STATE OF MEDICON VALLEY 2019

An Analysis of Life Science in Greater Copenhagen
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TABLE OF CONTENTS

1. SUMMARY ................................................................................................................. 4
2. FACTS AND FIGURES ................................................................................................ 8
3. THE BEACONS OF MEDICON VALLEY ....................................................................... 18
4. CLUSTER RANKING .................................................................................................. 22
5. ANALYSIS ............................................................................................................... 50
6. APPENDIX ............................................................................................................... 54
   - LARGER MEETINGS AND CONFERENCES ............................................................ 55
   - REPORTS AND FACTS ............................................................................................ 56
   - ORGANISATIONS .................................................................................................... 58
   - STATISTICS AND METHODOLOGY ................................................................. 60
   - REFERENCE LIST ................................................................................................... 66

PREFACE

The winds of change continue to blow through Medicon Valley and the Danish and Swedish life science industry. The region’s life science industry is still expanding, and new products are being launched, although turnover in the region’s largest pharmaceutical companies has temporarily plateaued. Novo Nordisk Foundation’s endeavour to establish a world-class innovation environment at COBIS in Copenhagen is progressing with the BioInnovation Institute. Medeon Science Park in Malmö is expanding with the new structure Forskaren 1, and Lund’s Medicon Village just inaugurated its newly constructed building The Spark.

Pharmaceutical exports are still rising. Between 2017 and 2018, Swedish life science exports increased by 10.6%; in the same period, Danish life science exports increased by 7.7%. According to Statistics Denmark, the Danish pharmaceutical industry grew over 20% between November 2017 and June 2019, and the sector now makes up one-fifth of Denmark’s industrial production. As the life science sector has grown more important for both the Danish and Swedish national economies, and with the increasing pressure on public healthcare systems in both countries, political interest has also grown. Denmark now has an internationalisation strategy for health and the life sciences, and the Swedish government presented an eight-point programme that forms the backbone for the upcoming Swedish life science strategy. While there are many common points of interest in the two countries’ ambitions and their choice of strategical areas, there are also certain important differences. In Denmark, the focus is clearly set on generating growth, and internationalisation and exports are keywords. The Swedish debate centres more on co-operation, and partnerships between private, public and academic actors are among the principal elements. Nordic collaboration has no prominent role as yet, although the countries share many of the challenges that face the sector in general.

There is also more potential for collaboration in academia. In a comparison with nine other leading European life science clusters, it was concluded that Medicon Valley’s researchers are cited more often than average in 15 of the region’s 20 largest research areas. The conclusion is part of a bibliometric analysis conducted by the Dutch research centre CWTS at Leiden University on behalf of Medicon Valley Alliance. While the result should certainly be considered a success for Medicon Valley, it also shows that there is still great potential for continued development in which trans-Øresund collaboration is an important element.

With its 250 members, the Danish-Swedish network organization Medicon Valley Alliance has a unique opportunity to build bridges between national and regional initiatives, as well as to create stronger links between the industry, academia and public healthcare providers in the region. In the years to come, Medicon Valley Alliance will place a strong emphasis on strengthening the organisation’s role as a facilitator of increased collaboration between our members, for the benefit of life science in Sweden and Denmark.

Copenhagen and Malmö
4 November 2019

Petter Hartman
CEO Medicon Valley Alliance
2018 was a record year for the Danish life science industry’s exports. In 2018, the export of medical products and devices was responsible for 15.4% of Denmark’s total exports; that share has doubled since 2008. Exports were valued at nearly 106 billion DKK – more than double what they were ten years ago. Life science exports were also record-high in Sweden in 2018, having risen 10.6% compared to 2017.

Increase in tax contribution in both countries

The life science sector in Denmark contributed 19.6 billion DKK in revenue in 2017, which is a 20% increase from 2016. Tax contributions from Swedish life science companies were 12.7 billion SEK in 2017; this is a 5.2% increase from 2016.

The region’s researchers are cited more frequently than average in 15 of the 20 largest subject areas for life science research in Medicon Valley. This was shown in CWTS’ survey of scientific publications and citations in the life sciences from 2006-2017. The 20 largest fields of research were responsible for more than 50% of the total number of scientific publications in the life sciences in Medicon Valley during the period examined.

Danish life science patent applications to the EPO in 2018. The number of Swedish patent requests was 373.

Medicon Valley’s life science sector employs 44,000 people.

Higher employment numbers, large acquisitions and hopes for a new blockbuster drug in oral-tablet form from Novo Nordisk for the treatment of type-2 diabetes are all indications of stable and positive developments in the continued renewal of Medicon Valley’s life science companies.

Employment rate on the rise

44,000 people are employed at Medicon Valley’s companies according to the latest statistics from 2017 – a 3.4% increase in one year. If consultants and subcontractors are included, the cluster’s importance is greater still. Last year, the largest employer, Novo Nordisk, had 16,300 employees in Denmark, and provided employment for another 7,900 people brought in via external companies. The majority of them work at the company’s facilities in Zealand and in the Capital Region of Denmark.

Acquisitions and new drugs bring growth

In the shift from older to new pharmaceuticals, the global turnover for Medicon Valley’s four largest life science companies (Novo Nordisk, Lundbeck, Ferring Pharmaceuticals and LEO Pharma) plateaued; the companies’ total turnover increased half a per cent last year, to 154 billion DKK. With the help of new drugs and acquisitions, turnover is expected to rise again. In 2019 so far, there have been six major acquisitions in Medicon Valley, worth more than 28 billion DKK. Of these, five concern sales in which the acquiring company is based in Medicon Valley. In addition, Widex, which manufactures hearing aids, has merged with Sivantos and become the new, larger company WS Audiology. An important new drug just won FDA approval in the USA: Novo Nordisk’s Rybelsus (Semaglutide) will give patients with type-2 diabetes the option of an oral tablet instead of injections.

Rising Danish and Swedish life science exports

Positive development is also apparent on a national level in both Denmark and Sweden. Danish life science exports rose by 7.7% last year to 106 billion DKK. Swedish life science exports rose 10.6% to the equivalent of 65 billion DKK. The number of patent applications submitted in the life sciences to the European Patent Office (EPO) last year increased ten per cent in Denmark and four per cent in Sweden.
Increased tax contributions from the life science sector

In Denmark, the life science sector’s total tax contributions in 2017 increased 20% to 19.6 billion DKK; in Sweden, tax contributions from the life science sector rose 5.2% to 12.7 billion SEK. Read more on page 13.

Competitive research

Measured in terms of scientific publications, research in Medicon Valley is in a good place, as a cluster ranking performed by the Dutch research centre CWTS at Leiden University on behalf of Medicon Valley Alliance shows.

Medicon Valley’s research in the life sciences is cited significantly more frequently than the international average in 15 of the region’s 20 largest areas of research. When it comes to the seven largest of these subject areas, the region places around the international average. In the study of living organisms (including microorganisms, plants, animals and human beings), but when describing antimicrobial resistance and personalised medicine.

ESS and MAX IV will affect life science

Another important factor that has yet to make a mark in the bibliometric analyses is the growth expected to accompany the material research facilities ESS and MAX IV, which will also affect the life sciences. Whilst the synchrotron radiation facility MAX IV in Lund is still in its start-up phase, the pan-European neutron research facility ESS in Lund is currently being constructed. The new research infrastructure is expected to create new opportunities in everything from biochemistry and molecular biology to microbiology, biotechnology and pharmacology: in extension, these can also be applied to many more areas in the life sciences.

Similar biobanks in Denmark and Sweden

Situated in a venerable white building just outside of central Copenhagen is Denmark’s State Serum Institute (SSI). SSI’s collaboration with Swedish universities is so intensive that the computer-generated network analysis performed by the research institution CWTS at Leiden University identified it as a Swedish actor. The close collaboration is largely because Sweden and Denmark have similar biobanks and registers, giving researchers the opportunity to carry out significantly larger register-based studies through collaboration between the countries.

– Collaboration with Sweden is clearly something we seek out – or that the Swedes seek out; it goes both ways. We’ve accrued know-how, and we co-publish many articles with Swedes every year. We know whom to contact, says Mads Melbye, Director of the State Serum Institute in Denmark. Read more on page 42.

Trans-Øresund cooperation

In addition to biobank collaboration, there are a number of other contiguous areas spanning the Øresund. This report is published by Medicon Valley Alliance, a network organisation for companies, universities and society across the Øresund. Denmark is very involved in the new materials research organisations MAX IV (operational) and European Spallation Source (operational in 2023) to be done to increase university collaboration across the Øresund.

– Government funding for specific collaborations between institutions in the Øresund Region would spark a lot of collaborations; funding is usually what controls how researchers organise their work.

Politicians in Region Skåne and the Capital Region of Denmark recently decided to increase collaboration across the Øresund. They are exploring new possibilities for a shared Danish-Swedish ambulance helicopter and collaboration within e.g. paediatrics and exchange of knowledge about the large hospital constructions underway in both countries.
FACTS AND FIGURES:  Positive development for Danish and Swedish life science

According to the latest statistics, the number of employees is on the rise in the life science sector in Medicon Valley and in Denmark and Sweden in general; patent applications are up; exports are increasing, and the sector’s contributions to the state coffers are growing in both countries. In Denmark, tax contributions from the life science sector grew 20% in 2017 compared to the previous year, and Danish exports have more than doubled over the past ten years.

- Life science exports from Denmark and Sweden have hit an all-time high. Danish life science exports are now worth close to 106 billion DKK, having more than doubled over the past ten years. Swedish life science exports have also reached a record high after rising 10.6% in 2018.
- In 2017, Danish life science sector contributed 19.6 billion DKK in tax revenue; this is 20% more than the preceding year. In total, income- and corporation tax contributions from Swedish life science companies were 12.7 billion SEK in 2017; this is a 5.2% increase from 2016.
- In 2018, Danish companies submitted 699 patent requests in the life sciences to the EPO; this is a 10% increase from 2017. In Sweden the increase was a more modest 4%.
- There were 44 000 employees in Medicon Valley in 2017 – the most recent year for which statistics are available. Compared with 2016, this represents a 3.4% increase.
- Medicon Valley’s main life science municipality is Gladsaxe (Bagsværd) outside Copenhagen; there are 8 600 employees in the life sciences in that Danish district. Among the companies there are Novo Nordisk’s headquarters and large facilities, as well as the sister company Novozymes.
- The second-largest municipality is Copenhagen, where there are 6 400 employees. Closely following Copenhagen with 6 000 employees is Ballerup. In Skåne, Malmö is the principal municipality for the life sciences with its 2 000 employees.

In Denmark as in Sweden, in 2017 the life science industry contributed more in taxes than in the preceding year. In Denmark, the rise has been substantial with a 20% increase in total tax revenue. Life science exports from Denmark and Sweden have hit an all-time high. Danish life science exports are now worth close to 106 billion DKK, having more than doubled over the past ten years. Swedish life science exports have also reached a record high after rising 10.6% in 2018.

The rise in the Danish life science industry’s tax contribution was substantial in 2017. The increase has been due to record high corporation tax. In total, the companies paid 10.4 billion DKK in corporation tax; this is 42% more than the preceding year. In Sweden, contributions from corporation tax on life science companies is at its highest since 2011.

When it comes to patent applications to the EPO in the life sciences, the number of requests from Denmark increased 10% in 2018 compared to the previous year. In Sweden, there was a 4% increase in the same period. Danish life science exports have doubled in the past ten years, although the increase from 2016 to 2017 was greater in Sweden (10.6%).

The number of employees in Medicon Valley was 44 000 in 2017 – a 3.4% increase compared to the previous year. At 6.2%, the increase in the region was greatest in Skåne.
RISING EMPLOYMENT IN MEDICON VALLEY

There were 44,000 employees in Medicon Valley in 2017 – the most recent year for which statistics are available. Compared with 2016, this represents a 3.4% increase. Within the region, the Capital Region of Denmark saw a 3.9% increase; Region Zealand had a 1.1% decrease, and Skåne experienced a 6.2% upswing between the two years. This is shown by figures from Statistics Sweden and Statistics Denmark.

In 2017, the number of people employed in the life science sector rose in Denmark as well as Sweden compared to the previous year. In Denmark, there was a 2.3% increase; in Sweden that number was 6.2%. Looking at the total period 2008-2017, Denmark saw an annual increase of 1.8%, while Sweden saw a 1.3% decrease.

Västra Götaland County is the Swedish region in which the greatest increase – 7% – occurred between 2016 and 2017; Skåne (6.2%) and Stockholm-Uppsala (5.8%) were not far behind. In Denmark, the greatest increase took place in the Capital Region of Denmark (3.9%), and there was a 1.1% decrease in Region Zealand.

These figures are based on statistics from Statistics Sweden and Statistics Denmark and are not directly comparable with figures from earlier reports; the reason is that the methodological definition of biotech companies has been broadened for this report.

In numbers: Medicon Valley’s life science sector employs 44,000 people. Of these, 32,700 are in the Capital Region of Denmark, 6,300 are in Region Zealand, and 5,000 are in Skåne. In Sweden on the whole, the sector employs 33,500 people; in Denmark that number is 43,200.

The Capital Region of Denmark is responsible for 74% of employment in the life science sector in Medicon Valley and nearly 76% of total employment in the Danish cluster. Stockholm-Uppsala is responsible for about 50% of Swedish employment in the life sciences. Medicon Valley’s part of the total employment in the life science sector in Denmark and Sweden is 57%.

Medicon Valley’s main life science municipality is Gladsaxe (Bagsværd); there are 8,600 employees in the life sciences in that Danish district. Among the companies there are Novo Nordisk’s headquarters and large facilities, as well as the sister company Novozymes. The graphic showing the five largest municipalities in Denmark and the three largest in Sweden is based on data from Statistics Sweden and Statistics Denmark, as well as information provided by the largest companies and Øresundinstituttet’s own research. The second-largest municipality is Copenhagen, where there are 6,400 employees and companies such as H. Lundbeck, Ferring Pharmaceuticals and Genmab. Closely following Copenhagen with 6,000 employees is Ballerup, where e.g. Leo Pharma’s headquarters and facilities for Novo Nordisk are located.

In Skåne, Malmö is the principal municipality for the life sciences with 2,000 employees. Among the companies there are Novo Nordisk’s Swedish office, Lundbeck, Leo Pharma and Ferring, as well as the headquarters for Atos Medical, Arjé and PolyPeptide. Helsingborg and Lund have the same number of employees in the life sciences – 1,100 – and include e.g. McNeil (Helsingborg) and Baxter (Lund).
Some examples of companies in the largest life science municipalities

- **Gladnsaxe** (Baggsværd): 8 600 employees
  - Headquarters and large facilities for Novo Nordisk and Novozymes.
- **Ballerup**: 6 000 employees
  - Novo Nordisk, LEO Pharma (headquarters, research and production site), GN Hearing, Synmphen and Pfizer are all based in Ballerup Municipality.
- **Copenhagen**: 6 400 employees
  - H. Lundbeck's life science environments are dominated by the medtech company Baxter (Gambro Lundia), Alligator Bioscience, Camurus and several smaller biotech companies at the science parks Medicon Village and Ideon.
- **Malmö**: 2 000 employees
  - Atos Medical (headquarters), Arjo (headquarters), Rechn Life Science, PolyPeptide Group, Nordic Drugs, Qpharma and numerous national and regional headquarters from the life science sector, e.g. Lundbeck, LEO Pharma and Novo Nordisk.
- **Kalundborg**: 3 700 employees
  - Production sites for Novo Nordisk and Novozymes.
- **Hillerød**: 3 500 employees
  - Novo Nordisk, Fujifilm - formerly Biogen (production site), PolyPeptide and Zymenex.

**Malmbi: 2 000 employees**
- Atos Medical (headquarters), Arjo (headquarters), Rechon Life Science, PolyPeptide Group, Nordic Drugs, Qpharma and numerous national and regional headquarters from the life science sector, e.g. Lundbeck, LEO Pharma and Novo Nordisk.

**Lund: 1 100 employees**
- Lund's life science environments are dominated by the medtech company Baxter (Gambro Lundia), Alligator Bioscience, Camurus and several smaller biotech companies at the science parks Medicon Village and Ideon.

**Helsingborg: 1 100 employees**
- McNeil, which develops and manufactures quit smoking products, is the largest life science company in Helsingborg.

**Copenhagen: 6 400 employees**
- Production sites for Novo Nordisk and Novozymes.

**Hillerød: 3 500 employees**
- Novo Nordisk, Fujifilm - formerly Biogen (production site), PolyPeptide and Zymenex.

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In a more long-term perspective however, the amount contributed via corporation tax has not grown; instead, the total revenue from life science companies’ corporation tax has dropped 12% since 2008, which corresponds to 788 million SEK.

In Sweden, companies in the life science sector are responsible for 1.9% of the total contributions from corporation- and income tax. The share has maintained the same level since 2014, but was previously higher. It reached a peak in 2009, when 2.5% of the total tax revenue came from companies in the life science sector.

The number of Danish patent applications in the life sciences to the European Patent Office (EPO) rose 10% last year. The greatest increase was in pharmaceuticals, although most patents are still sought for biotechnology. Swedish patent applications rose by 4% – most were in biotech – but moderately, the rise in numbers in biotechnology (271).

In 2018, Danish companies submitted 699 patent requests in the life sciences to the EPO; this is a 10% increase from 2017 and the highest entry in the years for which statistics are available; i.e. since 2009. When it comes to subject matter, the greatest increase in patent requests in Denmark was in pharmaceuticals – from 123 applications in 2017 to 194 in 2018; this represents a 58% increase. Despite a slight – four per cent – decrease in 2018 compared with the previous year, most patent applications in Denmark are still submitted in biotechnology (271).

When it comes to patent applications from Swedish life science companies, the rise in numbers from 2017 to 2018 was somewhat more modest: four per cent, from 358 to 373. Whilst development has been consistently positive since 2014, it has not yet returned to the 2010 peak, when the number of patent requests was 521. In 2018, Swedish applications to the EPO were predominantly in medical technology (200). The sharpest increase of 2018 compared to the previous year was in biotechnology – 29%. Applications for pharmaceuticals patents on the other hand decreased 13%, going from 96 in 2017 to 84 in 2018.

Among the Danish and Swedish companies on the EPO’s list of last year’s 25 top applicants are Novo Nordisk in medical technology (15th with 80 applications), pharmaceuticals (14th with 25 applications), and in biotechnology (16th with 29 applications). In addition, Danish Novozymes is in 3rd place for biotechnology with its 115 applications. AstraZeneca, whose roots are in Sweden and the UK, came 21st in pharmaceuticals with 22 applications.

699

Danish life science patent applications to the EPO in 2018. The number of Swedish patent applications was 373.
RECORD-HIGH LIFE SCIENCE EXPORTS

Life science exports from Denmark and Sweden have hit an all-time high. Danish life science exports are now worth close to 106 billion DKK, having more than doubled over the past ten years. Swedish life science exports have also reached a record high after rising 10.6% in 2018. China took over Germany’s place as Sweden’s largest export market. While China is also a growing market for the Danish life science industry, the US remains Denmark’s largest export market.

After a rather weak 2017 with little growth, Danish life science exports rose significantly in 2018. Total exports are nearly 106 billion DKK for a 7.7% increase compared to 2017; looking at the past decade, this represents more than a doubling of exports. Danish life science exports are responsible for more than 15% of Denmark’s total exportation of goods; that is the highest share recorded between 2008-2018.

The US is Denmark’s largest export market. In 2018 it grew still more, and life science exports to the USA were valued at 28 billion DKK – a 21% increase compared to 2017. After the US, China is the Danish life science industry’s largest export market. Medical products and devices worth 8.7 billion DKK were exported to the Chinese market, but the increase from 2017 – one per cent – was minimal. Seen in a long-term perspective however, exports to China have risen substantially. The average annual growth between 2008-2018 was 23%.

Danish exports to Germany, Sweden, the UK and Italy decreased in 2018. The four countries are among the top ten export markets for the Danish life science industry. Exports to France and Canada rose however, and the two countries are now 6th and 10th respectively on the top-ten list. In a long-term perspective, exports rose to all of the Danish life science industry’s ten largest markets between 2008-2018.

China overtook Germany and became Sweden’s largest export market for life science products last year. In 2018, exports to China were valued at 12 billion SEK – a 21% increase compared to 2017. As in Denmark, Swedish life science exports to the Chinese market have risen markedly in the past decade. From 2008 to 2018, the average annual growth was 29%. Germany is the second-largest export market for the Swedish life science industry, followed by the US. The annual growth to these two markets has been somewhat more modest but nonetheless positive. Exports to France, Belgium and the UK have fallen in the past decade, however. There was growth in all of the export markets on the top-ten list in 2018 with the exception of the UK; exports to Britain decreased five per cent compared to 2017.

The Swedish life science industry’s exports in 2018 were worth a total of 89 billion SEK (equivalent to nearly 65 billion DKK); that is a 10.6% rise compared to 2017, and a record high for the decade. The life science industry is responsible for 6.2% of Sweden’s total exportation of goods – a share that has been quite stable in recent years.

Sweden and Denmark are both important export countries for medical products and devices; in relation to the population, Denmark holds 4th and Sweden 10th place on the list of countries with the most life science exports per capita. The country with the highest exports in the life science sector is Germany, which is responsible for 15.2% of global sales. Following Germany are Switzerland and the US; Ireland is the largest exporter in terms of population size, followed by Switzerland, Belgium and Denmark.

FACTS AND FIGURES

THE PRINCIPAL EXPORT MARKETS FOR DANISH LIFE SCIENCE

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports in millions (DKK) 2018</th>
<th>Annual growth 08-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>27,899</td>
<td>15%</td>
</tr>
<tr>
<td>China</td>
<td>8,689</td>
<td>23%</td>
</tr>
<tr>
<td>Germany</td>
<td>5,786</td>
<td>3%</td>
</tr>
<tr>
<td>Japan</td>
<td>4,977</td>
<td>6%</td>
</tr>
<tr>
<td>Sweden</td>
<td>4,802</td>
<td>2%</td>
</tr>
<tr>
<td>France and Monaco</td>
<td>3,642</td>
<td>2%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>3,581</td>
<td>6%</td>
</tr>
<tr>
<td>Norway</td>
<td>2,915</td>
<td>10%</td>
</tr>
<tr>
<td>Italy</td>
<td>2,684</td>
<td>6%</td>
</tr>
<tr>
<td>Canada</td>
<td>2,632</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: Statistics Denmark

VALUE OF EXPORTS IN LIFE SCIENCE, IN MILLIONS (DKK)

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports per capita, USD</th>
<th>Percentage of global life science export</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>8,689</td>
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</tr>
<tr>
<td>USA</td>
<td>27,899</td>
<td>4%</td>
</tr>
<tr>
<td>Germany</td>
<td>5,786</td>
<td>1%</td>
</tr>
<tr>
<td>Japan</td>
<td>4,977</td>
<td>6%</td>
</tr>
<tr>
<td>Sweden</td>
<td>4,802</td>
<td>2%</td>
</tr>
<tr>
<td>France and Monaco</td>
<td>3,642</td>
<td>2%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>3,581</td>
<td>6%</td>
</tr>
<tr>
<td>Norway</td>
<td>2,915</td>
<td>10%</td>
</tr>
<tr>
<td>Italy</td>
<td>2,684</td>
<td>6%</td>
</tr>
<tr>
<td>Canada</td>
<td>2,632</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: Statistics Denmark

THE PRINCIPAL EXPORT MARKETS FOR SWEDISH LIFE SCIENCE

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports in millions (SEK) 2018</th>
<th>Annual growth 08-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>9,010</td>
<td>29%</td>
</tr>
<tr>
<td>Germany</td>
<td>8,347</td>
<td>4%</td>
</tr>
<tr>
<td>USA</td>
<td>8,174</td>
<td>1%</td>
</tr>
<tr>
<td>Japan</td>
<td>4,484</td>
<td>22%</td>
</tr>
<tr>
<td>Norway</td>
<td>3,815</td>
<td>4%</td>
</tr>
<tr>
<td>France and Monaco</td>
<td>3,080</td>
<td>-4%</td>
</tr>
<tr>
<td>Australia</td>
<td>2,795</td>
<td>3%</td>
</tr>
<tr>
<td>Belgium</td>
<td>2,620</td>
<td>-3%</td>
</tr>
<tr>
<td>Great Britain and Northern Ireland</td>
<td>1,917</td>
<td>-3%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1,714</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: SCB/Statistics Sweden and Riksbanken

LIFE SCIENCE EXPORTS IN DENMARK AND SWEDEN IN 2018

<table>
<thead>
<tr>
<th>Country</th>
<th>Millions DKK</th>
<th>Export share 2018</th>
<th>Growth (one year)</th>
<th>Annual growth 2008-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>105,876</td>
<td>15.4%</td>
<td>7.7%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Sweden</td>
<td>64,786</td>
<td>6.2%</td>
<td>10.6%</td>
<td>2.9%</td>
</tr>
</tbody>
</table>

Source: Statistics Denmark and SCB/Statistics Sweden and Riksbanken

* Figures are for medical and pharmaceutical products and medical instruments, apparatuses etc. Annual growth is calculated on figures in national currency.
THE BEACONS OF MEDICON VALLEY:
New strategies, directors and products

THE WINDS OF CHANGE ARE STILL SWEEPING THROUGH MEDICON VALLEY

The region’s major pharmaceutical and biotech companies are not the only ones making strong progress. The beacons of research and innovation are shining brighter; the materials research facility MAX IV in Lund is operational and European Spallation Source in Lund, whose data centre is in Copenhagen, will open the doors to its first researchers in 2023. The BioInnovation Institute is moving along at Copenhagen Bio Science Park, and Medicon Village in Lund and Medeon Science Park in Malmö are adding on. Ideon Science park in Lund is also growing.

Change is also afoot for the big pharmaceutical companies; there are new chief executives for the four largest of them (Novo Nordisk 2017, Lundbeck 2018 and Ferring and LEO Pharma 2019). Strategies are being modernised and research investments are starting to make their marks as new products. The region’s largest pharmaceutical company, Novo Nordisk, received FDA approval for its new diabetes products Ozempic and Rybelsus, which are expected to be blockbusters.

Medicon Valley is still in transformation. New chief executives have taken the helms of the region’s four major pharmaceutical companies since 2017. The companies’ sales have plateaued, but new products are being launched. Some of the region’s biotech companies have entered a strong growth phase, and several deals worth billions of crowns have been presented this year. New investments are a keyword when it comes to the region’s life science parks.

- The Novo Nordisk Foundation, The Lundbeck Foundation, Dr Frederik Paulsen Foundation and the LEO Foundation control the ownership of Medicon Valley’s largest companies: Novo Nordisk, H. Lundbeck, Ferring Pharmaceuticals and LEO Pharma. Foundation ownership prevents acquisition and thus secures the companies’ continued presence in the region in the future. Foundation ownership also means that company management can act with a long-term perspective. Some of the foundations invest in new biotech companies and make large donations to universities in the region.

- Medicon Valley is also home to a globally leading cluster of hearing aid manufacturers: Oticon, GN Hearing and WS Audiology.

- Medicon Valley’s biotech companies are thriving. Since 2014, New York-based Bristol-Myers-Squibb has invested 13 billion DKK in Danish biotech companies. Bavarian Nordic, Zealand Pharma and Genmab are just a few examples of Danish companies making strong headway. And there are more and more biotech companies sprouting forth from Lund’s science parks Medicon Village and Ideon.

- There are also many medtech companies in the region, such as Coloplast, Baxter (formerly Gambro), Arjo, Nolato Medical and Alos Medical.

- Medicon Valley’s academic spectrum in the life sciences is broad, with nine learning institutions that do research in the field. Globally leading diabetes research and neuroscientific research take place at the University of Copenhagen, as well as at Lund University. DTU and Malmö University are both highly advanced in areas such as bioengineering and biological surfaces.
THE NOVO NORDISK FOUNDATION GROUP

Novo Nordisk Foundation is an industrial foundation whose objective is to act as majority shareholder in the publicly traded Novo Nordisk and Novozymes, as well as to support scientific, humanitarian and social causes.

Novo Holdings is the Foundation’s wholly owned subsidiary. It manages the Foundation’s endowment and its controlling interests in the publicly traded companies Novo Nordisk and Novozymes. Via the platforms Seeds, Ventures and Principal Investments, investments are made in external biotech companies at various stages of development. Novo Holding also has 13 large, more long-term investments, including investments in five Danish companies: Chr. Hansen, Sonion, Symphogen, Velosio Pharmaceuticals and Xelia Pharmaceuticals.

Novo Nordisk is the original company behind the group, and today it is Denmark’s largest pharmaceutical company and a globally leading insulin manufacturer. The company also makes drugs for obesity, haemophilia and growth disorders.

Turnover 2018: 111.8 billion DKK

Novozymes was founded in 2000 as a demerger from Novo Nordisk. Novozymes is a publicly traded biotechnology company and a globally leading manufacturer of industrial enzymes as well as a major producer of microorganisms.

Turnover 2018: 14.4 billion DKK
Number of employees 2018: 6,427, of whom 2,687 in Denmark. Facilities in Medicom Valley: Headquarters in Bagsværd outside Copenhagen and offices in Bredstad and Malmö. Research facilities in Måløv and Hillerød. Production facilities in Varlase, Søborg, Målev, Gentofte, Køge, Kalundborg and Hillerød.

THE LUNDBECK FOUNDATION

Is an industrial foundation whose objective is to maintain and expand the activities of H. Lundbeck and to provide support for scientific, humanitarian and social causes. Lundbeck and ALK-Abelló, as well as in Falck A/S. The largest shareholder in the publicly traded companies have been supplied by the companies themselves.

Turnover 2018: 18.1 billion DKK
Number of employees 2018: 5,389, of whom 1,769 in Denmark and 75 in Sweden.
Facilities in Medicom Valley: Headquarters and production in Valby/Copenhagen and production in Odsherred. Office in Malmö.

FERRING PHARMACEUTICALS

Is a wholly privately owned pharmaceutical company with its roots around the Bresund. Ferring is run by Frederik Paulsen through the Dr Frederik Paulsen Foundation. There are also a number of pharmaceutical companies in Malmö with a historic link to Ferring: PolyPeptide Group, Qpharma, Nordic Drugs and Euro Diagnostica.

Turnover 2018: 1.89 billion EUR
Number of employees 2018: 6,500, of whom 575 in Denmark and 19 in Sweden
Facilities in Medicom Valley: Ferring Pharmaceuticals A/S, also called Ferring International Pharma Science Centre, and Ferring Lægemidler A/S in Bredstad (Copenhagen), and a sales office in Malmö and API-manufacturing Syntese in Hvidovre Municipality outside Copenhagen. Headquarters in Switzerland.

LEO FOUNDATION

Was established in 1984 to secure LEO Pharma’s future as an independent, research-based Danish pharmaceutical company. The foundation also supports international research with focus on dermatology.

LEO Pharma is an entirely privately/foundation-owned pharmaceutical company with focus on the development and production of medicines for dermatology and thrombosis.

Turnover 2018: 10.4 billion DKK
Number of employees 2018: 5,847 of whom 2,119 in Denmark and 35 in Sweden.
Facilities in Medicom Valley: Headquarters, Research and production in Billerup outside Copenhagen. Office in Malmö.

GLOBALLY LEADING HEARING AID MANUFACTURERS

In addition, DTU and Malmö University are both highly advanced in areas such as bioengineering and biological surfaces.
Life science researchers in Medicon Valley produced the greatest number of scientific publications from 2006-2016 were Biochemistry & Molecular Biology (4.7% of total publications), Endocrinology & Metabolism (3.9%), Oncology (3.7%), Neuroscience (3.5%) and Medicine, General & Internal (3.2%). This was shown by a bibliometric analysis performed by the Dutch research institution CWTS at Leiden University on behalf of Medicon Valley Alliance.

Together, the 20 largest research areas in Medicon Valley are responsible for more than 50% of the scientific publications in the period studied.

In 15 of those areas, publications by Medicon Valley researchers were cited significantly more often than the international average for their respective fields of research from 2006–2017. The remaining five are just above or below the average in the international comparison.

Compared with nine other leading European life science clusters, Medicon Valley places around midway in the seven largest subject areas in the region.

The Swedish government has taken initiatives to get more researchers and students from abroad to stay in the country, and the Danish government is also seeking to make it easier to recruit qualified experts from abroad.

Medicon Valley research in the life sciences is cited significantly more often than the international average in 15 of the region’s 20 major areas of research. When it comes to the seven largest of these subject areas, the region places around midway or just below in a comparison with nine other outstanding European life science clusters, according to an analysis by the Dutch research centre CWTS.
Oft cited: Medicon Valley’s researchers

The region’s researchers are cited significantly more often than average in 15 of the 20 largest subject areas for life science research in Medicon Valley. This was shown in CWTS’ survey of scientific publications and citations in the life sciences from 2006-2017.

Close to the middle in a European comparison

Medicon Valley is above the median when it comes to the number of citations per scientific publication from an international perspective. But in a comparison with nine other leading European life science clusters, the Swedish-Danish region comes in at just about in the middle, as a review of the seven largest topics in Medicon Valley showed. The study was performed by the Dutch research institute CWTS at Leiden University.

"It is very, very important that we perform good basic research, because one can never predict what will turn out to be exciting. But at the end of the day, the most important thing is that the results we produce can be used.”

Thue Schwartz, professor at Novo Nordisk Center for Basic Metabolic Research at the University of Copenhagen, believes that getting his research results out there is important, so he developed a number of spin-off companies. Read more in the interview on page 40.

The ten largest areas of research in the life sciences in Medicon Valley

Based on scientific publications from 2006-2016,
1. Biochemistry & molecular biology
2. Endocrinology & metabolism
3. Oncology
4. Neurosciences
5. Medicine, general & internal
6. Public, environmental & occupational health
7. Pharmacology & pharmacy
8. Cardiac & cardiovascular systems
9. Immunology
10. Surgery

"Government funding for specific collaborations between institutions in the Øresund Region would spark a lot of collaborations, because funding is usually what controls how researchers organise their work.”

Anna Blom, professor of Medical Protein Chemistry at Lund University, in an interview about funding, research conditions in the region, and Øresund collaboration, in which she sees great potential for development. Read more on page 38.

Most quoted

Based on the international average in the respective fields, the five topics in the life sciences within which Medicon Valley’s researchers’ scientific publications were most frequently cited from 2006-2017 are:
- Medicine, general & internal (MNCS: 1.71)
- Cell biology (MNCS: 1.61)
- Genetics & heredity (MNCS: 1.46)
- Plant sciences (MNCS: 1.40)
- Sport sciences (MNCS: 1.39)

An MNCS score of 1 entails that a publication has been cited as frequently as the international average in its field of research. This list is based on the 40 main research areas in the life sciences in Medicon Valley.
is also substantiated in the university’s internal analysis, which foregrounds e.g. DTU’s research in medical protein chemistry.

Biochemistry and molecular biology are also an area in which smaller universities in Medicon Valley perform research. Among others, the universities in Roskilde and Malmö perform research that can be fully or partially categorised in this field.

According to Anna Blom, Professor of Medical Protein Chemistry at Lund University and head of the Swedish Research Council’s Scientific Council for Medicine and Health, the biochemistry groups in the region – and in Skåne specifically – maintain a strong international level, but they can hardly be called globally-leading.

– In my opinion, this is due in part to under-funding and an excessive administrative burden placed on researchers, as well as lacking infrastructure. Contemporary research requires extremely advanced methods – not least animal models and expensive equipment. That’s not something that can be maintained by individual research groups; it needs to be created by the universities, and the extent to which that is being done isn’t sufficient, she says.

Read more about Anna Blom’s research on the complementary system of the immune system in an interview on page 38.

Linking research and industry
Endocrinology & Metabolism follow Biochemistry & Molecular Biology in size order and have long since been an important research subject in the region, particularly at the larger universities and university hospitals. The subject area concerns research on hormones and metabolism and includes e.g. diabetes. It can be linked to the region’s successful life science industry.

– Endocrinology is high on the list, which is not strange – there’s a strong tradition in the field, built on the foundation cast by Novo Nordisk, says Bo Ahrén from Lund University.

Research and industry have gradually developed a relationship of mutual exchange, and each contributes to the other.

– It’s also related to the Novo Nordisk Foundation’s strategic investments in that area. Endocrinology and metabolism have been an important part of the pharmaceuticals industry in the Copenhagen area. We consider that particular subject area a strong one for us, and there are also implications for the industry, where we’ve for example trained employees, says Mogens Holst Nielsen, Vice Dean

FACTS: DEFINITION OF SUBJECT CATEGORIES

• The publications were categorised according to the scientific journals in which they were published. Each journal was attributed to one or more subject categories using fractional counting, by the same principle, a publication that appeared in that journal was seen as belonging to these subject categories.

• The subject categories were defined by aggregating Web of Science’s journal subject categories. This was done according to the fixed classification system called the NOWT system (Netherlands Observatory for Science and Technology). NOWT is a formal cooperation between the Centre for Science and Technology Studies (CWTS) linked to Leiden University and the Maastricht Economic Research Institute on Innovation and Technology (MERIT) of Maastricht University, and is funded by the Dutch Ministry of Education, Culture and Science, Directorate Research and Science Policy.

• The subject categories encompass areas of varying size; for example, Biochemistry & Molecular Biology covers a broad field with many scientific journals, whilst other subject areas may include significantly fewer scientific journals.

MEDICON VALLEY MIDWAY BETWEEN EUROPEAN LIFE SCIENCE CLUSTERS FOR SCIENTIFIC PUBLICATIONS AND CITATION FREQUENCY

In a comparison with nine other outstanding European life science clusters, the percentage increase in the number of scientific publications from 2006-2016 was greatest in Medicon Valley. The Danish-Swedish region took sixth place in the comprehensive comparison, both for articles produced and citation frequency, as an analysis performed by the research institute CWTS on behalf of Medicon Valley Alliance shows. The analysis results were presented in detail in last year’s annual report “State of Medicon Valley 2018 – An Analysis of Life Science in Greater Copenhagen”. The following is a summary of the report.

• Medicon Valley’s researchers produced 32,027 scientific publications in the life sciences during the period studied, 2006-2016. From 2006-2017, 13% of those publications were among the 10% most frequently cited in their respective fields.

• The number of scientific publications in Medicon Valley increased 23% from the period 2006-2009 to the period 2013-2016, the increase was percentually greater than in any other cluster in the study.

• The study comprised a bibliometric comparison of ten European life science clusters, one of which is Medicon Valley. It was carried out by the Dutch research institute CWTS at Leiden University on behalf of Medicon Valley Alliance. The study included the following clusters:
  - London-Cambridge-Oxford
  - The Netherlands
  - Ile de France/Paris
  - Flanders
  - Stockholm-Uppsala
  - Scotland
  - Medicon Valley
  - Zurich
  - BioValley (a German-French-Swiss cluster that includes Basel, Alsace, Freiburg, Karlsruhe, Mulhouse and Strasbourg)
  - Munich

• The European life science clusters in the comparison that produced the greatest number of scientific publications during the period studied were London-Cambridge-Oxford (116,263), the Netherlands (90,779), and French-German-Swiss BioValley (49,825). The clusters with the largest proportion of scientific publications among the ten per cent most frequently cited internationally in their respective fields were London-Cambridge-Oxford (17%), Zurich (14%), and Scotland (15%).

• The clusters in the comparison that resemble Medicon Valley most closely are Stockholm-Uppsala, Flanders, and to a degree, Munich.

• International collaboration was a part of 54% of Medicon Valley’s scientific publications and led to significantly more citations than publications that were the result of national collaboration or the work of individual research groups. The research networks in the transborder region are however predominantly national.

• Internal research networks in Sweden and Denmark are marked stronger than research networks that cross the Øresund Strait, as shown by CWTS’ network analysis of the Swedish and Danish research institutions with which actors in Medicon Valley collaborate in the life sciences. Although practical issues and border obstacles throw a spanner in the works, universities in Medicon Valley believe that more trans-Øresund cooperation could strengthen research. The research facilities ESS and MAX IV, as well as a coordinated strategy for diabetes research, are highlighted as ways to bring the region closer together.

• Life science research is performed in several hospitals on the Danish side of the strait, whilst on the Swedish side it is concentrated primarily in Skåne University Hospital.

STATE OF MEDICON VALLEY • November 2019

STATE OF MEDICON VALLEY • November 2019
**MAIN FIELDS OF RESEARCH AND THEIR IMPACT**

The diagram shows the 40 subject areas in which research institutions in Medicon Valley produced the greatest number of scientific publications from 2006-2016, as well as the citation degree of these publications in relation to the international average in each respective research area (MNCS) from 2006-2017. 1 indicates that a publication has been cited as frequently as the calculated average for its field of research. In the diagram, the colour blue indicates an MNCS score over 1.2 (above average), red an MNCS score of 0.8-1.2 (average), and orange an MNCS score below 0.8 (below average).

**Source:** CWTS B.V.

**The five subject areas in which Medicon Valley's research institutions produced the greatest number of scientific publications from 2006-2016 were Biochemistry & Molecular Biology (4.7% of total publications), Endocrinology & Metabolism (3.9%), Oncology (3.7%), Neuroscience (3.5%) and Medicine, General & Internal (3.2%).**

**Fifteen of Medicon Valley's 20 largest areas of research are on a level that the research institute CWTS classifies as high with regard to the publications' citation degree in relation to the international average within each respective subject field (MNCS) from 2006-2017. That entails that their MNCS score is over 1.2 on a scale in which 1 indicates that a publication has been cited as frequently as the calculated average for its respective field of research. The remaining five research areas in the top 20 range from 0.99 and 1.13, i.e. approximately or slightly above average.**

**Research performed at university hospitals and research institutions**

In descending size order according to CWTS' bibliometric comparison, the major fields Biochemistry & Molecular Biology and Endocrinology & Metabolism are followed by Oncology, then Neuroscience, which is also linked to the region's life science industry. Cancer research is distributed throughout many of the region's learning institutions, and is among other things the primary focus of the Danish organisation the Danish Cancer Society. Neuroscience has long since been an important field of research, with multiple centres and operations at Lund University, where research on e.g. Parkinson's and Alzheimer's has been internationally acclaimed. The University of Copenhagen has also made active investments in the area, particularly in recent years.

Following Neuroscience is Medicine, General & Internal, which primarily includes clinical research and care for widespread diseases such as lung- and heart disease, diabetes, and neurological disorders, particularly in combination. Research is primarily performed at the university hospitals in Copenhagen and elsewhere in Zealand and in Skåne.

The subject area is followed by Public, Environmental and Occupational Health, a transdisciplinary field concerned with improving a nation's health and investigating the effect of surroundings and work environments on health. The Danish National Institute of Public Health should be mentioned in relation to the latter area. It is located in Copenhagen, although it is officially part of Aarhus University. The institute's research focuses...
TEN LIFE SCIENCE CLUSTERS IN COMPARISON

- On behalf of Medicon Valley Alliance, the research institute CWTS at Leiden University conducted a comparison of the bibliometric performance of ten life science clusters in Europe, one of which is Medicon Valley:
  - London-Cambridge-Oxford
  - Netherlands
  - Île de France/Paris
  - Flanders
  - Stockholm-Uppsala
  - Scotland
  - Medicon Valley
  - Zurich
  - BioValley (a German-French-Swiss cluster that includes Basel, Alsace, Freiburg, Karlsruhe, Mulhouse and Strasbourg)
  - Munich

- In the report, clusters are defined as areas in which universities and other research institutions are fairly densely located in a specific geographic area, where internal collaboration is customary or habitual, and where there is an established cluster organisation of some kind.

- Based on these criteria, we compiled a list of 15 European life science clusters. To do this, we identified the geographic areas that are home to the first 25 universities on the European list of the greatest number of published articles in the field “Biomedical and Health Sciences” in the Leiden Ranking 2012-2015, as well as studying the selection in a number of earlier reports on life science clusters to avoid overlooking clusters where e.g. there is no single, large university, or no transborder clusters.

- We then reduced these 15 clusters to ten by analysing how many articles were published by universities in the 15 European life science clusters, and the frequency with which they were cited. The comparison was done in Leiden Ranking “Biomedical and Health Sciences” 2012-2015.

- The clusters differ in terms of size and the number of research institutions. Some clusters are larger, more well positioned and conduct more research than others. The objective has been to represent the clusters’ significance and research positions in relation to one another, and not to show how each cluster performs according to its own unique conditions – a project that would require a significantly larger scope than the present one.

- The comparison has been done for the years 2006-2016. Citations have also been counted through 2017.

- The source was the research database Web of Science, and the publications selected for these regions were limited to those designated to the higher-level category of “Medical and Life Sciences”.

- All of the scientific publications in the relevant categories and journals from each region were counted, regardless of whether the research was conducted at e.g. a university, university hospital, other research institutions, or at a commercial enterprise.

- The representation of these results is further modulated by CWTS’ comparison with nine other successful life science clusters in Europe, specifically French-German-Swiss BioValley, Flanders, Île de France, London-Cambridge-Oxford, Munich, the Netherlands, Scotland, Stockholm-Uppsala and Zurich. In this group of clusters, Medicon Valley’s placement was in the middle in most cases, both in terms of the number of scientific publications produced and the citation frequency of those publications – see the diagrams on pages 31-34.

- If the perspective is broadened to encompass the 40 largest research areas in Medicon Valley from 2006-2017, only one subject – Zoology – was cited significantly less frequently than the international average for its respective field of research.

- The seventh largest field of research with regard to the number of scientific publications in CWTS’ comparison is Pharmacology and Pharmacy, which concerns how substances such as pharmaceuticals interact with the human body or other living organisms. Research in the field is performed at e.g. the University of Copenhagen, Lund University, and DTU, where the Dean of Research Katrine Krogh Andersen foregrounds Pharmacology as one of the university’s more important subject areas.

Many citations from an international perspective

Together, the 20 largest research areas in Medicon Valley are responsible for more than 50% of the scientific publications in the period studied. In 15 of those areas, publications by Medicon Valley researchers were cited significantly more frequently than the international average for their respective fields of research from 2006-2017. The remaining five are just above or below the average in an international comparison.

If the perspective is broadened to encompass the 40 largest research areas in Medicon Valley from 2006-2017, only one subject – Zoology – was cited significantly less frequently than the international average for its respective field of research.

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Neuroscience places lowest

One subject area that falls out of line is Neuroscience; whilst Medicon Valley researchers’ publications were cited slightly more often than the global average, in terms of citations, the region clearly performed more poorly in the European comparison. This came as a surprise to Bo Ahrén, Pro Vice-Chancellor at Lund University.

– Neuroscience is one of the very strongest areas in Lund when it comes to medicine; that has been the case for decades, and the tradition is strong.
The diagrams below show the number of scientific publications (total publications) in the respective subject area from 2006-2017, as well as the citation degree of these publications in relation to the international average in the respective research areas (MNCS) from 2006-2017. 1 indicates that a publication has been cited as frequently as the average for its respective field of research.

ENDOCRINOLOGY & METABOLISM

- Medicon Valley places third compared to the other life science clusters in the analysis. Only London-Cambridge-Oxford and the Netherlands produced a greater number of scientific publications than Medicon Valley during the period in question.
- In terms of the number of citations with regard to the international average in each respective field of research, Medicon Valley is at the middle and shares sixth place with Stockholm-Uppsala.

ONCOLOGY

- Medicon Valley is just below the average compared to the other life science clusters in terms of both the number of citations (seventh place) and citation frequency (sixth place).

NEUROSCIENCES

- Medicon Valley’s citation frequency is the lowest of all ten clusters in the comparison, and it places seventh for the number of publications.

The same goes for Denmark, where Lundbeck is the driving force. The results were low all the same. I had expected different results, considering the excellent researchers we have here, many of whom are absolutely at the forefront globally, he says. None of the people interviewed had a clear understanding of or explanation for the low results. Mogens Holst Nissen, Vice Dean for Research at the University of Copenhagen’s Faculty of Health and Medical Sciences, believes that could be about to change, however. Neuroscience, as mentioned, is one of the areas in which the University of Copenhagen has made growth investments, e.g. by recruiting researchers and pooling strength in a common institution.

- Neuroscience in particular is in a phase that we expect to mean continued development and a reinforcement for the region. We expect that it will be discernible in the future, in the years to come, he says.

Remarkably high number of citations in Medicine, General & Internal

A very successful subject area in terms of the citation frequency of Medicon Valley researchers’ scientific publications is Medicine, General & Internal. During the period studied (2006-2017), the MNCS score for the area was 1.71 (a score of 1 entails that a publication was cited as frequently as the international average for its field of research). The score is comparatively a very high one. Medicine, General & Internal comprises clinical research and care for widespread diseases such as COPD, heart failure, diabetes, neurological disorders, or infections. In other words, there is no sharp divide between Medicine, General & Internal and the other major fields of research.

Bo Ahrén reasons that the comparatively poorer result for Neuroscience could be related to the way the research has been classified.

- There are of course sources of error in bibliometry. However, the other subject areas have the placement one would expect them to, he says.

Despite the high citation frequency for research in Medicine, General & Internal in Medicon Valley, the region still remains close to the median in relation to the other nine European clusters studied.

There are other such examples in which Medicon Valley maintains its place in the middle in the European comparison, e.g. Public, Environmental & Occupational Health. This is true although Medicon Valley researchers’ citation frequency in that particular area is unusually low compared to the international average: the MNCS score is 0.99 and thus lower than the international average.

However, according to the Dutch research institution CWTS, which performed the bibliometric analysis, based on the material no general conclusions can be drawn regarding whether a European trend can be discerned concerning the areas in which research is performed and how frequently the scientific publications are cited.

Private foundations make major investments in the life sciences

The subject areas in which development is strongest is clearly linked to where the research resources are,
The diagrams below show the number of scientific publications (total publications) in the respective subject area from 2006-2016, as well as the citation degree of these publications in relation to the international average in the respective research areas (MNCS) from 2006-2017. It indicates that a publication has been cited as frequently as the average for its respective field of research.

**MEDICINE, GENERAL & INTERNAL**

- Medicon Valley is close to the median compared to the other life science clusters, despite the high MNCS score of 1.71. Medicon Valley places fourth for citation frequency and sixth for the number of publications.

**PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH**

- Medicon Valley is close to the middle compared to the other selected life science clusters, despite the relatively low MNCS score. Medicon Valley places fourth for the number of publications and fifth for citation frequency.

**PHARMACOLOGY & PHARMACY**

- With an MNCS score of 1.13, the region shares seventh place in a comparison of the life science clusters’ citation frequency. Medicon Valley comes in sixth for the number of scientific publications.

According to several of the people interviewed for this report. In part, this is because of political investments: in recent years, the Swedish and Danish governments have prioritised e.g. antimicrobial resistance and personalised medicine. The industry also exerts influence, particularly in Denmark, where companies have a tradition of creating research foundations with a great deal of resources to distribute. In the life sciences, two such foundations are the Novo Nordisk Foundation and the Lundbeck Foundation. The practice is less common in Sweden, although the Wallenberg Foundations are one example that they do exist there as well.

- Private foundations are distributing more and more funds; there has been an enormous increase in the past ten years, so that there are more resources for research in private foundations than in the public ones. The life sciences are an area in which the majority of resources are clearly in private foundations, so we can reinforce those environments, says Katrine Krogh Andersen, who was Dean of Research at the Technical University of Denmark (DTU) at the time of the interview.

In January 2020, she will take over her new position as Dean of the Faculty of Science at the University of Copenhagen.

As an example, she mentions the multiple research centres started by the Novo Nordisk Foundation, such as the Novo Nordisk Foundation Center for Biosustainability at DTU, as well as the Novo Nordisk Foundation’s so-called Challenge Programme, with investments of 60 million DKK.

- It’s thus a question of some very large investments made by these foundations, which target excellent researchers – both Danish and international researchers that they’d like to bring to Denmark. I think that within a few years that will mean a real fortification of research in the life sciences, she says. Katrine Krogh Andersen also points out that since this development just started around ten years ago, only the first phase is visible in the bibliometric analyses being performed now.

- Since research funds are predominantly distributed by actors external to the universities, the learning institutions themselves have a difficult time influencing the direction of the research being performed, says Anna Blom from Lund University.

Lund University is also involved with the distribution of research grants from the Swedish Research Council, and it is part of numerous Swedish research committees and foundations.

- The university has extremely limited possibilities to steer my research – because all of my funding is external and in part from the government, but above all from private financiers such as the Wallenberg Foundations or the Swedish Cancer Society. That being so, it’s important to invest in individuals and develop them. Ideally both women and men, she says.
Anna Blom emphasises the importance of individual researchers who construct a successful environment in a particular area and in doing so lay the foundation for a strong field of research at their university or in their region.

– When I came here in 1993, diabetes was not yet the very largest research area at Lund University. The successful environment that we have today was built up by Professor Leif Groop, who was recruited from Finland and was a wonderful leader for many years. He was a brilliant researcher himself, but he was also able to recruit a whole pool of researchers. Now that he’s retired, there’s a whole group of younger professors in the field of diabetes with a variety of competencies, and together they’re creating a fantastic environment, she says.

According to Blom, the case is similar in e.g. neuroscience.

Thue Schwartz, Professor at the Novo Nordisk Center for Basic Metabolic Research at the University of Copenhagen, is also convinced that individual researchers can play a vital role in the emergence of a successful field of research.

Schwartz also strongly emphasises the funding opportunities that the Novo Nordisk Foundation and others provide within the life sciences, specifically in metabolism and endocrinology.

**Effects of ESS and MAX IV not yet apparent in the analysis**

Another important factor that has yet to make a mark in the bibliometric analyses is the growth expected to accompany the materials research facilities ESS and MAX IV, which will also affect the life sciences. Whilst the synchrotron radiation facility MAX IV in Lund is still in its start-up phase, the pan-European neutron research facility ESS in Lund is currently being constructed. ESS’ data centre is located in Copenhagen. The new research infrastructure is expected to create new opportunities in everything from biochemistry and molecular biology to microbiology, biotechnology and pharmacology; in extension, these can also be applied to many more areas in the life sciences.

In addition, the research facilities are expected to have a broader influence on the research community.

– Building up MAX IV and ESS will attract Danish researchers and lead to increased internationalisation, as well as more collaboration with Denmark within those fields, says Bo Ahrén from Lund University.

International collaboration generally leads to an increase in the citation impact of scientific publications, Ahrén points out, and other rectors and deans foreground the importance of working together – not only in Medicon Valley, but in a broader international perspective.

**Prioritisation and profiling as strategies**

According to Kerstin Tham, Vice Chancellor at Malmö University, an investment with the potential to strengthen the region would be a more clearly defined prioritisation according to subject area. She recommends for example a research strategy in diabetes to give the region a stronger profile in relation to e.g. Stockholm-Uppsala.

– Comparisons like these are valuable and allow us to see the strengths we have and could perhaps reinforce further. One such area of strength is endocrinology. It would be incredibly valuable if the region created an even more defined image compa-
Anna Blom is Professor of Medical Protein Chemistry at Lund University and the head of a research group that focuses on a part of the immune system called the complement system. She believes that research in Sweden would benefit from more long-term research grants – and suggests specially designated funds for trans-Øresund collaboration. In Blom’s opinion, the current research exchange between the Swedish and Danish parts of the region is far too meagre.

Earlier this year, Anna Blom was appointed “Wallenberg Scholar”, receiving a five-year grant of 18 million SEK for free basic research from the Knut and Alice Wallenberg Foundation. Blom heads a group of 20 researchers whose research work focuses on the complement system, which forms a part of the innate immune system in all organisms from humans to sea cucumbers. The work of the research group – which, according to Anna Blom, can be counted among the top five globally in its field – has come to expand: the research ranges from studying how bacteria defend themselves against the complement system in the hopes of finding alternatives to antibiotics to investigating complement’s role in rheumatological illnesses related to the immune system to find new kinds of therapy or improve diagnostics. In addition, Anna Blom and her colleagues study the complementary system’s role in diabetes. The group is also continuing work with their discovery that people with breast cancer whose cancer cells produce a larger amount of the protein COMP have poorer prognoses, a much higher number of metastases, respond worse to treatment, and succumb much more quickly to the disease.

– In part, it can be used as a diagnostic tool – if a woman who gets breast cancer has indications of this protein, the treatment should presumably be much more quickly to the disease. And of course, we also try to figure out: Can we use this knowledge to develop a treatment? says Anna Blom. "I have a small collaboration with Copenhagen, but that’s because there is someone there in exactly my research field."

Anna Blom heads an immunology research group at Lund University.

Anna Blom then got a position at Lund University, located at the Wallenberg Laboratory in Malmö. She started out there as a post-doc, but today she is a professor and the head of a large research group. She is also chair of the Swedish Research Council’s Scientific Council for Medicine and Health, and has a part-time position in clinical chemistry at the clinic at Skåne University Hospital, and is assistant prefect for strategic issues at her institute.

– I have a lot of other tasks on top of those, as female professors typically do. For her better or worse, it takes time away from doing research, but on the other hand, someone has to help create an environment that works well, she says.

Loyalty to her academic institution is one of the reasons Anna Blom chose to stay at Lund University. She also sees many advantages to working in Skåne and the Øresund Region – from Sweden being a country with fairly good gender equality and one in which, in Anna Blom’s experience, meritocracy is alive and well and corruption is practically non-existent – to the area’s good communications, which make it relatively easy to recruit new employees.

Of the 20 researchers in Anna Blom’s group, only two are Swedes – the rest are from e.g. Greece, Germany, Turkey, Italy, and England. The choice was a conscious one made by Anna Blom, who seeks the exchange of ideas and experience that occurs when people with different backgrounds meet. She has practically never worked with Danes, however, and finds that a more extensive collaboration with the Danish part of Medicon Valley is lacking.

– There are no natural meeting places; at any rate I’ve never been invited to any or seen any relevant occasions. I have a small collaboration with Copenhagen, but that’s because there is someone there in exactly my research field. He could just as well be in Brussels; I would be working with him just the same.

As Anna Blom sees it, there is a lack of interest in the Øresund Region in Stockholm, both when it comes to regional development as well as in terms of research.

– Government funding for specific collaborations between institutions in the Øresund Region would spark a lot of collaborations; funding is usually what controls how researchers organise their work.

She’d also like to see transborder conferences, for example in her own field of immunology. Or more meeting places and networks where researchers can meet and get to know each other.

– Occasionally I’m invited to Copenhagen as an opponent for a PhD defence, and looking at that fantastic, new research building Mærsk Tower – yes, well, there must be a whole lot of research being done there. That’s exciting, but I have no idea who the researchers are, she says.

Even if she prefers to recruit internationally and work with researchers around the globe, Anna Blom sees a lot of benefits to local collaborations across the Øresund Strait. A major advantage is that the proximity makes it easier to perform experiments together, and that the universities can share expensive equipment and facilities. On top of that, Anna Blom sees a climate-friendly aspect to choosing collaboration partners who are nearby.

– I just went to San Diego to give a lecture; flying 24 hours back and forth for that purpose is crazy. It isn’t sustainable, and I don’t think it can continue. A lot of people want to meet in person – and that can really be necessary when the discussions are complicated – and in those cases it’s so much easier to go to Denmark, she says.

Through her position at the Swedish Research Council and other research foundations, Anna Blom has insight into how research funding works from the perspective of the government as well as from that of the researcher. She believes that the potential is there for improvements that would benefit research in the region and give it more of a competitive edge.

– There is a definite need for more stability and long-term funding so researchers can dedicate themselves to somewhat more risky research endeavours that might not produce results for a long time, because that is a precondition for finding real breakthroughs, she says.

She also points out the size of grants; a typical grant from the Swedish Research Council lasts for three years and the length of a post-doc position.

– When you apply for a grant in for example the USA, you can receive full funding for the project at hand. Here, the grant covers maybe ten or twenty per cent of what is needed. I write around 20 applications a year just to be able to maintain a group, because my university doesn’t give me any funding other than my own salary. That is the case for most of the people in my department, she says.

In the long term, Anna Blom hopes to be able to contribute to increased knowledge and improved diagnostics or treatments for illnesses.

– Personally, I enjoy simply understanding things, seeing how they work. And discovering something that no one has ever seen before. That’s the driving force, it’s really the best, she says.
CLUSTER RANKING

BRINGING RESEARCH RESULTS TO THE PEOPLE WITH SPIN-OFF COMPANIES

Thue Schwartz divides his time between basic research on how the building blocks created when the body breaks down food affect receptors in adipose tissue and bringing the results of his research to the public via the companies he starts up. He is a professor at the Novo Nordisk Foundation Center for Basic Metabolic Research at the University of Copenhagen, and collaborations with Sweden have been extremely important throughout long stretches of his career thus far.

Collaboration with Swedish research colleagues already took off at the start of Thue Schwartz’ career. Though he trained as a doctor, he chose to begin researching gastrointestinal hormones. At the time – in the 1970s and 80s – there was an excellent research group at Lund University that focused on the very same subject as Thue Schwartz’ group at the University of Copenhagen, just using a different approach.

– Lund – with Rolf Håkansson in pharmacology and Frank Sundler in anatomy – was our most important collaboration partner and we worked together very closely, he says.

Little by little, Thue Schwartz’ research came to be more about how hormones affect receptors in the body. He worked at Novo Nordisk for a while in the 1990s, but chose to return to the university. A few years later, he started his own biotech company, 7TM Pharma. His research grew more specifically oriented toward endocrinology and metabolism around ten years ago, when he was part of a funding application for the centre that is now the Novo Nordisk Center for Basic Metabolic Research, where he is now professor.

– I was still involved with receptors, but this time I was working with receptors for metabolites, he says, referring to the metabolic substance created when the body breaks down food, or in fatty tissue.

They’re generally considered the building blocks of the body, or seen as small units of energy, Thue Schwartz explains.

– But from our perspective, many also function as extracellular signal molecules, so the way they work is that they’re created in one cell and send a signal to the adjacent cell, or to the cell that creates the metabolite. When we started ten years ago it was an entirely new field of research, he says.

Thue Schwartz and the research group of 12-15 people he leads are trying to understand how metabolites function as both units of energy and neurotransmitters, e.g. in adipose tissue. In the work they do, they collaborate closely with other colleagues at the Novo Nordisk Center for Basic Metabolic Research, but also with a research group at the Wallenberg Laboratory at the Sahlgrenska Academy at the University of Gothenburg that specialises in the importance of gut flora for health.

– I invested in equipment at Sahlgrenska with Professor Fredrik Bäckhed, who is based there, and I employed him part-time in my division of the centre (Novo Nordisk Foundation Center for Basic Metabolic Research). After we had been sharing knowledge and resources for a few years we received a large research grant together with Jens Nielsen from Chalmers, says Thue Schwartz.

At the moment, he isn’t involved in any collaborations in what is traditionally classified as Medicon Valley or the Øresund Region.

– But if you expand the Øresund Region to include Gothenburg, I am. After all, it’s the same train line, he says.

Parallel to his research, Thue Schwartz has started up a number of companies as a way to bring his research out into the world. He was also involved in starting up Denmark’s first biotech venture fund, BankInvest BBU.

The youngest company in which he is part-owner is Embark Biotech, whose goal is to develop new treatment methods for obesity. It’s based on the group’s research into new ways to stimulate adipose tissue to use fat, rather than store it.

– In November of 2018 we signed an extensive collaboration-, research- and development contract with Novo Nordisk, he says. Thue Schwartz points out that he believes there is little public funding. It’s a bit of a shame that we’re so dependent on the private foundations.”

Thue Nordisk was signed at a very early stage, the reason being that the parties involved knew each other well and trusted each other.

– We were confident that they would receive it well – and vice versa – and the development has been insanely good. It’s great to see that basic research can be put to good use, he says.

Thue Schwartz believes that the conditions for performing life science research in Medicon Valley are extraordinarily good because of the good funding opportunities in Denmark. As he sees it though, that’s mostly due to resources from large research foundations like the Novo Nordisk Foundation and the Lundbeck Foundation.

– There is clearly too little public funding. It’s a bit of a shame that we’re so dependent on the private foundations, he says.

At the same time, he considers the research funding from the Novo Nordisk Foundation very positive, particularly because of its broad scope: there are possibilities to apply for funding for everything from large research centres to specific research projects to the recruitment of new researchers or for giving young researchers opportunities abroad.

– You can basically apply for funds to do anything. That’s extremely important. And it isn’t limited to endocrinology and metabolistic research, even if they do welcome those; it covers biomedical research and other areas as well, says Thue Schwartz.

In addition, he highlights that the Novo Nordisk Foundation often grants long-term funding with relatively few partners involved, which leaves more in the coffers for each research group and allows for more focused collaboration.

Thue Schwartz points out that he believes there are good opportunities to fund newly established companies as well, since there are funds available for many different phases of development. The Novo Nordisk Foundation is also very active via Novo Holdings in that respect, he says.

Personally, Thue Schwartz finds the combination of research and entrepreneurship important.

– It is very, very important that we perform good basic research, because one can never predict what will turn out to be exciting. But at the end of the day, the most important thing is that the results we produce can be used. Basic research is what motivates me, for us to understand what’s going on – but one great and important thing is that we can utilise that basic research for patient treatment, he says.

He believes that research in endocrinology and metabolism will continue to be a strong area for Medicon Valley in the future. The factors that strengthen the region in that area right now – like the interplay of research and industry, funding opportunities and the existing tradition in endocrinology and metabolism – should endure, says Thue Schwartz.

– There will of course be changes to the areas of focus, but that’s just variations on a theme. While gut hormones were the most important thing last century, I think that the focus will shift more and more to fatty tissue. Another thing is that our understanding of the central nervous system’s importance in endocrinology has been a very good field of research, but I think in the future it’s going to be really, really big, he says.
SCANDINAVIAN BIOBANKS INSTRUMENTAL IN EXTENSIVE TRANSBORDER COLLABORATION

Denmark’s State Serum Institute (SSI) collaborates extensively with Swedish universities – so much so that a computer-generated network analysis located the Danish research institute as part of Sweden. This is largely because Sweden and Denmark have similar biobanks and registers, giving researchers the opportunity to carry out significantly larger register-based studies through collaboration between the countries.

– Collaboration with Sweden is clearly something we seek out – or that the Swedes seek out; it goes both ways. We’ve accrued know-how, and we co-publish many articles with Swedes every year. We know whom to contact, says Mads Melbye, Director of the State Serum Institute.

There are four main themes for research at the institute: epidemiologic research, vaccine research, research on infectious disease preparedness – e.g. antibiotic resistance and the development and implementations of new diagnostic methods – and research on congenital disease. In addition, SSI runs the Danish National Biobank. Of the ca 700 research on congenital disease. In addition, SSI also runs the Danish National Biobank. Of the ca 700 employees at the state-run research institute, which operates under the auspices of the Danish Ministry of Health, around 150 work primarily in research. SSI is currently working to build up a large centre for antimicrobial resistance with the World Bank and others.

– We are very actively involved in antimicrobial resistance and collaborate internationally. But we also have large-scale projects in other areas, such as e.g. a vaccine development project and a large genetic project, says Mads Melbye.

He is unsurprised by the results of the computer-generated network analysis performed by the research centre CWTS at Leiden University. Collaboration between different research institutions is shown in different colours, so actors who produce scientific publications together frequently are automatically assigned the same colour. In the specific network analysis that shows collaboration between research institutions in Medicon Valley – both internally and with other research institutions throughout Sweden and Denmark – SSI is conspicuous; it is the only actor that the computer program VOSviewer does not place in its own country’s network.

– We try to work on a Scandinavian level with our register-based studies. We use large population groups, and in many of our projects we include the Swedish population as well. In such cases, all of Sweden is included. But in many of the projects, there are researchers in Malmö or Lund whom we’ve met who present the Swedish data set, says Mads Melbye.

In Scandinarvia and Sweden in particular, the registers are organised in such a similar manner that extensive collaboration is motivated, he explains.

In addition to register-based studies, SSI also collaborates occasionally with universities in Lund, Malmö and the rest of Sweden on specific research projects. Within Medicon Valley, for example, there have been collaborations focusing on infectious diseases, oncology and blood disorders.

– At the moment however, there is no specific project tying together the Øresund Region per se. It’s more that many of our employees live on the other side of the Øresund Strait, and we recruit a lot of people from Sweden, says Mads Melbye. He admits that he is astonished by how little contact there is between the universities in Malmö and Lund and the large research institutions in Copenhagen.

– The contact is more specific to individuals – we don’t take part in any special events. I find that there is unbelievably little being done on an organisational level to pull the region together. I don’t know of any specially designated facilities or research funds, or common infrastructures. The only thing that comes to mind are the big materials research facilities; besides them I don’t know of any other projects, he says.

An opportunity to which Mads Melbye – who is also a professor at Stanford University in the USA – calls attention is a post doc-programme in Silicon Valley where 30 post docs receive assistance commercialising their research results, meeting every fortnight with industry representatives, advisers and other start-up companies.

– Something similar would be conceivable for the Øresund Region. Thirty students could be taken on, regardless of whether they live in Sweden or Denmark. It would also be a way to bring together industry and academia, he says.

“I find that there is unbelievably little being done on an organisational level to pull the region together.”

FACTS

Denmark’s State Serum Institute (SSI) is located as part of Sweden in the network analysis. This is largely because Sweden and Denmark have similar biobanks and registers, giving researchers the opportunity to carry out significantly larger register-based studies through collaboration between the countries.


To read more of the network analysis prepared by the research institution CWTS at Leiden University to which this article refers, see Medicon Valley Alliance’s 2018 annual report: State of Medicon Valley 2018 – An Analysis of Life Science in Greater Copenhagen.

THREE CURRENT RESEARCH ENDEAVOURS IN THE LIFE SCIENCES

– The International Centre for Interdisciplinary Solutions on AMR is the name of the knowledge and research centre on antimicrobial resistance that the State Serum Institute is currently building up with World Bank and the collaborative organisation Consultative Group on International Agricultural Research (CGIAR), which works to secure the future food supply. Last November, Denmark’s then-Minister of Health Ellen Tranæ Nerby signed a memorandum of understanding with the ambition to construct the centre and eventually generate 400-500 jobs in Denmark. Two Danish ministries are involved in the project: the Ministry of Health (formerly the Ministry of Health and the Aged), which is behind the State Serum Institute, and the Ministry of the Environment and Food.

– Genomic Medicine Sweden is a project that aims to make practical use of genomic innovation in health care and implement a sustainable precision medicine infrastructure in Sweden. Region Skåne is coordinating the work, which involves all of the Swedish regions and brings together clinics, researchers, companies and patient organisations.

– The Capital Region of Denmark, Region Zealand, the University of Copenhagen, and the Technical University of Denmark (DTU) are also working collaboratively on a shared data infrastructure project to be used by clinicians and researchers in their work with precision medicine. In addition, a genome centre is being created to assist clinics and researchers with analyses, as well as a biobank centre that will support researchers whose studies are based on biological samples and genetics.
### UNIVERSITIES, REGIONS AND RESEARCH INSTITUTIONS

Source: The universities and research institutions own numbers. Life science researchers includes professors, associate professors, lecturers, post docs, doctoral students, etc. See footnotes in the Appendix for more information about the figures.

* Researchers at the hospitals in the region often conduct research part-time. Some of the researchers at the hospitals and at the Danish Cancer Society also have part-time positions at the universities in the region.

** The numbers for Lund University are not complete.

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1. **REGION ZEALAND***
   - Life science researchers: 550
   - of which professors: 30
   - of which doctoral students: 140
   - Life science students: ~

2. **ROSKILDE UNIVERSITY**
   - Life science researchers: 55
   - of which professors: 6
   - of which doctoral students: 19
   - Life science students: 424

3. **TECHNICAL UNIVERSITY OF DENMARK (DTU)**
   - Life science researchers: 1170
   - of which professors: 82
   - of which doctoral students: 442
   - Life science students: 4024

4. **UNIVERSITY OF COPENHAGEN**
   - Life science researchers: 6809
   - of which professors: 682
   - of which doctoral students: 2473
   - Life science students: 15283

5. **THE NATIONAL INSTITUTE OF PUBLIC HEALTH (NIHP), UNIVERSITY OF SOUTHERN DENMARK**
   - Life science researchers: 97
   - of which professors: 6
   - of which doctoral students: 15
   - Life science students: ~

6. **REGION HOVEDSTADEN***
   - Life science researchers: 3748
   - of which professors: 231
   - of which doctoral students: 813
   - Life science students: ~

7. **AALBORG UNIVERSITY**
   - Life science researchers: 22
   - of which professors: 3
   - of which doctoral students: 4
   - Life science students: ~

8. **STATE SERUM INSTITUTE**
   - Life science researchers: 150
   - of which professors: 30
   - of which doctoral students: 86
   - Life science students: ~

9. **DANISH CANCER SOCIETY***
   - Life science researchers: 162
   - of which professors: 9
   - of which doctoral students: 52
   - Life science students: ~

10. **MALMÖ UNIVERSITY**
    - Life science researchers: 120
    - of which professors: 30
    - of which doctoral students: 86
    - Life science students: ca 2000

11. **REGION SKÅNE***
    - Life science researchers: ca 1800
    - of which professors: 107
    - of which doctoral students: 736
    - Life science students: ~

12. **THE SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCE IN ALNARP**
    - Life science researchers: 189
    - of which professors: 21
    - of which doctoral students: 60
    - Life science students: 564

13. **LUND UNIVERSITY**
    - Life science researchers: 3533
    - of which professors: 189
    - of which doctoral students: 1122
    - Life science students: ca 2780

14. **KRISTIANSTAD UNIVERSITY**
    - Life science researchers: 50
    - of which professors: 8
    - of which doctoral students: 10
    - Life science students: ca 800

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Other learning institutions:
- Copenhagen Business School (CBS) does not conduct life science research in the traditional sense, but it is touched upon, for example through research in organisation and public management.
- The vocational school the Copenhagen School of Design and Technology conducts a small amount of research on optometry.
25th best in the world in medicine and the life sciences

...is how the University of Copenhagen placed in the QS World Ranking Life Sciences & Medicine in 2019.

Greatest number of scientific publications: University of Copenhagen

Of Medicon Valley’s centres of learning, the University of Copenhagen produced the greatest number of scientific publications in the period 2014-2017, which is the most recent period studied in the official Leiden Ranking (i.e., not the special report prepared for Medicon Valley Alliance). The same goes for the field Biomedical and Health Sciences. Leiden Ranking is based solely on the number of scientific publications and the frequency with which they have been cited as compared to averages in their respective subject areas.

American universities top the list

Seen globally, the ranking lists are dominated by American universities. In Europe, the highest placing universities are primarily British, as well as Swiss.

... but it’s difficult to see a trend

Looking back on recent years, there are no clearly discernible trends for the region as a whole – neither positive nor negative. There is no ranking list in which all of the region’s centres of learning have placed higher – or lower – over time; their placements vary from list to list.

One university whose ranking has improved significantly however is Aalborg University, which has a small-scale life science research division in Medicon Valley. The University of Copenhagen is also ranked increasingly higher on most of the ranking lists.

Improved placement...

The University of Copenhagen has improved its position in the Shanghai Ranking, moving from number 43 in 2009 to number 26 in 2019.

LUND UNIVERSITY ON TOP IN THE TIMES HIGHER EDUCATION RANKING. The University of Copenhagen tends to be the region’s highest ranked centre of learning, but Lund University topped the list of Medicon Valley’s learning institutions in the Times Higher Education Ranking list.

The placement of the region’s universities varies significantly between ranking lists. They are also based on different criteria: Times Higher Education Ranking, Shanghai Ranking and QS World Ranking all take into account scientific publications and citations, but other than that, their parameters are rather diverse. Shanghai Ranking for example takes into consideration the number of Nobel Prize winners and other distinctions, as well as scientific publications in the journals Nature and Science. For QS World University Ranking, the university’s academic reputation comprises 40% of the assessment, whilst Times Higher Education considers e.g. instruction, which comprises 30% of the criteria.

TECHNICAL UNIVERSITY OF DENMARK CITED MOST FREQUENTLY. The Technical University of Denmark (DTU) is the seat of learning in Medicon Valley whose articles were most often among the ten per cent most frequently cited in their respective subject areas, according to the Leiden Ranking for 2014-2017. If looking exclusively at research in Biomedical and Health Sciences, the University of Copenhagen was highest on the list, followed by DTU and Lund University.

Roskilde and Malmö Universities – to each its own list

The universities that feature on more or less all of the larger ranking lists are: University of Copenhagen, Lund University, DTU, Aalborg University, the Swedish University of Agricultural Sciences and the University of Southern Denmark – the three latermost of which have branches in Medicon Valley, whilst their primary operations are outside of the region. In addition, Roskilde University is on the Times Higher Education’s list (placement 601-800), and Malmö University ranks 401-450 on QS’ special list for the Life Sciences & Medicine.

Three influential ranking lists

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<tr>
<td>University of Copenhagen</td>
<td>101 (116)</td>
<td>26 (29)</td>
<td>81 (79)</td>
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<tr>
<td>Lund University</td>
<td>96 (98)</td>
<td>101-150 (101-150)</td>
<td>92 (92)</td>
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<tr>
<td>Technical University of Denmark (DTU)</td>
<td>184 (163)</td>
<td>101-150 (151-200)</td>
<td>112 (112)</td>
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<tr>
<td>Aalborg University</td>
<td>201-250 (194)</td>
<td>201-300 (201-300)</td>
<td>324 (343)</td>
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<tr>
<td>University of Southern Denmark</td>
<td>251-300 (251-300)</td>
<td>301-400 (301-400)</td>
<td>372 (376)</td>
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<tr>
<td>Swedish University of Agricultural Sciences</td>
<td>301-350 (251-300)</td>
<td>301-400 (201-300)</td>
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<tr>
<td>Roskilde University</td>
<td>601-800 (601-800)</td>
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Footnote: Shanghai Ranking is published by the independent organisation ShanghaiRanking Consultancy. Times Higher Education is published by the eponymous journal and reviewed by PricewaterhouseCoopers (PwC). QS World University Rankings is published by the British student guidance company Quacquarelli Symonds (QS).
GOVERNMENT INITIATIVES FAVOUR MORE INTERNATIONAL RESEARCHERS IN MEDICON VALLEY

The Danish government wants to make it easier to recruit qualified personnel from abroad, and more and more researchers on both sides of the Øresund Strait are being employed by the materials research centres ESS and MAX IV. The Swedish government has proposed a bill that will make things easier for international students and researchers and let them stay in Sweden after their time at a university or college. The number of international talents who took advantage of tax relief schemes in Sweden and Denmark also rose in 2018 and 2016; the latter is the most recent year for which relevant Danish statistics are available. The number of international students in the region rose slightly between the scholastic year 2016-17 and 2017-18 due to increases in the Danish part of Medicon Valley.

Already in 2018, changes were made to make the Danish tax relief scheme more attractive, with the maximum period for which it could be used extended from five to seven years. At the same time, the fixed tax rate rose one percentage unit, from 26% to 27%.

An agreement between the new Danish government and the parties that supported it made following the 2019 elections stipulate that employers with a concrete shortage of qualified personnel should be able to recruit qualified workers from abroad more easily. Precisely which services this will encompass will be determined by the Minister of Employment and the parties that support it made following the 2019 elections stipulates that employers with a concrete shortage of qualified personnel should be able to recruit qualified workers from abroad more easily.

In Denmark, the number of international research students in the life sciences who were enrolled in a programme on 1 October increased six per cent from 2016 to 2017, according to data from Statistics Denmark. Statistics show a steady increase in the number of international researchers who participated in the Danish tax relief scheme for researchers and key employees almost every year since 2001. Between 2001-2016, there was an increase from 647 to 2 645 participants, and only in 2011 did the number decrease slightly.

International students

In eastern Denmark, the number of international students in the life sciences who were enrolled in the area, it is probable that this will affect the number of international researchers who come to Medicon Valley for employment continuing to rise in the coming years.

In 2018, the number of international researchers who were approved for the Swedish tax relief scheme increased slightly, going from 740 in 2017 to 786 in 2018. In 2018, 1 042 applications to participate in the scheme were submitted. These figures are all for Sweden, not Medicon Valley specifically.

In Denmark, the most recent figures available are for 2016 and were published in the beginning of 2018. Statistics show a steady increase in the number of international researchers who participated in the Danish tax relief scheme for researchers and key employees almost every year since 2001. Between 2001-2016, there was an increase from 647 to 2 645 participants, and only in 2011 did the number decrease slightly.

International students

In eastern Denmark, the number of international students in the life sciences who were enrolled in a programme on 1 October increased six per cent from 2016 to 2017, according to data from Statistics Denmark. Statistics show that the number continued to rise in 2018 as well, albeit slightly more slowly. That means that the trend is continuing: the number of international students in the life sciences in eastern Denmark has increased steadily ever since 2007.

In the rest of Denmark however, the number of students in the life sciences decreased four per cent in 2017 compared to 2016, and the decrease grew in 2018.

Thus, while the number of international students in life science programmes in eastern Denmark increased, the corresponding figure in Skåne decreased by five per cent between the scholastic year 2016-17 and 2017-18, according to statistics from Statistics Sweden. More recent statistics are not yet available for Sweden. The decrease in Skåne goes against the trend elsewhere in Sweden for the period in question.

When looking at the past five years however, the number of international students in the life sciences in Skåne appears to be relatively stable, whilst the number of research students has decreased slightly over the same period in the Swedish part of Medicon Valley.

On the whole, the number of international students enrolled in life science programmes in Medicon Valley increased two per cent in the scholastic year 2017-2018, to 3 497; this is due to the greater number of international students in eastern Denmark, which offsets the decrease in Skåne.

The number of international research students in the region rose four per cent in the same period; this is also due to increases on the Danish side of the Øresund Strait. The number remained essentially unchanged in Skåne.

NUMBER OF INTERNATIONAL STUDENTS IN THE STUDY YEAR 2017/18

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Students</th>
<th>of whom in research programmes</th>
<th>Change 2008/09 - 2017/18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skåne</td>
<td>1 048</td>
<td>309</td>
<td>16%</td>
</tr>
<tr>
<td>Stockholm-Uppsala region</td>
<td>3 952</td>
<td>1 972</td>
<td>37%</td>
</tr>
<tr>
<td>Västra Götaland</td>
<td>1 004</td>
<td>237</td>
<td>28%</td>
</tr>
<tr>
<td>Sweden, rest of</td>
<td>2 022</td>
<td>241</td>
<td>39%</td>
</tr>
<tr>
<td>Sweden</td>
<td>8 026</td>
<td>2 399</td>
<td>32%</td>
</tr>
<tr>
<td>Eastern Denmark</td>
<td>2 449</td>
<td>925</td>
<td>124%</td>
</tr>
<tr>
<td>Denmark, rest of</td>
<td>1 525</td>
<td>339</td>
<td>60%</td>
</tr>
<tr>
<td>Denmark</td>
<td>3 974</td>
<td>1 264</td>
<td>94%</td>
</tr>
</tbody>
</table>

Medicon Valley | 3 497 | 1 234 | 93%

Source: Statistics Sweden and Statistics Denmark

FACTS: IMPROVED TAX RELIEF SCHEME IN DENMARK

• Both Denmark and Sweden offer special tax schemes for foreign employees to make it easier for companies and universities to attract talent from other countries.
• The Danish system is distinctly more advantageous. While a key employee in the Danish scheme needs to earn a minimum of 65 100 DKK per month including employer benefits, a foreign expert in Sweden needs a monthly salary of 91 001 SEK to be approved.
• When comparing the minimum level for the salary in Denmark and Sweden, it is important to note that the salary on a Swedish payslip is generally lower than its Danish counterpart due to differences in the way the social security systems are financed. In Sweden, employers have to pay employer contributions for the employee in addition to their salary, whilst in Denmark, the social security system is financed via income taxes.
• In Sweden, tax relief can be received for a period of maximum three years; in Denmark, the tax relief period was extended from five to seven years in 2018.
The businesses of Medicon Valley are transforming. Among other things, there are fresh strategies, new products and company acquisitions. On the macro level, development is stable: exports and employment numbers are up, and the number of patent applications has increased.

• Things are going well for the life science industry in Denmark, Sweden and Medicon Valley. Danish pharmaceutical exports rose 7.7% in 2018, and Swedish exports rose 10.6%. In 2017 there were 44,000 people employed in the life sciences in Medicon Valley – a 3.4% increase in one year. But the sector’s importance for the region reaches far wider. On top of Novo Nordisk’s 14,300 employees in Denmark at the end of 2018, 7,900 people were brought in as consultants from external companies; employment via subcontractors should be added to this.

• One indication of the strong revivification of Medicon Valley’s companies are six large company acquisitions made in 2019, which were worth over 28 billion DKK. The acquiring companies were Lundbeck, LEO Pharma, Bavarian Nordic, Zealand Pharma and Fujifilm. Furthermore, one of the region’s major hearing aid manufacturers, Widex, merged with Sivantos; today, the new company is called WS Audiology. For Medicon Valley’s larger life science companies, the transition also means renewed strategies.

• This September, Novo Nordisk received approval from the American FDA for Rybelsus (semaglutide), its new type-2 diabetes drug in oral tablet form. Some analysts believe that it will prove a new blockbuster drug. It won’t necessarily generate as many new Danish jobs in Medicon Valley as previous Novo Nordisk best-sellers however, as the company made large investments in a manufacturing plant for the tablets in the US.

• For several years now, the innovation- and support system for the life science sector has been in a development phase that includes national life science offices and strategies, new materials research facilities, and flourishing science parks. Research is also an area of strength. According to an analysis performed by the Dutch research centre CWTS at Leiden University, the region’s researchers are cited with above average frequency in 15 of Medicon Valley’s 20 principal subject areas.

Restructuring and growth set the tone for Danish and Swedish life science, particularly in the trans-border Medicon Valley region. In recent years, the supporting structure for the life sciences, which is both innovative and promotes exportation, has undergone important developments. On the whole, the conditions have improved for the life sciences to become a sector with a stabilising effect in the next recession, at least on the Danish side of Medicon Valley. In Skåne, there are no life science companies giving local employment to more than 1,000 employees.

On the Danish side of Medicon Valley, the four largest life science companies and the region’s major medtech company employ a total of 22,200 people locally. But life science is also growing in Skåne – there...
are new biotech companies, driving science parks, and two material research facilities.

In 2018, the turnover of the region’s four major life science companies (Novo Nordisk, Lundbeck, Ferring Pharmaceuticals and LEO Pharma) and Medicon Valley’s largest medtech company (Coloplast) grew one per cent to 171 billion DKK. The differences between the companies are many, however. Coloplast and Lundbeck are bringing both profit and turnover to nearly 106 billion DKK – more than double what they were ten years ago. Life science exports are increasing dramatically in both countries and the number of patent applications in the life sciences being developed into new companies. On the Swedish side of the Øresund, the science cluster spanning the island of Zealand in Eastern Denmark and the Skåne region of Southern Sweden. Today, the Danish-Swedish region is marketed internationally with the name ‘Greater Copenhagen’, and its increasing population has reached four million residents. In Sweden, the same geographical area is often called the ‘Bresund Region’.

National focus on the life sciences

In recent years, the life sciences have increasingly become a focal point for the Danish as well as the Swedish government. Both countries have established national offices for the life sciences. In February 2019, Denmark launched an internationalisation strategy with seven key areas that will help realise the government’s vision of making Denmark one of Europe’s leading life science nations. Sweden’s national coordinator for the life sciences, Jenni Nordik, has been tasked with creating a national life science strategy aimed at making Sweden a leading nation in the field. Eight prioritised areas have already been selected.

Major investments are being made in the two material research facilities on the Swedish side of Medicon Valley, in Lund. MAX IV and the upcoming European Spallation Source, ESS, are both expected to have important impact on life science research. Both are being co-funded by Denmark,ESS, for which Sweden and Denmark are host nations, will be operational in Lund in 2023, but ESS’ Data Management and Software Centre (DMS) at COBIS in Copenhagen was already inaugurated on 29 October 2019.

Collaborating biobanks

Another concrete national collaboration effort is the data exchange between the national biobanks, which are a unique research resource. Swedish and Danish biobanks are comprehensive and similarly structured. Read more on page 42.

A Danish strength in the life sciences is the fact that the country’s major pharma companies are steered by industrial foundations, which prevents the companies from being acquired whilst also ensuring the donation of profits to research. The largest of them is the Novo Nordisk Foundation, which also makes its mark on the Swedish side of Medicon Valley. The Novo Nordisk Foundation’s latest major endeavour is the BioInnovation Institute, BII, at COBIS in Copenhagen. The ambition with BII is to create an outstanding innovation environment that leads to more research results from the life sciences being developed into new companies. On the Swedish side of the Øresund, the foundation-owned Medicon Village Science Park in Lund did some adding on, whilst Medeon Science Park in Malmö is currently expanding its premises.

National life science offices, collaborating Danish-Swedish biobanks and universities, new materials research facilities and expanding science parks all mean that the support and innovations systems in the life sciences have gained greater power, both nationally and in Medicon Valley.

Research in Medicon Valley is also competitive in a global context. It can be seen clearly how Medicon Valley researchers are cited with significant above-average frequency internationally in 15 of the region’s 20 most important subject areas. The conclusion is part of a bibliometric analysis conducted by the Dutch research centre CWTS at Leiden University on behalf of Medicon Valley Alliance. The four areas of research that generated the greatest number of scientific publications in the life sciences in Medicon Valley from 2006-2016 are biochemistry and molecular biology, endocrinology and metabolism, and oncology.

In a comparison of publication volume and citation frequency in the region’s seven largest subject areas, Medicon Valley places in the middle or slightly below compared with nine other European life science clusters. Read more about the cluster ranking of research on page 22.

On the macro level, the latest statistics show there have been continued notable successes in Denmark and Sweden and within Medicon Valley. Pharmaceutical exports are increasing dramatically in both countries and the number of patent applications in the life sciences is growing, as is the number of employees. In 2017 there were 44,000 people employed in the life sciences in Medicon Valley. But the importance for the region’s labour market is greater still. At the end of 2018, just Novo Nordisk had 16,300 employees in Denmark (converted to full-time). If personnel hired via consultant companies are included, 24,800 people were employed by Novo Nordisk. Today, Novo Nordisk is the Danish company with the highest profits, and its turnover has increased from 29 billion DKK in 2004 to 112 billion DKK in 2018.
APPENDIX: Facts and definitions

LARGER MEETINGS AND CONFERENCES

Below are some of the larger meetings and conferences being arranged in the Greater Copenhagen Region in the coming year, as well as a selection of international meeting places in which representatives from organizations and companies from the region’s life science cluster will be participating.

- 7 November 2019, Stockholm
  Bioscience 2019

- 11 November 2019, Rome
  European Statistical Forum

- 11-13 November 2019, Hamburg
  BIO-Europe

- 13-14 November 2019, London
  European Microbiome Congress

- 18-19 November 2019, Berlin
  Symbio Markets

- 18-21 November 2019, Düsseldorf
  Medica

- 19 November 2019, Copenhagen
  Healthtech Nordic Investor Forum 2019

- 20 November 2019, Boston
  Drug Development Boot Camp 2019

- 27 November 2019, Copenhagen
  NOME Annual Meeting

- 4-5 December 2019, New York
  The Nordic-American Life Science Conference

- 10-11 December 2019, Marseille
  BioFIT 2019

- 11 December 2019, London
  Genesis 2019

- 18-19 November 2019, Stockholm
  Bioscience 2019

- 11 December 2019, London
  Medicon Valley Alliance New Year’s Reception

- 27-30 January 2020, Dubai
  Arab Health

- 31 January 2020, Copenhagen
  Medicon Valley Alliance New Year’s Reception

- 23-25 March 2020, Paris
  BIO-Europe Spring

- 8 April 2020, Lund
  The Future of Swedish and Danish Life Science

- 8-12 April 2020, Tokyo
  A Gateway to Japanese Healthcare Market

- 28-30 April 2020, Copenhagen
  Int. Forum on Quality & Safety in Healthcare

- 24 June 2020, London
  Anglonordic Life Science Conference

- 5-9 September 2020, Copenhagen
  EuroTox 2020

- 8-10 September 2020, Malmö
  Nordic Life Science Days 2020

- November 2020, Copenhagen
  Medicon Valley Alliance Annual Meeting

NORDIC LIFE SCIENCE DAYS RETURNS TO MALMÖ

The annual Nordic Life Science Days was held in Malmö from 10-12 of September this year. It was the third time the conference was held in Sweden’s third largest city, and this year there was a record number of companies and organisations participating from 40 different countries. Around 60% of the 1 300 delegates were from the Nordic countries, but there was a significant increase in Chinese, German, and American participants, according to managing director Olivier Duchamp, who spoke to News Øresund. Moreover, there was an increased investor presence this year. Sweden-BIO was the event’s main organiser, and holding the event in Malmö was a chance to showcase their logistic-and professional expertise. Nordic Life Science Days will return to MalmöMässan next year from September 9-10.
The following is a selection of recent reports from the life sciences in Sweden, Denmark and Greater Copenhagen.

Before the change of government in Denmark this June, the parthing administration released two reports. The first is called Internationaliseringssstrategi for sundhed og life science (Internationalisation strategy for health and the life sciences; in Danish), published by the Ministry of Health in February. Via seven central areas of focus, the report describes how Denmark can become one of Europe’s leading life science nations by increasing exports and attracting greater knowledge and more investments in the health- and life science sectors.

A second report entitled Danske styrker inde for forskning, teknologi og uddannelse (Danish strength in research, technology and education; in Danish), prepared by IRIS Group for the Danish Business Authority in June of 2019, describes a series of research and technology strengths in Denmark and highlights healthtech, food science, biotech and pharmaceuticals as areas of strength. According to the report, life science research is strong both in terms of scientific production, research quality and industry collaboration.

Earlier this year, Region Skåne released a report called Skånska Styrkeområden – ett underlag till regionalt tillväxt- och innovationsarbete i Skåne (Scanian areas of strength – a basis for regional growth and innovation in Skåne; in Swedish). The report puts the spotlight on the life science industry as one of seven areas of strength and a highly productive sector, and medical and physiological research as the region’s most outstanding research.

Rambøll also did an investigation of the life science industry, publishing the report Innovationsframtid Skåne – analyser av bronsschemråden (Innovation future Skåne – sector area analysis; in Swedish) in April of 2019. The report highlights three sectors in which “smart specialisation” is under way: precision medicine; construction, supply and renovation; and material innovation and production. In addition, the report points out that there are 50 medicine- and pharmaceuticals businesses in the region, and a total of 301 companies in personalized medicine.

Invest in Skåne brought out a report in a joint effort with Invest in Stockholm, Business Region Göteborg and SwedenBio called Bridging the Gap – a survey-based report on financing activities in the Life Science sector in May, 2019. The report underscores that the most common source of funding for life science companies is private equity financing. Public fund programmes and public equity offers are the second most frequently used funding sources.

Funding details were also an issue touched on in Lägesrapport 2019: investeringsut riklig o kvalitet, fokus life science (Progress report: investments and quality, focus life science; in Swedish), released by ForskaSve rige. Among other things, the results indicate that around 25% of the total state-sponsored funding goes to medical research and development in Sweden.

ForskaSverige was also responsible for an opinion survey about medical research in August, 2019. 80% of Swedes believe that investments in medical research can and should be increased. 87% believe that Sweden should be a leading nation when it comes to medical research, since according to the population Sweden is involved in the development of new medical products and health care treatments.

The report Omvärldsanalys – styrkeområden gynn samma för utvecklingen av life science i Sverige (Competitive Intelligence – Favorable Areas of Strength for Life Science Development in Sweden; English presentation available) from February 2019 was prepared for Sweden’s Innovation Agency Vinnova. Regarding research, the report highlights Region Skåne’s research environments as a position of strength, as well as its research infrastructure and innovation that supports innovation structures.

The region is also foregrounded as specialised in personalized medicine. However, according to respondents to the report’s survey, procuring funds for mid-sized (30-100 million SEK) life science innovation projects is difficult.

In the Danish Association of the Pharmaceutical Industry’s annual report Lægemiddelindustriens nøgletal (The pharmaceutical industry: key figures; in Danish) from February 2019 mentions that the life science industry comprises just one-third of all private research and development work in Denmark.

In September, the Confederation of Danish Industry (DI) released the analysis Sundhedsindustrien er afgørende for Danmark (The healthcare industry is vital for Denmark; in Danish), which notes that every second company and over 80% of employment in the healthcare industry is in the capital region. It also highlights that the pharmaceutical industry was responsible for 28% of the Danish economy’s value growth between 2007-2017, taking into consideration that the sector comprises just one per cent of Denmark’s total employment.

Health data is another central area of the life science industry to come under the lens in the report Værdien af bedre adgang til sundhedsdata (The value of improved access to health data; in Danish), prepared by Deloitte this June. According to the pharmaceuticals industry, increased use of and access data would facilitate fulfilling the need for new pharmaceuticals, recruiting patients for clinical trials, and evaluating effects – and side effects – for the authorities, so new pharmaceuticals could be used to help patients more quickly.

In an international context, Deloitte released the report Global Life Science Outlook, which describes big data as the new rapid growth currency of the medical sector in the effort to deliver more personalised products. The report mentions that the increased use of data and digital solutions can ensure improved patient involvement, provide better insight for the evaluation of clinical trials, and make the product development process faster.

The annual report Pulse of the Industry from Ernst & Young came out in September of 2019. It highlights that data-driven business models and “solutions are crucial for continued growth in the sector – which saw rising profits around the globe for the third consecutive year. Digital solutions and artificial intelligence are also in the spotlight as particular areas for increased innovation in the medtech industry; the American federal agency for food and drug (FDA) has already approved at least 33 algorithms.

The European Federation of Pharmaceutical Industries and Associations published the annual report The Pharmaceutical Industry in Figures in June. It notes e.g. that research and development for the pharmaceutical market is experiencing strong growth in Brazil (11.4%), China (7.3%) and India (11.2%), whilst the five largest European markets have grown an average of five per cent.

Finally, in September the report Achieving a Healthier and More Sustainable Future for All was released by the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA). In it, the organisation highlights three general strategies that are necessary to ensure universal health care. Among other things they include disease surveillance and appropriate response systems, investments that are both sufficient and innovative, and improved access to medicine and vaccines at lower costs.
TRADE AND NETWORKING ORGANISATIONS:
- ASCRO – Swedish association focused on clinical research and clinical trials.
- BioPeople – a publicly funded catalyst for collaboration between companies and public research.
- Cluster Excellence Denmark – a support function for clusters and innovative networks in Denmark co-funded by the Danish Agency for Institutions and Educational Grants and the regions.
- CHC, Copenhagen Healthtech Cluster – Danish organisation that aims to create growth opportunities within healthcare.
- CHI, Copenhagen Health Innovation – Danish organisation focused on developing new educational and development activities within healthcare.
- Dansk Biotech – Danish trade organisation for companies in biotechnology.
- EuropaBio, the European Association for Bioindustries – European trade organisation for the biotechnology industry.
- EFPIA, European Federation of Pharmaceutical Industries and Associations – European trade association for the pharmaceutical industry in Europe.
- FOIN, the Association of Innovative Settings in Denmark – Danish trade association for science parks and innovative settings, formerly Forskerparkforeningen.
- The Science Park Organisation.
- Healthcare Denmark – Danish organisation with political mandate to market the Danish health care sector.
- Kemi & Life Science – Danish trade community and network for distributors and manufacturers of chemicals.
- LfD Danmark – Trade association for the pharmaceutical industry.
- Lif Sverige (researching pharmaceutical companies).
- Lægemiddelstyrelsen /Danish Medicines Agency – Danish authority that tests and approves pharmaceuticals.
- Läkemedelsverket/Medical Products Agency – Swedish authority that tests and approves pharmaceuticals.
- Labiotech.eu – European news site on the biotechnology industry.
- Medwatch – Danish news site on the medical and pharmaceutical industries.
- Nordic Life Science News – news and news site on the Nordic life science industry.
- Pharma Industry – Swedish trade journal for the pharmaceutical industry.
- SISP, Swedish Incubators & Science Parks – Swedish trade association for incubators and science parks.
- Synapse Life Science Connect – a student-driven, non-profit organisation that strives to link the academic bioscience community and the life science industries.
- Tapet och registreringsverket/Swedish Patent and Registration Office – Swedish authority for intellectual property rights.
- Teknologiföretagen – Swedish start-up and investment organisation.
- Varemærkestyrelsen – Danish trade association for companies working in diagnostics, laboratory equipment, analysis and biotechnology.
- Vinnova – Swedish authority that works to promote Swedish research.
- Wonderful Copenhagen – Danish organisation working to attract e.g. life science conferences to the Medicon Valley region.

PUBLIC ACTORS:
- Copenhagen Capacity – A public initiative to promote investments and economic development in Greater Copenhagen.
- Erhvervsstyrelsen – Danish business authority that works to improve companies’ competitive strength.
- Innovationsfonden – Fund from the Danish Ministry of Higher Education and Science that invests in new knowledge initiatives.
- Invest in Skåne – A public initiative to attract foreign investments to the region, promote exports and internationalisation for companies in Skåne region.
- Läkemedelsverket/Medical Products Agency – Swedish authority that tests and approves pharmaceuticals.
- Läkemedelsverket/Medical Products Agency.
- Medwatch – Danish news site on the medical and pharmaceutical industries.
- Nordic Life Science News – news and news site on the Nordic life science industry.
- Pharma Industry – Swedish trade journal for the pharmaceutical industry.
- Swedish Labtech – Swedish trade association for companies working in diagnostics, laboratory equipment, analysis and biotechnology.
- Swedish Medtech – Swedish trade association for medical technology.
- SISP, Swedish Incubators & Science Parks – Swedish trade association for incubators and science parks.
- Synapse Life Science Connect – a student-driven, non-profit organisation that strives to link the academic bioscience community and the life science industries.

SCIENCE PARKS IN MEDICON VILLAGE THAT COMPLETELY OR SIGNIFICANTLY FOCUS ON THE LIFE SCIENCES:
- DTU Science Park – focus on deep tech. Located in Harsholm and Lyngby. Formerly known as Scion DTU.
- Cobis – focus on life science. Located in Copenhagen. Owned by DTU Science Park and Symbion.
- Symbion – focus on life science, foodtech, edtech, hardware/makerpace and Saas. Located in Copenhagen.
- Ideon – focus on future transportsations, smart cities, smart materials and health tech. Located in Lund.
- Krinova – focus on food, the environment and health. Located in Kristianstad.
- Medeon – focus on food. Located in Malmö.
- Medicon Village – focus on life science. Located in Lund.

MEDIA:
- Dagens medicin – Swedish journal about the healthcare sector.
- Dagens medicin, Dagens Pharma, Kommunal Sundhed og Praktisk medicin – Danish journals about the healthcare sector.
- European Biotechnology News – European journal about life science.
- Greater Copenhagen Life Science Magazine – Scandinavian life science magazine published by the Danish marketing and advertising agency Nem Media.
- Kemivärlden Biotech – Scandinavian journal for chemistry, chemical engineering and biotechnology.
- Labiotech.eu – European news site on the biotechnology industry.
- Medwatch – Danish news site on the medical and pharmaceutical industries.
- Nordic Life Science News – news and news site on the Nordic life science industry.
- Pharma Industry – Swedish trade journal for the pharmaceutical industry.

LEARNING AND RESEARCH INSTITUTIONS IN MEDI- CON VALLEY WITH ACTIVITY IN THE LIFE SCIENCES:
- University of Copenhagen – A large university with departments for health and medical sciences, science, humanities, law, social sciences and theology.
- Technical University of Denmark (DTU) – A technical university in Kongens Lyngby, just north of Copenhagen.
- Roskilde University – A university in the middle of Zealand with emphasis on transdisciplinarity.
- Aalborg University in Copenhagen – A campus of Aalborg University in Jutland with a broad range of departments.
- The National Institute of Public Health (NIHPI), University of Southern Denmark – A research institution that is part of the University of Southern Denmark, but also serves the Danish authorities, supporting them in research and counsel on public health.
- CBS – A university in Copenhagen with focus on economics, as well as educational training in Business Administration and Bioentrepreneurship.
- Copenhagen School of Design and Technology – An institute of higher education in Copenhagen with some research in optometry.
- Capital Region of Denmark – The region encompasses a large number of hospitals, predominantly in Copenhagen and northern Zealand. The largest of them is Rigshospitalet.
- Region Zealand – The region encompasses a number of hospitals, primarily in Zealand and Lolland. The most important of them is Zealand University Hospital in Roskilde and Køge.
- The State Serum Institute, Copenhagen – A research institution of the Danish Ministry of Health. Its focus is on diagnostics, epidemiological monitoring and vaccination research.
- The Danish Cancer Society, Copenhagen – A patient organisation to fight cancer. With a research centre in Copenhagen.
- Lund University – A large university with departments for medicine, science, technology, the humanities, law, economics, theology, art, music and theatre.
- Malmö University – A new university with a transdisciplinary focus.
- The Swedish University of Agricultural Sciences in Alnarp – One of the largest campuses of the Swedish University of Agricultural Sciences, which has campuses throughout Sweden. Its main areas are landscape architecture, horticulture and plant production.
- Kristianstad University – a college in north-eastern Skåne with a strong focus on education.
- Region Skåne – The region encompasses a number of hospitals in Skåne, the largest of which is Skåne University Hospital in Lund and Malmö.
Statistics and method

Describing the life science sector with statistics is a challenge. The sector is far from homogenous, and it shifts over time. There are only five sub-areas designated in the national statistics as exclusively life science sectors; the remainder are spread out over a long string of sector codes. The same is true for universities where life science is not a clearly defined research area. Therefore, the exclusive use of statistics from the national statistics offices cannot provide a sufficiently complete and comprehensive representation. We have thus also chosen to complement the statistics with facts from the Nordic Business Key, as well as information provided by the companies and universities themselves.

The macro-level numbers in this report and certain special figures, such as for example domestic and international students, have been specially requested from Statistics Denmark and Statistics Sweden. We have used the following statistical divisions to define the life science sector and export of life science products:

- SNI and DB07-sector codes are exclusive to life science sectors, used for figures regarding employment: 21 Manufacture of basic pharmaceutical products and pharmaceutical preparations 26.60.10 Manufacture of hearing aids and supplies 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment 32.5 Manufacture of medical and dental instruments and supplies 46.46.10 Wholesale trade of medical goods and nursing supplies.

The following codes are used for the description of scientific research and employment:

- 72.11 Research and experimental development in biotechnology and medical research
- 72.19 Other research and experimental development in natural sciences and engineering.

These two industries encompass companies whose primary purpose is research in natural sciences and not life science production companies.

Some of these are life science companies; however, since the sectors also contain research within other areas than life science, the sectors are not included in the figures for employment in the life sciences, but are instead presented separately.

The commodity groupings (SITC) in trade statistics utilised to describe exports:

- 54 - Medical and pharmaceutical products
- 872 - Medical Instruments and appliances and similar equipment.

About the figures

Taxation, Pages 8–17

Defining the Danish life science sector to calculate taxes

In the statistics for the number of employees in the life science sector, the sector is defined according to the sector of the workplaces. This definition cannot be used in the calculation of the sector's tax contributions, since corporation tax is paid on the company/concern level, and the main sector of a workplace does not necessarily correspond to the company's main sector. The following method has thus been used:

1. For each year, the number of full-time employees who work at a workplace whose main sector is life science is tallied.
2. Information is retrieved for the companies/concerns to which these workplaces belong. The number of employees who work in life science branches at these workplaces is tallied, as well as the number of employees on the company/concern level.
3. For a given year, a company/concern in the life science sector is included if:
   a. the company/concern has employed more than 50% of its employees at workplaces in the life science sector during the year in question, or
   b. the company/concern meets criterion a) throughout the entire period 2008-2017 for the majority of its active period.

It has been necessary to include criterion b) in order to encompass companies/concerns that pay taxes via a holding company certain years, and in others via the producing company.

The source for the Swedish figures of income and corporation tax is the FRIDA database. FRIDA is a combined individual and firm register for all Swedish companies. The life science sector has been defined according to the sector of the company’s headquarters.

Corporation tax

Corporation tax for Danish life science companies is defined as the corporation tax paid by companies/concerns that fulfill the above criteria. For Sweden corporation tax is the company’s final tax, which consists of state tax (bolagskatt) on the year’s result (22% of reported surplus) plus other taxes that may be applicable, e.g. yield tax.

Income tax

Income tax for people employed in the life science sector is defined for people employed in the companies/consulting firms that fulfill the criteria described in ‘Defining the Life Science Sector’. Income tax is determined geographically according to where the income is earned, and not where the employee resides. Thus, border commuters from Sweden are included in the analysis of Danish income tax. Residents of Denmark who work abroad are in turn not included in the analysis of Danish income tax.

Income tax is calculated from the total personal income; i.e. it is calculated from salary and self-employment, as well as any transfers of income that are subject to taxation.

In Denmark, income tax is equivalent to the total personal final tax on income, including labour market contributions. The total personal final tax includes state tax, health care tax, municipal tax, temporary corporation tax, tax on stock dividends and stock profit, and labour market contributions. Final tax is determined after the deductions have been made and various tax additions have been included.

The amount of labour market contributions paid for employees in the life science sector is calculated by in- ferring that the labour market contributions comprise the same share of the total income tax, including labour mar- ket contributions, for the life science sector in its entirety as for the economy as a whole. The income tax, excluding labour market contributions, for employees in the life science sector is divided by the share of the total income tax including labour market contributions, comprised by the labour market contributions for the economy as a whole, to calculate the income tax including labour market contributions for employees in the life science sector.

In Sweden, income tax is equal to the total income tax on gainful employment. The source for this data is the Swedish income register for the period 2008-2017. Income from gainful employment includes income from a position of staff employment including benefits, surplus from business operations, sickness benefits, unemployment benefits, and pension income after general deductions. These may be social security duties to another country, alimony or social contributions.

Income and corporation tax comprise only part of the amount included in the treasury through taxes and other duties; of which value-added tax is the absolute largest in both countries. In Sweden, duties and other taxes include e.g. a municipal property tax, burial tax, duties to religious communities, vehicle tax and a series of excise duties on e.g. alcohol and tobacco. In Denmark there are a large number of taxes and duties in addition to corporation tax and income tax, for example municipal property tax, which is calculated based on value, registration duties on cars and a number of excise duties on products such as tobacco, wine, spirits, chocolate and sugar.

Export, Pages 8–17

The figures for the global pharmaceuticals market are the amounts invoiced to pharmacies and hospitals by distribu- ters. Those amounts are not equivalent to the amounts that manufacturers of pharmaceuticals receive for their products; discounts and other price agreements are not included. The source for the information on the global market is IQVIA. The source for the global market export is the UN Comtrade database and figures for the Danish and Swedish life science export are retrieved from Statistics Denmark and Statistics Sweden, respectively.

Employment, Pages 8–17

The employment figures cover the manufacturing sectors: 21 Pharmaceuticals, 26.60.10 Manufacture of hearing aids and supplies 26.60.9 Manufactory of irradiation, electromedical and electrotherapeutic equipment, 32.5 Manufacture of medical and dental instruments and supplies.

The sources are the foreign trade classification system for goods (Standard International Trade Classification). The sources are the foreign trade statistics from Statistics Denmark and Statistics Sweden, respectively.

Sector classification

The definition of life science often includes:

- Biotechnology companies
- Pharmaceutical companies
- Medical technology companies

The disadvantage is that the life science industry is not shown in its entirety. Therefore, the figures are supple-
mented by figures for employees at life science compa-
nies not covered by the national statistical figures from
Statistics Denmark and Statistics Sweden; an example of a
company that we have supplemented with employee
figures is Novo Nordisk. The supplementary information
has been collected from the relevant companies either via
e-mail, telephone or via the company website; from Nordic
Business Key; www.allabolasg.se; or from news articles.

PATENTS, PAGES 8–17
For patent applications figures from the European Patent
Office (EPO) are used. Normally, a patent application to
EPO is preceded by an application to the national patent
office. The filing date for the application to the national
patent office is the priority date for the subsequent appli-
cation to EPO. The publishing date for a patent application
to EPO is usually 18 months after the priority date. Patent
information from United States Patent and Trademark
Office (USPTO) is rather old at the time of publishing,
and for that reason it has been chosen primarily to
present data for EPO, even though the interest in patent
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APPENDIX

THE EFFECT OF SECTOR DRIFT AND SECTOR CHANGE

Statistics for the number of employees in the life science sector are based on figures from the register-based Labour Force Statistics in Denmark (RAS) and Sweden (RAMS). The employment sever-off figures cover the manufacturing sectors: 21 Pharmaceu-
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tromedical and electrotherapeutic equip-
ment, 92.30.00 Manufacture of medical and dental
instruments and supplies and 46.44.10 Wholesale of pharmaceutical and nursing goods. Sector drift and sector changes for individual companies can affect
the figures to a greater or lesser degree. The more
detailed statistics are for individual sectors and smaller geographic areas, the more visible sector
drift and change of sector can be.

The employment sever-off figures for sector drift
are a change in a company’s product portfolio that
eventually leads to it belonging to a different sector
than it did originally. A change of sector is the switch
to another sector code without changes to the com-
pany’s product portfolio.

State of Medicon Valley 2017 contains an
example (Coloplast) of how sector code can
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change over time.
All scientific publications in the relevant categories from every region have been included, regardless of whether the research was performed at e.g. a university, a university hospital, or other research institutions or commercial enterprises.

Selection of the bibliometric database
CWTS conducted its analysis in an in-house version of Web of Science:
“CWTS Citation Index (CI) system will be used for these analyses. The core of this system is comprised of an enhanced version of Clarivate’s citation indexes: Web of Science (WoS) version of the Science Citation Index, SCI (indexed); Social Science Citation Index, SSCI and Arts & Humanities Citation Index, AIHC.
We therefore calculate our indicators based on our in-house version of the WoS database. WoS is a bibliographic database that covers the publications of about 12 000 journals in the sciences, the social sciences, and the arts and humanities.”

Definition of life science
CWTS has limited its bibliometric analysis to encompass only publications within the category life sciences. They define this category as follows:
“... all the publications selected for these regions were limited to those that are designated to the higher level category of ‘Medical and Life Sciences’. This category is a derivative of those Web of Science categories that adhere to the moniker that was defined for this higher level field of science. This is to some extent an arbitrary process in which choices are made on the basis of best practice and educated assumption.”

The complete list of categories is as follows:

INTERVIEW LIST
• Bo Ahren, Pro Vice-Chancellor, Lund University, meeting, 7 Sept. 2018
• Erik Bisgaard Madsen, Dean, Associate dean for Trade and Government Collaboration, Faculty of Science – University of Copenhagen, telephone, 24 Aug. 2018
• Anna Blom, professor of Medical Protein Chemistry, Lund University, meeting, 14 May 2019
• Mogens Holst Nissen, Vice Dean for Research, Faculty of Health and Medical Sciences – University of Copenhagen, telephone, 20 Aug. 2018
• Katrine Krogh Andersen, Dean of Research, DTU, meeting, 4 Sept. 2018
• Mads Melbye, Director, State Serum Institute, telephone, 25 June 2019
• Thue Schwartz, professor at the Novo Nordisk Foundation Center for Basic Metabolic Research – University of Copenhagen, meeting, 11 June 2019
• Kerstin Tham, Vice-Chancellor, Malmö University, meeting, 17 Sept. 2018
• Trine Wintere, Vice Dean of Innovation & External relations, Faculty of Health and Medical Sciences – University of Copenhagen, telephone, 20 Aug. 2018
REFERENCE LIST

The exact sources are provided with the statistics in the respective chapters and on pages 60-65.

PRIMARY STATISTICAL SOURCES:

• SCB/Statistics Sweden, including customised analyses
• Statistics Denmark, including customised analyses
• UN Comtrade
• World Bank

OTHER SOURCES:

• Bisnode, Nordic Business Key, business database
• CWTS B.V. Benchmark Life Science Regions Research for Medicon Valley Alliance 2006-2016/17, August 2018
• CWTS Leiden Ranking, www.cwts.nl
• CVR, www.datacvr.virk.dk
• Forskarskattenämnden, Om skattelättnaderna, statistik över inkomna ansökningar om skattelättnader (About Tax Relief, Statistics for Applications Received for Tax Relief), www.skatteverket.se
• Fujifilm, Fujifilm Completes Acquisition of Biogen’s Manufacturing Site in Denmark, August 2019
• Ministry of Enterprise and Innovation in Sweden, Life sciences road map – pathway to a national strategy, 2018
• The Danish Government, Retfærdig retning for Danmark, 2019
• The Riksbank, www.riksbank.se
• Shanghai Ranking – Academic Ranking of World Universities 2018
• Danish Ministry of Taxation, Skatteøkonomisk analyse, December 2018
• Swedish Ministry of Education, Nya regler om uppehållstillstånd för forskning och studier inom högre utbildning, 2019
• Swedish Tax Agency, www.skatterattsnamnden.se
• Times Higher Education – World University Rankings 2018
• Ministry of Foreign Affairs of Denmark and The Ministry of Health, Internationaliseringssstrategi for sundhed og life science, 2019 (Internationalisation Strategy for Health and Life Science)
• QS World University Rankings 2019
• Press releases and annual reports from respective companies.
• In addition, we received data via email from companies, municipalities, trade organisations, universities and other players.

Behind the report:
MEDICON VALLEY ALLIANCE AND ØRESUNDSINSTITUTTET

Øresundsinstituttet and Medicon Valley Alliance have a long-term analysis collaboration. State of the Region is an annual analysis of the developments in Medicon Valley. Medicon Valley Alliance and Øresundsinstituttet are both member-based, and a selection of the member-actors are represented in the board of directors.
The analysis “State of Medicon Valley” is prepared by Øresundsinstituttet and commissioned by Medicon Valley Alliance.

ØRESUNDSINSTITUTTET

Øi is an independent Danish-Swedish centre for analytics and information that brings together more than 100 actors from the industry, the public sector and academic institutions with the aim of strengthening knowledge about societal developments on both sides of the Øresund Strait. As a member of Øresundsinstituttet, you become part of our strong Danish-Swedish network – and gain access to network meetings, facts, analyses and news about developments in the Greater Copenhagen region.

MEDICON VALLEY ALLIANCE

MVA is a Gold Label-certified, non-profit member organisation in the Danish-Swedish life science cluster Medicon Valley. Its 250 members include universities, hospitals, human life science businesses, regional governments and service providers that employ approximately 140 000 people and represent the Region’s ‘double triple-helix’. The activities in MVA focus on strengthening collaborations for a vibrant life science ecosystem in Medicon Valley through networking events and increased collaboration across borders and sectors.

THE VISION
The vision is to be a well-known and respected member-driven contributor to the realisation and positioning of Medicon Valley as the most competitive and vital life science cluster in Northern Europe.

THE MISSION
MVA is committed to realising Medicon Valley’s potential by facilitating networking, knowledge-sharing, and collaboration, analysing challenges and potentials, and mobilising support from key opinion leaders.

CALL TO ACTION
Read more about the Danish-Swedish life science cluster organisation Medicon Valley Alliance’s events and activities on www.mva.org, where you can also find more information about how YOUR company can benefit from a membership.