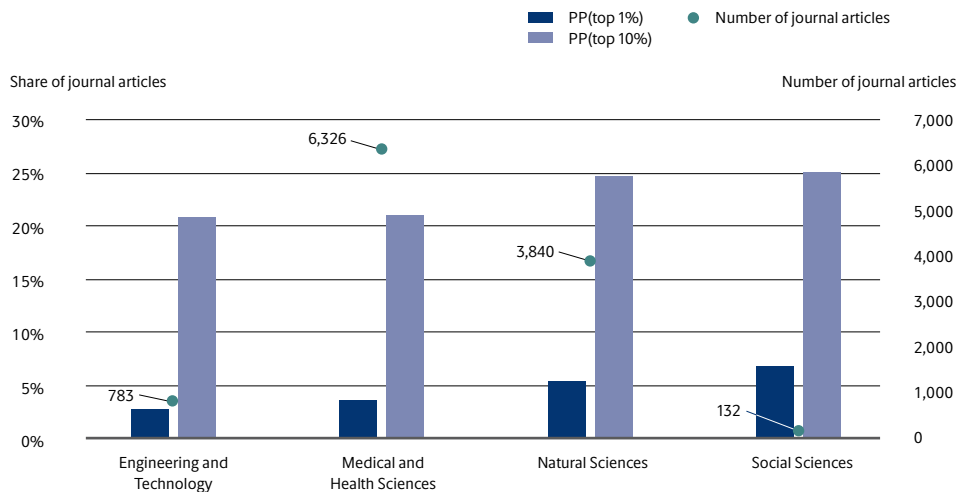


Note: The 20 most frequently used Web of Science subject categories are sorted according to PP(Top 10%), descending from the left to the right. Only includes areas with a total of 100 or more publications in the period. A publication may count in more than one category.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Clarivate Analytics/Incites.

More than half the Foundation-funded journal articles (57%) refer to the medical and health sciences. 35% of the journal articles are within natural sciences and 7% are within engineering and technology. However, grant recipients deliver high impact research within all supported fields of science (Figure 5.6).

Figure 5.6 Share of publications among the top 10% most frequently cited in the world – PP(top 10%), 2016–2019, and volume of publications, by OECD Field of Science and Technology



Note: Only includes areas with a total of 100 or more publications in the period.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Clarivate Analytics/Incites.

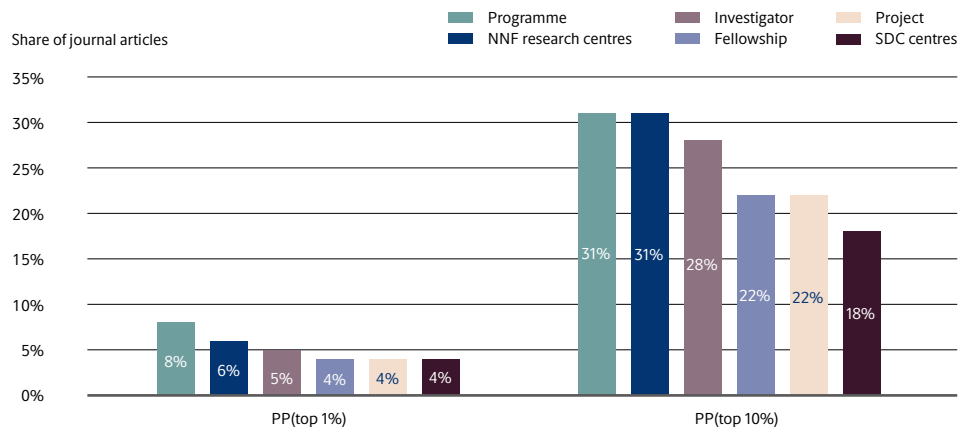
While 90% of the output with STEM fields are journal articles, the majority of the output from the Foundation's grantees within humanities (research in art) are books, book chapters, dissertations and other types of publications which are not registered in Web of Science. The Foundation's grantees within humanities delivered 217 publications in the period 2016–2020.

5.4 Citation impact in grant instruments

This section compares the citation levels of articles supported through different research funding mechanisms of the Foundation. We show that the Foundation's programme grants deliver the highest share of highly cited journal articles. Research centres are second. Fellowship grants are mainly targeted younger researchers (PhD students and postdoctoral fellows). The share of journal articles of fellowship grantees among the world's most cited is four times higher than the world average for top 1% publications and over two times higher for top 10% articles (Figure 5.7).

Figure 5.7

PP(top 10%) by grant instruments for the period 2016–19



Note: Data covers selected research grant instruments of the Foundation. The grant instruments are sorted according to their share of journal articles in PP(top 10%) for 2016–2019, descending from left to right.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science and Clarivate Analytics/Incites.



6 Developing innovative products and solutions

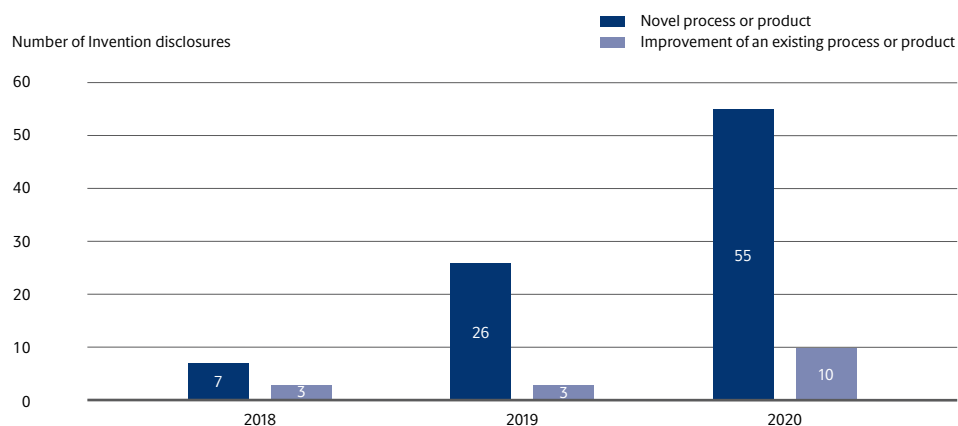
Innovation constitutes a critical bridge in translating scientific discoveries into products and solutions that improve the health of people and the environment. The Foundation supports innovation activities at research institutions through a number of grant instruments. These include research and education grants that lead to innovative solutions, and dedicated innovation grants for commercialization of research discoveries. The Foundation is building a strong innovation ecosystem that promotes scientific discoveries with commercial potential within life science (pharma, MedTech and industrial biotech). Reporting on intellectual property as well as products and interventions from grant recipients of the Foundation grants on medical products and interventions has increased significantly since 2016.

6.1 Scientific discoveries and innovative solutions

Research supported by the Foundation feed into the technological and commercial innovation process. The road to commercialization is complex and often begins with researchers filing an ‘invention disclosure’ based on their new research knowledge at the research institution where they are based. Establishing ownership and commercialization rights for the invention opens up for patent filing, which often is the next step for commercial exploitation.

Figure 6.1

Invention disclosures distributed on processes and products, 2018–2020



Note: Data on invention disclosures has been collected for the first time and cover active grants in 2020. The number of disclosures for 2018 and 2019 may therefore be underreported.

Sources: Novo Nordisk Foundation/researchfish*.

In 2020, recipients of Foundation grants reported 65 invention disclosures, covering novel and improved processes and products (Figure 6.1). In 56 of these instances, the public research institutions have taken ownership of the invention, corresponding to 86% of the disclosures.

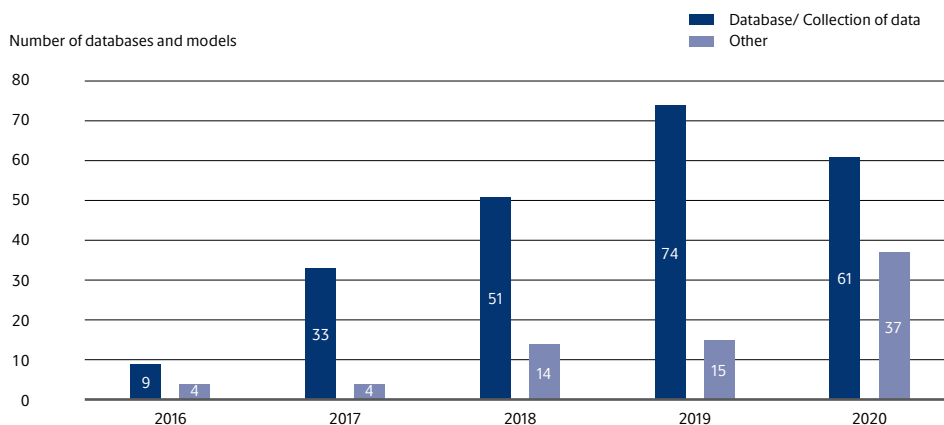
The Foundation grant recipients have reported contributions to many new innovations and discoveries, including medical products and interventions covering development of drugs, medical devices, vaccines, diagnostic tools etc. All in all, 113 medical products and interventions based on Foundation grants have been reported between 2016 and 2020.

Innovation can also contribute to new products more indirectly, by accelerating the process of research and development. This may involve providing knowledge to other researchers, industry and/or members of the public, e.g. through the sharing of research databases or analysis methods. This includes data processing and control systems allowing for data matching, monitoring, modelling, and grid infrastructure. The recipients of grants reported 98 activities in 2020; of which 61 were within the category database and collection of data (Figure 6.2).

The reported databases cover a broad range of subjects and purposes, from an atlas of how immune cells respond in acute COVID-19 to a database on cellular models for testing candidate drugs for the treatment of human tumours. The number of databases and models has grown from 2016 to 2020 and shows a relatively steady increase. This also goes for the group of 'Other', covering e.g. computer models and data analysis techniques (Figure 6.2). Approximately 50% of the research databases and models in 2020 are being shared with other researchers.

Figure 6.2

Research databases and models, 2016–2020



Sources: Novo Nordisk Foundation/researchfish*.

Examples of solutions based on Foundation grants

As described above, research ideas that benefit society can be in the form of direct translations into products or approaches used to benefit patients and the public, or it can be ideas that help to accelerate and improve the research of other scientists, which then results in benefits to patients or the public. This is illustrated in the following two examples that showcase the value of the research findings and their application, as well as highlighting the time it takes to build a successful bridge from research to application.

Tracoline 2.0, 2014–2020

Tracoline 2.0 is a markerless tracking device for accurately measuring patients' head movements while they are undergoing an MRI invented by Oline Vinter Olesen from the Technical University of Denmark. The prototype device has been validated and was developed based on an Exploratory Pre-Seed Grant in 2014 to provide online motion tracking during MRI/PET brain acquisitions.

Tracoline uses infrared light to track the movements of the patient's head without needing 'markers' to be attached to their head – in an approach similar to that used for facial recognition in mobile phones. The software interfaces with MRI scanners and allows real-time motion correction to precisely register the patient's head movements during MRI scanning. Normally any movement will degrade the quality of the MRI images so Tracoline can improve the quality of MRIs, thereby also improving diagnosis and treatment. It also reduces the need to perform rescans and reduces the scan time, leading to lower costs.

The product is currently used mainly at facilities with research MRI scanners and is being commercialized by TraInnovations. The tracker is used worldwide by pilot customers e.g. at Boston Children's Hospital, Massachusetts General Hospital, Karolinska University Hospital, and Rigshospitalet.

The Skinatlas website, 2016–2020

The Skinatlas website provides researchers with a catalogue of the proteins located in healthy skin. The atlas was constructed and is maintained by physician scientist Beatrice Dyring-Andersen from the Novo Nordisk Center for Protein Research at University of Copenhagen. Beatrice's work grew out of her postdoctoral fellowship for studies abroad, granted by the Novo Nordisk Foundation in 2015.

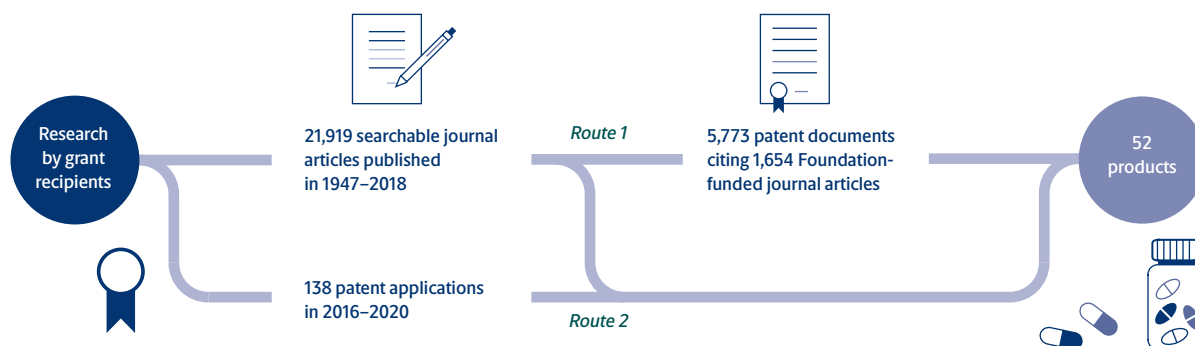
Researchers can search for data on individual proteins and download data including protein profiles including spatial and quantitative data. The website is used by researchers in academia and industry, both as reference material on known proteins and to help characterize the functions of previously unknown proteins. Through collaborative efforts with the Leo Foundation Skin Immunology Research Center and the Department of Dermatology at Gentofte Hospital, the Skinatlas will help accelerate skin research, with the ambition of supporting identification of new treatment targets. Beatrice has received the Foundation's Clinical Emerging Investigator Grant 2021 and will - together with collaborators - develop the Skinatlas to include data from skin diseases, such as psoriasis, eczema, allergies, and other inflammatory skin diseases.

Several researchers from other countries are currently using the data for further research in their respective fields and within days of launching, the atlas had had more than 1000 visitors.

6.2 Patent innovation activities based on Foundation-funded research

The flow of public research-based knowledge to the private sector (i.e. public research spillover), can follow several routes. This section examines public research spillover through patent activities through either 1) patent documents that reference Foundation-funded journal articles (route 1), or 2) the direct link from research conducted by grant recipients who have filed patents (route 2). Figure 6.3 illustrates these two routes.

Figure 6.3 Public research spillover through industry collaboration and patent activities



Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science; Dimensions (Google Big Query); EPO DOCDB.

Patent documents citing Foundation-funded journal articles (route 1)

Of 21,919 publications funded by the Foundation between 1947–2018, 1,654 journal articles, or 6%, are currently cited in patent applications and granted patents (hereafter patent documents). This rate is about three times the world average². As explained below, the rate at which Foundation-funded research will eventually be cited in patent documents is likely to be around 18% due to a time lag in citations.

Examining the identified citations of Foundation-funded research, these 1,654 journal articles are cited in 5,773 distinct patent documents belonging to 2,383 patent families. Using a unique database created by researchers from Ecole Polytech de Lausanne, we can trace 78 patents documents citing Foundation-supported journal articles and patent applications filed by grant recipients to 52 commercial products worldwide. These products are primarily pharmaceutical products, which reflects the Foundations' historical focus on biomedical and health research. However, in the years to come, this picture may change, as the Foundation has increased the breadth of its funding to include, e.g., biotech solutions to sustainable development. The latest priority date, i.e. date of invention, is in 2011, reflecting how long it can take for a biomedical invention to reach product launch.

² This citation rate in patent documents is three times the comparable world average rate (based on a matching stratified sample of 5000 journal articles within the same fields and years; see Societal Impact of Novo Nordisk Foundation Grants 2018).

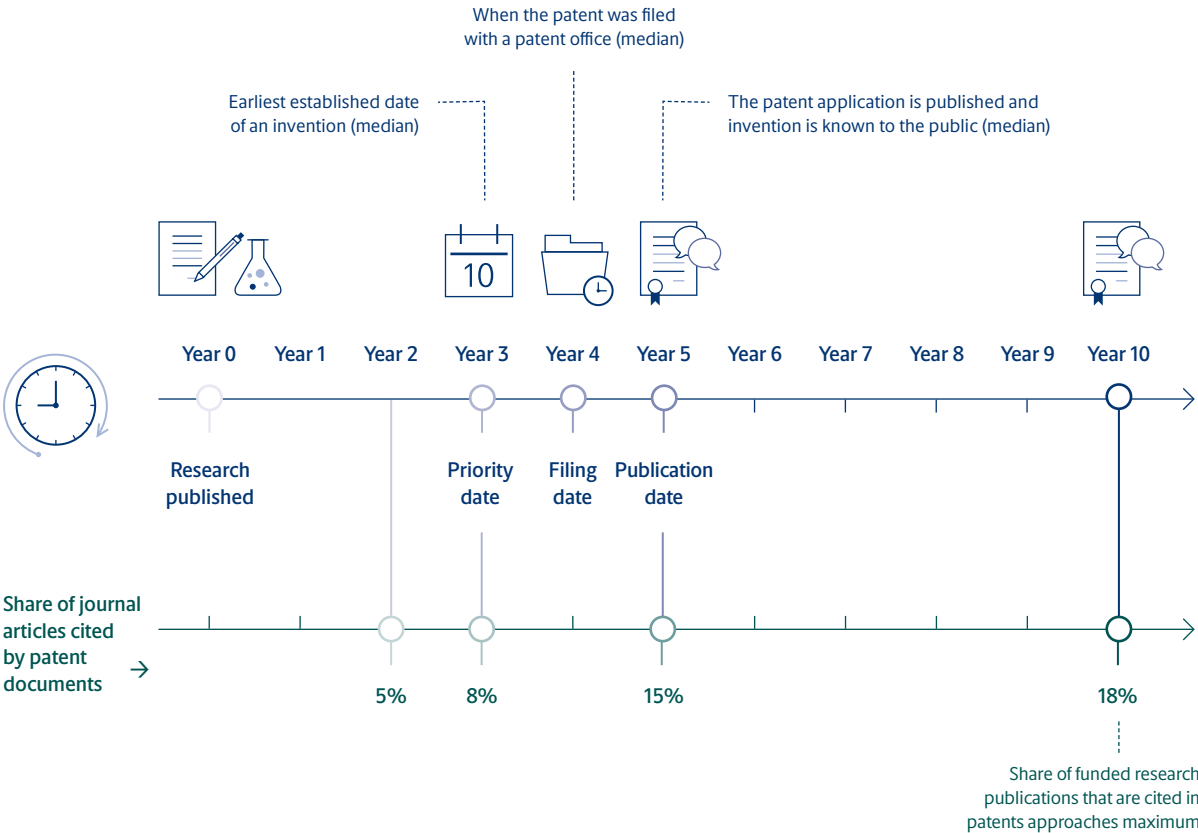
Estimating the full extent of use of published research results in inventions takes several years (route 1)

Measuring the fraction of patent documents that refer to Foundation-supported research takes time because of two types of time lag: First, there is a knowledge absorption time lag, measured as the time between the publication date of a journal article and the priority date of the referencing patent documents, which is about three years. Second, there is also a non-disclosure time lag because patent applications are only published 1½ year after the date of the invention (priority date).

This implies that the median time lag between when an article is published and when its citation by a patent document can be observed is 4½ years for published patent applications and 7½ years for granted patents.

Therefore, articles should be more than 7½ years old to estimate the likely 'final' rate of citation by patent documents. Analysing journal articles that are more than 9 years old we find that at least 18% of all Foundation-funded journal articles are eventually cited in patent documents.

Figure 6.4 Observing patent citations of public Foundation-funded research takes years

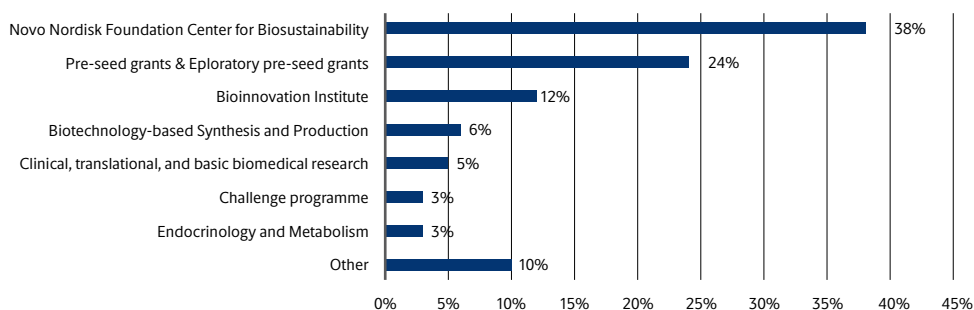


Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science; Dimensions (Google Big Query); EPO DOCDB.

Grant type-distribution of grant recipients that have reported filing for patent as a direct result of their Foundation-funded research (route 2)

For the period 2016–2020, recipients of Foundation grants reported 138 patent applications or patents granted. In 2020 alone, publication or granting of 36 patents was reported. Most of the patenting activity this year was reported by recipients of innovation grants from the Bioinnovation Institute which has been funded by the Novo Nordisk Foundation but was established as an independent foundation with commercial interests in December 2020 (Figure 6.5). Of the 138 distinct patents, 39 are reported as licensed and a further 11 are the subject of discussions with industry.

Figure 6.5 Share of patent applications and granted patents filed by grant recipients, 2016–2020



Note: BioInnovation Institute has offered Proof of Concept since 2019 and Pre-seed since 2020.

Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science.

7. Creating jobs and growth

Investments in research, innovation, education and research hospitals also benefit society through the creation of companies, jobs and economic growth. This section details the direct job effect of Foundation-funded activities, including employment for more than 5,500 people in 2020 and around 700 people who are employed in spinouts based on Foundation grants over the past 15 years.

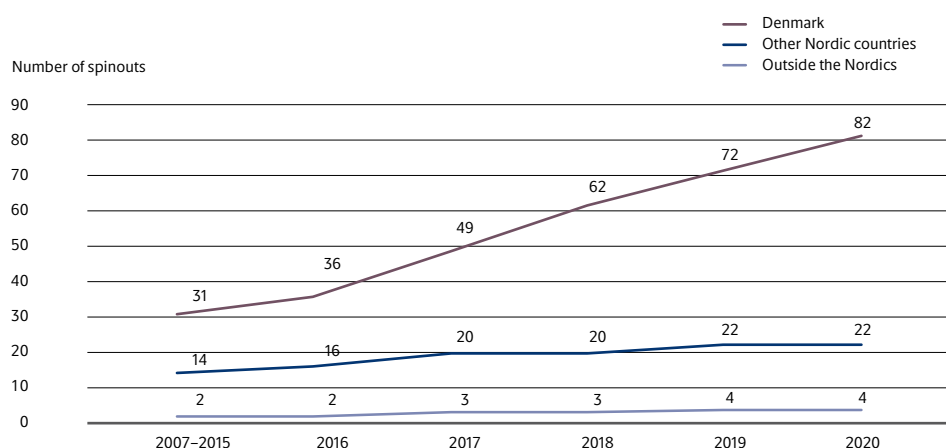
7.1 Spinouts based on Foundation-supported research

When researchers have a new insight, it might be the first step towards a commercial opportunity and possibly form the basis of a new company. Spinouts that are based on innovative solutions by researchers which have received support from the Foundation are generally founded by researchers based in universities or hospitals. The Foundation has supported research discoveries and innovative solutions through innovation grants since 2007, and the support involves mentoring as well as funding of early academic research, proof-of concept grants and commercialisation of research discoveries, follow-on investments and support for exits. The support is provided across the Foundation's innovation initiatives, the Foundation-funded BioInnovation Institute (BII) and Novo Seeds.

The innovation and research grantees have reported establishing 108 spinouts from 2007–2020. In the period 2016–2020, the total is 61 spinouts: 51 have been established in Denmark, eight in the other Nordic countries and two in countries outside the Nordics (Figure 7.1).

Figure 7.1

Total spinouts distributed by year of establishment and location 2016–2020




Source: Novo Nordisk Foundation.

The ability of recipients of Foundation grants to attract additional funding for commercialization is a key market-based indication of the value of their research projects. The spinouts supported since 2007 have attracted more than DKK 7 billion (€1 billion) in grants, loans and investments.

Several existing Nordic flagship companies within the life sciences were supported by the Foundation's grant and seed money in their early stages and developed into mature biotech companies. These include the companies Orphazyme, Galecto Biotech and IO Biotech, which have attracted more than DKK 4.5 billion (€0.6 billion) in total funding (Figure 7.2). In an illustration of the long-term nature of commercialization, all these companies have received their first grant more than six years ago, and two of them more than 10 years ago.

Figure 7.2 Nordic flagship life science companies based on Foundation innovation grants



Company	Orphazyme	Galecto Biotech	IO Biotech
First grant awarded	2009	2010	2014
Founded	2009	2011	2017
Current ownership	Public Markets	Public Markets	Novo Seeds and co-investors
Total funding in DKK	+1.8 billion	+1.6 billion	+1.1 billion

Sources: Novo Nordisk Foundation/Novo Holdings.

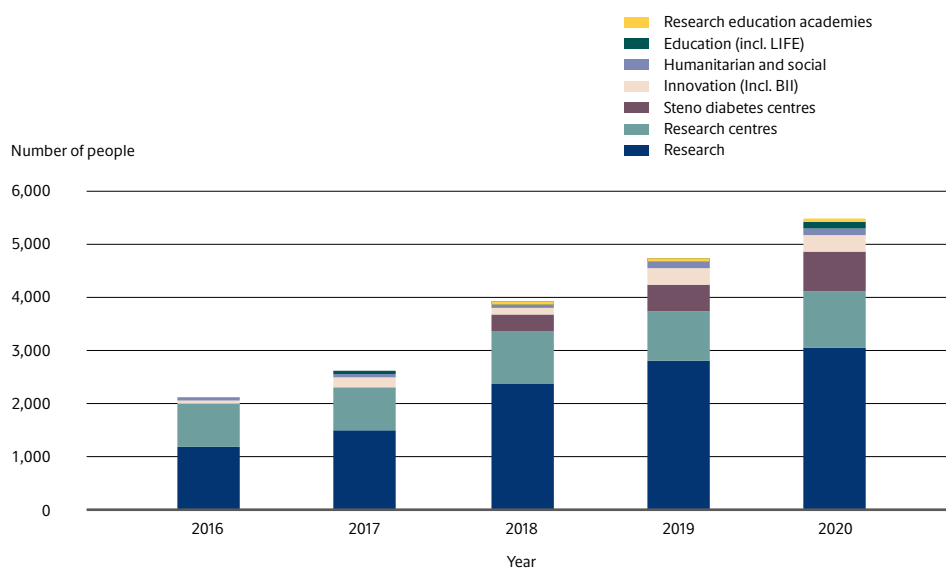
The spinouts based on Foundation grants and loans start as Micro start-ups. By 2020, the spinouts had created around 700 jobs. 84% of the jobs are in Denmark, 13% in the other Nordic countries and 3% in the rest of the world. Average per active spinout is 7.2 jobs.

7.2 Job creation in Foundation grants

The number of jobs in Foundation-funded activities has increased in line with the increase in the Foundation's grant and payout amounts. The number of jobs fully or partly funded by Foundation grants has increased from 2,100 people in 2016 to 5,500 people in 2020. This year, around 4,600 of these jobs were in science, and around 900 were in non-scientific activities such as administration, technical support as well as jobs in relation to grants in the humanitarian and development aid, social activities, and educational sector. (Figure 7.3).

Figure 7.3

Jobs in all Foundation-funded grant-giving activities



Note: Jobs cover grantees, team members as well as staff at centres and institutes.

Sources: Novo Nordisk Foundation/researchfish*.

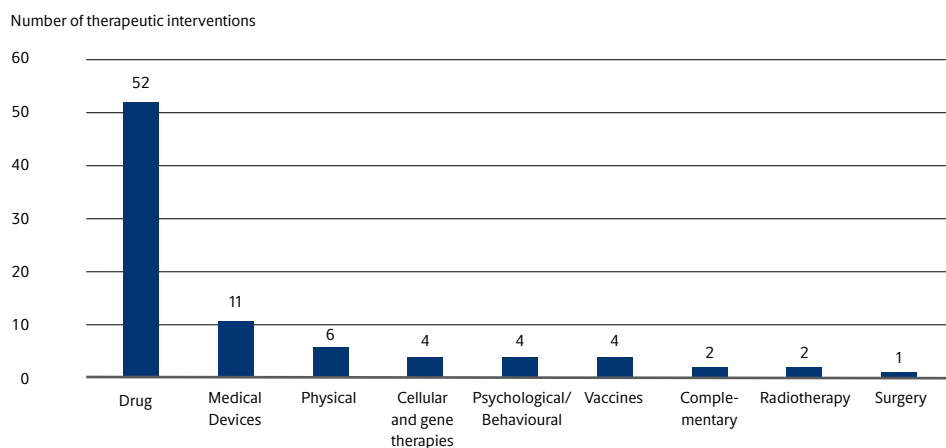
8. Developing healthcare and new medicine

This section presents the medical interventions, treatments for diseases, clinical trials, health interventions, diagnostics, and clinical guidelines that have been developed from Foundation-supported research. Section 7 examined some of these through the innovation and product development, in this section they are examined from a health perspective. Historically, the Foundation has awarded its largest grant amounts in biomedicine and biotechnology as well as research hospital activities within diabetes. This background in biomedicine and biotechnology has led to many types of impacts across the health sector.

8.1 Medical interventions and products based on grants

The Foundation funds researchers who as part of their research invent medical interventions and products. Since 2014, 104 grant recipients have reported 139 medical interventions and products. Of the medical interventions reported in 2014–2020, 62% are therapeutic interventions that directly affect patients. Of these, 52 are drugs, 11 are medical devices, six are physical interventions, with the remaining 17 across a variety of other types of therapeutic interventions (Figure 8.1).

Figure 8.1 Therapeutic interventions by type, 2014–2020

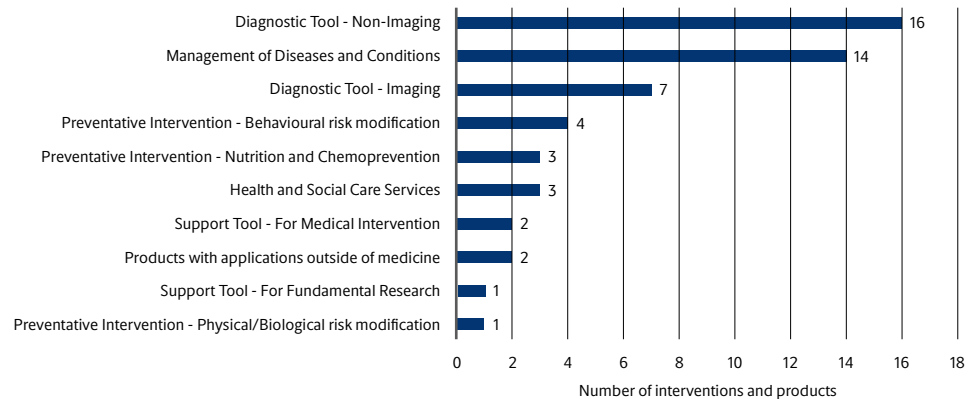


Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science.

Through medical interventions and products, the Foundation's grants have a significant impact on health and patient care. One grant recipient reported a novel way of administering cancer medication that uses a biodegradable drug-delivery system that has shown very promising therapeutic perspectives for cancer therapy and will ultimately ease the treatment for people with cancer. Other examples of medical products and interventions include diagnostic tools, tools to manage diseases and preventive interventions (Figure 8.2).

Figure 8.2

Other medical interventions and products, 2014–2020

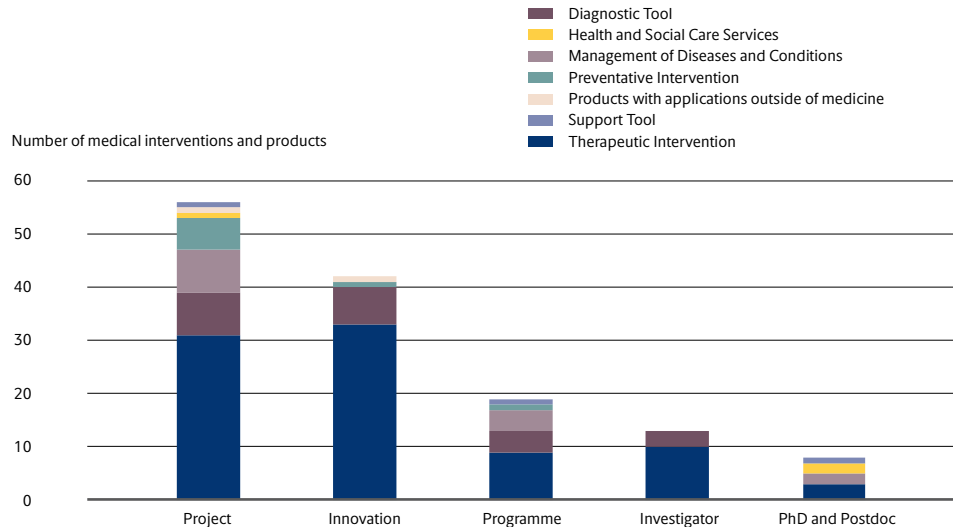


Sources: Novo Nordisk Foundation/researchfish®.

Most medical interventions and products are reported by the recipients of project, partnership and innovation grants, with innovation grants reporting the highest number of therapeutic interventions. Project grants report most solutions for management of diseases and diagnostic tools, followed by partnerships.

Figure 8.3

Medical interventions and products by type of grant, 2014–2020



Note: Centre grants have not reported medical interventions and products.

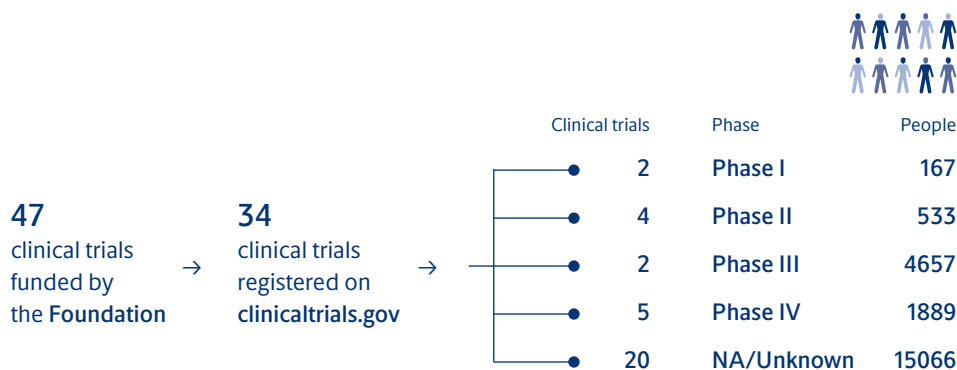
Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science.

Clinical guidelines are systematically prepared scientific recommendations aiming to guide and support healthcare professionals in decision-making. The extent to which clinical guidelines or recommendation papers for clinicians cite the research conducted by the grant recipients is indicative of the significance of the research for the patients. The general perception of the publications being referenced in guidelines is that the research behind the publication is likely to influence the treatment of patients.

8.2 Clinical trials in grants

The Foundation funds researchers who conduct investigator-initiated clinical trials. In 2014–2020, grant recipients reported a total of 47 clinical trials, of which 34 are registered in the US clinical trial registry clinicaltrials.gov. These 34 clinical trials were further analysed. 25 of the clinical trials were conducted in Denmark. In total, 22,312 people are enrolled in the 34 clinical trials. Medical inventions go through several clinical trials before being approved for the market. Grant recipients have reported clinical trials in all the different phases, with NA/unknown, which also covers observational clinical trials, as the most frequent phase (Figure 8.4).

Figure 8.4 Clinical trials funded by the Foundation, 2014–2020

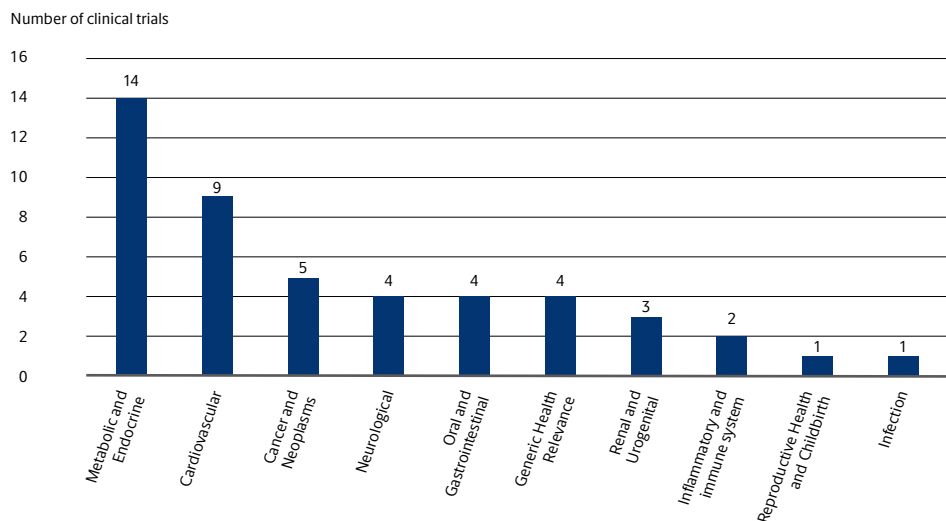


Note: [Clinicaltrials.gov](https://clinicaltrials.gov) is the United States clinical trials registry. Any clinical trial which is in any way connected to the United States must be registered. Phase 1 is the first test involving humans, with the main goal of testing the safety of the intervention in a small number of subjects. Phase 2 trials study the efficacy in a larger group of people (up to a few hundred). Phase 3 trials are large-scale (several thousands of people) randomised trials and the final trial phase before regulatory approval. Phase 4 trials are post-marketing surveillance trials.

Sources: [Novo Nordisk Foundation/researchfish*/Impact-of-Science](https://www.novonordisk.com/en/researchfish/Impact-of-Science) and clinicaltrials.gov.

The clinical trials reported by grant recipients are mostly within the health category Metabolic and Endocrine (one of the Foundation's historical focus areas), which includes diabetes and obesity, comprising 30% of the number of total trials (Figure 8.5).

Figure 8.5 Health categories for clinical trials, 2014–2020



Note: The health categories are mapped according to the Health Research Classification System (www.hrcsonline.net). The analysis is of the 47 clinical trials found in clinicaltrials.gov.

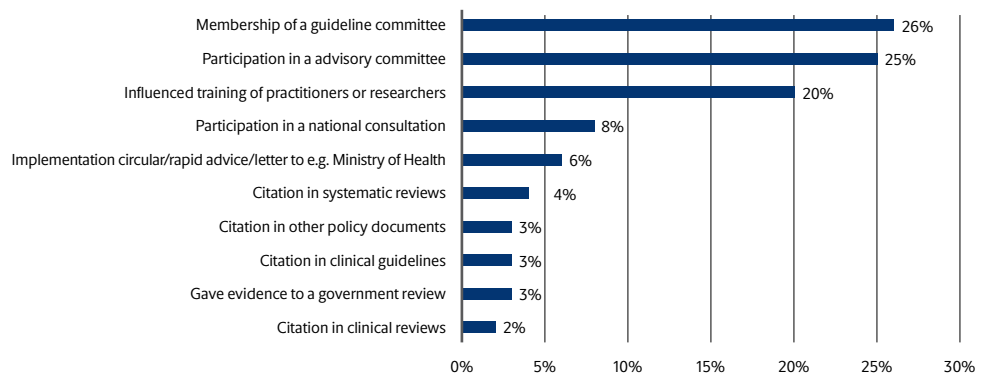
Sources: Novo Nordisk Foundation/researchfish.org/Impact-of-Science and clinicaltrials.gov.

8.3 Using Foundation-funded research in clinical guidelines

In addition to developing new treatments or diagnostics directly, grant recipients may contribute to society by advising or presenting evidence to government or other public authorities, and contribute to training of practitioners and researchers. Researchers may also contribute to improved patient care by developing and revising clinical guidelines which recommend how diseases should be diagnosed and treated. Grant recipients reported a total of 466 such contributions in the period 2016–2020. Of the contributions reported, 26% concern membership of a guideline committee, 25% relate to participation in an advisory committee. 21% concern contributing to training practitioners or researchers. The other activities cover a wide range of advisory functions (Figure 8.6).

Figure 8.6

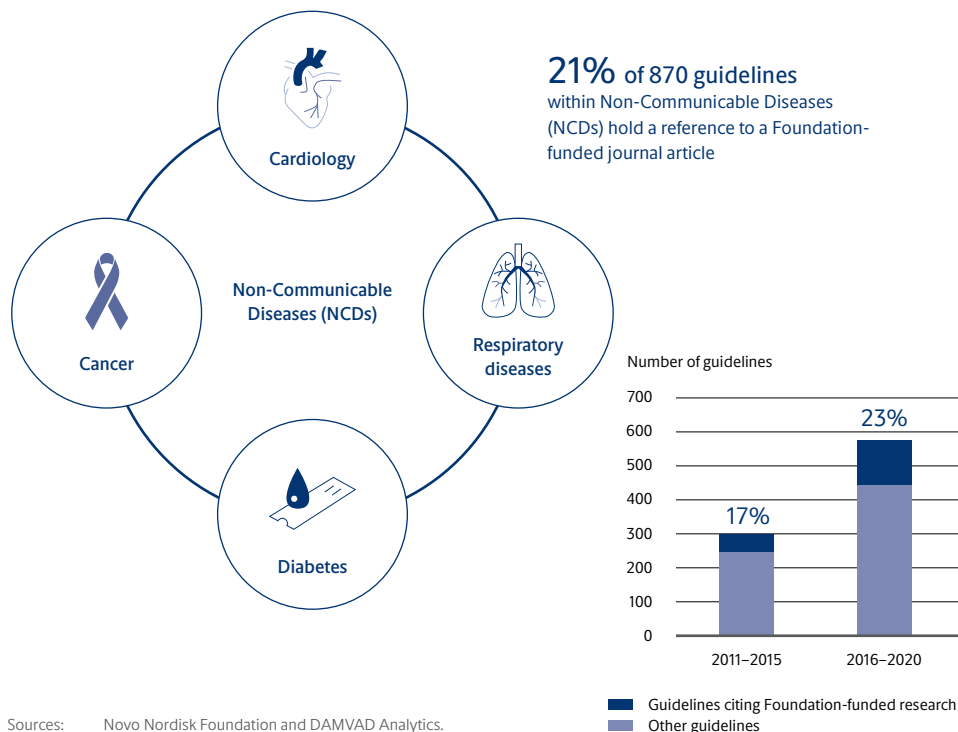
The 466 contributions to practice guidelines and advisory functions in 2016–2020



Sources: Novo Nordisk Foundation/researchfish*/Impact-of-Science.

Figure 8.7

Foundation-funded journal articles contribute to the treatment of patients within the four Non-Communicable Diseases



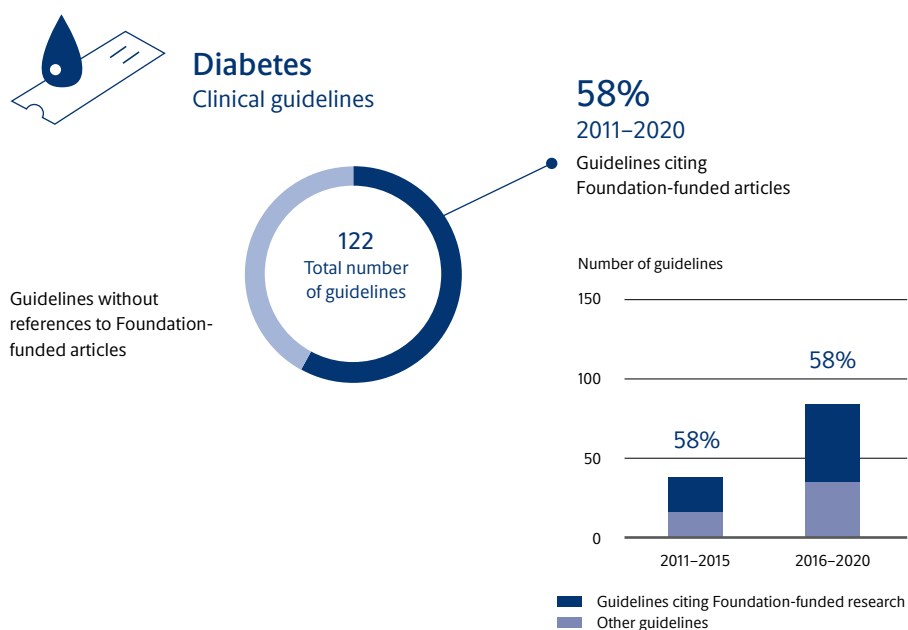
Sources: Novo Nordisk Foundation and DAMVAD Analytics.

In addition to the examining grant recipients' direct advisory contributions through their participation in the development of guidelines, the extent to which guidelines cite Foundation-funded journal articles can also be measured. Many Foundation-funded journal articles are cited in guidelines on the treatment of patients within the four Non-Communicable Diseases (NCDs): diabetes, respiratory diseases, cardiovascular diseases and cancer. Our analyses show that 1,146 Foundation-funded journal articles were cited in guidelines between 2011 and 2020, and that 21% of 870 guidelines covering the four areas of disease cite Foundation-funded journal articles (Figure 8.7). The share was 23% in the period 2016-2020 which was higher than in the previous five year period.

The data includes guidelines published between 2011 and 2020 in Denmark, the other Nordic countries and in the United Kingdom and the United States, and by international organizations such as the European Union and the World Health Organization (WHO). Clinical guidelines and recommendations for clinicians are continually updated with the latest achievements in research and new knowledge on patient care. Some are updated annually and others every 5–10 years.

Figure 8.8

Clinical guidelines and recommendations – Diabetes



Note: The data include clinical guidelines published by Denmark's public health authorities and international publishers of guidelines such as the World Health Organization, European Association for the Study of Diabetes, International Diabetes Federation, National Institute for Health and Care Excellence (NICE) and American Diabetes Association.

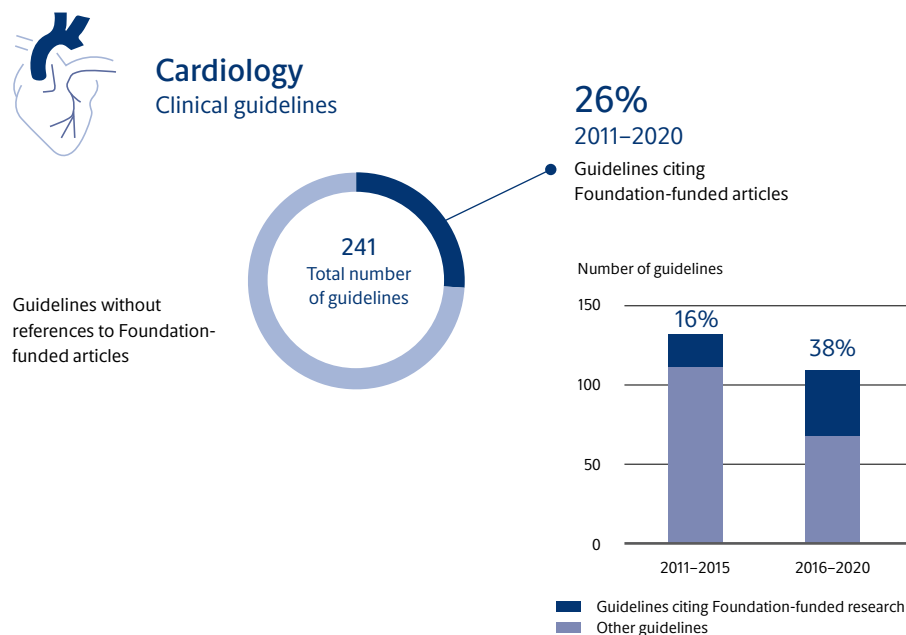
Sources: Novo Nordisk Foundation and DAMVAD Analytics.

Clinical guidelines within diabetes

Historically, the Foundation has focused on diabetes and diabetes complications, but in the past decade more emphasis has been placed on supporting research on other noncommunicable diseases such as cardiovascular diseases and cancer.

The analysis shows that, even with a steep increase in the number of guidelines within diabetes between 2011–2015 and 2016–2020, the share of guidelines that cite research published by grant recipients is unchanged between the two periods: 58% in 2011–2015 and 2016–2020.

Figure 8.9 Clinical guidelines for cardiovascular diseases



Note: The data include clinical guidelines published by Denmark's public health authorities and international publishers of guidelines such as the World Health Organization, American Heart Association, American College of Cardiology, British Cardiovascular Society, European Society of Cardiology, European Heart Rhythm Association, and the European Society of Hypertension.

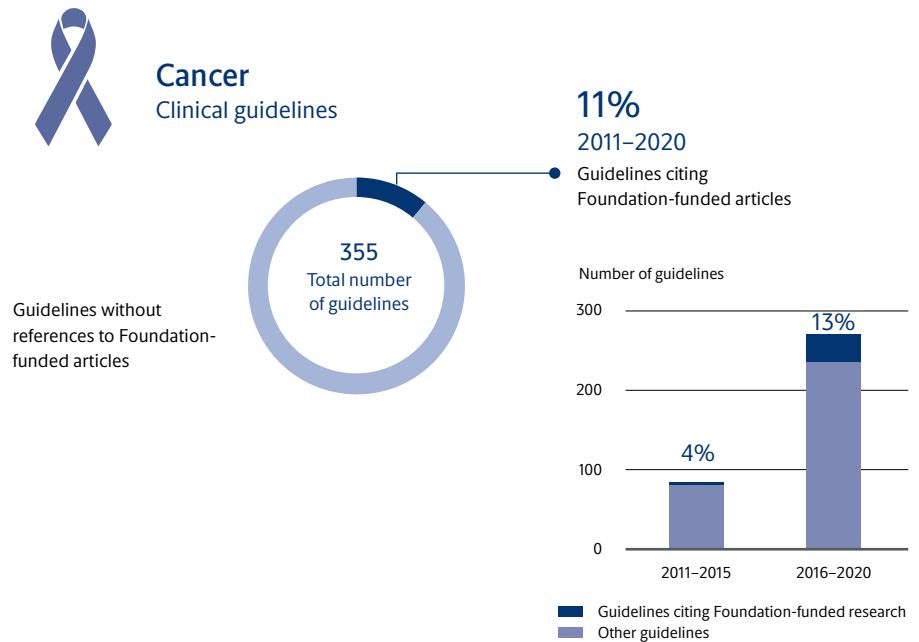
Sources: Novo Nordisk Foundation and DAMVAD Analytics.

Clinical guidelines and recommendations within cardiovascular diseases

Figure 8.9 shows the contribution of Foundation-supported research in guidelines and recommendations on cardiovascular diseases. The number of active guidelines remains comparable, but the share that cite articles by grant recipients doubled from 2011–2015 (16%) to 2016–2020 (38%) demonstrating the increased influence of Foundation supported research.

Figure 8.10

Clinical guidelines for cancer



Note: The data include clinical guidelines published by Denmark's public health authorities and international publishers of guidelines such as the World Health Organization, European Society for Medical Oncology (ESMO), National Institute for Health and Care Excellence (NICE) and American Society of Clinical Oncology (ASCO).

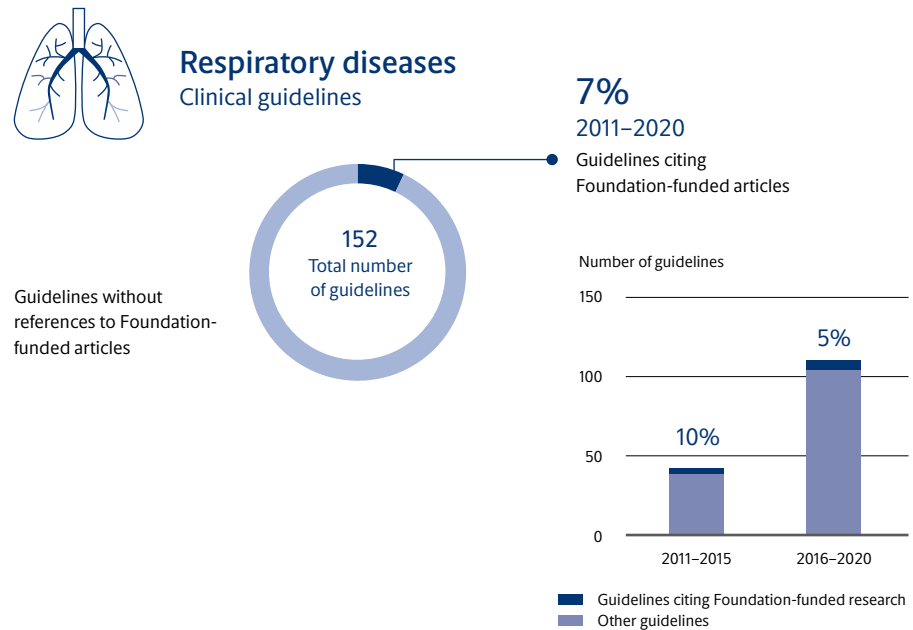
Sources: Novo Nordisk Foundation and DAMVAD Analytics.

Clinical guidelines within cancer diseases

Figure 8.10 shows the number of clinical guidelines concerning cancer published by the public authorities in Denmark, the other Nordic countries and internationally. Our calculations show that the grant recipients contributed to 38 (11%) of the guidelines covering cancer, published in all the Nordic countries, UK and the US, as well as by international organizations. And further to that, the share of guidelines that cite articles by grant recipients increased considerably between 2011–2015 (4%) to 2016–2020 (13%).

Figure 8.11

Clinical guidelines for non-communicable respiratory diseases



Note: The data include clinical guidelines published by Denmark's public health authorities and international publishers of guidelines such as the World Health Organization, the European Respiratory Society, British Thoracic Society, and the American Thoracic Society.

Sources: Novo Nordisk Foundation and DAMVAD Analytics.

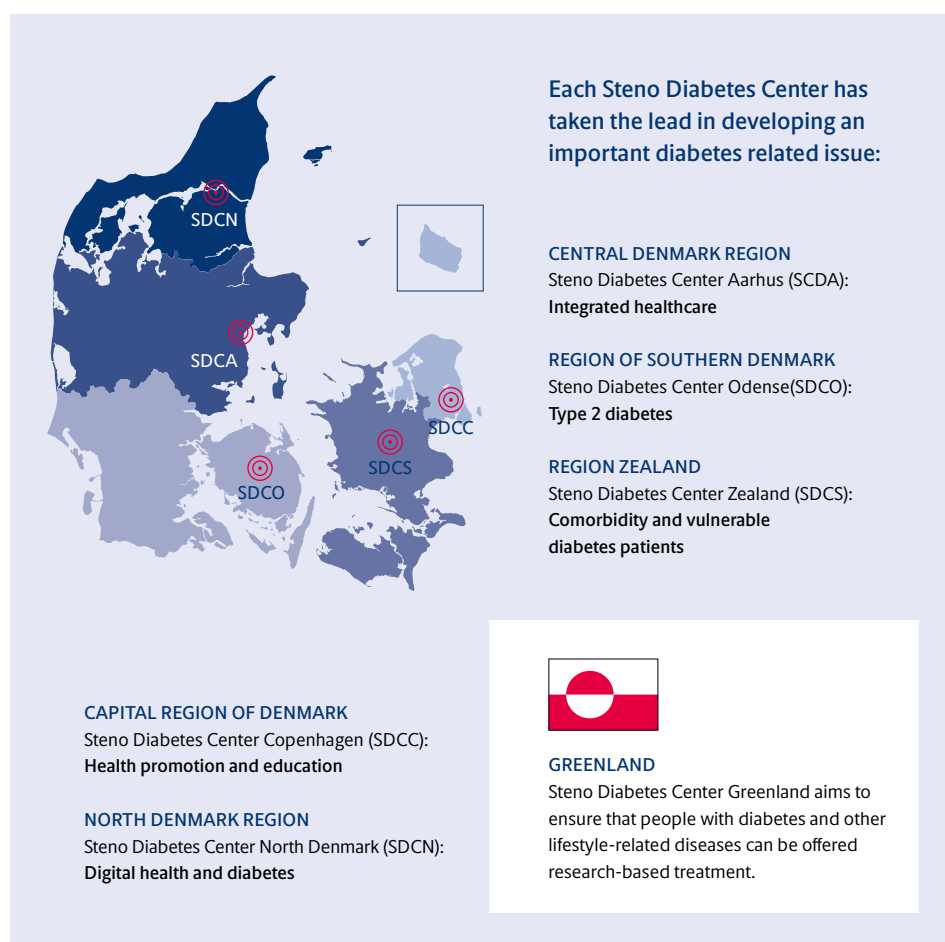
Clinical guidelines within respiratory diseases

Figure 8.11 shows the number of clinical guidelines within respiratory diseases published by the public authorities in all the Nordic countries and internationally. Our calculations show that the grant recipients contributed to 10 (7%) of the guidelines covering the non-communicable respiratory diseases, published between 2011 and 2020. In the last five years, the number of guidelines has more than doubled, but the number of references to Foundation-funded journal articles has remained the same across the ten-year period, hence the 5–percentage point decrease in coverage between 2011–2015 and 2016–2020.

8.4 People treated at the Steno Diabetes Centers

The Steno Diabetes Centers are aiming to advance all aspects of diabetes care in Denmark across a patient's lifetime through a public-private partnership model. Over a 13-year period, the Foundation has awarded DKK 7.8 billion to the five Danish administrative regions, which run the hospitals in Denmark, and to Greenland. The goals are to facilitate the development of Danish diabetology to a top international level and to increase the life expectancy and quality of life for people with diabetes in the Danish Realm. The services provided include a wide range of healthcare services related to diabetes, including diagnosis, treatment, eye scanning and examination, podiatry, dietary guidance, and courses in a food laboratory.

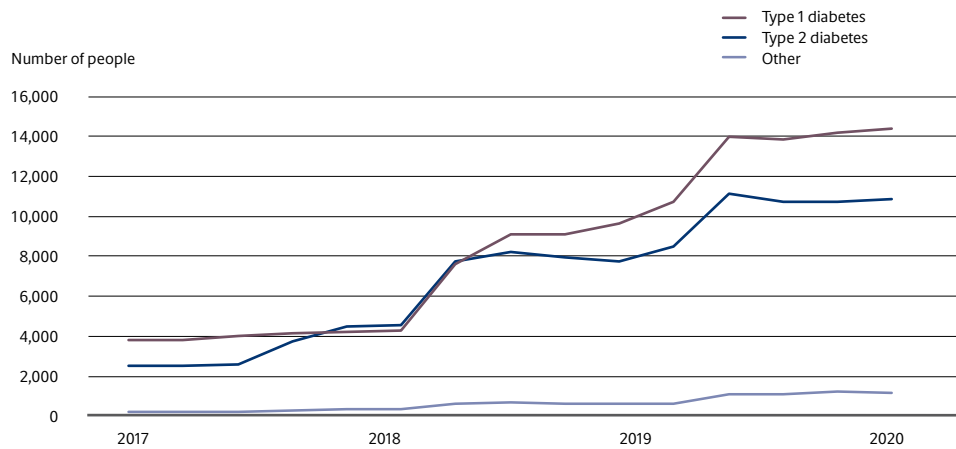
Figure 8.12 The landscape of the Steno Diabetes Centres



The number of patients treated by the centres has continued to increase. The total number of people treated at the Steno Diabetes Centers was about 7,000 in 2017, and by the end of 2020, the figure was 26,000. After a rapid increase as new centres opened from 2017 to 2019, the number of patients remained constant during 2020, most likely because of COVID-19 restrictions at Danish hospitals. Figure 8.14 shows the number of people treated for type 1 and 2 diabetes in the period 2017–2020.

Figure 8.14

People treated at the Steno Diabetes Centers according to type of diabetes, 2017–2020



Source: Novo Nordisk Foundation.

9. Developing world-class education

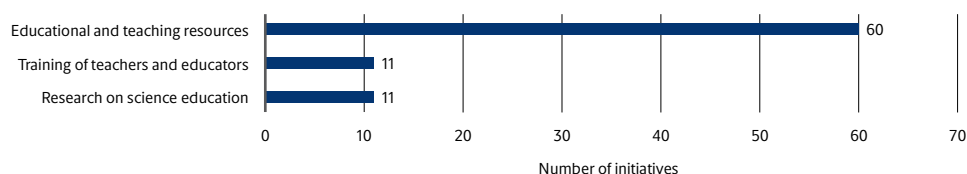
To improve people's lives and create a sustainable society, it is important that new generations receive the best education possible and that the insights from research are used in educations and are disseminated across society. This chapter investigates the outcomes of the Foundation's grant-giving within education and outreach activities. Firstly, we show the number of school initiatives and the reach through our different types of education grants (pre-school to youth education, higher education, and specific research education programmes). Secondly, we show the results of the Foundation's support for outreach. We then identify the education activities which are indirectly funded by research grants primarily at universities. Finally, we describe the education activities at the Steno Diabetes Centres.

9.1 School initiatives aimed at STEM education

The Foundation is dedicated to developing world-class education within science and technology in order to cultivate engagement, learning and the development of competencies within the field for children and adolescents. We support STEM education from early school to youth education. In 2018–2020, the Foundation supported 82 education initiatives. They reached more than 101,000 people (children, youths, and adults) in 2020. The grants were primarily awarded to develop and enhance teaching resources, teaching methods and teaching expertise within STEM subjects at all levels, e.g. courses and teaching events, to large-scale science festivals and science competitions (Figure 9.1).

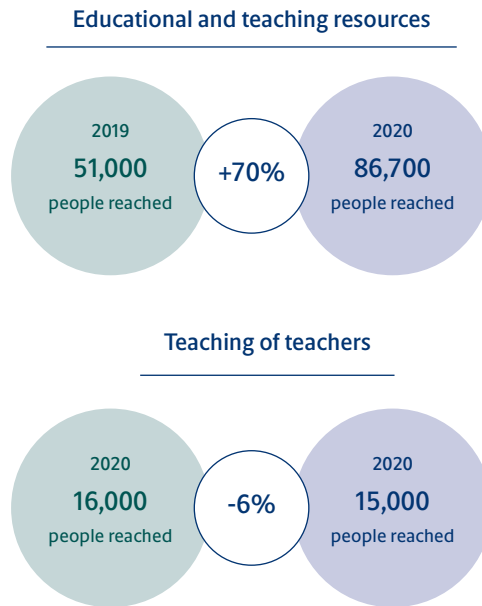
Figure 9.1

Overview over the number of new education initiatives, 2018–2020



Sources: Novo Nordisk Foundation/researchfish*/FoundGood.

Figure 9.2 Number of people reached by school initiatives aimed at STEM education



Sources: Novo Nordisk Foundation/researchfish*/FoundGood.

An example of an educational and teaching grant is the Young Scientists project which has been supported by the Foundation since 2011. Young Scientists is a competition in which children and youths can make the best science-based project. It is held in collaboration with schools and teachers nationwide in Denmark. During the project year, children in primary and lower secondary schools and youths in general upper secondary schools work on and develop projects within the STEM fields, culminating in one young scientist of the year being awarded in each school group. In 2020, despite the COVID-19 pandemic, the Young Scientists still managed to recruit more than 1,400 projects for the competition and included virtual events such as meetings and feedback sessions with jurors and live streams. Since 2016, the Young Scientists project has recruited more than 7,000 children and youths for 5,000 projects.

An example of a training of teachers and educators grant is LabSTEM Laboratory for integrated STEM teaching and learning. This initiative establishes dedicated STEM didactic and develop specific teaching tools to be used in classroom teaching. The tools are meant to integrate mathematics into the other STEM subjects for them to be easily accessible and useful to teachers who teach technology, engineering or science. The project involves 300 professionals from day care, primary and secondary education as well as students and researchers.

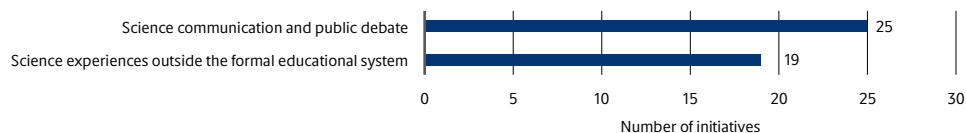
9.2 Outreach activities within natural sciences

The Foundation has supported science communication, public debates on sciences and science experiences outside the formal educational system for several years. In 2019 and 2020, the Foundation developed new open calls that focused specifically on natural science communication using novel communication platforms. 32 grants were awarded in total (six grants had focus on COVID-19 outreach activities). The aim was to contribute to engagement and interest in natural science and technology and to facilitate a qualified public debate on topics within natural science.

Before 2018, outreach grants were given as individual stand-alone grants or as part of research and education grants. Thus, the Foundation has a portfolio of more than 40 dedicated outreach grants and hundreds of active research grants with outreach activities. The new project portfolio will report their activities during 2021 and onwards. Outreach activities within STEM is likewise a growing field of funding within the Foundation, and in 2020 more than DKK 180 million DKK was awarded to outreach projects.

Figure 9.3

Overview over the number of outreach initiatives, 2018–2020

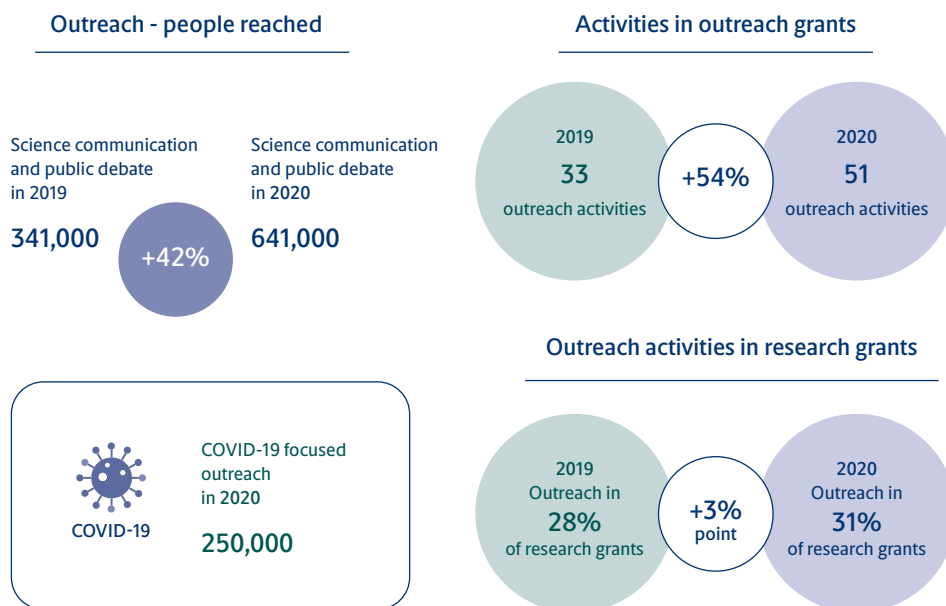


Sources: Novo Nordisk Foundation/researchfish*/FoundGood.

Activities on science communication and public debate include festivals, science debate (workshops, conferences, online events, podcasts etc.) and talks and presentations to the non-scientific community. Activities giving science experience outside the formal educational system include development of exhibitions at science museums, learning games and science clubs for children. In 2020, more than 641,000 people combined were reached by outreach activities from outreach dedicated grants and from research grants (Figure 9.4). In addition, the Foundation's COVID-19 focused outreach activities reached approximately 250,000 people.

Klimax is an example of an outreach project from 2019, which makes YouTube videos aimed at young people on the climate change crisis. The video series explains how using evidence based science and technologies can help remedy the negative effects of the climate change crisis. So far the videos have reached more than 50,000 young people aged 16–19.

Figure 9.4 Foundation-funded outreach activities and their reach from pre-school children to adults, 2019–2020

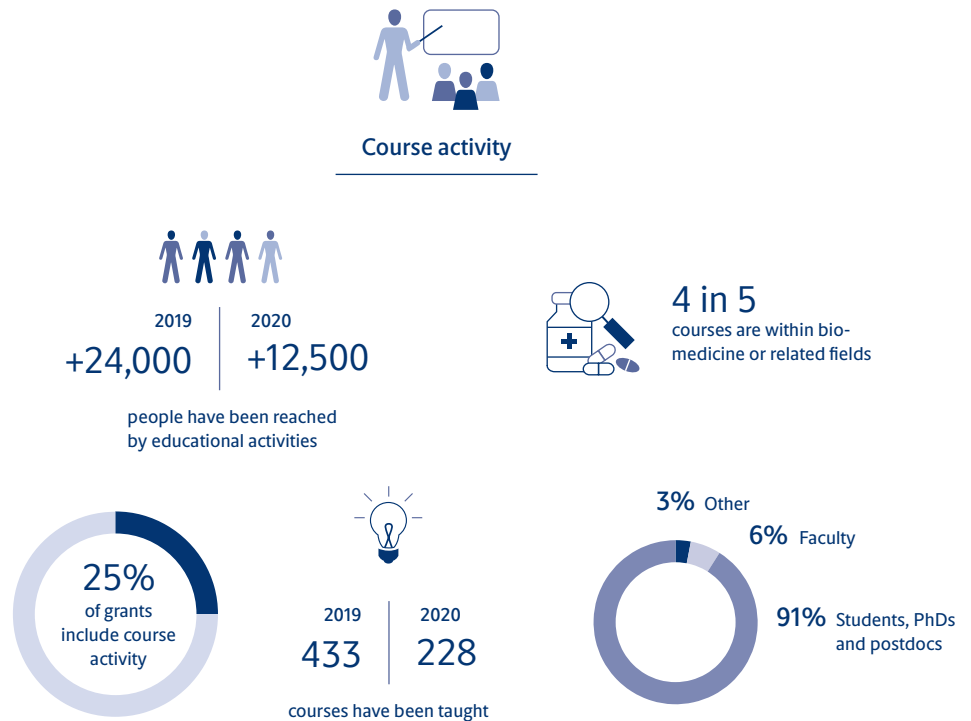


Sources: Novo Nordisk Foundation/researchfish*/FoundGood.

9.3 Research-based educational activities by grant recipients

Grant recipients may transfer their knowledge and skills indirectly through course activities. This section analyses the extent to which grant recipients report that they have carried out educational activities in connection with their grant. The reported activities from grants active in 2019 and 2020 are analysed, so that only educational activities taking place during active funding is included in the analyses.

Figure 9.5 Many Foundation-funded research grants include education activities in 2019–2020



Note: Steno Diabetes Centres are not included.
Sources: Novo Nordisk Foundation/researchfish*.

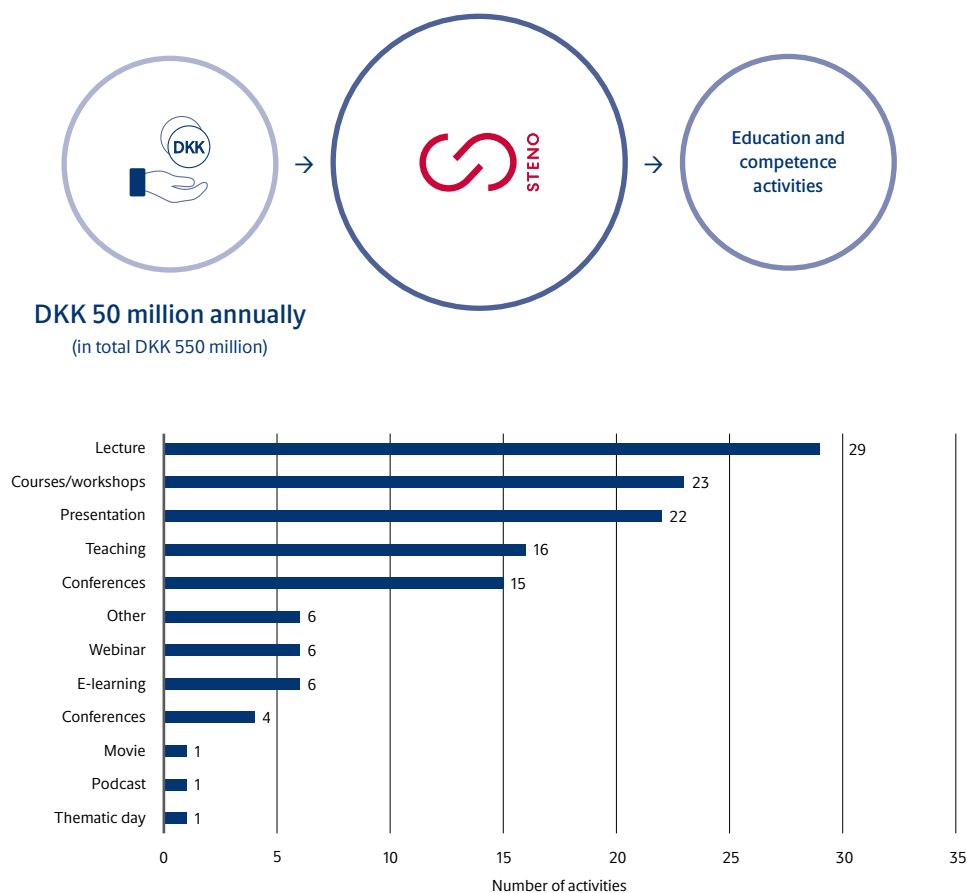
25% of active grants include some kind of course activity, of which approx. 20% are within bi-omedicine or related fields. However, there has been a significant decline in the total number of course activities and total number of people reached in 2020 compared to 2019, which is likely due to restrictions and lockdown during the COVID-19 pandemic.

9.4 Education activities within diabetes healthcare

The Novo Nordisk Foundation's public-private partnership grant to the Steno Diabetes Centres includes DKK 50 million annually (in total DKK 550 million for the period 2017–2029) earmarked for educational and competence development at the Steno Diabetes Centres. The overall purpose is to ensure a longer and better life for people with diabetes and to reduce and prevent new cases of diabetes by increasing the competences among professionals at the Steno Diabetes Centres, professionals in relevant hospital departments, in general practice, in municipalities, patients and relatives. This should ensure that treatment and prevention of diabetes are handled by staff with up-to-date knowledge about the area.

Figure 9.6

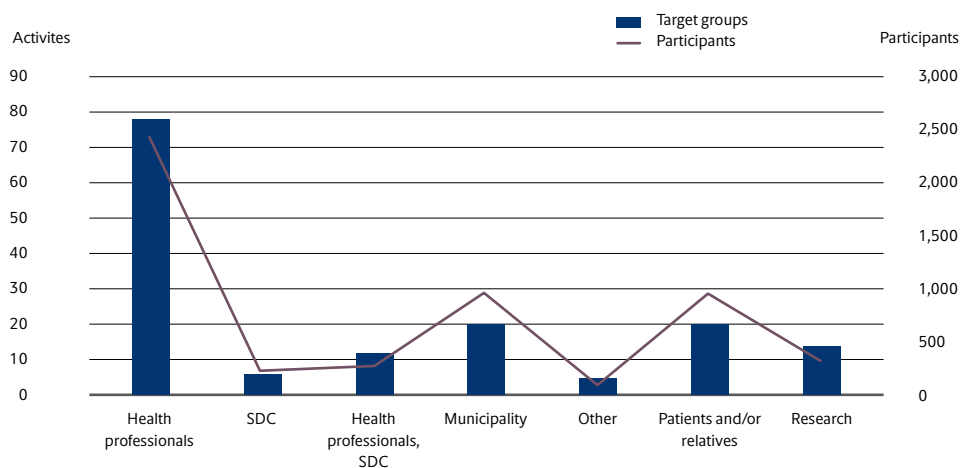
Education and competence activities at the Steno Diabetes Centres, 2020



In 2020, data on educational and competence activities have been collected for all centres for the first time. When analysing the data, it is important to know that the Steno Diabetes Centres are differently organized, as some centres' are only dedicated to competence development and others cover both competence development and education activities. The different types of activities are shown in Figure 9.6.

173 education and competence activities were registered across the five Steno Diabetes Centres (Figure 9.7). In total, over 6,000 participants are registered to have participated in an education and competence activity.

Figure 9.7 The number of education and competence activities and participants by different target groups



Note: There is not 100% reporting coverage and some activities and participants may be counted more than once.

10. Empowering vulnerable groups in society

This chapter presents information on how the Foundation has empowered vulnerable groups in society. Through its social grant activities, the Foundation improves the lives of thousands of people in Denmark. The Foundation's footprint internationally is significant, since more than 1.6 million people were reached with help from 2018–2020.

10.1 Vulnerable people supported in Denmark through social grants

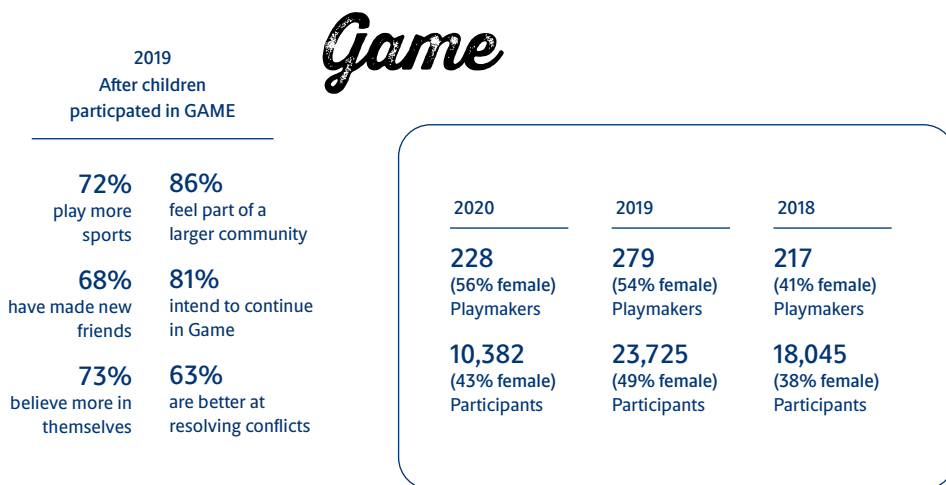
The Foundation supports social causes to improve the quality of life and opportunities for disadvantaged children and youths in Denmark, with a focus on healthy weight and increased learning opportunities. 52 social grants were awarded and DKK 115 million granted from 2018–2020. Some of the grants supported information to vulnerable people during the COVID-19 crisis. The following sections present the qualitative results of two of our social grants, namely a grant focusing on health-vulnerable children in cities (“The GAME Project”) and a grant supporting health-vulnerable veterans returning from military interventions (“The Veteran Effort”), and the Foundation's social responses to the COVID-19 pandemic.

The GAME Project improves the quality of life for health-vulnerable children

Inequality in health is particularly present in vulnerable housing areas. In these areas, children and young people seldom find their way into sports associations due to economic, social, or cultural barriers. The Foundation has therefore allocated DKK 19.3 million to the GAME Project, which aims to prevent obesity and diabetes among vulnerable young people. It is a partnership of the international non-profit street organization GAME and Health Promotion Research at Steno Diabetes Center Copenhagen.

Figure 10.1

GAME statistics for Denmark



Source: GAME.

The GAME Project trains young people to become Playmakers, i.e. role models on how to motivate more children to be physically active and engage in communities in urban settings. The project implements peer-led street sport activities as a venue for fostering empowerment in underserved neighborhoods. Figure 10.1 shows the development in several indicators for the project in Denmark and results from a representative survey conducted in 2019 in Denmark. Many of the indicators show positive progress, but 2020 has been affected by the limitations to participation due to the COVID-19 pandemic. The project's focus on inclusion, being a part of a community, gaining self-esteem and playing more sport has started to yield positive results in terms of improved life quality for the children.

The GAME Project strives for a gender balance among volunteers, playmakers, and participants. In Denmark, female participants, both as playmakers and as attendees, have increased over the years. These results are landmarks for gender equality and show that by persistent effort and focus, impact has been made when it comes to attracting and sustaining girls' participation in physical activity. During the COVID-19 lockdowns in 2020 there was a decrease in attendance, but due to a very close contact between employees and participants, online training, virtual check-in with participants, walks with the particularly vulnerable were introduced, having a positive effect on keeping the girls involved in the activities.

Gender equality

Female participation in the GAME Project has required an approach of observing and listening – to the girls, their parents, their communities – and using the latest results from literature on gender equality. Hence concepts have had to be developed, which could be tested on a smaller scale before they could be taken to the streets. One of the new concepts promising positive results is the new multi-sports activity 'GAME Girls Zone'. GAME Girls Zone is a sports practice for girls led by female playmakers. Critically, the practice provides space for friendships and it is not focused on one sport but a variety of activities, and the girls have a say in choosing the training content.

Female playmakers are crucial for girls' participations. One of them is Maymi Asgari, who is a playmaker in a GAME Girls Zone. Maymi grew

up in a socially disadvantaged area in Denmark and has always played soccer. She became a playmaker because she was well known in her community and loves sports. Being a playmaker in the GAME Girls Zone is meaningful for Maymi, because it gives her an opportunity to be a role model for young girls who suffer from being shy and are uncomfortable with physical activity. She motivates girls to feel safe and be confident with physical activity. She enjoys that the focus in the GAME Project is to be included and be a part of a community. She understands and can relate to the young girls' insecurities and can show them that they are good enough just as they are. In this way, she can be an active voice against the negative structures and barriers she experienced herself when she was a little girl.

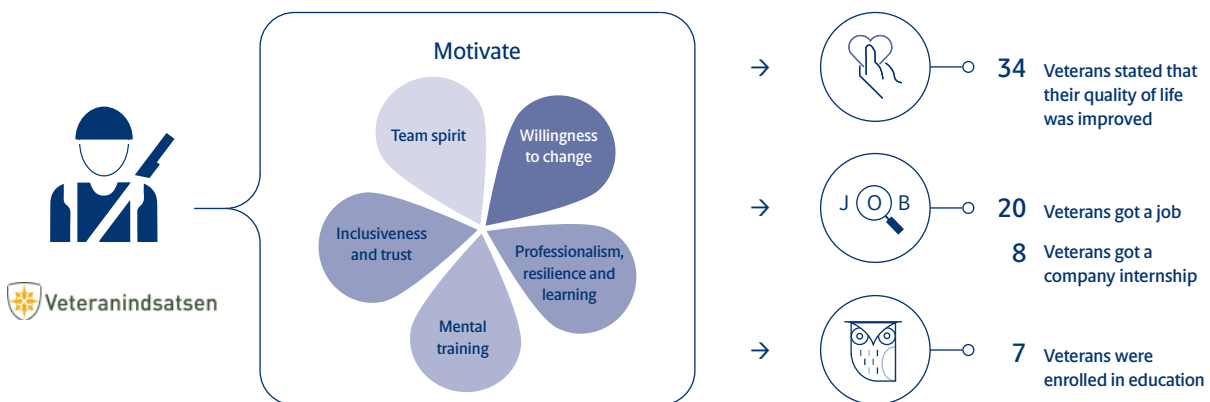
The Veteran Effort improved the lives of veteran soldiers and had socioeconomic effects

Since 1992, Denmark has deployed 43,000 soldiers abroad. When the soldiers return from military service, they often suffer from mental problems such as post-traumatic stress. The need for a special effort for veterans who return home from military service abroad with mental injuries has created the framework for the Veteran Effort, which the Foundation has supported with almost DKK 5 million from 2017–2019. The main goal is to rehabilitate mentally vulnerable veterans through a focused intervention to enable them to achieve employment or enroll in education. 42 veterans have been participating in the project.

Figure 10.2 illustrates how the project motivates vulnerable veterans to move away from a military career to a civilian identity. The programme lasts eight weeks, and the activities are carefully organized and adjusted to the reality of the veteran's life. The programme complements their competences to empower them and enhance their quality of life. At the same time, the project relies on close cooperation between public authorities (job centres and social administrations), vocational schools, civil society and the labor market³. Figure 10.2 shows the results from the project.

Figure 10.2

The model and results of The Veteran Effort



The programme has been scaled to several municipalities in Denmark. There are also socioeconomic effects for society. Calculations based on the results of the project estimate a positive economic return of DKK 4.4 per million per year after the first years of the programme (calculations are made by Cabi and Virksomhed for Social Ansvar (2020)). The positive return comes from lower unemployment salaries and higher taxes, growth in companies, and lower social and health costs for municipalities.

³ The programme was designed in collaboration with the Council for the Mentally Vulnerable in the Labour Market, The Vocational Institution Tietgen Business, The Veteran Home Association, Odense, the municipalities of Haderslev, Nyborg and Odense as well as companies on Funen and in Southern Jutland.

Social responses to the COVID-19 pandemic

In 2020, the Novo Nordisk Foundation awarded over DKK 22 million to 23 projects mitigating the consequences of the COVID-19-pandemic for socially vulnerable citizens. When the pandemic hit Denmark in March 2020, there was a worry in non-governmental organizations and municipalities for the homeless, for people suffering from mental illness and others finding themselves in a socially vulnerable situation.

Most of the social COVID-19 interventions were carried out by charitable organizations in partnership with or supported by municipalities, regional or central authorities. Examples of initiatives:

- COVID-19 information was translated into 30 languages and made available on the internet.
- A campaign targeted ethnic minorities covered 26 languages and established a telephone hotline and a website translating the latest news and recommendations - including a chat function.
- Counselling of elderly and mentally vulnerable people was also arranged, as well as support to vulnerable children and families by handing out at-home activity boxes and access to a psycho-social hotline.

See Figure 10. 3 for several outcomes of the Social COVID-19 interventions.

Figure 10.3

Outcomes from the Social COVID-19 interventions, 2020



Source: Novo Nordisk Foundation.

10.2 Vulnerable people supported internationally

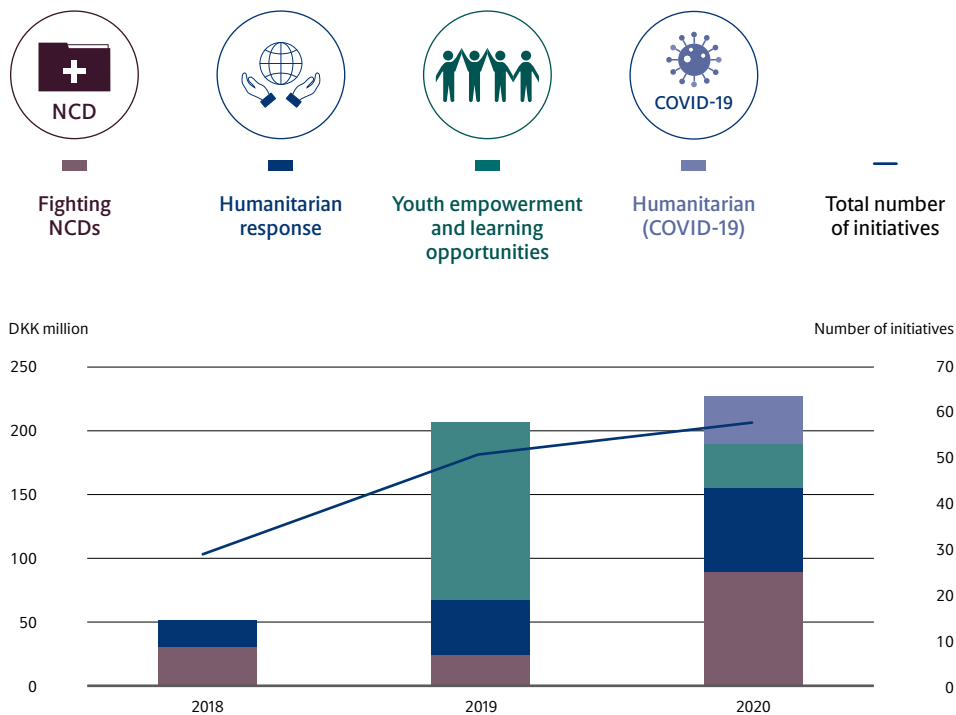
The Foundation supports humanitarian and development initiatives which aim to improve the opportunities for disadvantaged children and young people, with a focus on youth empowerment and learning opportunities, fighting NCDs and humanitarian crises globally.

Humanitarian and development initiatives

From 2018 to 2020, the Foundation has, in total, awarded 138 humanitarian grants and supported 9 humanitarian partnerships with a total granted amount of almost DKK 500 million.

Figure 10.4 shows the development since 2018 in the number of grants and the granted amounts for the strategic focus areas, fighting non-communicable diseases (NCDs), youth empowerment and learning, and humanitarian responses. In addition, in 2020, the Foundation awarded 20 humanitarian grants in response to the COVID-19 crisis.

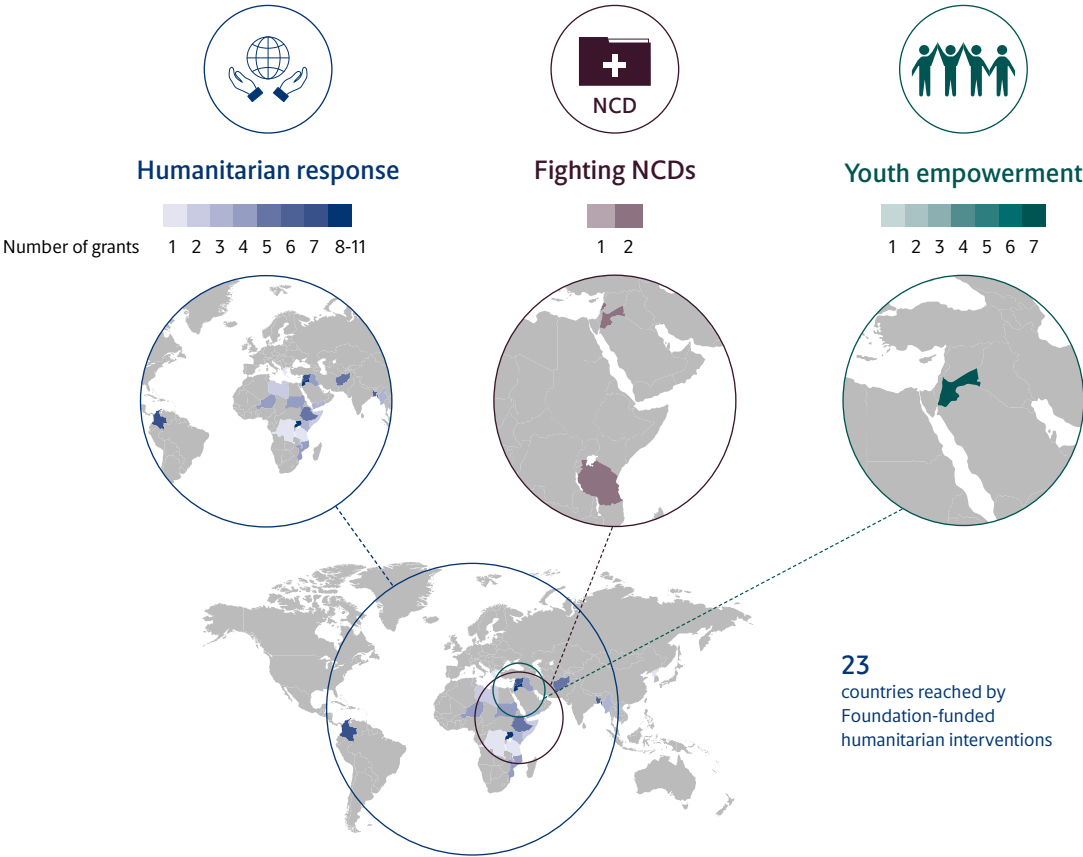
Figure 10.4 Humanitarian grant amounts and number of initiatives



Source: Novo Nordisk Foundation.

The Foundation has supported activities globally in low and middle-income countries for many years. Figure 10.5 shows the geographical distribution in 2018–2020 for the different focus areas of the number of humanitarian grants.

Figure 10.5 Geographical distribution of the Foundation’s grant for humanitarian and development initiatives within different focus areas, 2018–2020

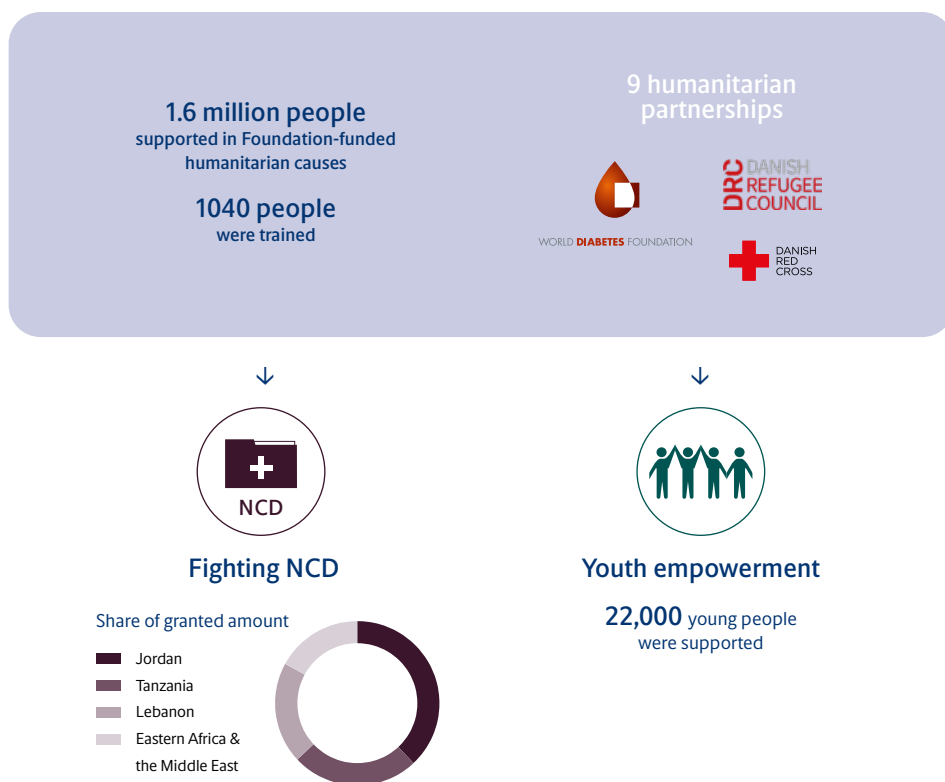


Sources: Novo Nordisk Foundation/FoundGood.

In accordance with the Foundation’s strategy for 2019–2023, the geographical focus is countries affected by the Syrian crisis, specifically Jordan, Lebanon and Syria. Youth empowerment and learning opportunities focuses on Jordan, fighting NDCs focuses on countries in eastern Africa, Jordan and Lebanon, and acute humanitarian responses focuses broadly worldwide.

Based on yearly reporting from active grants in 2018–2020, at least 1.6 million people have benefitted from receiving assistance from the allocated support towards humanitarian responses, youth empowerment and fighting NCDs, (Figure 10.6). In 2019 and 2018, approximately 0.4 million people and 0.1 million people benefitted respectively from the Foundation’s humanitarian support.

Figure 10.6 Results from Humanitarian and development initiatives, 2018–2020



Sources: Novo Nordisk Foundation/FoundGood.

The Foundation mainly operates through major partnerships with NGOs and international organizations. From 2018–2020, nine humanitarian partnerships accounted for over DKK 300 million. The humanitarian partnerships awarded for fighting NCDs in Eastern Africa and the Middle East were established with the World Diabetes Foundation and the Red Cross.

The main country of support for youth empowerment is Jordan. The main partnerships were established with Red Cross and Danish Refugee Council.

Humanitarian responses to the COVID-19 pandemic

When the COVID-19 pandemic spread around the globe during the first half of 2020, the Novo Nordisk Foundation responded by granting a total of DKK 36 million to mitigate the economic, health and educational consequences among people living in poverty and other disadvantaged population groups in low- and middle-income countries. The Foundation supported a total of 20 Humanitarian COVID-19 projects, which were all implemented by well-established non-governmental organizations - often in collaboration with local partners and in accordance with the Novo Nordisk Foundation strategy of building local capacity to secure long-term solutions.

Figure 10.7

Outcomes from the Humanitarian COVID-19 interventions, 2020



Sources: Novo Nordisk Foundation/FoundGood.

Syrian refugees in Jordan, pregnant women in Myanmar and communities in Sudan affected by floods were among the people benefitting from the Novo Nordisk Foundation emergency humanitarian response to the pandemic. The Foundation granted DKK 20 million to five initiatives in Jordan and Tanzania, a first urgent response to the COVID-19 situation building mainly on The Foundation's existing multi-year partnerships with World Diabetes Foundation, UNICEF, and Danish Refugee Council.



Part III

The Foundation's commercial purpose

11. The societal impact of commercial activities

The commercial purpose of the Novo Nordisk Foundation is to provide a stable basis for the commercial and research activities of the life science portfolio of companies which the Foundation controls through Novo Holdings A/S or has a substantial investment in (stakeholder share). This chapter illustrates some of the societal impacts of these commercial activities. The chapter focuses on the Novo Group and life science companies with equity investments where Novo Holdings' ownership share ranges between 5% and 100%. If not otherwise stated, the analyses include the Novo Group⁴ (Novo Nordisk A/S, Novozymes A/S, and Novo Holdings A/S).

11.1 Stimulating research collaboration

Not only does the Foundation fund research in universities and research institutions, it also owns and invests through its holdings company Novo Holdings A/S in research-intensive companies. This section analyses the co-authorship patterns of journal articles published by companies invested in.

The companies in the portfolio published more than 3,161 journal articles from 2016 to 2020. 75% were published with co-authors from academia. The analysis also shows a high share of international co-authorship, with the proportion of international co-authorship increasing from 63% to 69% in 2016–2020. Like the international co-authorship level of grant recipients' publications, this is also above the average share for all Danish journal articles in 2015–2018, which was 59% (www.leidenranking.com), as well as above the average share of other countries' journal articles.

⁴ The Novo Group consists of Novo Nordisk A/S, Novozymes A/S and Novo Holdings A/S. The Novo Nordisk Foundation Group consists of the Novo Nordisk Foundation, the Novo Group and the companies in Novo Holdings' investment portfolio.

Researchers at University of Copenhagen have published 559 journal articles with the portfolio companies since 2016. The second highest number of articles by portfolio companies co-authored with academia is with the Technical University of Denmark (221 articles). The portfolio companies publish with 18 out of the top 20 highest ranked universities in the world within biomedicine and health sciences. Table 11.1 shows the twenty universities with the highest number of articles co-authored with portfolio companies.

Table 11.1 The 20 universities with the highest number of articles published with companies

The 20 universities worldwide with the highest number of articles published with the Novo Group and life science portfolio companies	Number of journal articles co-authored	Leiden Ranking
University of Copenhagen	559	136
Technical University of Denmark	221	133
Medical University of Graz	193	304
Heidelberg University	153	160
Lund University	108	208
University of Oxford	97	6
Aarhus University	92	205
Rigshospitalet	88	136
Harvard University	86	8
Charité - Humboldt-Universität zu Berlin	63	204
Imperial College London	60	14
University of Toronto	58	70
University of Washington, Seattle	54	43
University of North Carolina at Chapel Hill	53	58
University College London	47	15
Northwestern University	33	48
Duke University	31	50
Stanford University	24	11
Johns Hopkins University	23	37
University of California, San Diego	22	16

Sources: Novo Nordisk Foundation/Impact-of-Science, Scopus and Incites.

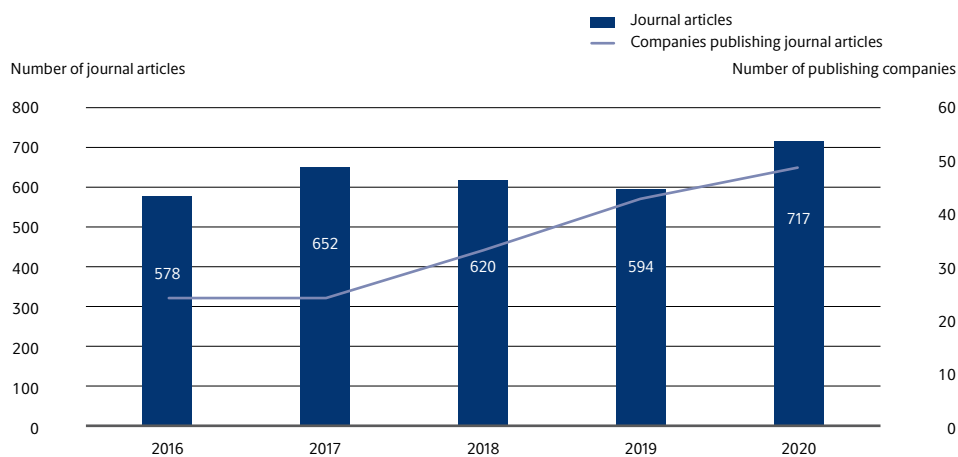
11.2 Promoting excellent research

Scientific journal articles from the Novo Group and the life science portfolio companies

Many of the companies invested in are research-active companies which spend a high share of their revenue in private research and development investments. This results in a high output of new knowledge and ideas. The companies published 3,161 journal articles in the period 2016–2020. In 2020 alone, 717 journal articles were published by 49 different companies in the portfolio (Figure 11.1). Over 35% of the companies published a journal article in 2020.

Figure 11.1

Number of journal articles, 2016–2020



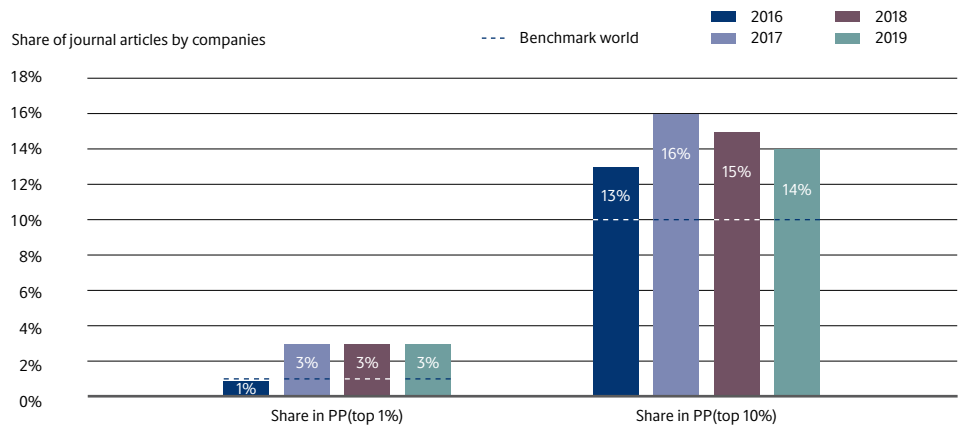
Note: The left axis shows the number of publications published, while the right axis shows the number of companies publishing publications.

Sources: Novo Nordisk Foundation, Novo Holdings and Scopus.

Citation impact of journal articles from the Novo Group and life science portfolio companies

This section describes the scientific impact of the journal articles published through commercial activities. Figure 11.2 illustrates how journal articles published by the companies invested in have an impact well above the world average. In 2019, the number of journal articles among the top 1% most cited in the world was 3%, three times higher than the world average. 14% of the journal articles were in 2019 among the top 10% most cited in the world.

Figure 11.2 Share of journal articles by companies among the top 1% and 10% most frequently cited journal articles in the world, 2016–2019

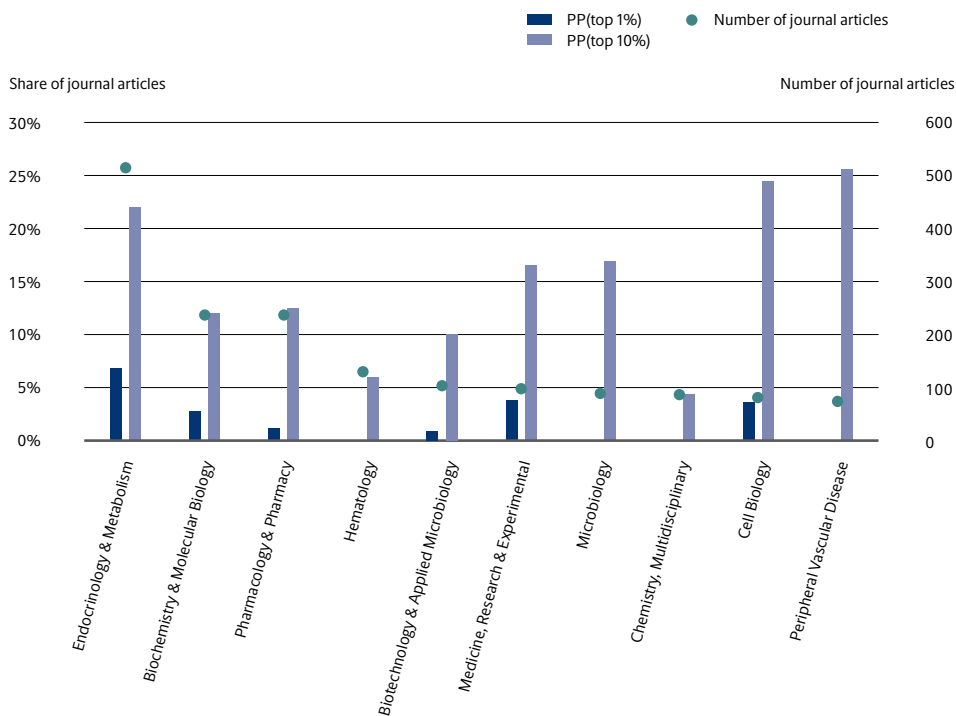


Sources: Novo Nordisk Foundation, Novo Holdings, Scopus and Incites.

Science fields of journal articles from the Novo Group and life science portfolio companies

Most articles (519 journal articles) were published by portfolio companies within endocrinology and metabolism in the period 2016–2019, with 22% of articles among the world’s ten percent most cited within this field. The second highest output are within biochemistry and molecular biology, with 241 journal articles with a citation impact score of 1.2 times the world average within this field. The third most frequent field of science for portfolio companies is pharmacology and pharmacy (Figure 11.3). The journal articles within cell biology and peripheral vascular disease have the highest share of articles (24%–26%) among the world’s 10% most cited articles within these fields.

Figure 11.3 Top 10 journal subject category among the top 10% most frequently cited in the world – PP(top 10%), 2016–2019



Note: The 10 most frequently used Web of Science subject categories are sorted according to the number of journal articles published by portfolio companies, descending from the left to the right. A publication may count in more than one category.

Sources: Novo Nordisk Foundation/Impact-of-Science, Novo Holdings and Clarivate Analytics/Incites.

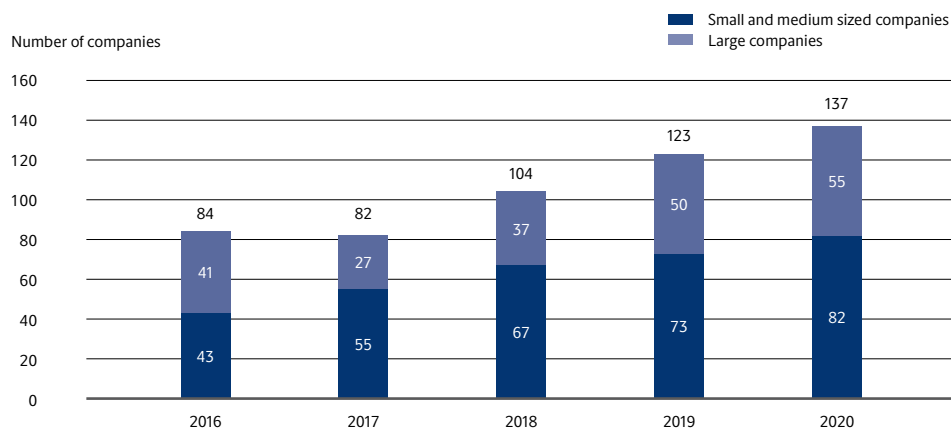
11.3 Creating jobs and growth

This section shows how the Novo Nordisk Foundation Group has built up the portfolio of companies and thereby contributed to the growth in jobs.

The portfolio size of companies

The size of the company portfolio has grown since 2016, both in terms of the number of companies, and employment. Since 2016, the number of companies in the portfolio has increased by 61%. It has grown from 84 companies to 137 in 2020, including Novo Nordisk A/S, Novozymes A/S and Novo Holdings A/S (Figure 11.4).

Figure 11.4 The number of portfolio companies, 2016–2020



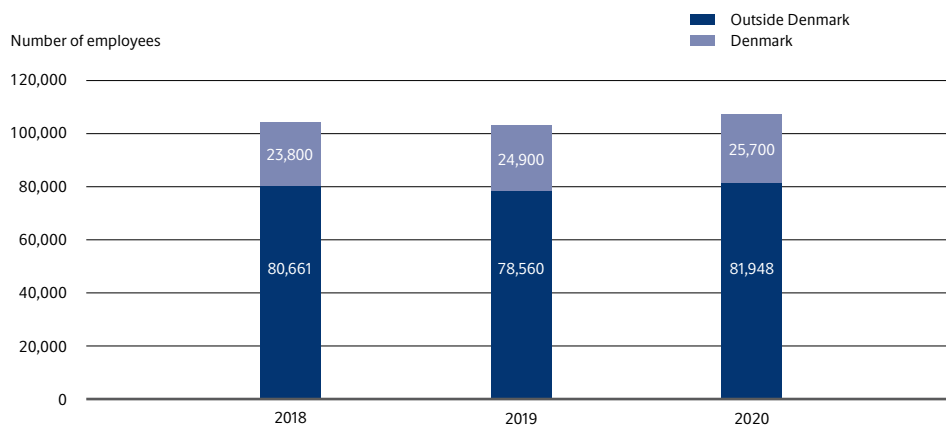
Note: The portfolio is here defined as companies with equity investments in and includes the Novo Group companies.
Sources: Novo Nordisk Foundation and Novo Holdings.

A large proportion of companies in the life sciences portfolio fall within the small and medium sized category, including investments in start-up companies. These small and medium sized companies are in the investment portfolio because they are evaluated to have a potential for growth. Since 2016, the size of the SME portfolio has grown from 43 in 2016 to 82 SMEs in 2020 (Figure 11.4).

People in the Novo Group and life science portfolio companies

In 2020, the Novo Group and the life science companies employed about 107,000 people - up from about 104,000 two years before (Figure 11.5).

Figure 11.5 Number of people employed in Danish based and foreign based companies, 2018–2020



Note: Exclusion/inclusion.

Sources: Novo Nordisk Foundation/Impact-of-Science, Novo Holdings and Statistics Denmark.

11.4 Developing solutions that support sustainability

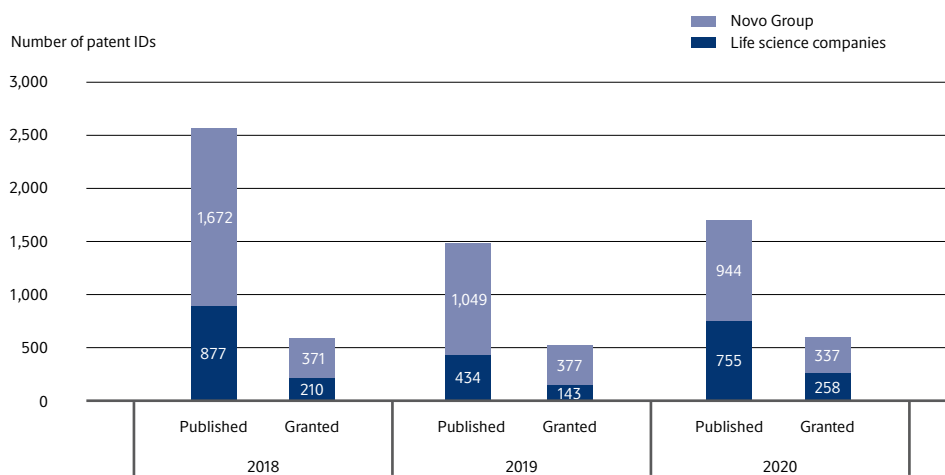
This section examines how the life science portfolio companies are contributing to development of new solutions for the benefit of people as revealed by their patent activity.

Patent activities based on Novo Group and life science portfolio companies

The companies in which the Novo Holdings has invested have contributed to a large number of patent applications. Since 2018, more than 5,700 patent applications have been published by the portfolio of companies, and more than 1,600 patents have been granted (Figure 11.6). The number of patents filed for 2019 and 2020 will be higher than shown, as patents are not published until 18 months after they are filed. In the period 2018–2020, Denmark based portfolio companies accounted for 19.8% of all granted patents and 14.4% of all published patents in Denmark.

Figure 11.6

Number of patent applications and granted patents filed in the Novo Group and the life science portfolio companies across technologies, 2018–2020



Note: There is a two-year delay patent reporting, which can help explain the drop in patents published from 2018–2019.
Sources: Novo Nordisk Foundation/Impact-of-Science, Novo Holdings, Dimensions.

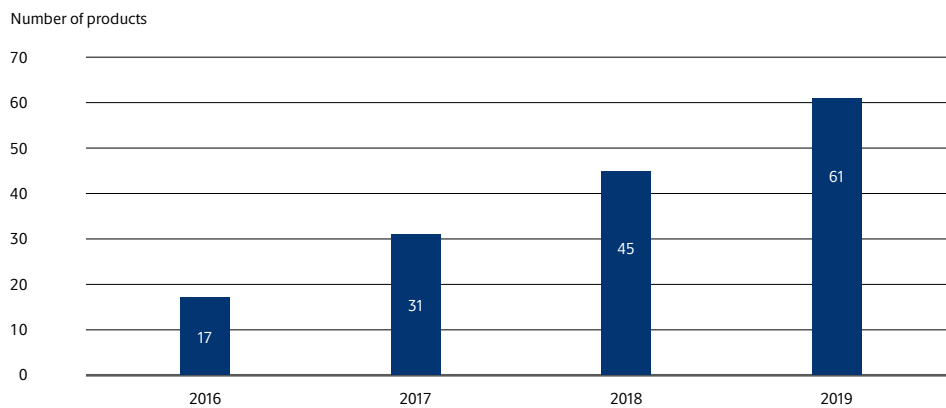
11.5 Developing healthcare and new medicine

Alongside patent activity, the production of new medicines and healthcare products can be examined directly. This section documents the Novo Group's and life sciences portfolio's range of innovative products and its large and growing pipeline of future products.

From 2016 to 2019, the Novo Group and the life science portfolio companies have produced 61 medical interventions and products that are protected by patents (Figure 11.7). Mapping the patents protecting the products into different types of patent technologies shows that the vast majority of products (96%) are within medical science or veterinarian science, followed by 14% in organic chemistry and 9% in biochemistry (products can be registered to more than one patent technology area).

Figure 11.7

Number of new medical interventions and products since 2016

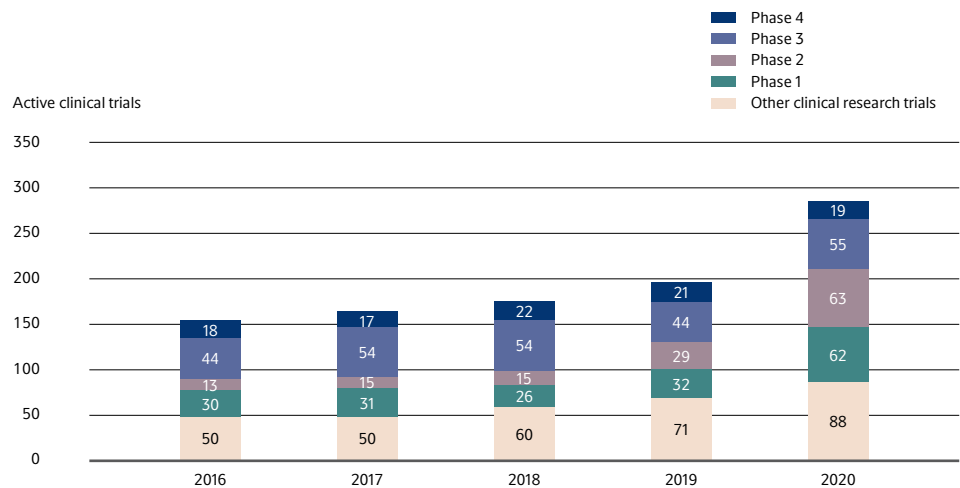


Sources: Novo Nordisk Foundation, Novo Holdings

Clinical trials in companies

Many of the life science portfolio companies and the Novo Group are developing new medicines and therapeutics. Before approval, these therapeutics undergo vigorous clinical trial testing. Between 2016–2020, almost 500 clinical trials were registered in the United States clinical trial registry clinicaltrials.gov by portfolio companies (Figure 11.8). As expected, the clinical trials supported by the commercial activities are more advanced in their clinical trial status, compared to the clinical trials reported by grantees, with 70% being in official clinical trial phases 1–4, 41% are in early clinical trial phases 1 and 2, and 30% in late clinical trial phases 3 and 4.

Figure 11.8 Active clinical trials of the portfolio companies, 2016–2020

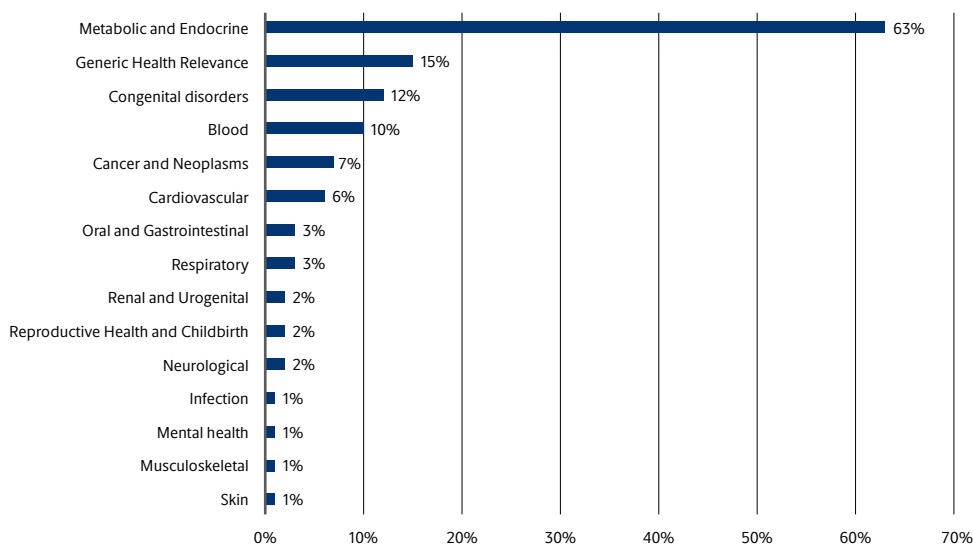


Note: The figure is showing the number of active clinical trials within the investment portfolio of a given year. A distinct clinical trial can therefore appear in multiple years.

Sources: Novo Nordisk Foundation, Novo Holdings, and clinicaltrials.gov.

Further analyses of the clinical trials show which health areas the clinical trials fall within. As expected, the majority of supported trials are in metabolic and endocrine conditions, which include diabetes (Figure 11.9).

Figure 11.9 Health categories of clinical trials, 2016–2020



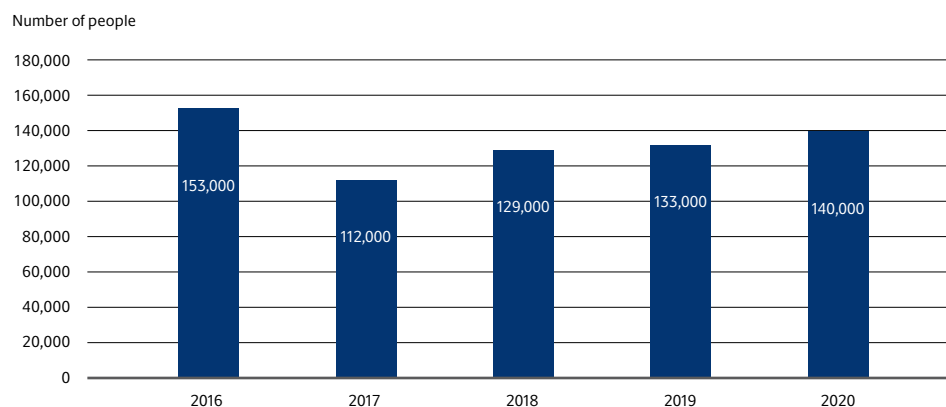
Note: The figure shows the number of people enrolled in active clinical trials within the investment portfolio of a given year. People enrolled in a specific clinical trial can therefore be counted more than once.

Sources: Novo Nordisk Foundation, Novo Holdings, and clinicaltrials.gov.

To ensure that new medicines and therapeutics are both safe and effective, they must be tested on many people within the clinical trials. The scale of the clinical trials is illustrated by the number of people enrolled. Over the past five years, more than 400,000 people have been enrolled in clinical trials supported by the portfolio companies. Between 112,000 and 153,000 people have been enrolled in active clinical trials of a given year in the period 2016–2020 (Figure 11.10). People enrolled in a specific clinical trial can be counted in more than one single year.

Figure 11.10

People enrolled in active clinical trials of the portfolio companies, 2016–2020



Sources: Novo Nordisk Foundation/Impact-of-Science, Novo Holdings, and clinicaltrials.gov.

Among the life science portfolio companies, Novo Holdings has invested in the company WCG, which delivers clinical services and technologies that maximize speed and efficiency for those who perform clinical trials. WCG improves the quality and efficiency of clinical trials, helping biopharmaceutical companies, Contract Research Organisations (CROs) and institutions facilitating the development of new treatments and therapies for patients.

11.6 Empowering vulnerable people through medicines, technologies, and services

The products and services of the companies in the Novo Nordisk Foundation Group help millions of people every year with pharmaceutical products, medical devices and technologies, and health services, including clinical health tests.

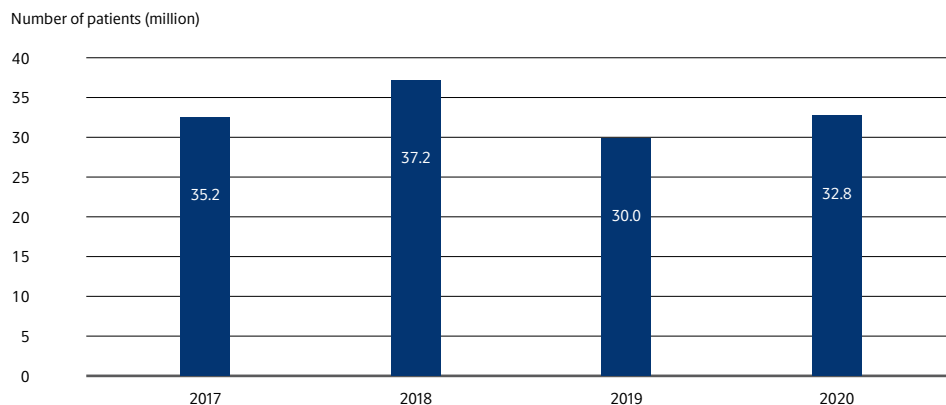
Pharmaceutical products (medicine)

The Foundation is built on the success of Novo Nordisk A/S, alongside other pharmaceutical companies. Today, through Novo Holdings, many investments have been made in companies that develop and supply vital medicines for people all over the world.

In 2020 alone, it is estimated that the portfolio of companies provided medicines to more than 32.8 million patients (Figure 11.11). This is nearly 10% more than in 2019, where the number of patients who used medicine produced by portfolio companies was approximately 30 million. The number was higher in 2017 and 2018, but the company BTG, which accounted for 8 million users of medicine, was sold and therefore did not count in 2019 and 2020.

Figure 11.11

Number of patient users of medicine, 2017–2020



Sources: Novo Nordisk Foundation, Novo Holdings, BTG and Novo Nordisk A/S.

Technology products (MedTech)

The The Novo Nordisk Foundation Group owns medicine device and technology companies which deliver solutions to millions of people in all age groups within hearing health, chronic diseases, and other types of healthcare and patient care. An example is Novo Holdings' 100% ownership of Sonion (since July 2014), a global leader in designing and manufacturing components and solutions for hearing instruments (hearing aids, in-ear earphones, and hearables/wearables) to improve people's quality of life all over the world. From small children to elderly people who have spent decades in silence, Sonion helps over 40 million every year.

Test facilities and services

The life science portfolio also comprises laboratories. Laboratory medicine makes a significant contribution to medical care. Around two thirds of medical diagnoses worldwide are based on or confirmed by medical laboratory tests. In February 2016, Novo Holdings invested in SYNLAB, which provides modern laboratory analyses that help to confirm diagnoses, derive the right decision from them and monitor the success of therapy. SYNLAB conducted hundreds of millions tests in 2020 alone.





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ISBN 978-87-972186-1-7

Nine principles for societal impact

Fostering
the development of research talent



Investing
in infrastructure



Supporting
research collaboration



Promoting
excellent research



Developing
innovative products and solutions



Creating
jobs and growth



Developing
healthcare and new medicine



Developing
world-class education



Empowering
vulnerable groups in society



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ISBN 978-87-972186-1-7