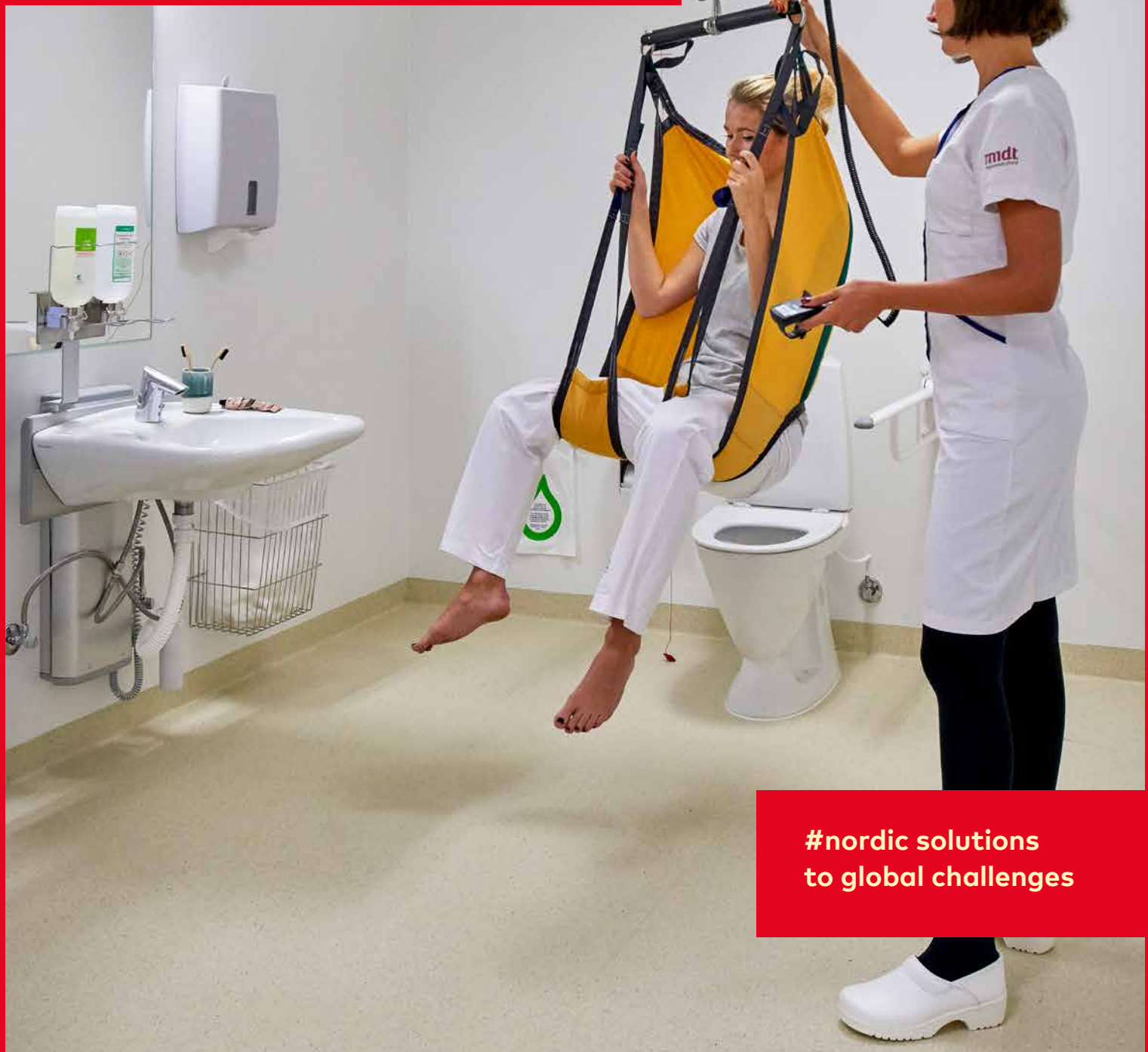




Strongholds and Qualities of the Nordic Health Tech Ecosystem



**#nordic solutions
to global challenges**

Strongholds and Qualities of the Nordic Health Tech Ecosystem

Menon Economics

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Preface

At the beginning of 2017, Nordic Innovation launched the Nordic Welfare Solutions project. The project runs from 2017 to 2019, and aims to showcase and export Nordic health and welfare solutions to the rest of the world.

With this project, we hope to create better access to key markets for Nordic companies offering innovative, effective and sustainable solutions to specific international projects. We know that Nordic cooperation can add value for companies both for branding purposes and accessing new markets. By working together, we create economy of scale by pooling resources and ensuring critical mass in a given market, and we create economies of scope by providing a broader product.

Nordic Welfare Solutions is a flagship project under the Nordic prime ministers' initiative Nordic Solutions to Global Challenges, which is coordinated by the Nordic Council of Ministers. The initiative promotes Nordic solutions and innovations addressing the UN's Sustainable Development Goals.

On assignment from Nordic Innovation, Menon Economics has carried out this analysis of strongholds and qualities of the Nordic health tech ecosystem. In addition to being a knowledge base for Nordic Innovation and our partners, we hope the report will encourage companies and organizations in the Nordic health tech ecosystem to work together in order to export Nordic welfare solutions.

To help us develop, scope and implement this project, we appointed a Nordic export task force. We would like to extend a special thanks to its members for their valuable input during interviews, workshops and throughout the work with this analysis.

The authors are responsible for the content of this report.

Oslo, February, 2018

Svein Berg
Managing Director, Nordic Innovation

**#nordic solutions
to global challenges**

Executive summary

Scope of the report

This report assembles a knowledge base for the Nordic Welfare Solutions project, and gives an overview of the core qualities and strongholds of the Nordic health tech ecosystem, concentrating exclusively on health tech solutions outside of the pharmaceutical industry.

The Nordic health care systems are globally renowned for providing efficient (in cost-benefit terms) and high-quality healthcare to its entire population. This is reflected in international media and political debates, which often point to the Nordics' successful healthcare models, and is confirmed by various international rankings.

Health tech solutions are increasingly part of larger health solution value chains or ecosystems, and companies delivering them are therefore likely to benefit from closer cooperation across industries and countries. Closer Nordic cooperation can help create stronger networks and a critical mass of companies, as well as improve market access and aid Nordic companies in exporting their solutions.

Below we present our main findings and conclusions.

Core qualities

What are the main features of the Nordic health care systems and the framework conditions for health tech in the Nordic countries? In this report, ten hypothesis on potential core qualities in the Nordic health tech ecosystem have been tested.

The findings suggest that the Nordic healthcare systems consistently deliver high quality healthcare to their citizens. The region possesses a healthcare infrastructure with leading knowledge and institutions, which is essential for developing a business stronghold. Moreover, it finds that the Nordic region excels at delivering equitable care to all citizens, relative to comparable regions. This feature, in combination with indicators revealing a high level of trust toward public institutions as well as between citizens, is likely to be important for the development, piloting and home-market commercialization of treatments within personalized medicine.

Analysis of internationally comparable data in the review of core qualities shows that key characteristics of the Nordic countries are high digital competitiveness and comparably high level of digital skills in its population. This makes the region well-suited to develop, test and launch solutions within telemedicine, digital healthcare and ambient assisted living technology.

The Nordic countries dominate international rankings of aggregated "green" performance and are home to leading businesses providing sustainable solutions to a range of business sectors. This includes healthcare and hospitals, where demanding public healthcare institutions encourage private companies to develop green solutions, thus making this sector a stronghold of the Nordic health tech industry.

The set of core qualities assessed in this analysis is important to determine why certain sectors within healthcare technology have become Nordic strongholds. Furthermore, the Nordic core qualities are important when assessing how these sectors may continue to grow, for instance through exports.

"There is an increasing global demand for Nordic smart health tech solutions."

Strongholds

For the purposes of this project, a stronghold has been defined as an area where the Nordic countries *"possess the necessary know-how and knowledge, innovative solutions and a Nordic ecosystem comprising relevant institutions, enterprises, universities and cluster organizations that can support the internationalization of Nordic health tech solutions"*.

The report finds that the following areas express Nordic strongholds within the health tech industry in a good way, and are areas that can serve as useful points of departure for future joint Nordic export initiatives.

1. **Sustainable & innovative hospitals:** This stronghold consists of different industries that participate in the construction and maintenance of hospitals – architects, companies within construction and engineering, solutions providers for increased energy efficiency and environmental performance, logistics providers and producers/suppliers of medical equipment.
2. **Smart digital solutions:** E-health and solutions that facilitate communication in the health sector.
3. **Ambient assisted living/care technology:** Monitoring, self-care solutions, rehabilitation equipment, etc.
4. **Personalized care:** Products based on collection and/or use of big data to create personalized health solutions.

In terms of number of companies, **sustainable & innovative hospitals** is the largest of the four strongholds, and can be argued to have a critical mass of players across industries. Companies within this stronghold benefit from an increasing worldwide demand for Nordic know-how and experience from building sustainable hospitals. There is potential for joint consortia offering easily implementable "turnkey" solutions for hospitals. Although the Nordic region has the potential to deliver value chains through consortia, few good cases exist today.

Smart digital solutions is the second largest stronghold. The Nordic region has a long history of world-leading companies within electronic communication and solutions. In the health tech area, the region has a relatively strong position in eHealth and technical applications. The infrastructure and knowledge level in the population make the region ideal for developing, testing and implementing new digital solutions within healthcare. Many of the companies identified in the business population are relatively small, but a large share of the companies has existed for more than six years, which suggests maturity and export readiness.

For **ambient assisted living technology**, the picture is somewhat similar. The high willingness and prioritization of enabling elderly and disabled to self-manage their lives in their own homes, and the public organization and financing of elderly care, has led to considerable public investments in self-care solutions. This has in turn led to the creation of a range of companies delivering products and services targeting elderly and disabled. And there is a great market potential for these solutions outside of the Nordics. A high share of treatment-specific products and services, for example within diabetes, disability and elderly care allows for a targeted Nordic export effort. Moreover, Nordic companies operating within the Smart digital solutions and Ambient assisted living technology strongholds are relatively export oriented.

The Nordic countries all possess health data and biobanks of the highest quality, and should be well positioned to develop new business around this. However, **personalized care** is a relatively small stronghold. There is an increasing global demand for Nordic smart health tech solutions. However, regulations limiting the access and use of valuable data from the high-quality health registers makes it challenging for companies to exploit those data.

Introduction

Project background

The Nordic countries have their respective strengths in a range of different health markets and segments, but have not yet fully utilized their potential for collaboration. Several studies have identified a potential for more extensive collaboration between the individual countries.¹ The potential for increased collaboration across clusters in the different Nordic countries remains to be leveraged. Nordic Innovation has launched a program – Innovative Nordic Welfare Solutions – to ignite more cross-border collaboration and release this potential.

The overall aim of this study has been to create a knowledge base that can inform a strategy for a joint export promotion effort and internationalization of Nordic healthcare companies.

The project consists of three main tasks:

- Identify Nordic "core qualities"
- Verify and elaborate on the four identified strongholds in the Nordic health ecosystem described in the project mandate
- Map out the Nordic companies within the strongholds

The analysis covers both the core strengths within the Nordic health industry, focusing on the companies developing and providing products within the health sector, and the strengths of the Nordic health ecosystem that the region offers. While the discussion on strongholds focuses on the strengths of companies in the private sector, the "core quality" discussion assesses the strengths of the health ecosystem (public and private).

For the purposes of this project, a stronghold has been defined as *"an area where we possess the necessary know-how and knowledge, innovative solutions and a Nordic ecosystem comprising relevant institutions, enterprises, universities, cluster organizations that can support the internationalization of Nordic health and welfare solutions. A strong business community and potential, and a certain Nordic balance, is required for an area to be a "Nordic" stronghold."*²

To identify and describe the core strengths – strongholds – of the Nordic health industry, we have focused on:

- *Identifying companies, products and services that can be targeted for a joint export promotion effort within the sub-categories of the strongholds.*
- *Verification of strongholds against a representative company population, interviews, literature review and survey results.*

¹ Notably the EY Nordic Life Sciences sector study 2014.

² The definition is stated in the project mandate by Nordic Innovation.

The stronghold should be supported by relevant core qualities. Hence, there is a certain relation between strongholds and core qualities; they are interrelated dimensions of the total Nordic health ecosystem.

Core qualities:

- *Focus on verifying core qualities that can be used in the branding/story telling of the Nordic health solutions identified under "strongholds".*
- *Qualitatively testing the core qualities through a benchmarking exercise, with the aim of finding a set of key core qualities.*

Data collection and method

The empirical approach we use in this report to test and verify the existence of potential strongholds, core qualities and the export potential of products and services produced within the Nordic health care system is based on four empirical sources. In the following, these four sources are described in detail.

Company database

To address the fundamental questions in this report in a systematic manner, a comprehensive company database has been developed. This database enables us to perform a quantitative analysis. Together with the in-depth interviews, an online survey, and analysis of relevant academic literature this quantitative analysis represents the main empirical input.

The database enables us to recognize and analyze patterns of strengths within the Nordic business population and to identify companies with particularly good export potential. The database does not aspire to be a complete overview of all companies operating within the health care industry in the Nordic countries. It focuses on *innovative companies that offer solutions that can be exported*.

Membership lists of health tech industry organizations in all the Nordic countries have been an important source of information during the compilation of the database. Most, if not all, of the leading companies within for example medtech are indeed members of these national organizations. However, industry organizations and clusters are not the only sources that have been used. An overview of the specific sources is included in the annex. Companies have been selected based on the following criteria:

- The company should originate from one of the five Nordic countries. In some cases, we have included Nordic subsidiaries of foreign companies. In those cases, the company has a long-standing presence and conducts R&D activities in the Nordics.
- Foreign companies that exclusively distribute or sell products in the Nordic market are not of interest, and hence excluded from the database.
- The activity of the companies included in the database must fall under the definitions of the stronghold. This implies that pharmaceutical companies and healthcare providers are excluded from the database.
- The companies figuring in the database produce a product or service that can be exported. Companies that only sell and distribute products produced by other companies are not included in the database.

After an initial collection of companies, a proposed company database was reviewed by the task force members. The database was then updated based on the task force members' feedback.

The final company database contains close to *700 companies*. To the best of our knowledge, all these companies satisfy the criteria listed above.³

Interviews

The purpose of the interviews has been to gain in-depth insight with respect to the more complex evaluation questions. The interviews we conducted were semi-structured, which implies that the respondents could associate freely, ask questions, and were not bound to choose between pre-made answer alternatives. In addition, the nature of the communication form of interviews permitted us to ask follow-up questions. The latter proved to be an advantage, especially when the interview object mentioned themes or aspects we had not thought of in advance. The interviews allowed us to ask more in-depth questions and receive more thorough answers than what can be expected from a survey. Hence, questions where it is natural to give more categorical answers were allocated to the survey. The information gained from the interviews and survey should be regarded as complementary.

The interviewees are members of organizations that are related to health care, export and business in the Nordic region. We did 15 interviews in total with a duration of approximately one hour, based on an interview guide.

Online survey

The purpose of the survey has been to gather information from the Nordic companies in the health and welfare industry. The survey asked about their experience of the strengths, core values, market barriers and export opportunities in the Nordic health and welfare industry.

The respondents to the survey are key employees in companies listed in the company database. Contact information was obtained from the internet, mainly from company home pages.

The respondents were asked to answer questions related to the strengths of the Nordic healthcare systems, the export potential of a variety of healthcare products and services produced in the Nordic region, the potential of current and future export markets, and the Nordic healthcare system's perceived core qualities. In addition, the survey results enabled us to see whether the opinions of employees in the business sector are in line with both the expert assessments obtained from the interviews, and relevant literature studies.

Literature review

The purpose of the literature study has been to qualitatively test the proposed Nordic strongholds and core qualities of the region considering a broad set of studies and reviews. We have reviewed research discussing specific features of international and regional healthcare, more comprehensive literature regarding innovation and business development in the Nordic region, as well as reviews of the Nordic region's current and potential export.

³ Nordic Innovation administers the database and can provide information upon request.

In the desk research, where the healthcare systems in the Nordics and their comparative strengths were reviewed, country reports from the European Observatory on Health Systems and Policies (EOHSP), the OECD and the World Economic Forum (WEF) have been central. In addition to research results, internationally comparable health and business indicators by the OECD and the WEF have been processed and analyzed and further contextualized to confirm or discard suggested strongholds and core qualities of the Nordic region.

In the process of reviewing the Nordic region's business environment for innovation and transformative technology within healthcare and its export potential, we have also conducted a literature study. Key sources of material in this research were reports and studies from NGOs, such as the WEF and the OECD, research institutes and consultancies, like FAFO, EY, KPMG and Menon's own publications, export promotion agencies from the Nordic countries, including Innovation Norway, Promote Iceland and Business Sweden, reports from the relevant industry organizations such as Healthcare Denmark, and official white papers and judicial documents from the Nordic governments.

The relevant information from a large set of reports and material reviewed in the literature study has been summarized and analyzed. This work has formed the basis for the evaluation of the suggested core qualities of the Nordic region, as well as the review of Nordic strongholds within the health industry and its export potential.

Core qualities

The Nordic welfare state model is increasingly acknowledged for its ability to deliver economic growth and equality at the same time. The Economist coined it the "next supermodel" on the front cover of the magazine already in 2013.⁴ An important reason is the high level of trust citizens in the Nordic societies show each other and its institutions. This is to be regarded as a core quality of the Nordic region, further fostering other qualities such as high-quality and equitable healthcare for all citizens. As an underlying premise, the considerable mutual trust in the Nordic societies, and the welfare model it has formed, help explain other core qualities that make the region an attractive place for the development and production of innovation. Well-developed and comprehensive safety nets, in terms of both healthcare and social security schemes, reduce the threshold for entrepreneurship and financially risky start-up operations. Society's trust that those who succeed will create well-paying jobs and pay a considerable share of their profits in taxes have further induced the establishment of tax incentives and public contribution schemes for innovative entrepreneurs.

Though "trust" as an overarching core quality is important in understanding the development of the Nordic welfare model, there are several other characteristics that make development of innovative solutions and new technology within healthcare so successful in the Nordic region. In the following chapter, we review ten suggested core qualities that are associated with the Nordic region and the Nordic healthcare system. The review is based upon a thorough literature study, a survey of Nordic companies producing products or services within the health industry and several interviews with stakeholders in the Nordic health industry.

The ten core qualities we review are:

1. The Nordic healthcare system is characterized by high quality and knowledge
2. The Nordic region provides equitable healthcare to all
3. The Nordic region has a competitive institutional environment that promotes innovation and entrepreneurship in healthcare
4. The Nordic region is at the forefront of "sustainable healthcare"
5. The Nordic region is recognized for smart digital and mobile healthcare solutions
6. The Nordic countries are early adopters of new treatments and technology and at the forefront of developing new production methods
7. Openness within public institutions to adopt new technology and well-functioning public-private partnerships that foster innovation
8. The Nordic healthcare model is based on openness and citizen involvement
9. The Nordic healthcare system is benefitted by the "Nordic way of work", which is built on trust, flat structures, and citizen trust in public institutions
10. Unique availability of register data of high quality that can be used to tailor medicine and treatment to individuals.

⁴ <https://www.economist.com/news/leaders/21571136-politicians-both-right-and-left-could-learn-nordic-countries-next-supermodel>

Overall results

Reviewing international rankings and comparisons across a range of societal features as well as an extensive review of studies and research reveals that there is considerable consistency between the results from our survey and the literature. Depicted below are the results from our survey. The suggested core qualities are ranked in accordance with the share of respondents who replied that they either “agree” or “strongly agree” with the statements.

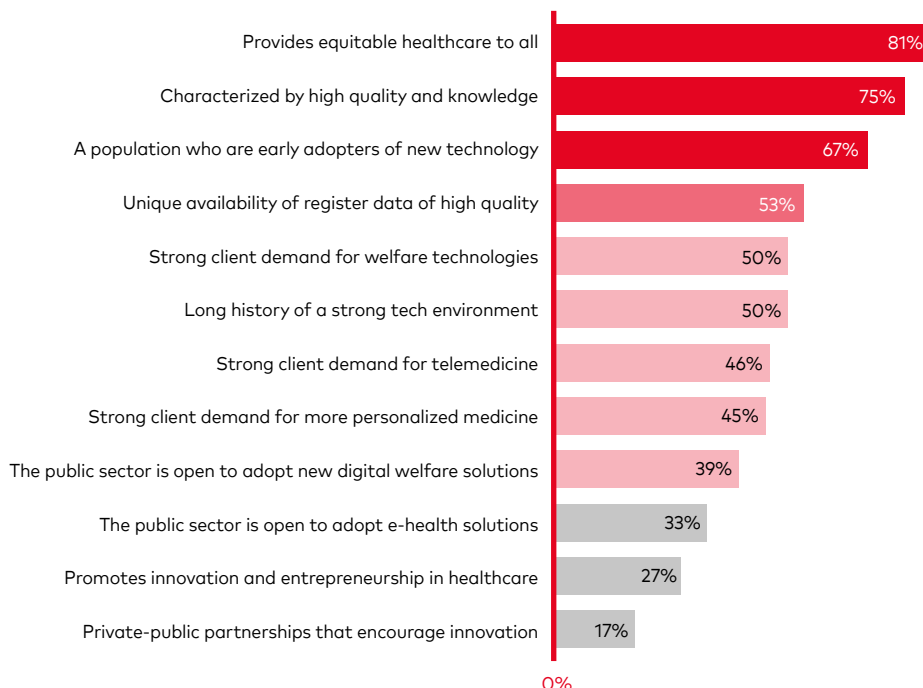


Figure 2-1:
Share of respondents that either “strongly agree” or “agree” with statements concerning the Nordic region.

Source: Menon Economics.

The three proposed core qualities which got the most and least support, respectively, are highlighted in the illustration above. In the literature and research study, we have executed an equivalent ranking of Nordic core qualities in relation to healthcare. This ranking is a result of a comprehensive evaluation of data from organizations such as the OECD, the World Economic Forum and the European Commission, as well as a review of studies and research within the realm of the proposed core qualities and the healthcare systems in the Nordic region. Below is a table showing the top and bottom three core qualities, from the survey and our evaluation.

| Indicators and qualitative testing | Survey results |
|--|---|
| The Nordic healthcare system is characterized by high quality and knowledge | The Nordic region provides equitable healthcare to all |
| The Nordic region provides equitable healthcare to all | Nordic healthcare system is characterized by high quality and knowledge |
| Unique availability of bio-banks and high-quality register data that can be used to tailor medicine and treatment to individuals | Nordic countries are early adopters of new treatments and technology |

Table 2-1:
Top three core qualities. Results from qualitative literature review vs. survey.

Source: Menon Economics.

The Nordic countries are all well-developed democracies with relatively small economic differences. These qualities of the region are an important reason for why the healthcare systems are both of high quality and regarded as equitable, in an international perspective. Considering that the Nordic healthcare systems are well-funded and equipped with high competence throughout the system makes them well-placed for the early implementation of new treatments, methods and products. Our survey reveals that the respondents consider this last feature to be a core quality of the Nordic model and healthcare system. The qualitative study does however find that there is some room for improvements with regards to procurements and implementation of new technology and solutions in Nordic hospitals.

The countries in the Nordic region all have well-developed registry-based population data covering a long time span. Combined with high levels of trust between citizens and towards public institutions this data provides unique research and development possibilities within fields such as personalized medicine and public health.

**Table 2-2:
Bottom three core
qualities. Results from
qualitative literature
review vs. survey.**

Source: Menon Economics.

| Indicators and qualitative testing | Survey results |
|---|---|
| The Nordic region has a competitive institutional environment that promotes innovation and entrepreneurship in healthcare | Well-functioning public-private partnerships drive the development of transformative healthcare solutions |
| Well-functioning public-private partnerships drive the development of transformative healthcare solutions | The Nordic region has a competitive institutional environment that promotes innovation and entrepreneurship in healthcare |
| Openness within public institutions to adopt new technology drives innovation | Openness within public institutions to adopt new technology drives innovation |

The above table shows the three proposed core qualities that both the qualitative study and survey regarded to be the least relevant and "true" core qualities of the Nordic region. As is evident, the qualitative study and the survey respondents concluded on the same three alternatives. Notably, all the above statements involve public institutions and their role in promoting and facilitating innovation within healthcare. The Nordic region generally scores well in international rankings of innovation, digitalization and technological adaption among public institutions. However, the countries in the region score less well on rankings of public procurements of advanced technologies. Studies suggests that this also holds for the public healthcare institutions (primarily hospitals), where a focus on increased productivity and risk aversion among public procurers has shrunk the room for innovative and transformative procurements.

In the following, the proposed core qualities are presented and discussed based on relevant internationally comparable indicators and research literature.

In the following, the proposed core qualities are presented and discussed based on relevant internationally comparable indicators and research literature.

Discussion of the core qualities

Healthcare system characterized by high quality and knowledge

In a comparative analysis of healthcare systems, with an ambition to compare or rank nations or regions by healthcare quality, one must define the scope of "quality". There are multiple approaches one could choose. Comparative indicators such as life expectancy, survival rates for certain diseases and amenable death rates are some examples of what is commonly used for this purpose. In international comparisons of these indicators, the Nordic countries generally score high. It is however important not to ascribe all differences in e.g. life expectancy among countries and regions to differences in the quality of their respective healthcare sectors. Factors outside the healthcare system, such as levels of alcohol and tobacco consumption and the level of education and income, may well affect cross-country variations in indicator values of healthcare quality.

Even though one could argue that survival rates for certain diseases and life expectancy might well be influenced by a range of factors, the quality of the healthcare system is by far the most important. In terms of life expectancy, the Nordics generally score quite well, although there are differences between the individual countries. As evident from the figure below, Denmark and Finland have a notably lower life expectancy than the three other Nordic countries. Note however that all the Nordic countries rank above the OECD average with regards to life expectancy.

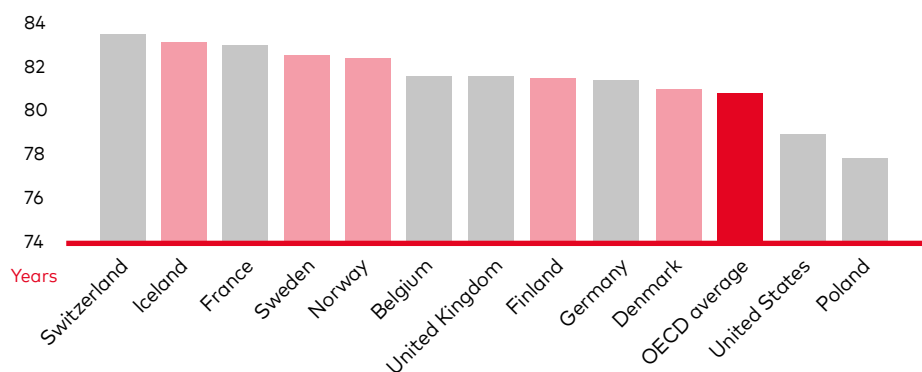


Figure 2-2:
Life expectancy at birth 2014, selected OECD-countries.

Source: OECD, 2017.

Life expectancy is one of several indicators that may be used to rank countries' healthcare systems. There are however also indices comprised of different countries' death rates from a range of diseases that should not be fatal if effective and correct medical care is provided. One such index and ranking is presented in a newly published article,⁵ where death rates from 32 specific diseases in 195 countries are assessed. In the overall index, the Nordic countries score well, with four countries being among the top seven healthcare systems in the world. Denmark however is an outlier in a Nordic perspective, ranking 24th.

⁵ Collaborators listed at the end of the article (2017), Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015: a novel analysis from the Global Burden of Disease Study 2015.

Deaths caused by different forms of cancer are of key importance in calculating the index values referred to above. In general, though, survival rates for several of the most life-threatening cancer forms are high in the Nordics, as illustrated by the figures below.

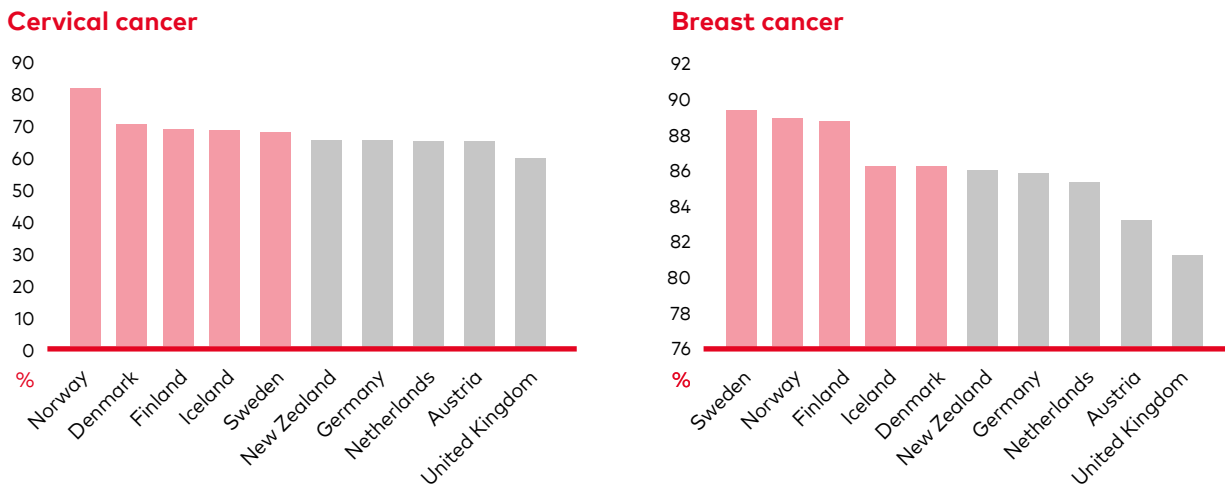


Figure 2-3:
Survival rates
for cervical and
breast cancer, total
population aged 15
years or older, selected
countries, 2007-2013.

Source: OECD (2017).

A well-established indicator for the quality of the healthcare system is the rate of amenable deaths. Amenable mortality refers to deaths that are potentially preventable by effective and correct medical care. A study by Joumard, Andre, Nicq and Chatal (2010)⁶ found that the Nordics have relatively few amenable deaths, compared to other OECD-countries. The study does however find that there are some notable differences within the Nordic region. Iceland stands out in the statistics with a very low prevalence of amenable deaths (only France had fewer), while Denmark is the Nordic country with the highest frequency of amenable deaths.

Indicators, as those illustrated and discussed above, show that the Nordic healthcare systems deliver healthcare services of high quality to their citizens compared with other countries and regions in the western world.

An alternative to international rankings based on indicators of medical performance of countries' respective health care systems are user surveys. User experience surveys regarding the healthcare sector in the Nordic countries are in general positive, though long waiting times are reported as a factor that reduces the patients' overall assessment of the quality of care they receive. However, as underlined by EOHSP in its report on user experience in Sweden,⁷ results in such surveys are affected by individuals' expectations. Citizens in the Nordics expect high quality healthcare services at very low personal cost. As there are low (if any) financial barriers to healthcare services, queues and waiting times are a natural consequence of the healthcare model in the Nordics. Some Nordic countries (Norway and Sweden) have at times been ranked rather poorly in Europe with respect to waiting times for non-critical care. Waiting times and hospital queues have however received considerable

⁶ Joumard, Isabelle and Andre, Christophe and Nicq, Chantal and Chatal, Olivier, Health Status Determinants: Lifestyle, Environment, Health Care Resources and Efficiency (2010). OECD Economics Department Working Paper No. 627.

⁷ European Observatory on Health Systems and Policies (EOHSP) (2012), Sweden – Health system review.

political attention in recent years, and waiting times as well as reported user experience have improved (EOHSP). As can be seen from Figure 2-1, our survey results confirm the findings from literature study and international rankings. Approximately 75 percent of the respondents in our survey agreed with the statement that the Nordic healthcare systems are characterized by high quality and knowledge.

Equitable healthcare to all citizens

All the Nordic countries have universal public healthcare systems that are primarily tax-financed, rather than through mandatory health insurance schemes.

In all the Nordic countries except Denmark, there are user fees for primary healthcare (in some countries this also applies to specialized/hospital healthcare services). All systems impose small personal co-payments on pharmaceuticals. The level of the user fees or co-payments generally contains some sort of maximum personal cost ceiling for the individual over a certain period (e.g. 12 months). If not, schemes are implemented in such a way that citizens lower on the income and wealth distribution scale get access to all necessary healthcare services regardless of personal income.

These features of the Nordic healthcare systems make them one of the most equitable in the world, providing high-quality care to all citizens, regardless of geographic location or socioeconomic status. One indicator of this is the low share of citizens reporting that costs are a barrier to necessary medical care. Although Norway and Sweden are the only countries included in the OECD statistic illustrated below, international health care reviews (notably country reviews by the EOHSP) reject the notion that personal costs are a barrier of significance in the three other Nordic countries.

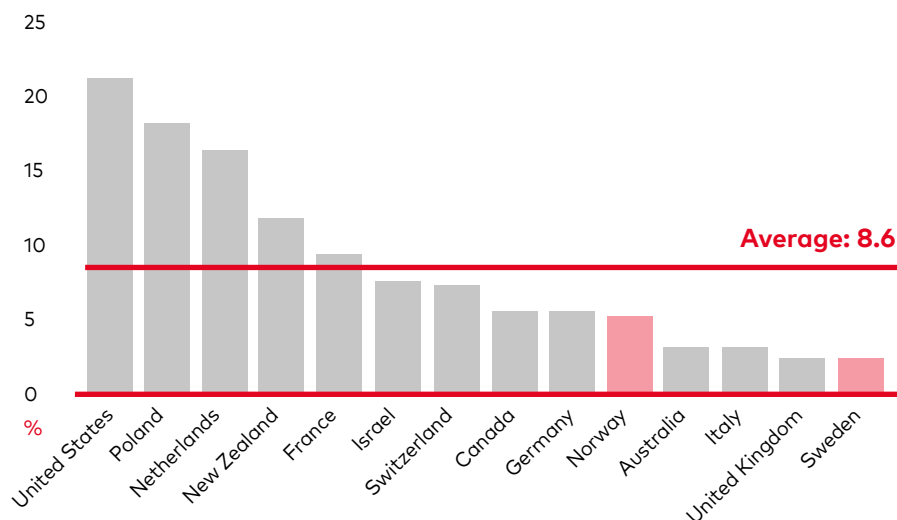


Figure 2-4: Medical tests, treatments or follow-up consultations skipped due to costs in healthcare. Results from 2013.⁸

(Sweden and Norway are the only Nordic countries who have reported data on this indicator). Source: OECD, 2017.

There are some variations within the Nordic region regarding access to high quality healthcare. EOHSP notes that geographical and socioeconomic inequities with respect to access and usage of healthcare services are comparatively low in Norway, Denmark and Iceland. Such differences may however be more pronounced in Finland and Sweden, according to some

⁸ Average for all countries for which 2013 data are available.

studies,⁹ which may partly be explained by the fact that both financing and organization of healthcare in these countries are more decentralized than in Denmark, Norway and Iceland.

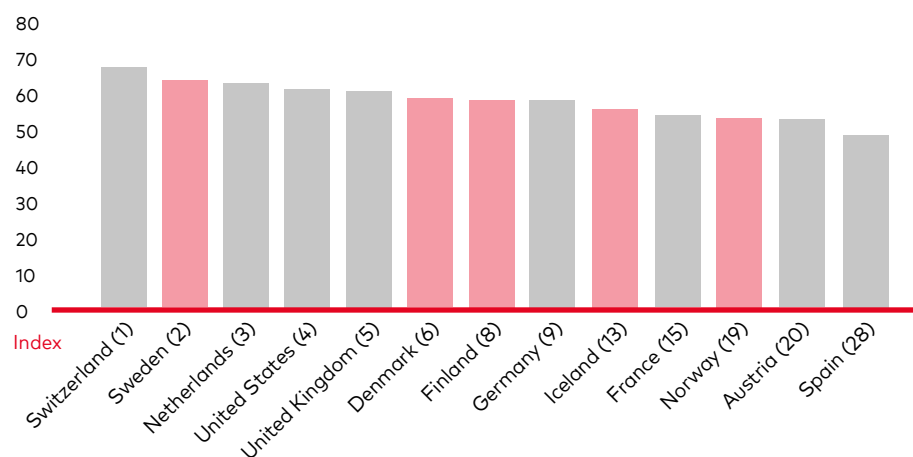
As a conclusion we find that access to high-quality healthcare services could well be defined as a core quality of the Nordic health care systems. This is supported by the fact that 81 percent of the respondents in our survey agree with the notion that a core quality of the Nordic health care systems is the feature of supplying equitable health care services to all citizens.

An institutional environment that promotes innovation and entrepreneurship

Despite small populations, the Nordic countries are at the international forefront with regards to innovation and entrepreneurship. A stable, reliable and well-functioning political environment, high levels of education and digital competence among the population, well-developed technological infrastructure and a high degree of business sophistication are put forth as key explanations in international rankings.

Figure 2-5:
Global Innovation Index 2017. Rank in parentheses.

Source: Cornell University, INSEAD, and the World Intellectual Property Organization, 2017.



As is evident from the ranking illustrated above, the Nordic region is represented by three of the regions' nations within the top ten in the world in terms of innovation. With regards to entrepreneurship, some Nordic countries also excel in international rankings. Sweden, Denmark and Iceland are all ranked within the top six in the world. Norway is however an outlier compared to the other Nordic countries with regards to both innovation and entrepreneurship (as can be seen in the ranking illustrated below).

It is also argued that the informal culture and ease of communication between companies and industries provide favorable conditions for the creation of *innovation ecosystems*.

⁹ van Doorslaer, Masseria and Koolman, (2006), Inequalities in access to medical care by income in developed countries.

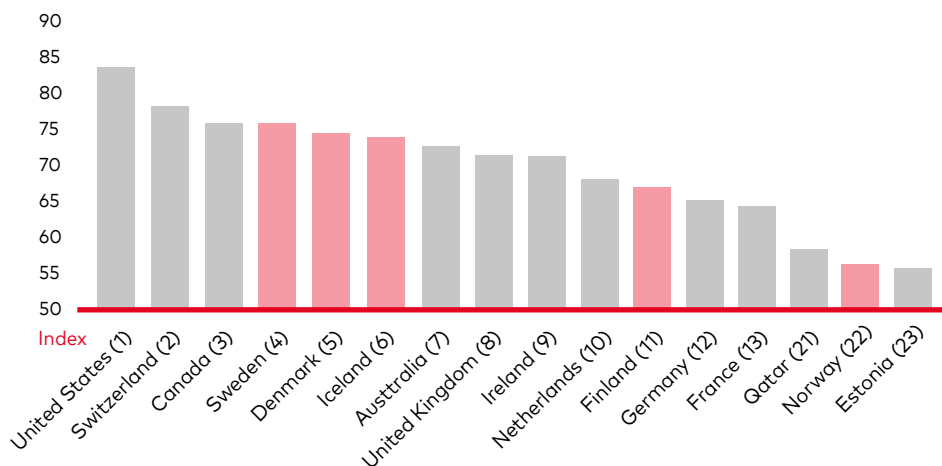


Figure 2-6:
Global Entrepreneurship
Index 2017, Rank in
parentheses.

Source: The Global Entrepreneurship and Development Institute (GED), 2017.

FAFO,¹⁰ a Norwegian research institute, notes that the Nordic innovation systems are among the most advanced in Europe and that this can partly be attributed to policies throughout the years that have increased education levels and technological competence as well as to gender equality policies that have increased employment rates and economic growth in all Nordic countries.

The fact that the Nordic economies are rich, with high labor costs and open capital markets, might also help explain why the Nordic countries are regarded as such good environments for innovation and entrepreneurship. As labor costs rise, innovations and solutions that rationalize the use of labor resources have an increased economic return. This economic mechanism is especially prevalent within the healthcare sector. Demographic changes and expected developments in the burden of disease towards higher life expectancy and more multimorbidity among the elderly are expected to create a huge increase in the demand for labor resources in the healthcare sector in most of the Western world. Demand for innovations that can streamline the production of goods and services needed in this sector is hence expected to grow.

International reviews and comparisons indicate that the Nordic region fosters considerable innovation and entrepreneurship. The fact that the buyers of health care technology and solutions are few and big, as the public sector is the biggest supplier of medical treatment (and hence buyer of technology and products), and that the Nordic market is small makes successful development and market access of innovations more difficult than in other systems and regions. Being big and few gives these buyers a stronger position in procurement negotiations, which may help to explain why a comparatively low share of the respondents in our survey agreed with the statement that the institutional environment in the Nordic region helps to foster entrepreneurship and innovation in healthcare, as is apparent in Figure 2-1.

¹⁰ FAFO (2014), Innovation and innovation policy in the Nordic region.

Sustainable healthcare – the Nordics at the forefront

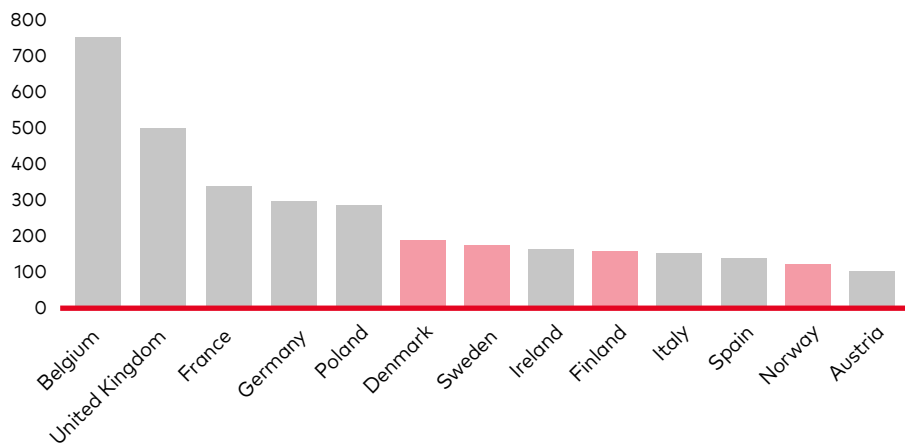
The term *sustainable healthcare* comprises several features within healthcare and hospitals, energy efficiency, corporate social responsibility and environmentally friendly production of pharmaceuticals being some examples.

The Nordic countries are generally regarded as the “greenest” countries in the world, dominating indices such as the Environmental Performance Index,¹¹ where the top four countries are Nordic, as well as the Global Green Economy Index¹² (Dual Citizen LLC), where all the Nordic countries are ranked among the top 9.

The focus on environmental sustainability in the Nordic countries has also transcended to healthcare. One indication for this are the high energy efficiency and comparatively low levels of CO₂- and NO_x-emissions from hospitals in the Nordic countries, as shown in the illustration below. Another example for the increased focus on sustainability in healthcare is the newly released Nordic guide to green procurements in the healthcare sector.¹³

Figure 2-7:
Carbon dioxide (tons)
per thousand inpatient
care discharges in 2014

Source: OECD (2017) and Eurostat (2017).



Sustainability as a general goal and policy can well be put forth as a core quality of the Nordic societies. Citizens in the Nordic countries value products and services with environmentally friendly characteristics, and this is reflected in political measures and priorities, such as green procurements. In the survey conducted in conjunction with this project we asked the respondents about their views on the Nordics' potential for export within Sustainable hospitals. As is evident from Figure 2-1, about 40 percent of the sample of respondents regard the export potential as either “high” or “very high”. In comparison, about 75 percent responded that Smart digital solutions have a “high” or “very high” export potential. One reason why sustainable hospitals are regarded as having less export potential than products and solutions in other healthcare market categories may be related to the characteristics of the products and solutions within this field.

¹¹ Hsu, A. et al. (2016). 2016 Environmental Performance Index.

¹² Dual Citizen LLC (2016), The Global Green Economy Index, GGEI 2016.

¹³ Nordic Council of Ministers and PlanMiljø (2017), Greener Textiles in Hospitals – Guide to green procurement in the healthcare sector. The guide was initiated by the Danish EPA, financed by the Nordic Council of Ministers and produced by PlanMiljø (a Danish consultancy) and TEM (a Swedish foundation).

The Nordic region is recognized for smart digital and mobile healthcare solutions

The feature of the Nordic countries of being early adopters of new technology is not unique to the healthcare sector. The ranking listed below depicts the results from World Economic Forum's surveys in 2015 and 2016 (weighted average of the two surveys) related to businesses' and public institutions' abilities to adopt new technologies.

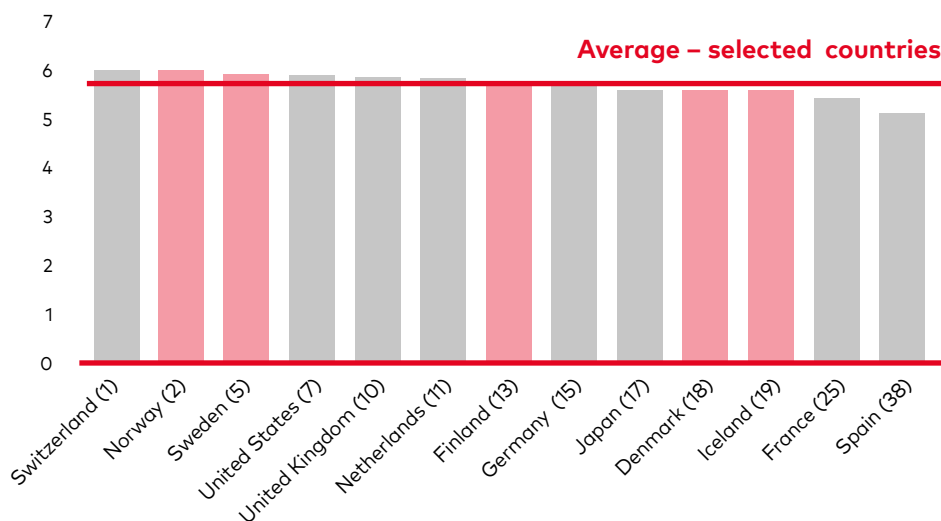


Figure 2-8: Perception of technological adoption among public institutions and private businesses. Index 1-7 (very good).

Source: World Economic Forum – The Global Competitiveness Report 2016-2017 (2016).

Although all the Nordic countries are ranked within the top 20 in the world, it is evident from the ranking and scores depicted above that there are some variations among the Nordic countries with regards to the countries' perceived technological adoption abilities.

The European Commission, like the World Economic Forum, also evaluates digital performance and competitiveness on a cross-national basis. The Digital Economy and Society Index (DESI) consists of five indicators.¹⁴ The composite index is illustrated below and shows that those Nordic countries that are members of the EU rank at the very top with regards to digitalization.

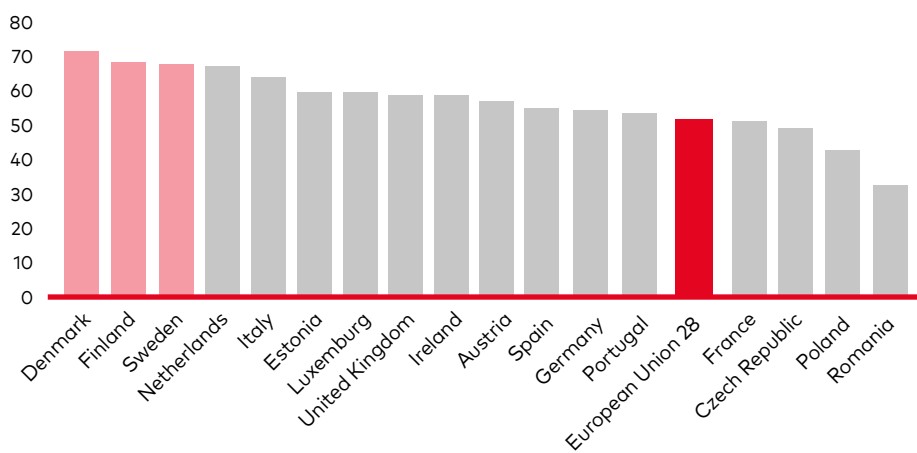


Figure 2-9: The Digital Economy and Society Index (DESI) 2017. Composite index values (0-100) for selected countries (Norway and Iceland are not members of the EU and hence not evaluated by the EC).

Source: The European Commission.

¹⁴ The five indicators are connectivity, human capital/digital skills, use of Internet by citizens, integration of digital technology by businesses, and digital public services. For a more detailed description, see <https://ec.europa.eu/digital-single-market/en/desi>.

Assessing the five different indicators that the overall index consists of, it is evident that the Nordic countries score particularly highly within *Integration of Digital Technology and Use of Internet*. Within healthcare, the high level of integration of digital information is evident in the Nordic hospitals' in-country digital exchange of patient information. Such systems improve the efficiency of healthcare and can also improve the quality of care. In 2014, such in-country digital information exchange did not exist in any other member states of the European Union.¹⁵ Additionally, our survey reveals that it is Smart digital solutions, products and solutions within healthcare that are considered to have the foremost export potential in the Nordic region.

The Nordics as early adopters of new technology

As is evident from the ranking of technological adaption among public institutions and private businesses (page 23), Norway and Sweden are put forth as being among the best in the world. Such rankings however are usually executed at an economy and country level and not for specific sectors. Hence, there are no countrywide rankings of the perception of the technological adaption within the healthcare systems in these different countries.

However, our survey results, where the respondents consist of businesses within the healthcare industry in the Nordic region, show that the respondents regard the Nordic populations' ability to adopt and implement new technology early as a key core quality of the region. The fact that the populations in the Nordic countries are early adopters of new technology, expect high quality healthcare and generally have high labor costs makes investments in new technology and solutions profitable. Hence, the Nordic region has a number of prerequisites that should favorize the region for pilot testing and early introduction of such products and services. One area of concern, highlighted in our survey, is however the public healthcare institutions' lack of incentives to procure innovative healthcare equipment and solutions. Considering the limited market size of the Nordic region, public procurers should be less risk averse when making procurements and more open to crediting innovative solutions in healthcare procurements.

Public-private partnerships that foster innovation

The ranking of different countries' public procurement of advanced technologies illustrated below is based on a cross-national survey, conducted by the World Economic Forum. Businesses in different countries have been asked to assess to what extent government purchasing decisions foster innovation. As is evident from the results, the Nordic countries are not among the countries where private businesses regard their respective governments as particularly successful in this area. Additionally, there are variations among the Nordic countries. Notably, Norway is ranked as number 16 in the world while Denmark is ranked at number 65, with a score value equivalent to the world average, at 3.4.

Considering how highly the Nordic countries rank in international comparisons, both with respect to innovation and entrepreneurship, as depicted in chapter p. 20–21, it may appear contradictory that the Nordics are not better at

¹⁵ EY (2014), Nordic Life Sciences sector study 2014.

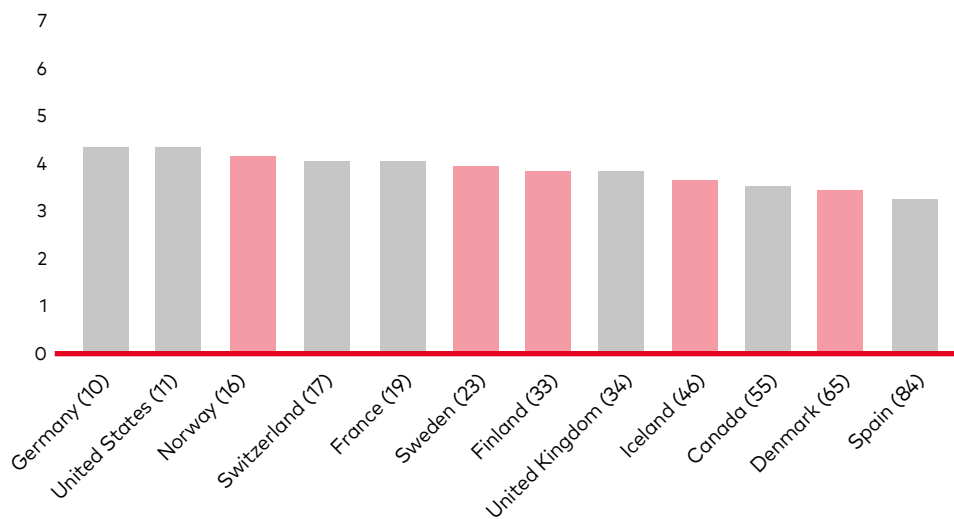


Figure 2-10: Government procurement of advanced technologies 2016, selected countries. Rank in parentheses. Points from 1–7 (best).

Source: World Economic Forum (2017).

innovation in their government procurements. One reason for this might be that the Nordic countries have incorporated procurement policies and standards which emphasize minimizing the financial risk for the procurer. To some extent, this assumption is confirmed in the literature. Survey results from a recent study conducted by Menon Economics¹⁶ found that more than half of the respondents (businesses in the Norwegian health industry) agree to the statement that the practice of public procurements of health technology hampers the development of new innovative technology and services. A report on innovation in European healthcare¹⁷ comes to the same conclusion.

As is evident from Figure 2-1, only 17 percent of the respondents to the survey conducted in this project agree with the statement that public-private partnerships in the Nordics encourage the development of transformative healthcare solutions. This finding is supported by reviews and studies of the Nordic healthcare systems. As discussed in chapter p. 20–21, there is however reason to believe that new technology which increases labor efficiency in healthcare may be vital for the financial sustainability of today's Nordic healthcare systems as costs in this sector are expected to increase rapidly in the coming decades. The public procurers of health technology and solutions in the Nordics could, and should, play a bigger role in the development of transformative technologies within healthcare.

The Nordic model is based on openness and citizen/patient involvement

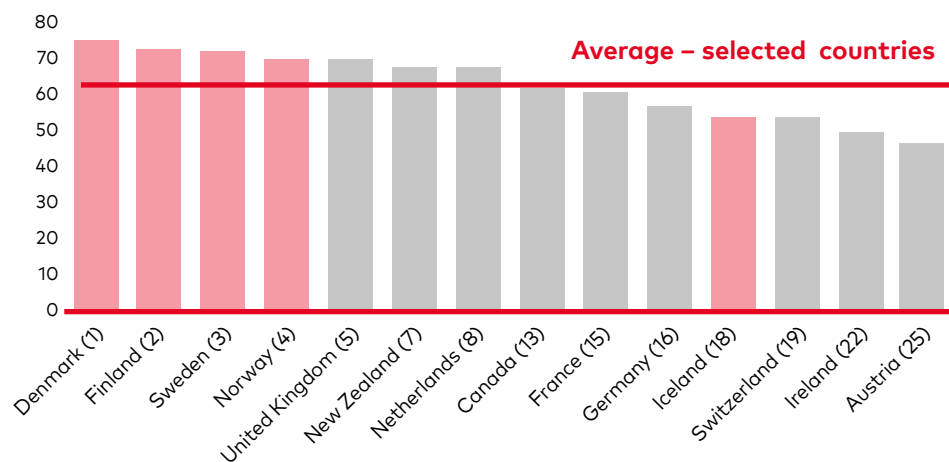
Transparency in healthcare improves the citizens' trust in the system and reinforces the social contract of tax financing in universal healthcare models such as those established in the Nordics. Further, research shows that transparency in health data and publications leads to improvements in the quality of healthcare and gives improved health outcomes.¹⁸

As is evident from the index illustrated above, the Nordic region has the most transparent healthcare systems in the world. The overall index is based on 27

¹⁶ Menon (2017), The Value of the Health Industry
¹⁷ LIF and Vasco Advisors (2012), Innovation in European healthcare – what can Sweden learn?
¹⁸ KPGM (2017), Through the looking glass – A practical path to improving healthcare through transparency.

Figure 2 11: Global health systems transparency index – composite results (overall ranking in parenthesis).

Source: KPMG (2017).



indicators for each country. KPMG notes that the Nordic countries especially excel in transparency in Finance, Governance and Personal healthcare data.¹⁹

The Nordic governments have had a focus on patient and citizen involvement in healthcare throughout the last decades. This focus on enhancing patients' involvement in decision-making and more generally to support a feeling of personal autonomy vis-à-vis the healthcare system, is motivated by the recognition that this makes patients more satisfied, feel more responsible for their own health as well as improving healthcare outcomes.²⁰

Patient and citizen involvement in healthcare has two dimensions. Firstly, involvement and participation in medical decisions concerning the individual. Although there are some differences among the countries in the Nordics, they have, as most western governments, implemented policies that strengthen the patient's judicial rights in the last decades. Examples for this are waiting time guarantees and the introduction of policies that extend the patients' right to choose healthcare providers (both within primary and specialized care/hospital). Secondly, patient organizations' influence on healthcare policy. Magnussen et al. (2009) notes that such organizations have a growing role in healthcare policy in the Nordics and that the prerequisites for them to get increased influence are at hand. This is due to several factors, whereof two are the characteristic of the Nordic healthcare system of multiple levels of governance, which enables patient organizations to interact with policy makers at different levels. Secondly, proposals for new legislation are in the Nordic countries distributed to the largest patient organizations for consideration and feedback which is then taken into account by policy makers.

The literature as well as comparable international statistics and reviews all suggest that transparency and patient involvement are to be considered a core quality of the Nordic healthcare model. This feature of the region and its healthcare systems, along with the well-developed and comprehensive register data, make the region an ideal place for clinical testing of new treatments, solutions and technologies.

¹⁹ Iceland lags the other Nordic countries in this index, mostly due to lower perceived transparency in Governance and Personal healthcare data compared to the other Nordic countries.

²⁰ Magnussen, Vrangbæk and Saltman (2009), Nordic Health Care Systems – Recent reforms and current policy challenges, chapter 6.

"The Nordic way of work"

A high level of trust, between citizens as well as towards public institutions, has positive effects on the economic performance of a society. As is evident from the ranking illustrated below, those of the Nordic countries for which data are available were all among the highest ranked.

Knack (2001)²¹ makes a distinction between these effects. Microeconomic effects of higher levels of trust concern interpersonal relations. Increased levels of this form of trust in a society have been proven to decrease transaction costs, enforce contracts and improve access to credit on the

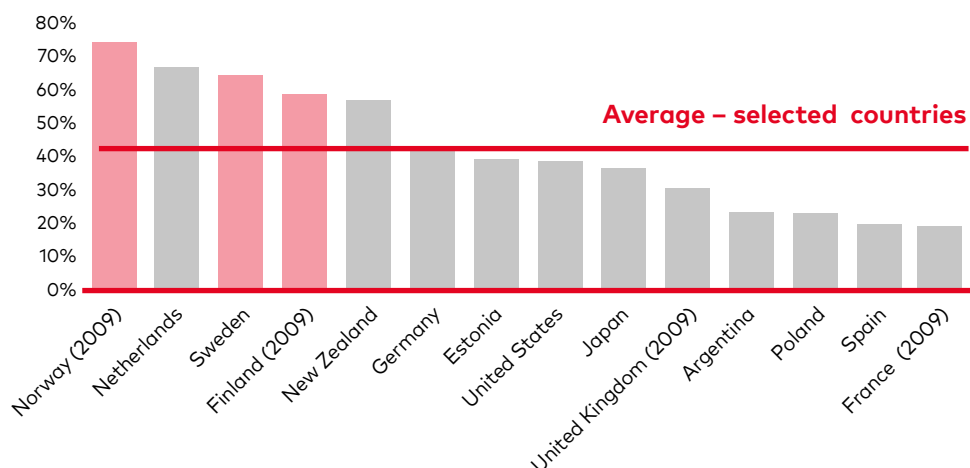


Figure 2 12: Trust in others, share of respondents agreeing to the statement "Most people can be trusted", 2014 (results from 2009, where 2014 is not reported). More than 100 countries included.

Source: Our World in Data, Oxford University.

individual level. On the macro-political level, Knack (2001) refers to studies showing how societies with higher levels of institutional trust have stronger democratic governance, higher efficiency in public administration as well as higher quality within economic policy in general.

International comparisons of the perceptions among employers and employees with regards to both how efficiently talent is preserved and nurtured and willingness to delegate authority²² indicates that a high level of trust in the Nordic societies and the flat structures/hierarchy foster efficiency.

The high level of trust is likely an important reason for the well-functioning and -performing healthcare systems in the Nordic countries, as documented in international studies and illustrated and discussed in chapter p. 19.

Unique health register data

All the Nordic countries have a long tradition of collecting registry-based population data in general, and in particular for healthcare purposes. The implementation of unique personal identifiers, established as early in the 1960s in the Nordic countries, enables linkages across a range of registers.²³

The comprehensiveness and longevity of the Nordic countries' health data stands unparalleled by other regions' and countries' data quality. In comparison, American health databases have for the most part been set up by health

²¹ Stephen Knack, Trust, Associational Life and Economic Performance (2001).

²² World Economic Forum, The Global Competitiveness Report 2006–2016.

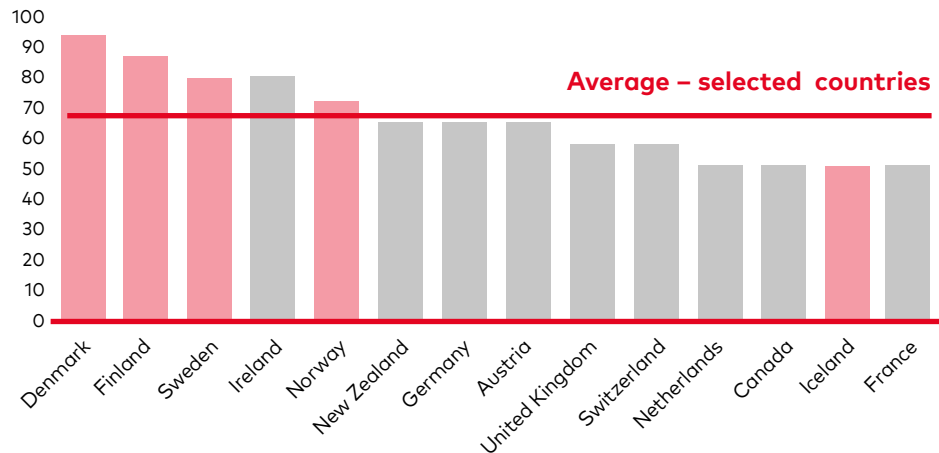
²³ K. Furu, B. Wettermark, M. Andersen, J. Martikainen, A. Almarsdottir and H. Sørensen (2009), The Nordic Countries as a Cohort for Pharmacoepidemiological Research.

insurance companies for administrative purposes and cover only selected populations. In the UK, as well as in the Netherlands, such databases have been established, but these databases only comprise a fraction of the population in the respective countries (Furu et al., 2009).

Whatever the quality of a countries' health databases, the availability of these data, for research purposes, is paramount to improving the quality of healthcare and to develop new products, solutions and services that can serve this purpose. As noted in chapter p. 25, the Nordic healthcare systems are ranked at the very top in international comparisons with respect to overall transparency. One of the six key dimensions of healthcare that is evaluated in the composition of the overall index depicted in Figure 2 11 is the countries healthcare data, in terms of access, ownership and safeguarding of the data. The ranking illustrated above reflects how the Nordics (with the exception of Iceland, in this case) are at the forefront with regards to transparency in personal healthcare data. This index is computed based on a range of indicators

Figure 2-13: Global health systems transparency index – Transparency in personal healthcare data, 2017.

Source: KPMG (2017).



concerning data availability and safeguarding. Digging deeper into the scores in these different indicators, it becomes apparent that the Nordics distinguish themselves from other countries with regards to reporting to patients when and how their data are being accessed by third parties.

High quality healthcare data that is accessible to researchers as well as the patients themselves is an important prerequisite for building trust in the healthcare institutions. In turn, research based on high quality and register based healthcare data and trust in the safeguarding of this personal information improves the quality of care and efficiency in producing healthcare.

Considering the quality of the personal health data in the Nordic region, as well as the general trust and reporting of usage of such data, there is scope for considerably more research. Citizen involvement and facilitation by the Nordic governments and public statistical agencies should be fostered.

From core qualities to Nordic strongholds

A range of societal features impacts on whether a business sector develops into a stronghold or not. Political, cultural and regulatory characteristics of a city, country or region are potential key determinants for the success of a

specific business sector. For the Nordic countries as a region, the discussion and review of the set of suggested core qualities within healthcare reveals that the Nordics, compared to other countries and regions, possess a set of characteristics that makes them an attractive region for research, testing and production of healthcare technology.

- We find evidence for the claim that the Nordic healthcare systems consistently deliver high quality healthcare to their citizens. The region possesses a health infrastructure with leading knowledge and institutions, which is essential for building up a business stronghold.
- Also, we find that the Nordic region excels at delivering equitable care to all citizens, relative to comparable regions. This feature, in combination with indicators revealing a high level of trust toward public institutions as well as between citizens, is likely important for the development, piloting and home market commercialization of treatments within personalized medicine.
- Analysis of internationally comparable data in the review of core qualities shows that a characteristic of the Nordic countries is a high digital competitiveness and a comparably high level of digital skills among its population. Well-developed infrastructure within ICT and a home market of potential users with a high level of digital knowledge make the region well-suited to developing, testing and launching solutions within telemedicine, digital healthcare solutions and ambient assisted living technology.
- As noted in chapter p. 22, the Nordic countries dominate international rankings of aggregated "green" performance. A longstanding and increasing focus on environmental issues in all aspects of society has contributed to the development of leading businesses within sustainable solutions in a range of business sectors. This includes healthcare and hospitals, where demanding public healthcare institutions encourage private businesses to develop green solutions, thus underpinning this sector as a stronghold of the Nordic health technology sector.
- Interviews²⁴ with US health sector players has revealed that a combination of Nordic healthcare and society-related core qualities and Nordic health tech strongholds, is meaningful in the US market. Important decision makers are aware that the Nordic healthcare systems deliver high outcome in terms of healthy populations (compared with the US). Driving down cost per health outcome is priority no. 1 in all parts of US healthcare. Hence Nordic solutions in at least three overall areas could be supported by a Nordic label.

²⁴ We wish to express our gratitude to important informants in the US and Canadian markets: Val Arthur Kratzman, Director at Finpro in New York, Åse Pettersen Bailey, Bus Dev. Manager & Program Director TINC, Innovation Norway – San Francisco & Silicon Valley, Hartti Suomela at Finpro in San Francisco/Silicon Valley, Katja Kotala at Nordic Innovation House in San Francisco/Silicon Valley, Anne Lidgard at Vinnova in San Francisco/Silicon Valley, Øyvind Enstad Haga, Director, Innovation Norway Toronto, Lydia Engholm, Business Sweden Toronto, Lori Woloshyn, Innovation Norway Toronto and Kerry Allerton, Danish Consulate in Toronto; Agata Leszkiewicz Business Sweden Toronto.

- Canadian health sector players seems to have a fair understanding of the Nordic healthcare systems and the core qualities we have described. This is revealed in interviews that has been part of the project's fact finding mission. There is a general understanding of the Nordic countries' health systems as being efficient, digitally advanced (although it may be more correct to speak of a perception of digitally savvy inhabitants and "progressive" societies here) and that the Nordic countries have the world's most healthy inhabitants.
- In addition to this comes a knowledge of Nordic design and architecture, which all in all implies that "Nordic core qualities" as a concept has a meaning in the Canadian healthcare market.

The set of core qualities assessed in this chapter is important for determining why certain sectors within healthcare technology have become Nordic strongholds. Furthermore, the Nordic core qualities are also important when assessing how these business sectors may continue to grow, for instance through exports. In the following chapter, we assess and verify four such business strongholds within healthcare technology in the Nordic region.

Nordic strongholds in health tech

This part of the analysis covers a discussion about the areas of particular strength within the Nordic health technology industry, focusing on Nordic companies developing and providing products within the health sector. The core strengths ("strongholds") in the Nordic health tech industry are identified and described in this analysis.

A stronghold is defined as "an area where we possess the necessary knowhow and knowledge, innovative solutions and a Nordic ecosystem comprising relevant institutions, enterprises, universities, cluster organizations that can support the internationalization of Nordic health and welfare solutions. A strong business community and potential, and a certain Nordic balance, is required for an area to be a "Nordic" stronghold".²⁵

The discussions in the preceding chapter, regarding Nordic core qualities in the healthcare sector, assess the relative strengths and weaknesses of the healthcare ecosystem as a whole. This means there are no distinctions of traits of the Nordic region that can be ascribed exclusively to either the public or private sector. In this chapter however, we focus specifically on the strengths in the private health tech sector.

The analysis has focused on identifying companies, products and services that can be targeted for a joint export promotion effort. The proposed strongholds are tested and verified against our company population and through interviews, literature review and survey results.

Four Nordic strongholds

Four Nordic strongholds that represent broad categories of health tech solutions

The point of departure for this project is a description of four potential strongholds. These four strongholds are broad categories of health solutions that cover most of the export-oriented health industries in the Nordics, with the exception of the largest single healthcare export industry, pharmaceuticals, which is not part of the scope of this project. The four proposed strongholds are:

1. Sustainable & innovative hospitals
2. Smart digital solutions
3. Ambient assisted living technology
4. Personalized care/medicine

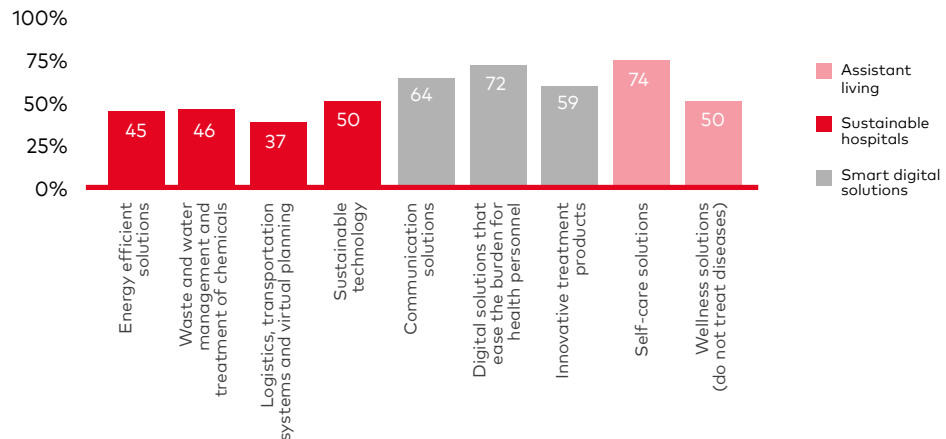
The four strongholds will be described in more detail later in this chapter.

²⁵ Definition as stated in the project mandate by Nordic Innovation.

The aim of the project has been to verify and further describe these four strongholds, using quantitative and qualitative methods. The main empirical tool of verification has been an extensive survey with respondents from all the Nordic countries. The survey results confirm that three of the strongholds are consistently rated as having a certain export potential:

Figure 3-1:
Survey results, respondents' rating of different sectors within the Nordic healthcare industry in terms of expected export potential. Share of respondents rating industries 5 or 6 (fairly high or high potential).

Source: Menon Economics (2017).



Furthermore, we have identified strong export companies in the five Nordic countries within all four strongholds. Interviews, testing against core qualities, comparison with descriptions of international health solution markets and testing against other empirical evidence (mainly through literature review) have further proven that these four strongholds are representative of the most relevant, competitive health technology solutions that the Nordic countries have to offer.

However, in addition to these approaches, we also wanted to test the export competitiveness of these strongholds and their respective industries by using the perhaps most usual empirical method for a country's or a region's (consisting of several countries) performance: Benchmarking the strongholds using a so called *revealed comparative advantage analysis*.

Testing and verifying by applying the revealed comparative advantage method

There are a range of interconnected factors that drive the attractiveness of a country or region, such as the Nordic region, as well as the competitiveness of the industries located there. Some examples of such factors are:

- Strategic location
- Favorable political framework
- Proximity to large, demanding customers
- Local rivalry
- Large pool of talent
- Rich and open flow of knowledge and ideas
- Relationships built on common trust
- A sound and predictable legal framework
- Soft location factors
- Specialized universities and research institutions
- Access to suppliers and service providers

In combination, these factors, some of which also play an important role in the discussion of Nordic core qualities in chapter 2, produce spirals of self-reinforcing growth – or decline, if they are absent. The mechanisms that drive industry competitiveness are summarized in the model below.²⁶

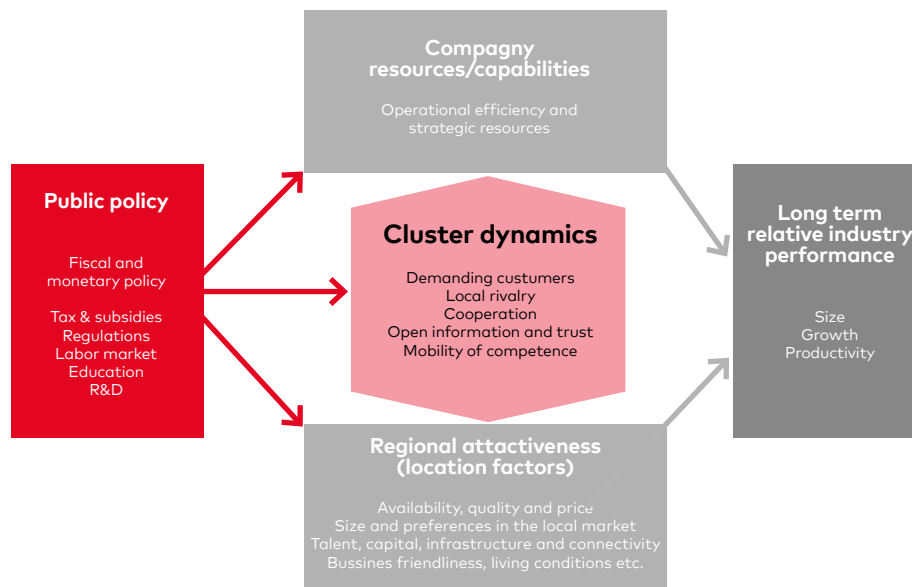


Figure 3-2:
Theoretical model
of industrial
competitiveness.

Source: Jakobsen et al, 2003
(*Attracting the winners*).

For the health technology and solutions sector in a region to prosper, two conditions must be satisfied: The companies must be competitive, and the region has to be attractive as a host for these companies. These two conditions are mutually dependent: The companies gain their competitiveness from resources available in the region, for example access to capital, talent and specialized suppliers – and the price for these resources and services. Accordingly, the attractiveness of the region increases when competitive companies are present. Governments play a central role in defining the attractiveness of the Nordic region. Through various public policy factors like taxes and subsidies, they determine the price of capital, labor and other input factors. The quality of the resources is also to a large extent determined by public investments in infrastructure, education and R&D.

The four main elements in the model depicted above, public policy factors, the companies' resources and competitiveness, the attractiveness of the region, and finally, the dynamics of the industry clusters, are all key determinants of the relative industry performance of the health technology sector in the Nordics.

Benchmarking the four identified Nordic strongholds, Sustainable & innovative hospitals, Smart digital solutions, Ambient assisted living technology and Personalized care, in terms of the sectors' long-term relative industry performance is conditional on high-quality and comparable data. Performance-based benchmarking is typically conducted by comparing relative sizes of business sectors (in terms of e.g. exports, value added or employment)

²⁶ Jakobsen et al (2003), *Attracting the winners*.

within different regions. A prominent example of such a measure is a *Balassa index*, which calculates the *Revealed Comparative Advantage* (RCA) of a certain country or region within a certain business sector. A well-performed benchmarking of the strongholds in the Nordic health technology sector against the same sectors in other regions requires comparable data, i.e. we need to identify all companies within production of e.g. Ambient assisted living technology in the Nordic as well as other countries and regions.

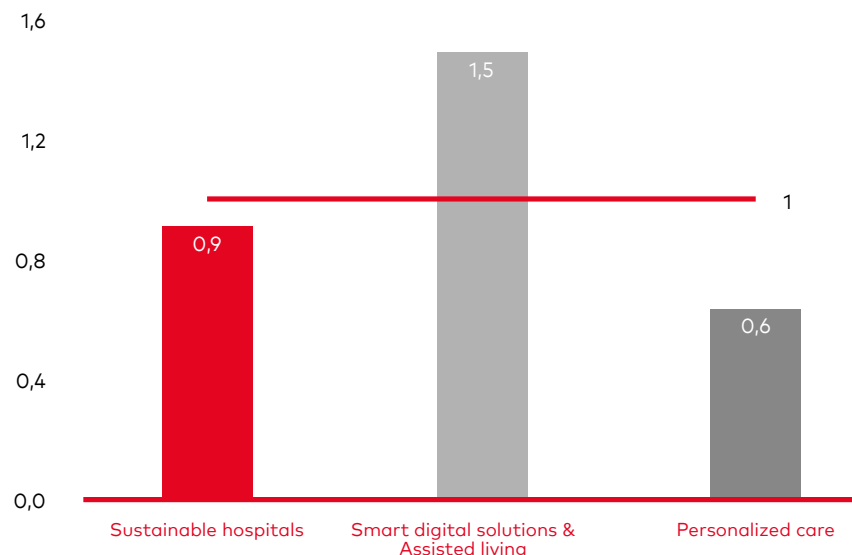
Below is a depiction of the RCA of the Nordic health technology sector, calculated on the basis of export volumes. The figures in the illustration are to be interpreted as follows:

- If the RCA of a sector has the value of one, the share of the aggregated Nordic export of that sector is equal to the same share of that sector's total export value in relation to total export in the world. This means an RCA value of one implies that the sector's size in the Nordics, in terms of exports, is the same as that sector's share of all international trade (illustrated by the horizontal line in the figure below).
- If the RCA is less than one, the sector's share of Nordic exports is comparatively low. If the RCA for a sector is higher than one, that sector's share of total Nordic export is comparatively high.

Here, it is important to note that the index calculates the values of two strongholds, Smart digital solutions and Ambient assisted living technology solutions, as one export sector. This is due to the classification of the export data for those sectors. There is no obvious way to distinguish export of smart digital solutions within healthcare and ambient assisted living technology respectively in the available data.

Figure 3-3a:
Benchmarking of the Nordic strongholds within the health industry. Revealed comparative advantage, by export volumes. Data from 2015.²⁷

Source: WTO/UN.

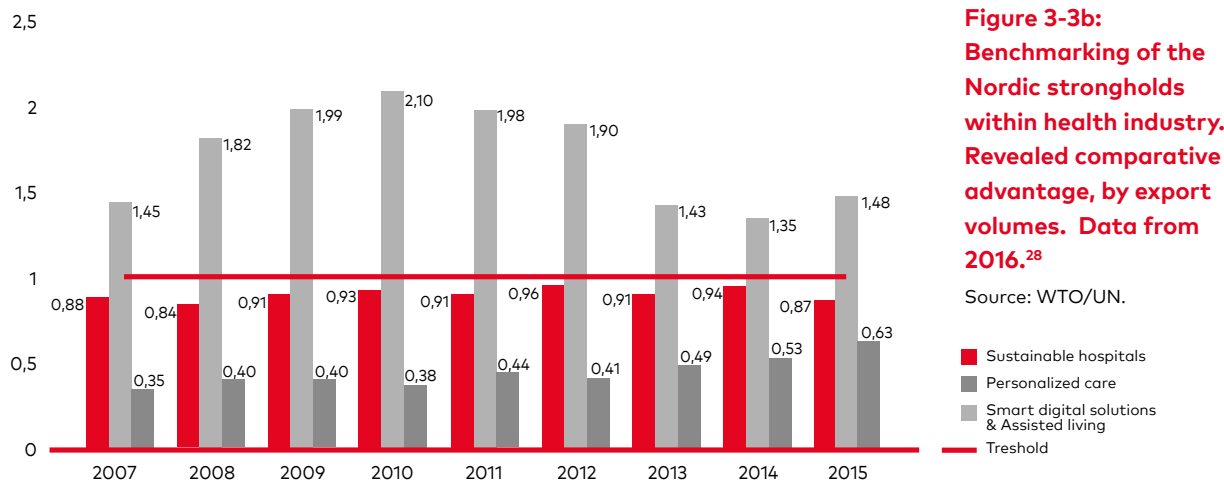


²⁷ The illustration uses data for 2015. There are export data covering 2016, though only for the export of products. As some included export classification codes are services, which only are published up to 2015, all data used are from 2015.

As evident from the calculations and the illustration, the export of smart digital solutions and ambient assisted living technology represents a considerably larger share of the total Nordic export compared to its equivalent share in the rest of the world. Export of products and services for constructing hospitals (medical technology equipment excluded) is close to the world average. Export of healthcare products within personalized care is comparatively low. However, as we show further on, this sector's Nordic RCA value has steadily increased throughout the past ten years.

Measured by performance in the sense of export volumes, the RCA calculations for the Nordic health technology sector indicate that Smart digital solutions and Ambient assisted living technology are to be regarded as Nordic strongholds in 2015. With respect to the RCA indicators, it seems somewhat crude to benchmark the strongholds based on a single year. Therefore, we calculate the indicators over the period 2007–2015. The time series enables us to judge whether the 2015 benchmarking is representative, in addition to analyzing how the exports of Nordic strongholds have developed over time.

As the figure below illustrates, Smart digital solutions and Ambient assisted living technology qualify as a stronghold through the whole period. The relative export share of products and services related to Sustainable & innovative hospitals relative to the world average is quite stable, and close to qualifying as a stronghold in several years, particularly in 2011 and 2014. Export of medical products classified as Personalized care is comparatively low. It is worth noticing, however, that the share of exports of products within Personalized care has shown an upward trend through the period. This implies that the



²⁸ Note that the index calculates the values of two strongholds, Smart digital solutions and Ambient assisted living technology, as one export sector. Also note that the data the RCA indicator illustrates above is not directly comparable with the database of Nordic companies assembled and categorized in in this project. The export data above is calculated based on product classification codes. The classification of the companies in our database on the other hand is based on an individual evaluation of each company and the products and services it produces. International export data are categorized by product or service groups, while our classification of companies follows which sector the company primarily delivers products and services to (healthcare). Within ICT solutions it is particularly difficult to isolate the export within healthcare. There is quite possibly some export of ICT solutions from the Nordics to the international healthcare sector not captured by our calculations depicted in Figure 3-3 (both a and b), as there is no specific classification of health ICT solutions in international export databases. Hence, the RCA calculations for the Nordic health technology sector are to be regarded as indicative estimates of the relative Nordic export within healthcare technology.

export of personalized care products from the Nordics as a share of total Nordic exports increases more than this product group's equivalent share of total worldwide exports. All else equal, this suggests that Nordic made personalized care products has strengthened its relative position on the world market over the past years, and may be on its way to becoming a Nordic stronghold if the trend continues.

Calculating the RCA of a business sector in terms of export volumes is one approach that can indicate whether a sector is to be considered a stronghold, based on historical data. This approach is however limited to registered export volumes and hence gives limited information about the region-specific attributes that may lay the ground for further growth within the different sectors. These are attributes such as regulations and competitiveness in the home market, as well as trends in international demand and politics (cf. Figure 3-2). In an analysis of business strongholds, such region-specific features and characteristics (and trends in these) are important in determining whether the sectors are to be considered strongholds or not. Hence, RCA is only used as an additional test method in this report.

In the next subsection, we will describe the four strongholds in more detail based on data and analysis from the company database. This includes country distribution, size and sub-categories within the Nordic health technology sector.

Four Nordic strongholds within health technology

The Nordic countries have some joint strong positions within the health industry. The analysis has assessed and verified four individual strongholds. These are listed in the table below with definitions and subsectors. The four strongholds are *Sustainable & innovative hospitals*, *Smart digital solutions*, *Ambient assisted living technology*²⁹ and *Personalized care and medicine*.

| Stronghold | Sub-category | Definition | Examples from the business population |
|--|---|---|---|
| Sustainable & innovative hospitals (SH) | Architecture, construction, and engineering | Architects and construction companies specialized in building sustainable hospitals | C.F. Møller – architects with experience in hospitals; Swedish Modules – Prefabricated operating rooms; Cowi – Advisory |
| | Solutions for increased energy efficiency and environmental performance | Solutions and systems such as ventilation systems, waste and water management systems, etc. | Hudevad Care – heating systems; Avidicare AB – temperature controlled airflow systems; MedClair – nitrous oxide destruction; Envac – waste management; BioTek – waste and water management |
| | Logistics | Solutions related to logistics, transportation systems and virtual planning, IT systems, and hospital equipment (furniture) | Easytrans – transport of patients; Intelligent Systems – logistics “systems”; Altiplan – automatic preparation of work schedules |
| | Medical devices | Medical equipment such as diagnostics, imaging technology, scanners, x-rays, etc. | Evosep – innovating how protein based clinical diagnostics are performed by applying new technology making sample separation faster |
| Smart digital solutions (SDS) | E-health and solutions that facilitate communication | Solutions that facilitate communication between health personnel and between health personnel and patients | Meedoc – Online doctor consultation; Linus AS – SMS and mobile solutions; Atostek – cloud-based prescription solution |
| Ambient assisted living technology | Self-care solutions | Solutions that enable patient self-care (treatment at home instead of at hospital) | Safecall – GPS systems for people who suffer from disorientation; Norske helsehus – construction of houses adapted for elderly people |
| | Rehabilitation equipment | Solutions that facilitate rehabilitation | |
| | Fitness and wellness | Products that enhance health and well-being, but do not treat disease or illness (wellness) | Biowatch – gives athletes and other interested persons access to health data for monitoring and prevention; Mindfit AS – mindfulness app |
| Personalized care (through health data) | | Products that collect and/or use data to create personalized and or/ more efficient health solutions | Combinostics – data-driven clinical decision-making tools; BC Platform s- platform for analyzing big data in health |

²⁹ Ambient assisted living technology includes all kinds of technologies that have a user perspective, and aim to improve the quality of welfare services through increased self-reliance, independence and dignity for recipients of health services. The origin of the term is Danish, and it is mostly used in the Nordic countries. We have decided to use this term in the current study, but for export purposes terms like “care technology” and (more narrowly) “solutions related to Ambient Assisted Living (AAL)” should be used.

There are multiple alternative ways of categorizing these solutions and industries. We have used definitions and categorizations that suit the purposes of this report and are in line with categories used by the national statistics offices in the Nordic countries.³⁰ The overall categorization and list of subsectors are not claimed to be exhaustive.

Overview of companies within strongholds

The company database contains companies that are categorized by stronghold, sub-sector, size, age, type of solutions offered, and the medical condition that the product or service is meant to treat. The companies included in the analysis only include those that offer solutions within one or more of the four identified strongholds and which could potentially be invited to join a joint Nordic export promotion effort. When selecting companies, we have used the following criteria:

- The company should originate from one of the five Nordic countries
 - *In some cases, we have included Nordic subsidiaries of foreign companies. These companies have a long-standing presence and conduct R&D activities in the Nordics.*
 - *We have not included foreign companies that only distribute and sell products on the Nordic market.*
- Activities should fall under the definitions of the stronghold. This implies that:
 - *No pharmaceutical companies have been included*
 - *No healthcare providers have been included*
- The company should have a service/product that can be exported. This implies that:
 - *Companies that only sell and distribute products from other companies have been excluded.*

We have analyzed characteristics of the different companies to detect joint strengths and implications for an export promotion effort. Table 3-1 provides an overview over the features, indicators, measures and evaluation criteria used to analyze the business population.

³⁰ We use so called NACE codes to group the industries and business together to constitute "strongholds". NACE (Nomenclature of Economic Activities) is the European statistical classification of economic activities. NACE groups organizations according to their business activities. Statistics produced on the basis of NACE are comparable at European level and, in general, at world level in line with the United Nations' International Standard Industrial Classification (ISIC).

| Feature | Indicator | Measure | Evaluation |
|---|--|--|--|
| Size of stronghold | Share of companies within strongholds and sub-sectors | Percentage distribution | A higher share is regarded as better as more companies imply that the stronghold is better suited for a joint export promotion effort |
| Size of companies within strongholds | Number of employees | Micro: <10 Small: 10–49 Medium: 49–249 Large: 250+ | The more small-to medium-sized companies the better, as these are likely to be the ones that are export-ready and in need of support |
| Age of companies within strongholds | Year of establishment | Young: Less than 5 years Medium: 6–19 years Old: 20+ years | The more medium-aged companies the better, as these are likely to be the ones that are export-ready and in need of support |
| Type of product | Type of service/product provided | Service, physical product, or application/software | Some types of products may be easier to adapt to new markets. Different potential in different markets. |
| Treatment area | i) Non-treatment specific ii) Treatment specific (classified according to treatment area) | Percentage distribution | i) Implications for export promotion strategy ii) Some strongholds or sub-sectors may benefit from treatment-specific export promotion effort |

Table 3-1: Overview of features and indicators used to analyze the business population.

Source: Menon Economics (2017).

Size of stronghold

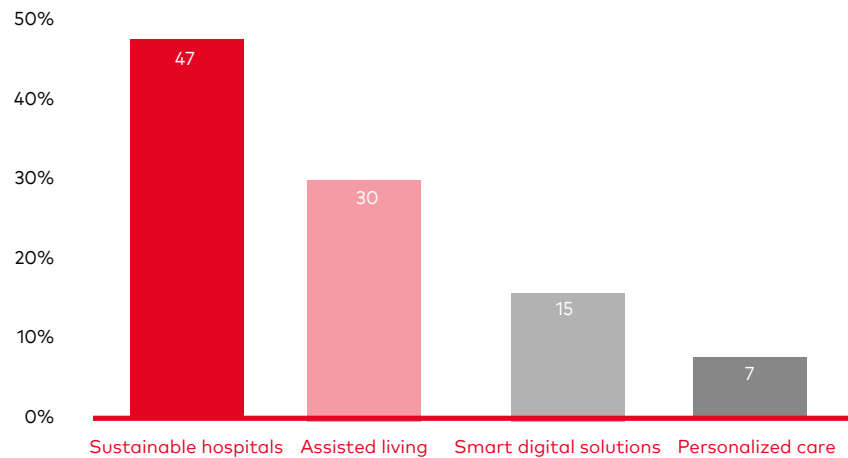
Based on the companies listed in the company database, the majority of our sample of Nordic health technology companies operate within the broad categories Sustainable & innovative hospitals and Ambient assisted living technology, while fewer companies fall within the Smart digital solutions and personalized care categories, respectively.³¹ As the figure below illustrates, close to half of the companies in the database fall into the Sustainable & innovative hospitals category, close to a third into Ambient assisted living technology, 15 percent into Smart digital solutions, while the remaining seven percent are classified under Personalized care. These findings are in line with our general

³¹ It is important to notice that the analysis of the four strongholds in this study and their relative performance is based on a selection of Nordic companies. Efforts have been made to make sure that this selection is representative for the total population of companies. We can however not know for sure whether there are asymmetries between our population of companies and the actual companies that could be argued to operate within the respective stronghold.

expectations as the two first categories contain more sub-sectors than the two latter categories. Indeed, while sustainable & innovative hospitals and Ambient assisted living technology contain four and three sub-sectors respectively, Smart digital solutions and Personalized care only contain one sub-sector each. In the process of assembling the company database, and the corresponding classification process that followed, we found that some of the strongholds contained firms that on aggregate offered a greater variety of products and services than others. We thus found it most reasonable to let the number of sub-sectors vary across the strongholds.

Figure 3-4:
Distribution of Nordic companies by strongholds. Share of total.

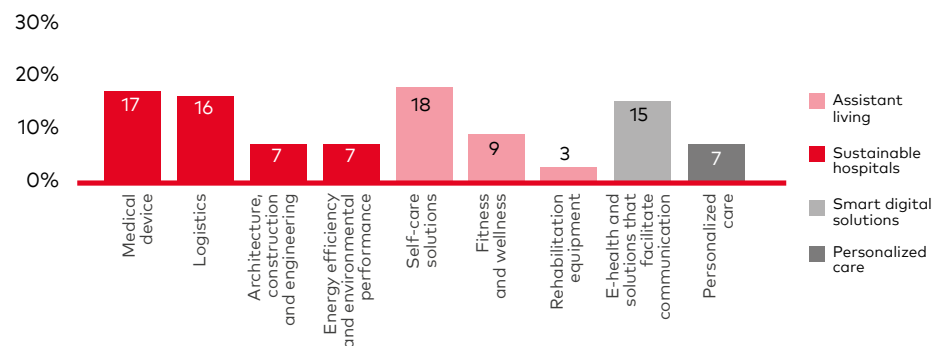
Source: Menon Economics (2017).



Within the sub-sectors, companies producing medical devices, logistics solutions, self-care solutions and E-health solutions tend to dominate. Arguably, the distribution based on sub-sectors reveals additional information regarding the company's main activity. For instance, it is worth noticing that although the category Smart digital solutions is rated second-last when we categorize by number of companies, its corresponding single sub-category is among the largest of all the sub-categories. As the figure below illustrates, we also find that there are significant differences in size across sub-sectors within the given stronghold. Ambient assisted living technology figures as an illustrative example; the relative size difference between self-care solutions and rehabilitation equipment is approximately 15 percentage points.

Figure 3-5:
Distribution of Nordic companies by sub-category. Percent of total.

Source: Menon Economics (2017).



A country-by-country analysis shows that the distribution of companies based on both strongholds and sub-sectors is quite similar across the five Nordic countries. The general picture is that Sustainable & innovative hospitals is the dominant stronghold in all countries, followed by Ambient assisted living

technology, Smart digital solutions and Personalized care. The proportion of companies that fall within the Smart digital solutions category is somewhat larger in Norway and Sweden than in the rest of the Nordic countries. The country distribution of companies according to stronghold is shown below.

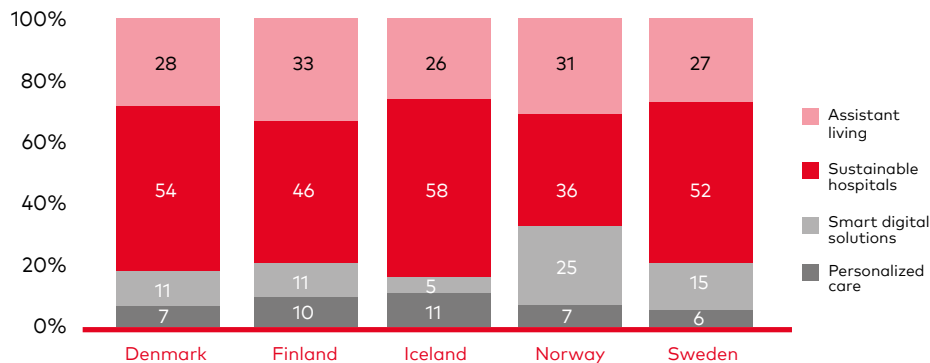


Figure 3-6:
Country distribution of companies by strongholds.

Source: Menon Economics (2017).

Size, age and export "maturity" of companies

Measuring company size by the number of employees, we find that a large share of the Nordic companies in the database have less than 10 employees. Following the European Union's size-classification system,³² these companies are regarded as micro-sized. As the illustration below shows, the share of companies classified as micro-sized is large and this tendency holds across strongholds. Furthermore, there are few companies with more than 200 employees. Hence only a minor share of the companies is regarded as large. As the company database mainly lists innovative companies that focus on digital or technological solutions, this finding seems reasonable; in addition to being relatively newly established, high-tech companies developing digital products and solutions tend to demand fewer employees than companies operating within more labor-intensive traditional industries.

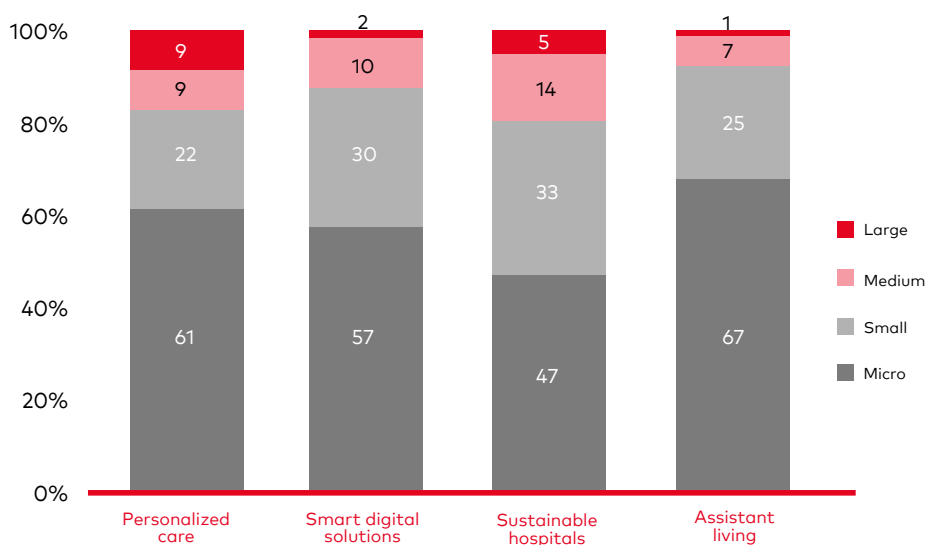


Figure 3-7:
Distribution of Nordic companies by size and strongholds.

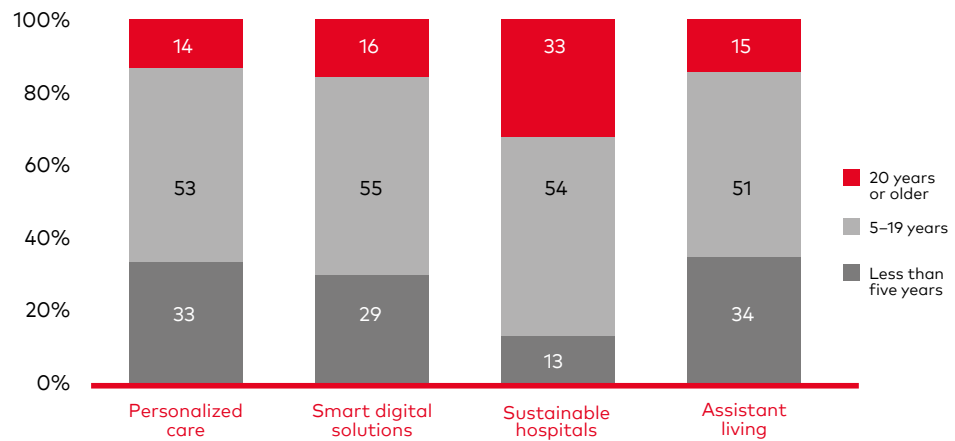
Source: Menon Economics (2017).

³² The EU defines companies with less than 10 employees as micro, companies with 10–49 employees as small, companies with 50–249 employees as medium-sized, and companies with 250+ employees as large.

The rather substantial proportion of micro-sized companies could lead one to believe that most of the companies in the database are young and newly established companies. However, the variety in terms of maturity among the companies is somewhat larger than what the general size-trend might suggest. As the figure below indicates, the majority of companies in the database is between five and 19 years of age, regardless of stronghold. In fact, over half of the companies are within this age-interval. Viewed in isolation, this indicates a large availability of export-mature companies. Strongholds containing companies that typically offer high-tech or digital products and solutions, such as Personalized care and Ambient assisted living technology, have the largest share of companies that are less than five years of age. Many of these companies offer products and solutions that hardly existed a decade ago, which at least in part explains their young age. In the opposite end of the age distribution, the most well-established companies are typically found within Sustainable & innovative hospitals. Just over one-third of the companies within this stronghold are 20 years or older.

Figure 3-8:
Age distribution of Nordic companies by year of establishment and strongholds.

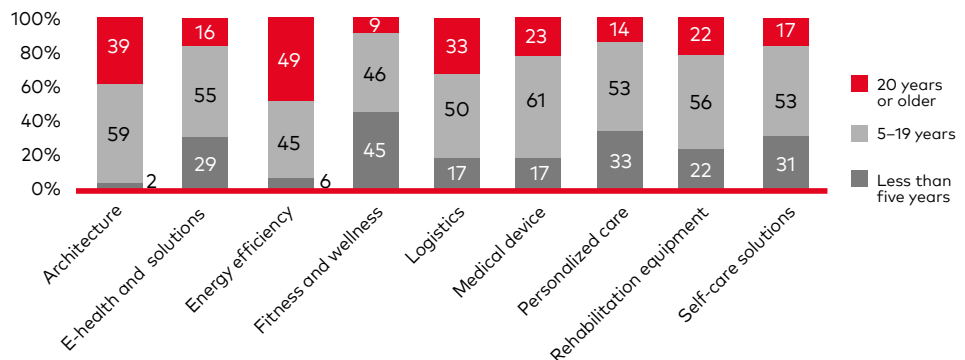
Source: Menon Economics (2017).



The age distribution in our population of companies indicates a considerable variety in average company age across sub-sectors. While the sub-sectors Architecture, construction & engineering, and Energy efficiency & environmental performance hardly contain any companies that are less than five years of age, sub-sectors such as Fitness & wellness, Personalized care, and Self-care solutions contain a fair amount of young companies. Despite these internal variations, medium-aged companies tend to dominate the age distribution within each stronghold.

Figure 3-9:
Age distribution of Nordic companies by year of establishment and sub-category.

Source: Menon Economics (2017).



At least to a certain extent, it would seem plausible to expect that larger and older companies are more export-ready and -oriented than smaller and younger companies. Taking the online survey results into account, however, this proves to be a simplification that fails to capture the perceived export potential of individual products and solutions. Indeed, factors such as market trends, the maturity of Nordic industries compared to equivalent industries in other countries, the degree of ease of market access, and governmental regulations, to mention a few, also affect the general export potential of products and solutions.

The respondents perceive Ambient assisted living technology and Smart digital solutions as the strongholds offering products and solutions with the greatest export potential. As previously mentioned, these strongholds contain a fair share of micro- and small-sized companies that are relatively young. We regard these as favorable characteristics with respect to a possible joint export promotion strategy. Judging by the survey results, it seems that the respondents agree with the notion that micro-sized and small companies established within the last 20 years have the greatest export potential. However, it is possible that the respondents, of whom a large share holds central positions in rather small and young companies, exaggerate the export potential of their own products. If this is the case, the survey results may give a somewhat false impression of the true export potential of the products and solutions within the strongholds that rate highest on export potential in the survey.

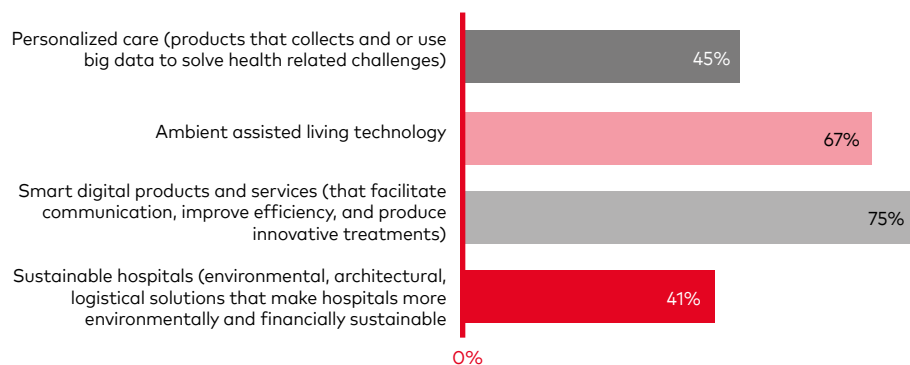


Figure 3-10:
The share of respondents that assess the export potential of products and solutions within the Nordic healthcare system as "very high" or "high".

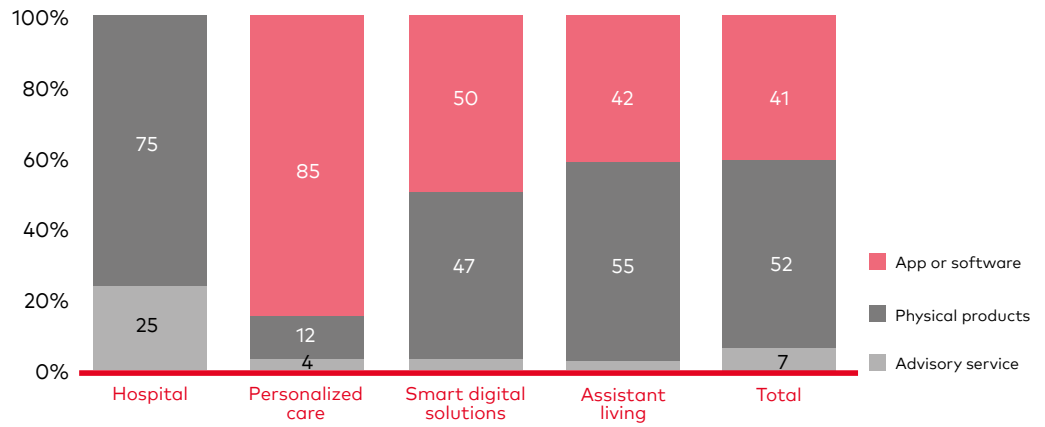
Source: Menon Economics (2017).

Type of products and treatment areas

There are considerable differences in terms of types of products across strongholds. For instance, while companies within Sustainable & innovative hospitals exclusively produce either advisory services or physical products, 85 percent of the companies within Personalized care produce software and app solutions. Companies producing physical products or software solutions dominate within Smart digital solutions and Ambient assisted living technology. In total, physical products dominate, followed by software and application solutions, while only seven percent of the companies offer advisory services as their main product.

Figure 3-11:
Distribution by type of products and services. Nordic companies within healthcare.

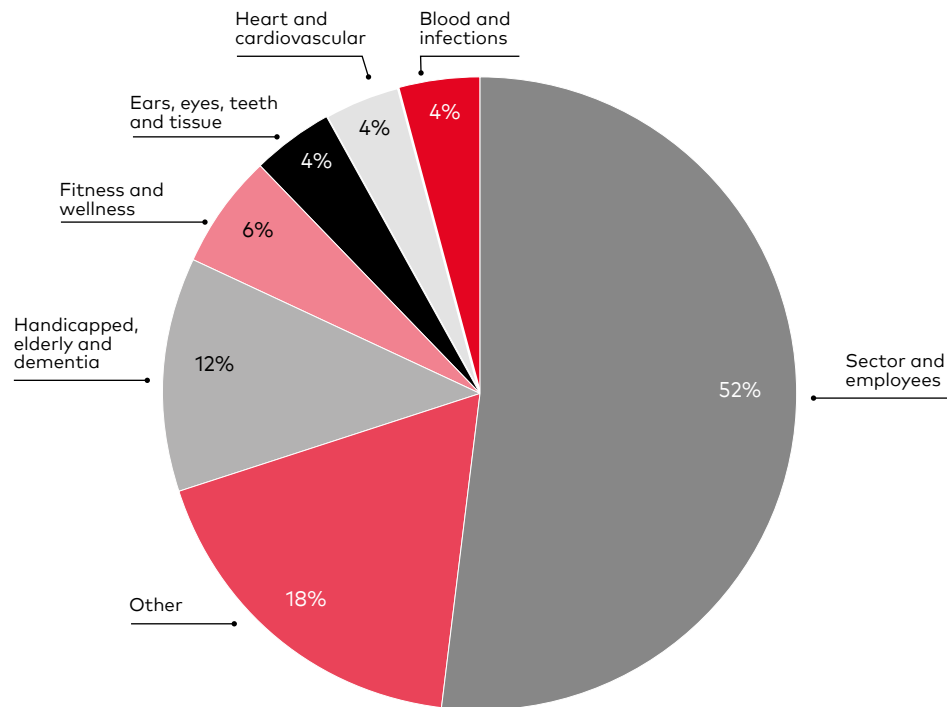
Source: Menon Economics (2017).



Over half of the companies in the database produce products or solutions that target employees within the healthcare sector. These products and solutions are not intended to treat medical conditions, but rather aim to increase the efficiency of employees in some way. These products include internal and external communication solutions, and devices or solutions that ease the burden of tasks related to treating patients. The second largest category of products, "other", includes solutions that aim to treat a broad range of medical conditions, including cancer, conditions related to stomach and insentience, diabetes and products related to child and fetus. None of the treatment-specific categories within the "other" category make up more than five percent of the total, and they have been put in the same category mainly for illustrative purposes. Products and solutions that target the handicapped, elderly and patients with dementia make up 12 percent of the total, while the remaining categories make up less than ten percent each.

Figure 3-12:
Distribution of companies according to the medical conditions their main product or solution targets.

Source: Menon Economics (2017).



Sustainable & innovative hospitals

The term "sustainable hospital" is in our context not restricted to *environmentally sustainable* solutions alone. Typically, we see innovative solutions with regards to for example waste disposal and avoiding unnecessary water consumption along with energy efficiency solutions and "sustainable" architecture/design within this segment. However, the term "sustainable hospitals" also covers e.g. products and solutions that limit side-effects of medical treatment, such as PVC free blood transfusions.³³ It might be argued that the Nordic countries should focus on environmentally sustainable hospital solutions only when using the concept "sustainable" in joint marketing efforts; we do however not consider this specific issue here. We put up a broader picture, looking at the whole hospital ecosystem with buildings and all integrated medical technology and ICT (which constitutes more than 30 percent of the construction costs). Hence, we are also focusing on the economic sustainability of hospitals: How the total infrastructure can deliver a safer, more environmentally friendly and better life time economy (which is often related to environmental sustainability).

Hospitals in the Nordic countries as well as in other regions of the world need to meet challenges related to the environmental impact, but also the need for more cost-efficient hospital care with a rapidly increasing elderly population. There are many hospitals being built in the Nordics right now. These hospitals need to live up to future demands on logistics, environmental regulations as well as new ways of organizing hospital "production" and clinical practice. Nordic companies are delivering products and services to these new hospitals. Areas to give prominence to are medical devices and products, logistics, architecture, construction and engineering and energy efficiency and environmental performance.

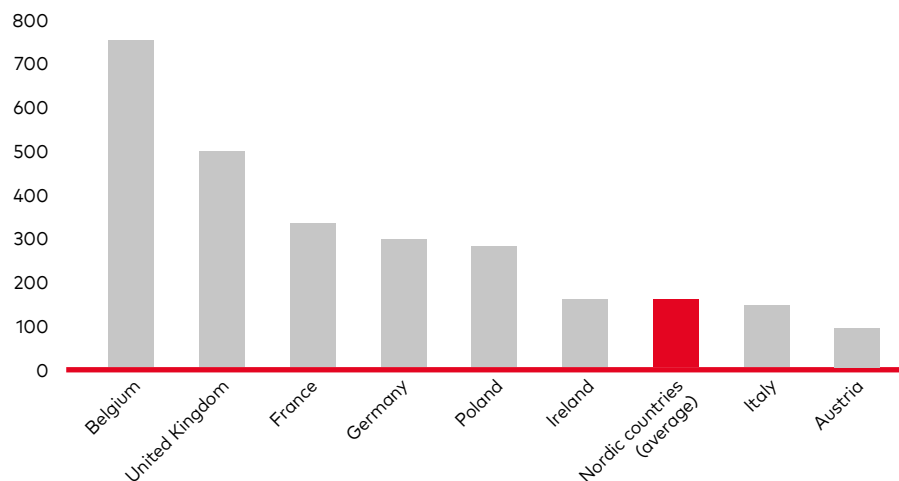
The Nordic countries have different areas of strength within building and managing Sustainable & innovative hospitals. Through interviews and other sources of information, we have been informed that Denmark for example is particularly good at dealing with complex logistics challenges for hospitals, provides innovative solutions for hospital ICT infrastructure and there is international demand for Danish architects. In Norway, experience and knowledge from the shipping and airport logistics industry are being used in the healthcare sector. This applies particularly to the construction of hospitals, where experience within logistics is used in the design. Sweden offers interesting waste and water treatment systems as well as environmentally friendly transportation and has some larger actors that could potentially act as integrators for "turnkey" solutions.

Although there are some country-specific characteristics in the Nordics with regards to strengths within the sector of sustainable healthcare and hospitals, the Nordic countries generally seem to share the focus on environmentally friendly hospitals. This is reflected in the ranking below, where CO₂-emission levels from hospitals are compared across a set of European countries.

³³ PVCfreeBloodBag" – a Swedish program financed by both private businesses and hospitals in Sweden. The program cooperates with hospitals throughout Europe to raise awareness and hopefully create a demand for the product.

Figure 3-13:
Tons of CO₂-emissions
per patient hospital
care discharge.
Estimates for 2014.

Source: OECD and Eurostat, 2017.



As international treaties concerning measures to reduce climate gas emissions are being signed and the general focus on sustainability is increasing, demand for green solutions in all markets is on the rise. This also includes healthcare and hospitals. As is evident from the illustration above, hospitals in the Nordic countries are some of the least polluting (in terms of CO₂-emissions) in Europe. The combined business strengths within both green solutions and architecture do in turn materialize in increased export opportunities. One example is CF Møller, a Danish architectural company headquartered in Aarhus. With experience within international healthcare planning, the company had a significant role in the Woodlands Integrated Healthcare Campus project in Singapore. The campus includes a new acute care hospital, community hospital and nursing home.

The following overview assesses some of the opportunities and challenges for businesses within the industry of sustainable hospitals in the Nordic region.

Opportunities

- Increasing worldwide demand for Nordic knowledge and experience from building sustainable hospitals.
- The Nordics have built a strong reputation due to many successful completed and ongoing projects.
- Potential for joint consortia offering "turnkey" solutions for hospitals.

Challenges

- Few good cases of existing Nordic "turnkey" solutions. Most hospitals built in the Nordic region rely on foreign companies.
- The Nordics have several internationally competitive companies, but they do not necessarily represent a complete value chain.
- Know-how is often concentrated within the public hospitals and there is a lack of incentives to commercialize this competence.

Export opportunities

The export opportunities from the Nordics are mainly related to services and knowledge. The business population detected for this study has a high share of consultancy companies. The composition of the company population and interviews also show that the Nordic industry for delivering products and services to hospitals has limits in some categories, suggesting potential difficulties for the Nordics in delivering "turnkey" solutions with only Nordic products internationally.

The business population identified in this project consists of a high share of micro- and small-sized companies. The sub-category Architecture, construction and engineering is an exception, as a relatively high share of companies in this category are medium- to large-sized. Considering the composition of Nordic companies within sustainable healthcare, delivering overall hospital solutions in other markets will require cooperation and partnerships both between Nordic and with local companies. Especially in more geographically and culturally remote markets, a Nordic offering may carry high risk and costs if delivered without local partners. A Nordic initiative to help foster such coordination may be fruitful, as it is challenging to identify suitable partners, as well as distributors of niche products, in new and remote markets.³⁴

Smart digital solutions

The Nordic region has a long history of world-leading companies within electronic communication and solutions. The NMT standard, Ericsson and Nokia are part of the reason for the early and successful Nordic business development within mobile technology. A great Nordic legacy of smart digital solutions created favorable conditions for the growth of many smaller tech companies in the years that followed.

The Nordic region has a strong position when it comes to smart digital solutions within healthcare. The Digital Economy and Society Index (DESI)³⁵ ranked the Nordic countries at the top in international comparisons relating to digitalization. Additionally, the digital infrastructure and technical knowledge in the population make the region an ideal location to develop, test and implement new digital solutions within healthcare. This is well illustrated in the radar chart depicted below. The chart shows all indicators from *The Global Competitiveness Report*³⁶ concerning ICT, as well as an indicator of

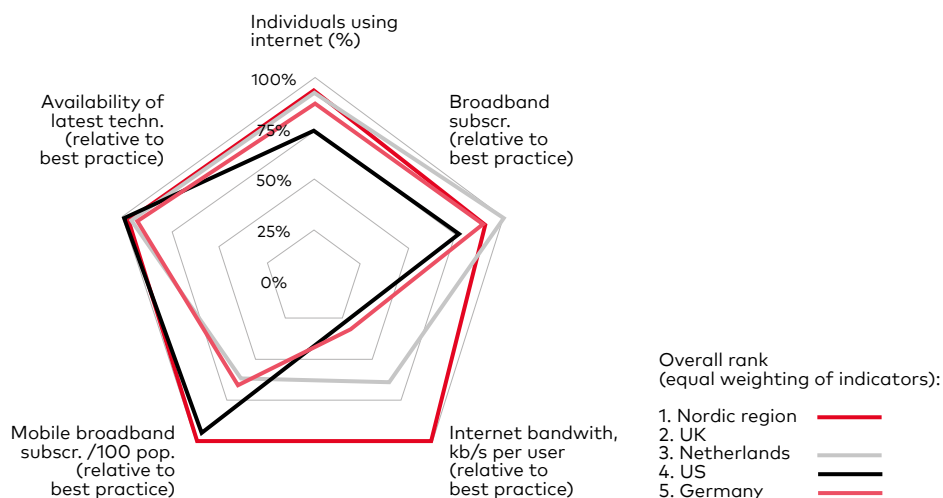


Figure 3-14:
ICT – infrastructure and level of sophistication in the Nordics,³⁷ relative to other advanced economies. Data from 2016.

Source: World Economic Forum – Global Competitiveness Report, 2016.

³⁴ Tillväktanalys (2016), Digitaliseringen av Kinas hälso- och sjukvård (Note: Report written in Swedish, with a summary published in English).

³⁵ <https://ec.europa.eu/digital-single-market/en/desi>.

³⁶ The Global Competitiveness Report 2016–2016, World Economic Forum.

³⁷ Note that the indicator values for the “Nordic region” in the illustration are the calculated average values for the five Nordic countries. This method of calculating a single set of indicator values for the Nordic region does give some biased results, as the populations in the different countries varies. A population weighing of the indicators would however not give dramatically different results.

the availability of new technology. For illustrative purposes, the different indicators have been calculated relative to the best performing country in the selection of countries (except for the indicator "Individuals using internet", which is stated in percentage points).

It is evident that ICT, in terms of both infrastructure and sophistication, is an area of strength for the Nordic region. This has laid the foundation for business development and export of digital solution and products in many areas, including technology aimed at the healthcare market. Another indication of how digital solutions in healthcare is a Nordic stronghold is the calculation of this sector's revealed competitive advantage, illustrated in Figure 3-3. We find that the Nordic export of such solutions and products, relative to the region's total export, is more than 50 percent higher than the equivalent share in the rest of the world.

That Smart digital solutions within healthcare is a stronghold of the Nordic health technology sector is also confirmed by the literature. For instance, the Nordic Life Sciences sector study 2014³⁸ states that "*the Nordic countries have established a strong position in Europe in terms of eHealth deployment in technical and clinical applications*". The report especially points to:

- Electronic Health Records (EHR) systems, which are almost standard in all Nordic countries.
- Electronic prescriptions, which are more widespread than in other European countries.
- Telemonitoring systems – Danish and Swedish hospitals are at the international forefront.
- In-country electronic exchange of patient information – several hospitals in Norway and Sweden have well-established systems for this, which was not (in 2014) the case in other member states in the European Union.

The Nordic region has a strong position within digital health industry solutions, but there are some national differences. Denmark and Sweden are particularly strong in telemonitoring systems in hospitals. Denmark has also long been at the international forefront in terms of technological advances and implementation of ICT solutions in hospitals and telemedicine.³⁹ For instance, the Swedish based company *Distributed Medical AB* develops telemedicine solutions that enable conferencing and education between hospitals and other locations. Its solution is used by a vast number of Hospitals in Europe, in addition to hospitals in the United Arab Emirates. Another example is the Danish company *Viewcare*, who delivers solutions for telemedicine to hospitals and municipalities in Denmark.

Finland has the largest share of ICT start-ups. Finland is also recognized as having a longstanding history of development and implementation of eHealth systems. The Finnish Ministry of Social Affairs and Health established already in 1996 its first strategy for the utilization of ICT in the public health and welfare sector. Since then, many Finnish companies have specialized in ICT solutions that target the healthcare industry. The company *9Solutions* is an illustrative example. Its solution combines the systems used by hospitals,

³⁸ EY (2014), Nordic Life Science Study 2014.

³⁹ Ibid. p. 30.

health centers, care homes and home care into one, which makes it possible to share information across healthcare institutions.

Norway has a long history within telemedicine, but has faced challenges both with regards to coordinating digital initiatives on a national level and the timing and standardization of individual initiatives. Norwegian pilot projects have been less focused on defining and measuring quantitative results compared to other Nordic counterparts. According to the EY report from 2014, Norway is still lagging slightly behind the other Nordic countries with regards to offering digital services and innovations to its citizens.

*Promote Iceland*⁴⁰ (a public-private partnership established to enhance Icelandic companies' competitiveness) notes that Iceland, with a high proportion of the population having access to the internet and social media as well as an interest in the early adoption of new technology, makes a great candidate for pilot testing of eHealth solutions. This is especially true of those with solutions going straight to consumers, for example apps for wellness, personal health, or patient engagement.

In interviews conducted by EY in its report on the Nordic Life Science sector, the potential benefits from increased collaboration among life science clusters across the Nordic countries are addressed. Representatives from both AstraZeneca and Karolinska Development note that the Nordic market for health technology is small. Getting access to larger markets earlier is important, due to large costs incurred in research, development and testing of innovate solutions. The interviewees claim that an overall export strategy for the Nordic countries could help to shorten the time it takes to gain market access for Nordic healthcare companies in general.

Through the interviews, the established business population and literature review for this study, we have identified the following opportunities and challenges with regards to Smart digital solutions as a Nordic stronghold:

Opportunities

- The region has a relatively strong position in eHealth and technical applications.
- Particularly strong positions within visualization, online services (online doctor consultation) and telemedicine.
- The Nordic countries are ranked top in international comparisons related to digitalization. The infrastructure and knowledge level in the population make the region ideal for developing, testing and implementing new digital solutions within healthcare.

Challenges

- The Nordics are world-leading in implementing eHealth solutions, but many of the digital systems currently in use in the Nordic hospitals are supplied by foreign companies. This is perhaps unavoidable given the importance of global software providers such as Microsoft and SAP, but nevertheless something that needs to be considered when assessing opportunities and challenges.

⁴⁰ Promote Iceland (2015), Healthcare IT & Device Sector Mapping in Iceland.

- Although there are many innovations coming out of the Nordic companies, many face difficulties in the commercialization and scaling-up phase – it is often difficult for companies to sell their products to public clients beyond the pilot phase.
- There is no unified industry. The companies, as well as their products and services, are highly diverse.

Export opportunities

The Nordic region has an unexploited export potential within Smart digital solutions. A relatively large share of companies identified in the business population has existed for more than six years, which suggests that the companies are relatively mature and ready for an export effort. On the other side, a relatively high share of the companies are small companies. At first glance, this would seem to indicate a lower level of export readiness, but that might not necessarily be the case as the tech industry in general tends to have fewer employees per company than other industries.

Today a high share of the export-ready products are apps and software, which potentially raises issues in terms of transferability to other markets. If we should suggest a potential treatment area to target for export promotion, diabetes solutions have a strong position in the Nordic countries (specifically in Denmark); this represents a large and fast-growing market (especially in China) and appears to have an unexploited potential.

Ambient assisted living technology

Figure 3-3 illustrates how the Nordic region has a strong revealed comparative advantage within digital health solutions and ambient assisted living technology. The reasons for this are the cultural, economic and demographic characteristics of the region, which in turn facilitates the continuation of ambient assisted living technology as a stronghold for the Nordic region in the future.

The Nordic region has a home-based elderly and disabled care model which gives rise to innovations in self-care solutions. Ten years ago, in Sweden, 94 percent of elderly people lived in their own homes, many of them even after developing a need for care and medical treatment, creating a large demand for self-care products.⁴¹ Finland is at the forefront within wellness solutions, which are highly different products helping primarily healthy individuals to live healthy lifestyles. The Nordic countries also have strong laws guaranteeing social inclusion and access to all parts of society for everyone. As evident from the ranking illustrated below, the countries in the Nordic region have among the lowest measured share of their elderly population being at risk of poverty and social exclusion in Europe. Well-developed pension systems and generous welfare states are key drivers behind this result. However, the laws guaranteeing social inclusion for vulnerable social groups like the disabled and the elderly are also important determinants.

⁴¹ Mary Robinson et al., pp. 163 (2007), *Global Health and Global Aging*.

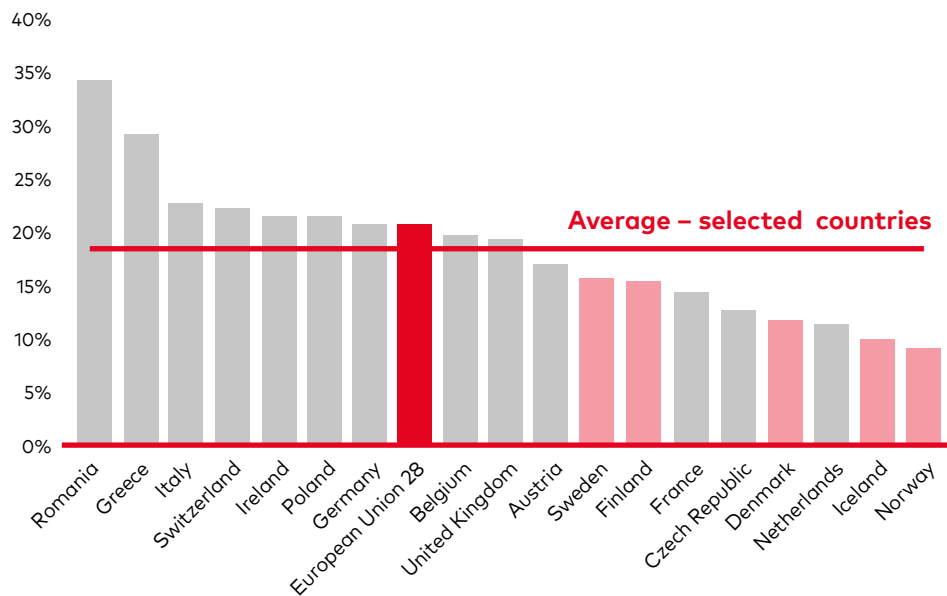


Figure 3-15:
The share of population (55 years or older) at risk of poverty or social exclusion in 2015.

Source: Eurostat.

The high willingness and prioritization of enabling elderly and disabled to self-manage their lives in their own homes, the demographic development of a steadily aging population and the public organization and financing of elderly care has led to considerable public investments in self-care solutions (see two examples in the text box below). In turn, this has led to the creation of a range of companies delivering products and solutions targeting elderly and disabled, enabling these vulnerable groups to live independently. Prominent examples are the Danish company *Safecall*, producing GPS systems for people who suffer from disorientation, and *Norske Helsehus*, which constructs houses specially adapted for the elderly and disabled.

The above-mentioned trends and characteristics of the Nordic region are important determinants explaining the public demand for ambient assisted living technology products and self-care solutions in the Nordic region. Additionally, the combination of high income levels, awareness of health risks and a considerable digital and technological competence amongst the population underpins private demand for products and applications within fitness and wellness. Hence, even though the home market for health technology companies is small for Nordic companies compared to their competitors in other countries and regions, the cultural characteristics of the Nordics have created a market with a high demand for such solutions, making the region a perfect place for developing and piloting such technology.

The literature review conducted in this study reveals that several pilot projects within telemedicine and ambient assisted living technology in Denmark and Norway have led to fewer hospitalizations, positive effects on health-related indicators, a reduction in the need and demand for home visits among patients and cost reductions. Results from two of these pilots are presented below.

Results from two pilots using ambient assisted living technology

A Danish study from 2012 (*Using preventive home monitoring to reduce hospital admission rates and reduce costs: a case study of telehealth among chronic obstructive pulmonary disease patients, Dinesen et al.*) conducted a randomized trial with patients diagnosed with COPD (chronic obstructive pulmonary disease). One half of the population were given equipment for preventive home monitoring with a telehealth monitoring device installed in their home, while the other half were assigned to traditional rehabilitation care. The statistical analysis revealed that the tele-rehabilitation group had significantly fewer hospital admissions during the 10-month follow-up period. The tele-rehabilitation group also improved more than the control group for a longer period, with a lower proportion of them in need of hospitalization. Future work requires large-scale studies of prolonged home monitoring and more extended follow-up.

The City of Oslo has conducted an evaluation¹ of a pilot project implemented in 2014 using ambient assisted living technology with the goal of improving the welfare of citizens who are heavy users of the public welfare services, as well as increasing cost efficiency in the public healthcare service. The evaluation revealed that the implementation of ambient assisted living technology had significant positive effects on health-related indicators and reported well-being among the recipients, as well as significant cost reducing effects on the municipalities' healthcare costs.

The economic benefits of ambient assisted living technology materialize through reductions in health care service consumption. The cost reductions from the project in the City of Oslo were quantified to a 32 percent reduction in health care costs, on average, and a 47 percent reduction for patients that had used the solution for a longer period of time.

¹ Source: Velferdsteknologi i sentrum, En kartlegging av effekten, Intro International og AHO, 2016.

Based on the literature review, the interviews and the business population, we have identified the following opportunities and challenges when it comes to ambient assisted living technology in the Nordics:

Opportunities

- Growing demand all over the world due to ageing populations.
- Global increase in lifestyle diseases contributes to growing focus on helping people live healthier lives.
- Wellness solutions can be easier to export as products can be sold directly to the user.

Challenges

- No unified industry: consists of startups and industry disrupters such as Telenor and Microsoft.
- Hard to get the first market entry in the public sector.
- International success requires easier access to the public home market to allow the companies to grow.

Export potential

The business population identified indicates a relatively large availability of companies producing ambient assisted living technology solutions in the Nordics. The main type of products and solutions are in the "self-care" segment, a market with great potential in other regions. A high share of treatment-specific products and services, especially within diabetes, disability and elderly care gives a potential for a targeted export effort. We do however find that the companies in this group have a lower degree of export-readiness. A large share of the companies consists of small companies and companies that have existed for less than six years, which suggests a relatively lower level of export readiness.

Personalized care/medicine

Personalized care/medicine became a term following the successful sequencing of the human genome in 2001. This breakthrough opened doors to identifying patients for which specific treatments were more beneficial and successful. New solutions for personalized medicine and care enable healthcare providers to give the right care, with the right dosage at the right time. Furthermore, the collection and analysis of such personalized treatment data from former patients makes it possible to match similar characteristics of new patients, speeding up the time spent on diagnosis as well as providing safer and more efficient treatment.⁴² The concept of personalized care is also increasing in scope as the financing of healthcare, internationally, is becoming more focused on outcome rather than volume.

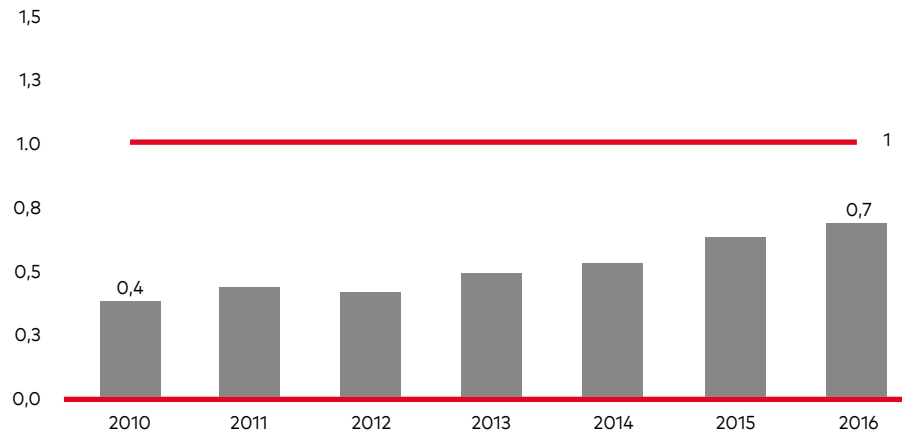
Big data and personalized care is a research area where the Nordic countries have an advantage over other regions in the world. The Nordic region has collected high quality registry data over many decades and its position in this field is close to unrivalled. In an EU funded handbook about cross-country

⁴² Panahiazar et al (2014), Empowering Personalized Medicine with Big Data and Semantic Web Technology: Promises, Challenges and Use Cases.

comparisons of healthcare data, the quality of populational healthcare data where each citizen is given a unique identifier is discussed. The handbook exemplifies with the high quality national register data in Norway, Sweden, Denmark and Israel.⁴³ In the verification of the Nordic strongholds within healthcare technology in chapter p. 32, we find that the Nordic *Revealed Comparative Advantage* (RCA), calculated based on export volumes, within personalized care was well below one in 2015. This implies that the Nordics' export of products within this sector is low relative to the total trade volume of such products. Below is a depiction of the Nordics' RCA in Personalized care, calculated for each year from 2010 to 2016.

Figure 3-16:
Revealed comparative advantage, by export volumes, Personalized care products.

Source: WTO/UN.



As shown in the illustration above, the Nordic RCA within Personalized care products is increasing. This implies that the Nordic export of products within this sector relative to the region's total export volume has increased more than the equivalent in the rest of the world for the past 6 years.

High quality population data with cross-sectoral identifiers represents a significant potential in terms of research and tailoring medicine and treatments to specific patients. The quality registers in the Nordics are one of the aspects of Nordic healthcare that attract the most international attention.

Several national research studies have stressed this advantage. Symbiocare, a communication platform promoting Swedish healthcare and life science industry, points out that "[a] key success factor for Sweden, acknowledging that Sweden scores high on international rankings on innovation, for further healthcare innovations is high quality data and patients' willingness to take part in piloting such medical innovations."⁴⁴

Another study, conducted on behalf of the Norwegian Research Council, states that Norway offers an interesting prospect to international companies in health innovation, since it has a stable and uncomplicated population with good national registers and diagnostic biobanks.⁴⁵ Additionally, the report

⁴³ Project funded by the European Commission, (2011), A Handbook to Access Health Care Data for Cross-country Comparisons of Efficiency and Quality.

⁴⁴ <http://www.symbiocare.org/top-quality-research-with-low-risk/>

⁴⁵ RAND Europe (2014), Supporting the development of a new health R&D strategy.

notes that there is a comparatively high willingness to pay for new healthcare solutions in Norway, both pharmaceuticals and health technology products. This applies to both the public healthcare sector and among citizens.

Denmark's national strategy for personalized medicine (2016) points out that *"collaboration on Personalized Medicine will increase the need for a joint infrastructure to collect and store biological samples and data, conduct genome sequencing and for registration, processing and sharing of data."*

A prominent example of a Nordic company within big data and healthcare is the Danish company GenoKey. It makes use of big data analysis to optimize the treatment of patients. Considering all the combinations of genomic risk factors, drug interactions and phenotypic influences, its solution makes it easier and faster for healthcare personnel to find the correct diagnosis as well as the optimal treatment. Further on, companies such as GenoKey supply pharmaceutical companies with data analysis based on the genetic characteristics of specific patient groups. This information is used to create varieties of pharmaceuticals optimizing dosages and minimizing side-effects according to the patient groups' genetic characteristics and similarities.

In a report by *Promote Iceland*,⁴⁶ it is noted that the quality of and access to rich population data, including health data, has enabled companies to develop innovative methods to analyze data which have led to faster detection of certain rare chronic diseases.

Another example for the use of health data is *Watson Health Center* by IBM in Helsinki. Maarit Palo, Executive for Governmental Affairs and University Relations at IBM Finland, explains why IBM started a health center in Finland: *"Finland is a forerunner in healthcare: a small but very agile and innovative country with a top-notch education system and lots of expertise. The Finnish legislation and biobanks enable the utilization of the country's extensive digital health databases, collected over decades. IBM, on the other hand, has been working on healthcare solutions based on cognitive computing and artificial intelligence, which have been eagerly welcomed by the global health sector. IBM's technology can help utilize Finland's unique databases in entirely new ways and create exciting new opportunities in healthcare."*

The Nordic countries all possess high-quality health data and biobanks and are all independently well equipped for establishing new businesses, as well as attracting foreign companies working within personalized medicine. However, there are a number of speciality areas where Nordic countries can leverage each other's knowledge. For instance, EY notes that Sweden in particular has a strong research and development competence within the medical field through its universities. Norway excels with regards to financing, with tax deduction schemes for research investments (SkatteFUNN) and comparatively better access to capital. Denmark has a strong pharmaceutical industry, due to its regulations. As health technology increasingly takes on new forms, such as personalized medicine, the Danish expertise and variety within pharmaceutical production may contribute in the development of health technology across the Nordic region.

⁴⁶ Promote Iceland (2015), Healthcare IT & Device Sector Mapping in Iceland.

Based on the literature review, the interviews and the business population, we have identified the following opportunities and challenges when it comes to personalized care:

Opportunities

- Increasing worldwide demand.
- The Nordics are well positioned to be at the forefront of developing products due to the existence of register data that can be used to tailor treatment to individual profiles.

Challenges

- Limited utilization of the register data as of today.
- To increase commercial use of the databases and register data, easier access is needed.
- Easier access to data requires resolving both regulatory issues as well as infrastructure issues (making data available through unified systems, etc.).

Export potential

High quality health registers and databases, genetic data and bio banks in the region have not been fully exploited yet. This data can be used to create solutions for personalized care. However, the number of companies utilizing the databases is limited as of today. The products and solutions produced today are mainly apps and software.

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Annex: List of interviews

Agata Leszkiewicz – Business Sweden, Toronto
Andri Marteinnsson – Promote Iceland
Anette Steenberg Williams – Trade Council Denmark
Anne Lidgard – Vinnova, San Francisco/Silicon Valley
Arild Kristensen – Norwegian Smart Care Cluster Program
Christian Graversen – Welfare Tech, Denmark
David Ludviksson – Federation of Icelandic Industries
Ebba Hult – Business Sweden
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Lucy Robertshaw – Industry expert, Sweden
Lydia Engholm – Business Sweden, Toronto
Nima Jokilaakso – Swecare Foundation
Tina Nordlander – Innovation Norway
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Åse Pettersen Bailey – Innovation Norway, San Francisco/Silicon Valley



Nordic Innovation is a vital instrument for the Nordic ministers of business, energy and regional policies and shall contribute to make the Nordic region a leading region for sustainable growth, and increase entrepreneurship, innovation and competitiveness in the Nordic region. We support projects and programs to stimulate innovation and works to improve the framework conditions for Nordic markets and exports.

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