GUIDE TO BUILDING NORDIC HOSPITAL INNOVATION MODELS

BASED ON ISRAELI MODELS

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TABLE OF CONTENTS

1. Executive Summary....4
2. Introduction....5
3. Health Innovation in Israel....6
4. Hospital Innovation in Israel....9
5. Eight Principles of Hospital Innovation....11
6. Building Blocks of Hospital Innovation....12
   - 6.1 Infrastructure....13
     - 6.1.1 Culture of Innovation....13
     - 6.1.2 Incentives....15
   - 6.2 Roles and Management Leadership....15
   - 6.3 Open Innovation....16
     - 6.3.1 Location and setup of open innovation....16
     - 6.3.2 Access to data....18
   - 6.4 External partnerships and Interface with Startups....21
   - 6.5 Funding and Commercialisation....22
7. Innovation Process....23
8. Keys for Success in Advancing Nordic Health Innovation....24
   - 8.1 Defining the Why....24
   - 8.2 Creating a culture of innovation and incentives....25
   - 8.3 Creating a storytelling....26
   - 8.4 Generating an income....26
   - 8.5 Establishing a political mandate....27
   - 8.6 Industry collaboration....27
   - 8.7 Data access and application....27
   - 8.8 International collaboration....28
9. Danish Hospital Innovation Models....28
   - 9.1 Odense University Hospital....28
     - 9.1.1 Specialised centres....29
     - 9.1.2 Public-private cooperation....29

9.1.3 Innovation process 29
9.1.4 Working strategically with innovation in-house 31
9.2 Copenhagen University Hospital (Rigshospitalet) 31
9.2.1 Guiding principles 32
9.2.2 Rigshospitalet's innovation model 32
9.2.3 Partnership strategy 33
9.2.4 Danish National Network of Innovative Hospitals 33
9.2.5 BETA.HEALTH – Danish National Innovation platform for future healthcare 34
9.3 Karolinska University Hospital 35
9.3.1 Innovation partnerships with industry 36
9.3.2 Match-making hospital-industry 36
9.3.3 Demand driven innovation 37
9.3.4 Strategic focus areas for innovation 37
9.3.5. Education and coaching 38
10. Establishing a Nordic Coalition of Innovation 39
11. Next Steps 40
12. Conclusion 41

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1. EXECUTIVE SUMMARY

Hospitals play a critical role in driving the future of healthcare innovation, both in terms of spinning out internal ideas, research and technological developments and in terms of providing industry with innovation resources for validation and scaling of health solutions. Israeli hospitals have developed into health innovation powerhouses and Nordic hospitals are following suit. Many Nordic healthcare innovation stakeholders, whether hospitals, industry, regions, ministries or politicians have visited Israel over the years and have been introduced to the success of the Israeli hospital innovation models.

This report seeks to go a level deeper and lays out a path to enhance the innovation capacity of Nordic hospitals through a deployment of adapted Israeli hospital innovation models. Innovation Centre Denmark in Tel Aviv, University Hospital of Copenhagen and Region Halland, in collaboration with EY Israel, have identified the main principles and building blocks of the Israeli hospital innovation models. The principles and building blocks represent a resource for hospital management and other innovation leaders within the hospital seeking to take steps to enhance the innovation models, methods and initiatives of the organisation. The guide is also a resource for corporates, investors, entrepreneurs, startup leaders, authorities and politicians to understand the challenges and keys of success for driving hospital innovation and hospital-industry collaborations and how all stakeholders of the innovation ecosystem can contribute to the advancement of Nordic health innovation. The report is meant to serve as an encouragement for hospitals, industry and health innovation ecosystems across the Nordics to join forces in advancing Nordic health innovation.

In addition to defining principles and building blocks of hospital innovation, we have also developed a tailored canvas and process for working with the building blocks in a Nordic context to create a flow of innovation in the hospital. The canvas and the building blocks were applied in a workshop in 2021 for Danish and Swedish hospitals. The template as well as the results of the workshop are included as appendices to the report. The template can be used by hospitals to run internal workshops on building or strengthening their hospital innovation model and methods. Innovation Centre Denmark in Tel Aviv is available to assist hospitals in running the innovation model workshop for management and staff, potentially including also industry representative and other stakeholders.

The guide and the development of the models are supported by Interreg ØKS and the Novo Nordisk Foundation.

2. INTRODUCTION

In the years to come, healthcare systems will be expected by the public, patients and politicians to provide higher quality healthcare services as well as more personalised and precise prevention, diagnostics and treatment for fewer resources. Innovation will have to deliver on these high expectations. As a result, recent years have seen an increasing global focus on the critical role of hospitals in driving health innovation. With their access to actual needs, research, medical experts, data, clinical trials and clinical validation, hospitals possess enormous unmatched capacities for translating research, ideas and needs into cutting-edge technological developments. In addition, as data-driven healthcare increases, companies become more and more dependent on collaboration with hospitals for advancement of their solutions. Many hospitals around the globe have taken on a fourth mission of innovation as another core function in addition to healthcare provision, research and education. Hospitals in Israel and the US are leading this evolution and have developed into epicentres of innovation, already showing impressive results.

Nordic hospitals are likewise increasing the focus on innovation. Hospital management faces an enormous task as the engine of this change. Many hospitals are currently establishing or expanding innovation units and developing methods and processes for internal innovation, commercialisation and public-private partnerships. To assist with this development, Innovation Centre Denmark in Tel Aviv, in collaboration with University Hospital of Copenhagen and Region Halland, designed and executed a masterclass in 2021 on building hospital innovation models with inspiration from Israeli models. The masterclass was geared towards management and innovation leaders of Danish and Swedish hospitals, corporates and regions. Israeli hospitals are internationally acknowledged innovation powerhouses with well-developed and proven methods of innovation. With similar public health systems, excellence in research, pools of data, focus on data-driven and patient-centred healthcare and a strong industry, core elements of the Israeli models are well adaptable to a Nordic context.

Based on the innovation models and methods of Israeli hospitals, Innovation Centre Denmark in Tel Aviv and partners have developed building blocks and principles of hospital innovation and defined the flow of innovation. We have also developed a tailored canvas and process for combining the elements of innovation into a model in a Nordic context. During the masterclass, we ran a workshop with the Danish and Swedish hospitals and industry representatives where we applied the building blocks in the canvas to start the development of Nordic innovation models. As part of the process, Danish and Swedish hospitals, industry and regions identified the keys for success and challenges facing Nordic hospital innovation.

The work of splitting the Israeli innovation models into building blocks was challenged by the fact that all parts are interdependent and linked. The building blocks should be seen as such

when working with them. How you decide to apply one building block will affect how you can apply the next building block. There are many options and variables to consider. This should be kept in mind when reading and applying the report as an inspiration.

The first part of this report sets the scene by outlining health innovation in Israel and the mechanisms driving the ecosystem. The second part zooms in on the role of Israeli hospitals in the innovation ecosystem and the third part of the report presents the principles of hospital innovation and studies the building blocks and flow of Israeli hospital innovation. The last part takes its point of departure in Danish hospital models and evaluates how a Nordic innovation model can be built based on inspiration from the Israeli hospitals.

The purpose of the report is to emphasize the importance of hospital innovation across the Nordic innovation ecosystem and provide Nordic hospitals with tools and inspiration in establishing or strengthening their own innovation model and in collaborating with industry and other stakeholders.

Definition: Innovation in this context refers to the ability to provide better response to existing needs or identify new needs for which one can create new technologies and solutions for the improvement of healthcare provision. In this report, it refers less to a new marketing method or organizational method of operating or business practice. In other words, innovation in this report does not refer the change of work processes although this is also important for any innovative organisation. However, this requires different models and methods than those presented in this report.

3. HEALTH INNOVATION IN ISRAEL

Israel is one of the world's leading hotspots for research and innovation, owing largely to a robust, deep-rooted scientific community, with three research institutions among the top 100 in the world. In 2021, the country ranked 7th (Sweden 5th, Denmark 6th) on the Bloomberg Innovation Index and took the top spots for R&D intensity and research concentration. Israel's main strength lies in the ability to translate research into life-changing technologies. This has resulted in Israel boasting the highest number of startup companies and unicorns per capita, the highest volume of venture capital per capita and the highest number of companies on NASDAQ after the US. The presence of more than 560 R&I centres of multinational corporates in Israel is also a testament to its enormous research and innovation power. All research institutions in Israel have special units for applied research and commercialisation of research results. Moreover, Israel has highly talented and educated human capital.

Economic growth in Israel is largely based on hi-tech and innovation, which requires participation and close collaboration between government, industry and research institutions.

Therefore, the Israeli government, through the Israeli Innovation Authority, plays a vital role in promoting innovation, ecosystem building and public-private partnerships. The government's strategy rests on two pillars: decentralisation to promote initiative and coordination to promote efficiency. Central planning and control is limited. Israel has instituted a comprehensive method for supporting innovation centred on a number of grants, which have proven efficient in advancing health innovation and prosperity:

1. **Magnet**
   An R&D grant program for the creation of public-private consortia to advance the commercialisation of products based on academic research in fields where Israeli industry has a competitive advantage. The purpose of the program is to promote applied research, advance collaboration between research institutions and companies and to study the market needs. The program also allows for exchange of knowledge and cooperation between companies operating in the same field, which may be difficult to achieve otherwise. The grant provides companies with 66 percent of approved budget and research institutions 100 percent of approved budget.

2. **Kamin**
   The program serves as a bridge between basic and applied research and is focused on commercialisation of research into technologies with commercial application. The grant is 85 percent of the approved budget for up to 2 years. The grant promotes collaboration between research institutions and companies.

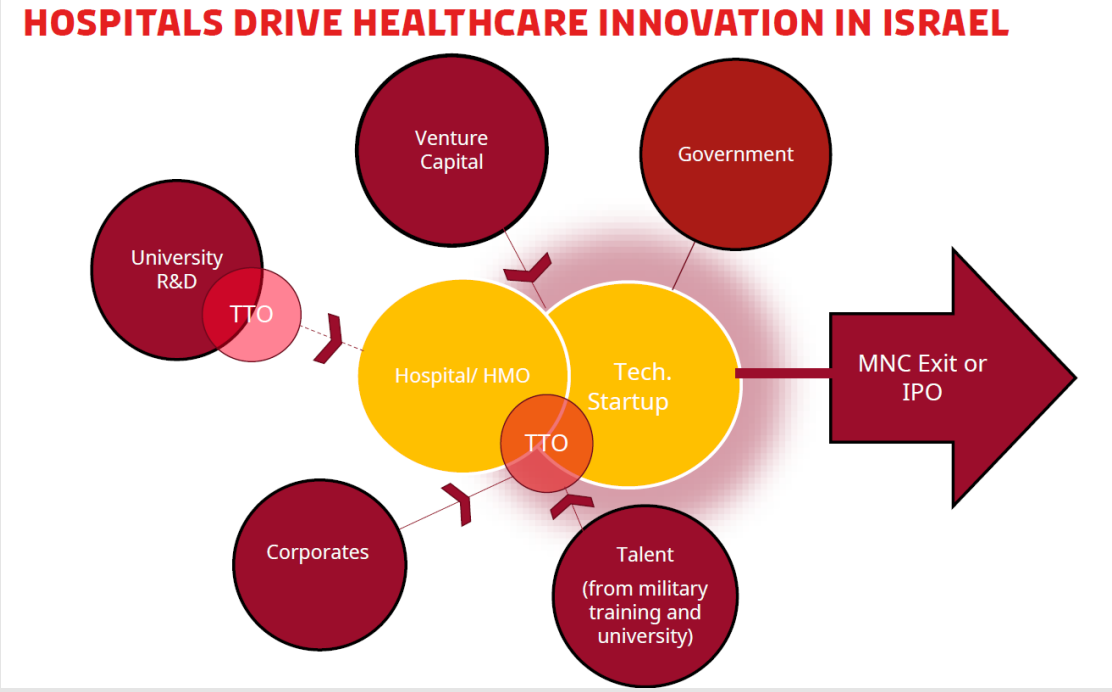
3. **Incubator program**
   A grant program for establishing incubators to support entrepreneurs, who are in the early stages of R&D, in founding a startup company based on innovative technological ideas. The program provides early stage investment and support in the form of office space, mentoring by seasoned entrepreneurs and investors, business support, financial support, legal support, HR and network. The program provides a grant of 85 percent of the approved budget of the startup company for two years. The incubator is licensed to investors or multinational companies, who provide the remaining 15 percent investment, in order to ensure that entrepreneurs are provided with hands-on assistance in establishing the startup company. The purpose of the incubator is to lead startup companies to a round A funding and it is the hope that the incubator owner will also invest in the company during the funding round, as a sign of the potential of the company. There are currently 19 incubators, of which half are within health innovation. As will be described later in the report, Rambam Hospital in Haifa is partner in an incubator as part of their open innovation model. Foreign investors and multinational companies can participate in the program on the same terms as Israeli entities and a

number of international investors and multinational companies run health incubators in Israel. The government does not take any form of equity in the companies.

Israel's dynamic Life Science sector is growing at a rapid pace, contributing substantially to the global healthcare market. With over 1.750 Healthtech and Life Science companies, there is no doubt that health innovation is one of Israel's innovation strongholds. In 2021, the country ranked 5th on the World Index of Healthcare Innovation (Denmark #11, Sweden #18). It is second to the US in the number of Medtech companies and more than 100 new Life Science and Healthtech companies launch each year in Israel. Life Science companies make up 35 percent of the ecosystem and raised a record USD 25.6 billion in 2021. For the past six years, 47 companies have been acquired in Mergers and Acquisitions for a total of USD 9.5 billion. During the current Covid-19 pandemic, Israel ranked second in coronavirus solution innovation.

The essence of the Israeli health innovation success is the dynamic, vibrant and well-coordinated innovation ecosystem of research institutions, companies, investors, multinationals and authorities purposely built by Israel to accelerate new solutions through strategic public-private partnerships. Israel's healthcare ecosystem is an ideal landscape for the creation and piloting of new health technologies and pharmaceuticals given its massive pool of data, its well-developed public healthcare system, its pragmatic regulatory environment and a system receptivity to new methods. The collaborative ecosystem has created a sandbox environment allowing entrepreneurs to quickly build, deploy, test and commercialise new solutions.

At the centre of the ecosystem are the Israeli hospitals, focusing not only on research but equally on translating research into new solutions in the strive to improve the quality of healthcare services in their own organisation but also on a global scale.



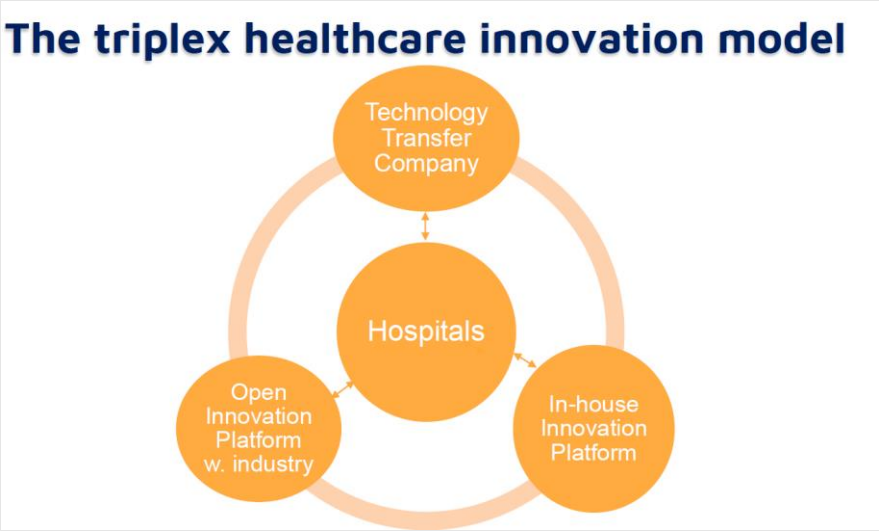
It should be noted that in Israel, healthcare innovation not only takes place in the secondary healthcare system. The four Health Maintenance Organisations in Israel (Clalit, Maccabi, Meuhedet and Leumi), that are responsible for provision of healthcare services to all citizens, also run community-based innovation centres fostering health innovation in the primary healthcare sector in Israel.

4. HOSPITAL INNOVATION IN ISRAEL

Hospital innovation in Israel is based on the principle that the Israeli healthcare system and economy cannot afford for hospitals to **not** be drivers of innovation. Hospital innovation improves the quality of healthcare services both in hospitals and in the primary healthcare sector, delivers new cutting-edge technologies responding to actual needs, allows for increased involvement of patients in innovation, accelerates the global scaling of industry solutions and represents an important national growth engine. Hospitals have access to deep knowledge of the needs of patients and healthcare systems. As a result, Israeli hospitals have a strong political mandate and support for driving innovation in terms of infrastructure, funding, framework conditions and legislation.

Israeli hospitals continue to produce myriad successful technological developments, such as the transcatheter aortic valve replacement at Sheba Hospital, the bloodstream infection prediction wearable at Ichilov Hospital and Nerivio for migraine prediction from Rambam Hospital, just to name a few.

Israel is home to the highest number of hospital innovation centres and accelerators per capita. All major hospitals have established innovation units that provide a systematic setup for bringing forth and commercialising needs, challenges and solutions as well as collaborating with industry. Israeli hospitals have developed proven, incentive-based models and methods for in-house innovation, technology transfer and open innovation enabling strong collaboration with industry, investors and other stakeholders.



In Israel, hospital innovation is fuelled by public-private partnerships. While most health systems focus on generating ideas from within the hospitals, Israeli hospitals place great emphasize on collaborations with startup companies, corporates and other stakeholders on external ideas and solutions.

Israeli hospitals also have a mandate to generate income from commercialisation, external innovation and collaboration with investors. Sheba Hospital, the largest hospital in Israel and the Middle East, has generated an income volume that, in addition to research and innovation, allows for financing of improved healthcare services at the hospital. The massive global publicity around the financial success of Israeli hospital innovation and the large setups of some of the innovation centres in Israel should not be misconstrued to mean that the primary focus of hospital innovation in Israel is economic growth. The main purpose is to bring forth all solutions that will improve healthcare, not only nationally but also globally. The income allows for sustainable innovation independent of public funding and it is reinvested in research and innovation grants. In Israel, income generation from R&I is seen as increasing rather than hampering the healthcare provision function of the hospital.

Israeli hospitals focus on data-driven health innovation and they have identified digital health, precision medicine and personalised medicine as fields with the greatest potential for meeting

the future needs of patients globally. The healthcare landscape is currently shifting towards a more integrated ecosystem, converging biopharma, medtech, digital health and healthcare into a single bio-convergent industry. In the coming years, bioconvergence will also constitute a major focus in Israeli hospital innovation.

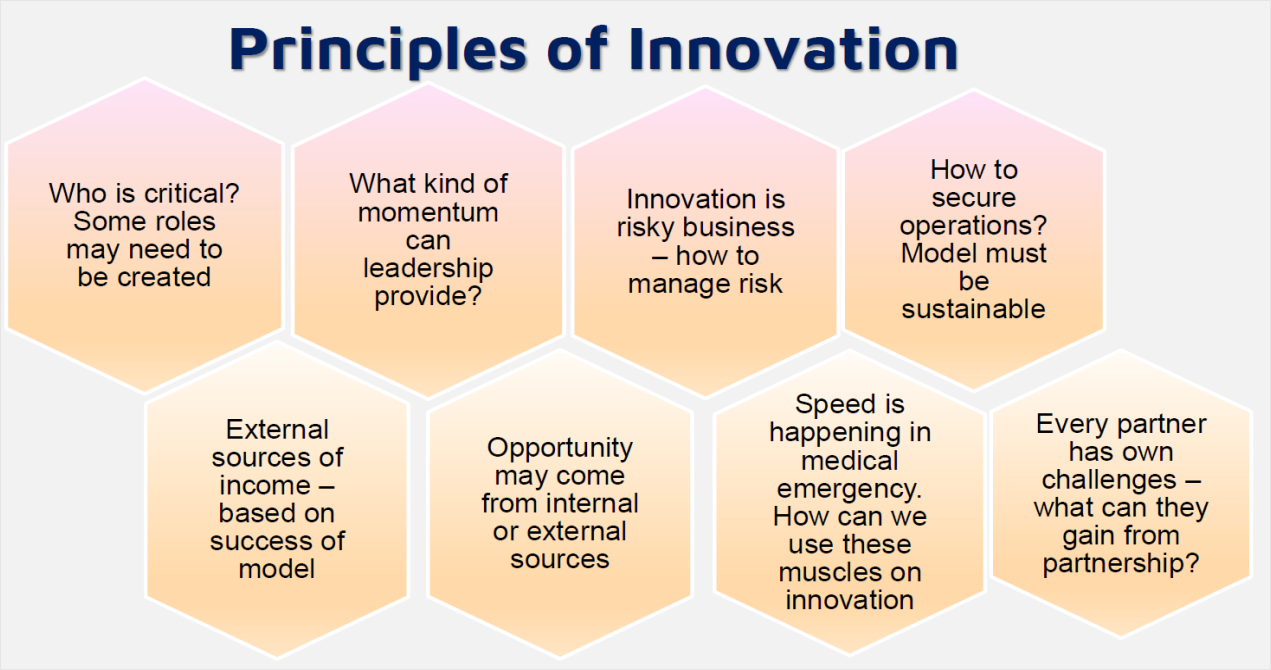
Many Nordic health innovation stakeholders have visited the large innovation centres, such as the ACR at Sheba Hospital in Tel Aviv, the Ichilov Med at Sourasky Hospital in Tel Aviv, the Hadassah Innovation Centre at the Hadassah Hospital in Jerusalem and the MindUp incubator of Rambam Hospital in Haifa. However, it is important to notice that also smaller hospitals in Israel have well-functioning and very successful innovation centres. The innovation models of the Israeli hospitals vary slightly, particularly in terms of open innovation setups, as described later in this report, but share an overall common structure based on eight principles of innovation and five building blocks.

5. EIGHT PRINCIPLES OF HOSPITAL INNOVATION

The principles of hospital innovation touch upon both internal innovation and open innovation partnerships with industry and other stakeholders. The principles represent some of the challenges that Israeli hospitals faced when initiating their innovation journey. The principles cover the main questions that a hospital must consider when working with the building blocks of innovation in establishing a sustainable innovation model.

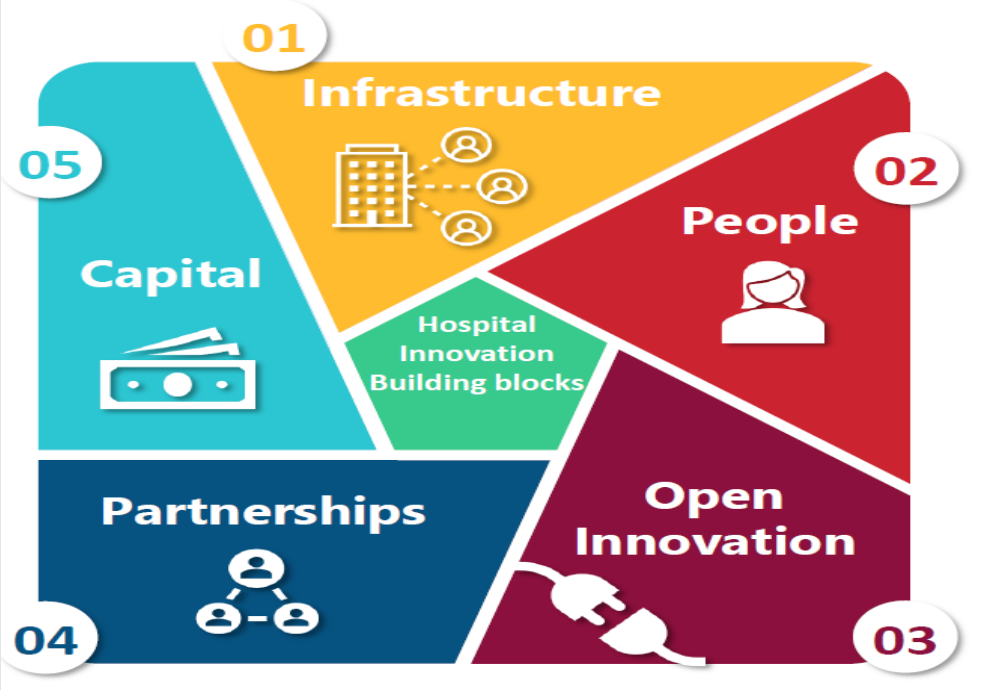
The principles of hospital innovation include:

1. Who is critical? Some roles may need to be created.
2. What kind of momentum can/must leadership provide?
3. Innovation is a risky business – how to manage the risk?
4. How to secure operations? Model must be sustainable in terms of funding.
5. External sources of income – based on success of model
6. Opportunities/innovation may come from internal or external sources.
7. Speed is happening in medical emergence. How can we use these muscles on innovation?
8. Every partner has own challenges – what can they gain from partnership?

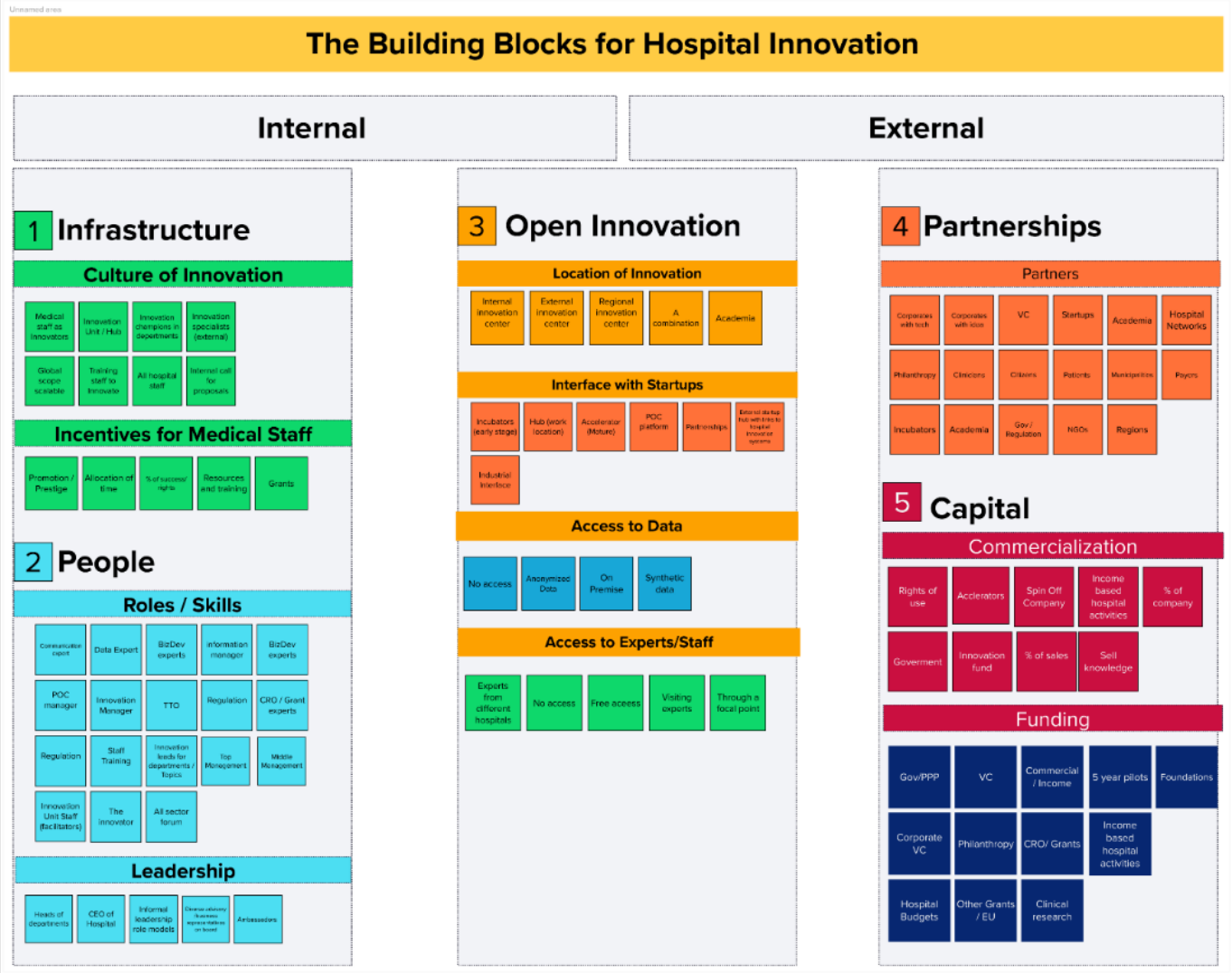


6. BUILDING BLOCKS OF HOSPITAL INNOVATION

The Israeli hospital innovation models consist of five main building blocks: 1) Infrastructure 2) People 3) Open Innovation 4) Partnerships 5) Capital.



For each building block, there exists a variety of approaches to innovation as presented in the figure below. Additional approaches may be relevant in a Nordic context as discussed later in the report.



6.1 INFRASTRUCTURE

The main elements of the Israeli innovation infrastructure in hospitals are the culture of innovation and incentives for innovators. These are critical in driving the innovation.

6.1.1 CULTURE OF INNOVATION

Israeli experiences clearly emphasize that strategies and processes are important but not sufficient to drive innovation. A culture of innovation is the foundation of hospital innovation and must sprout from both the bottom-up and the top-down. Prior to the

establishment of hospital-driven innovation centres, Israeli healthcare professionals were trying on their own to develop new health solutions and collaborate with startup companies in scaling new solutions, yet they were challenged by the lack of infrastructure, skills, funding, resources and mandate. The volume of hospital innovation was very limited. However, since hospital CEOs made a conscious decision to prioritize innovation, health innovation in Israel has flourished for both hospitals and industry, and the whole ecosystem has moved close to the hospitals.

In Israel, management is actively involved in the creation and maintenance of an innovation culture as part of the organisation DNA through establishing and supporting systematic innovation activities. Management has a large effect on the innovation culture of the hospital and can create conditions and behaviour that either hinder or advance innovation. According to Israeli experiences, the lack of active support and promotion of innovation by hospital management negatively affects the innovation culture of the hospital.

Innovation is risky business and risk management requires building a culture of innovation where staff are encouraged to try out new ideas and where failure is an accepted part of the process. It is not about not failing but about failing fast. It is the role of management to carry the risk of innovation and embed a culture of freedom to fail. Naturally, the organisation should learn from failures. Israeli innovators and entrepreneurs meet for "failure nights" to share failures in order to learn from them and each other. Hospitals should have a tool for communicating failures, successes and innovation projects internally to keep staff informed and involved. At the same time, hospitals should celebrate new innovation successes and partnerships internally and externally. Boast about your achievements and about your staff even if that is not a Nordic trait. It is an international trait.

"The fastest way to succeed is to double your failure rate" – Thomas Watson, IBM

Israeli hospitals have established a very strong storytelling of the actual ROI of innovation, which entails more than the development of new solutions and generation of commercial income. Hospital innovation affects the quality of healthcare, the quality of hospital services, research volume, competence development of healthcare professionals, industry competitiveness and international collaborations. Storytelling is an important tool for accelerating internal motivation, public-private partnerships, private investments as well as political mandate and support for prioritizing innovation, raising funds and finding solutions for regulatory obstacles, such as access to data. Through a strong storytelling, Israeli hospitals, together with the Israeli innovation ecosystem and Israeli politicians, have managed to stage Israel as an innovation powerhouse on the global scene. This provides an important element of prestige for the hospital innovators and attracts international partners for collaboration.

As a method of manifesting the internal innovation culture, Israelis have established a corps of innovation champions known internally and in the ecosystem as strong and successful innovators. These champions serve as important motivators and advisors for other staff members in reflecting the value of engaging in innovation. Management alone cannot carry the culture.

6.1.2 INCENTIVES

A major aspect of the culture of innovation is providing incentives, as innovation requires sacrifice of publications, research promotions, time and other resources. Incentives signal that the hospital takes innovation seriously, values the efforts of staff to innovate and is willing to invest in innovators. Research institutions systematically reward research publications and accomplishments with prestige, reputation, tenure, prizes, etc. Often, inventors must waive publications and other research rewards when engaging in translational research and innovation. In order to ensure the motivation of inventors, hospitals in Israel aim to transform innovation into a prestigious field on par with research. Financial incentives is one tool for doing so and the one that has proven most efficient in the Israeli context. When an invention at an Israeli hospital generates an income through sale, licencing or royalties, the funds are distributed between the inventor (30-40 percent), the lab or department of the inventor (30-40 percent) and the hospital (30-40 percent). The income creates an incentive for both the inventor and for the lab/department to innovate. Israel has produced millionaires among healthcare professionals, which has not resulted in an outflow of healthcare professionals from the healthcare system or distraction from other important functions of healthcare professionals.

Designated time for innovation, funding (generated through innovation income) and celebration of innovation champions are other tools that are applied in Israel. Motivating incentives may not necessarily be monetary in a Nordic context but could provide recognition among peers, competence development or dedicated time for innovation. Nordic hospitals should determine what motivates Nordic healthcare professionals to innovate without presuming that improving healthcare is a sufficient motivator for the individual.

6.2 ROLES AND MANAGEMENT LEADERSHIP

As mentioned under the culture of innovation section above, management plays a critical role in stirring innovation and attracting external partners. In addition to management, the hospital needs leaders at all levels in centres, departments and teams who channel the hospital innovation culture and vision to think differently to the staff. Israeli hospitals have

implemented innovation KPIs at all levels of the organisation to guide leaders in the mission and vision. Israeli hospitals do not measure how many healthcare professionals initiate an innovation process, as these are considered vanity KPIs, but focus on the number of solutions generated as well as the number of external partnerships, grants and income.

Due to the risky nature of innovation, centres need to have a risk strategy in place in order to achieve a sustainable innovation model. In Israel, management, along with authorities and the political level, has taken on the responsibility of mitigating the risk in order to allow staff to engage in innovation. The most crucial function of management entails obtaining a political mandate for prioritizing innovation as a mission of the hospital and for dealing with the challenges and barriers of innovation, such as securing external funding, reducing bureaucracy in commercialisation, opening the doors to industry, providing access to data, etc.

"Management's job is not to prevent risk but to build the capacity to recover when failures occur. If we aren't always a little scared, we're not doing our job" – Ed Catmull, Pixar

All the Israeli innovation centres have a Director of Innovation coming from within the hospital with a medical background and solid knowledge of the functions of the hospital. The rest of the innovation staff come with business backgrounds as the main functions of the centre are business oriented towards identifying marketable research and ideas and assisting internal and external teams scale new solutions. The legal functions of contracts and IP are outsourced as they are considered minor functions.

6.3 OPEN INNOVATION

The main factors to consider when establishing an open innovation setup are location of the open innovation, collaboration with external partners (particularly startup companies) and access to data.

6.3.1 LOCATION AND SETUP OF OPEN INNOVATION

The general setup of innovation units at Israeli hospitals consists of 1) innovation centre for in-house innovation 2) technology transfer office for commercialisation 3) innovation centre for open innovation and external collaborations. The innovation centres are physical spaces where staff and external partners can innovate. They also have free access to walk around the hospital campus. Israeli centres place great emphasize on the physical presence. Innovation requires the possibility of sitting together exchanging ideas and knowledge. It is not enough to do it in the different departments. The setup for in-house innovation and technology transfer is identical across the hospitals.

For open innovation, three types of innovation setups dominate the Israel hospital innovation landscape:

1) innovation centre on campus,
2) collaborating with co-working space on campus and
3) participation in joint venture incubator off campus

The university hospital of Sheba has developed the most advanced setup in Israel with the well-known ARC launched in 2018 on campus. ARC stands for **A**ccelerates innovation and **R**edesigns healthcare by **C**ollaborating with partners and it is based on the principles of open innovation, international collaboration and a physical home for innovation. Sheba has attracted a broad spectrum of external partners to take up physical space at the two-story innovation lab: academic institutions, startups, corporates and other stakeholders, such as ministries, health maintenance organisations, military and international medical centres. In addition, the hospital has several strategic partnerships with international medical centres, such as North Zealand Hospital, without physical presence. The hospital plans to expand the lab to a 16-floors innovation centre by 2025 with a vision to establish an entire bio-innovation valley around the hospital. ARC encompasses six innovation hubs within Big Data & AI, Precision Medicine, Telemedicine, Virtualization in Medicine, Innovation of Surgery and Rehabilitation. ARC produces approx. 25 inventions, 20 patents, 20 commercial agreements, 30 innovation projects, 250 IRB and 1-3 startups annually. In 2021, startup companies based on technology invented and developed at Sheba raised USD 110M. The second-largest university hospital of Ichilov has established a similar Ichilov Tech innovation centre on campus comprising of Imed Lab for internal innovation, Imed Capital for investments, Imed Biz for collaboration with startups and corporates and Imed Global for international partnerships. In addition, the centre runs 10 departmental innovation hubs driving internal innovation and three accelerators scaling internal solutions. The centre currently collaborates with 60 startup companies.

Instead of building its own innovation centre, the university hospital of Hadassah has chosen a more low-risk model by entering into a strategic partnership with the co-working space Biohouse to build and run an innovation centre on campus. While Biohouse provides the innovation labs, Hadassah provides the innovation and commercialisation support and access to the hospital resources and assets through the Technology Transfer Office, which remains the focal point of the innovation initiatives. In addition, IBM Alpha Zone powers an accelerator program at the Biohouse for hospital innovators and external post-seed-stage startup companies. IBM provides mentoring and free access to tools and infrastructure. Since the launch in 2019, over 20 companies have graduated from the program. Hadassah generates 30 commercialisation agreements and 100 innovation agreements annually and has established over 60 startup companies to date.

Similar to Hadassah Hospital, Rambam Hospital in Haifa currently runs internal innovation initiatives through the Technology Transfer Office while open innovation with industry and scaling of internal innovation is done off campus through the incubator MindUp. The incubator is a joint venture between Medtronic, IBM, Pitango Ventures and Rambam Hospital. Rambam provides in-kind access to hospital resources and clinical advice in return for incubation of its own spin-offs. However, with an increased volume of in-house innovation and increased focus on the importance of research and innovation at hospitals, Rambam is accelerating its role with the establishment of an onsite 20-story discovery tower to include research institutions, a satellite of Haifa University and an open innovation space for startups and corporates to facilitate onsite collaborations.

From Israeli experiences, initial engagement in open innovation through low-risk participation in joint venture with industrial partners is preferable. Once internal innovation reaches a certain volume, on-campus setup will be required to maintain an internal innovation culture and provide adequate access to hospital resources for external partners.

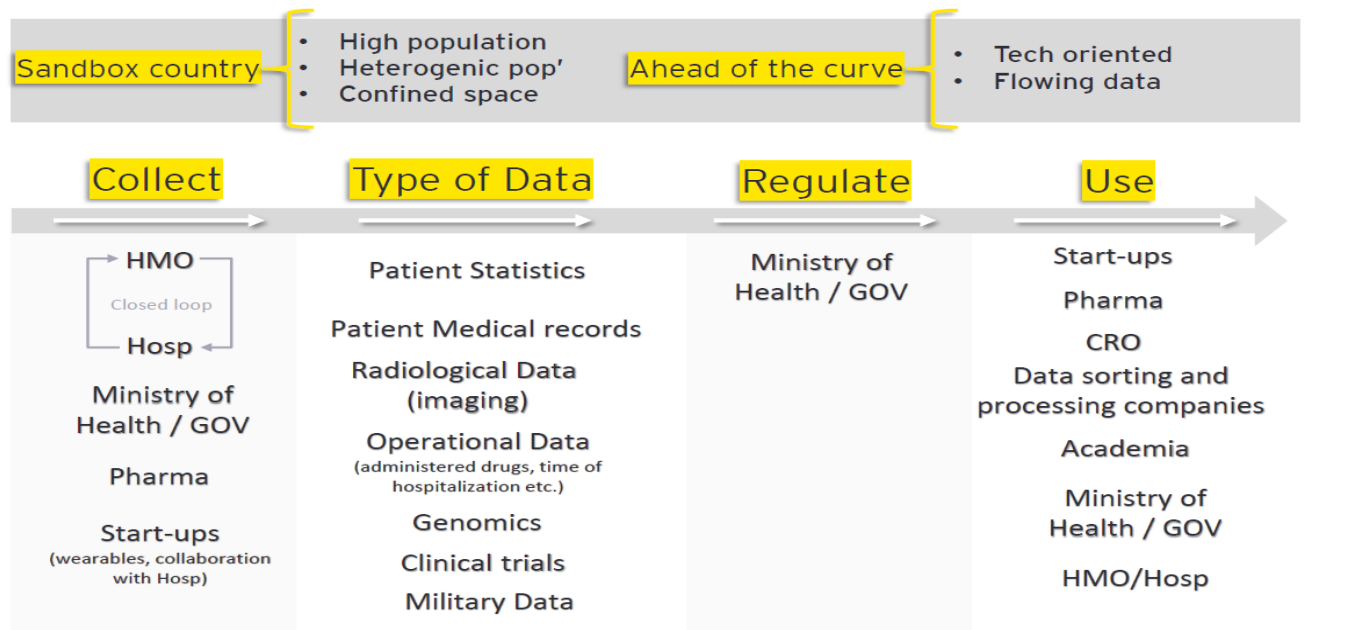
6.3.2 ACCESS TO DATA

Like Denmark, Israel possesses a massive pool of digitalised healthcare data from the medical records of more than 98 percent of the population. As data-driven healthcare solutions are revolutionising healthcare, access to data is crucial for providing cutting-edge solutions to patients globally. As a result, the Israeli government decided to provide access to data to advance research and innovation. In 2019 the government launched a USD 300M initiative to provide researchers, entrepreneurs and medical institutions access to data, focusing primarily on commercializing and otherwise deriving value from the country's medical databanks. In 2021, the government approved an additional USD 17.6M for a new program allowing hospitals, health maintenance organisations and other health data owners to build the infrastructure required for anonymized data sharing and R&D with startup companies. Data sharing will be for insights, analysis, validation and trials. The purpose is to create an international standard for sharing medical data.

The Israeli government is actively encouraging the use of the medical data in research and innovation of new cutting-edge solutions, particularly to boost the development of precision and personalised medicine. From a political perspective, the catalyst for the efforts of the authorities to find ways to provide access to data for R&I was the realization of the value of health data on a larger scale. The Israeli government considers the data a national asset for improving public health, public health policy and global health, for attracting multinationals and investors to the ecosystem and strengthening the competitiveness of

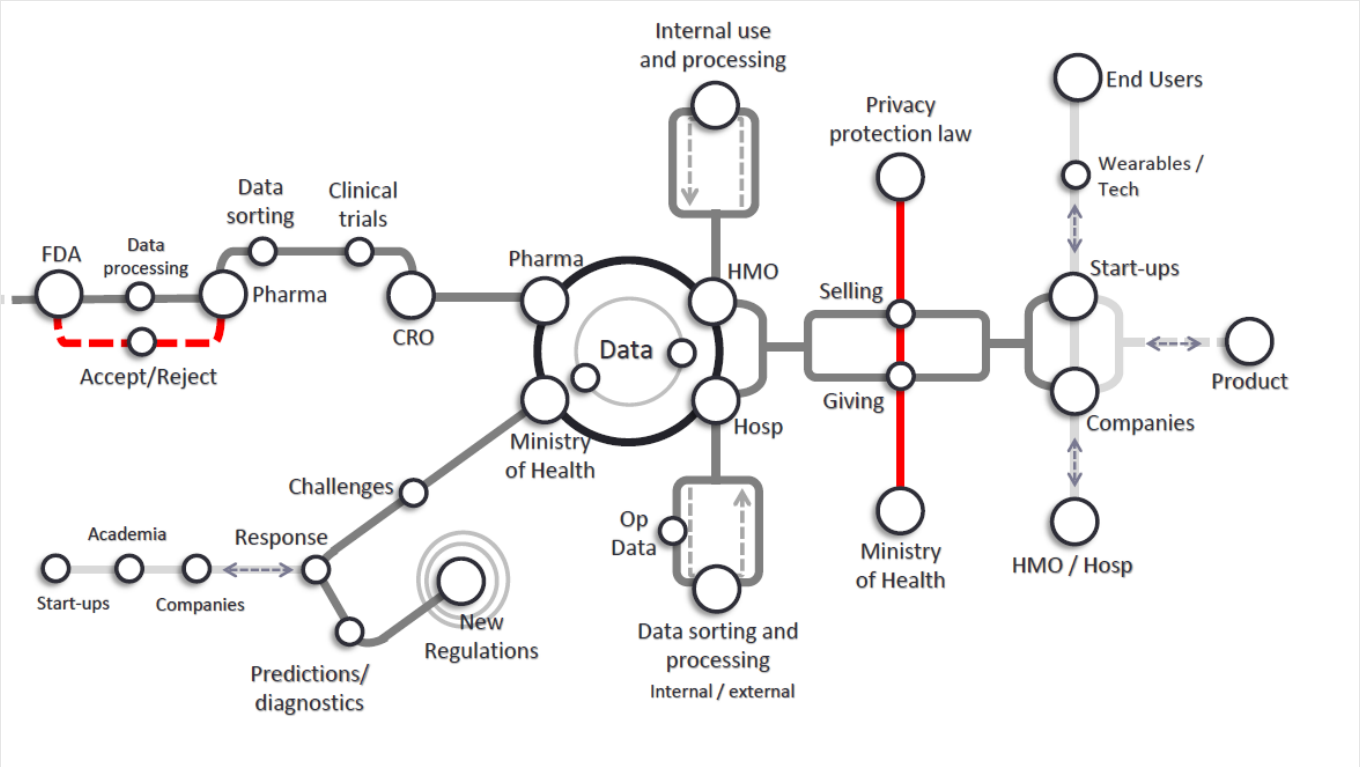
Israeli industry. Data, along with talent and ease of testing, is a main reason for the massive presence of multinational R&D centres in Israel.

Israeli Data Ecosystem:



Through extension of regulations (e.g. applying opt-out instead of opt-in requirements) and application of new technologies for processing data into anonymised and synthetic data, Israeli authorities have given hospitals and other data owners permission to provide access to data for researchers and entrepreneurs from research institutions and industry. The law details the type of consent and protection required, including cybersecurity protection, but recognises that there are technologies to ensure that data is only used for the purpose it was shared and that data can be utilized while being protected. Regulations also allow Israeli organisations to charge a fee for access to data. Some hospitals require industry to work on the data onsite at the hospital and only extract the results while other hospitals allow the extraction of certain kinds of data outside the hospital.

Flow of Medical Data in Israel:



The Ministry of Health in Israel plays a very active role in promoting health innovation and application of health data. In 2018, the ministry opened a digital unit for advancing digital health innovation in Israel. The initiatives include hackathons with hospitals and health maintenance organisations where local innovators and startups are provided with a challenge and data to come up with new solutions. The ministry also provides sandboxes for playing with data. As such, the ministry works to push hospitals to not only focus on supplying services but to be open to innovation and collaboration with industry.

Application of data in research and innovation is a main contributor to the impressive results that the ecosystem is yielding. Recently during the Covid-19 pandemic, Israel contributed to the advancement of vaccines and global health by providing medical data to Pfizer and later other pharmaceuticals. Finding a good balance between protection and enabling is a difficult challenge. Israel may be an inspiration for other countries on means of applying medical data for research and innovation without violating or compromising privacy concerns

6.4 EXTERNAL PARTNERSHIPS AND INTERFACE WITH STARTUPS

Current and future healthcare challenges cannot be solved without participation of external experts – including industry and patients – and the influx of bright ideas from outside. Therefore, Israeli hospitals prioritize collaborations with a variety of external stakeholders as a way of boosting internal innovation and assisting with external innovation. Environments where staff are exposed to a wide range of different thinking, people, backgrounds and points of view provide good grounds for innovation, skills and motivation that could not be generated internally. Israeli hospitals work very purposely on attracting the ecosystem to be in or around the hospitals, where they can sit together with hospital innovators. Startups are an extremely efficient vehicle for spinning-out and scaling hospital innovation. They are small, have tight budgets, work with high speed and have no bureaucracy – something Technology Transfer Offices try to copy in their setup.

Hospitals assist industry in accelerating solutions from outside by providing access to hospital assets for development and validation as well as data. Collaboration with industry is not limited to solutions of relevance and interest for the hospital. Hospitals will invite in companies with solutions that are marketable and deemed impactful on a global scale. Industry growth is dependent on collaboration with hospitals and Israel prefers that companies keep their R&I activities in Israel. Through collaboration with industry, hospitals will also ensure that new solutions meet the actual needs in clinical setting and become accessible for patients. Hospitals recognize that hospitals and industry are co-dependent. If one shrinks, the other will not prosper either.

Israeli hospitals acknowledge that startup companies attract investors and multinational companies. Multinational corporates are important collaboration partners, who provide knowledge, skills and research grants while scouting for spin-off and investment opportunities. Their presence at the hospital produces more IP from hospital. For the corporates, working with Israeli hospitals provides a relatively low risk – high reward environment with access to high quality innovation deal flow and fast, cost-effective R&D. In addition, Israeli hospitals are an extremely important source of health data for corporates.

Israeli hospitals have realised that they must work *with* businesses, *like* a business. This entails low level of bureaucracy, short turn-around time, systematic processes, high flexibility and open-door policy. The need to function as a business is one reason that Israeli innovation centres and technology transfer offices are set up as private companies owned by the hospital but with the agility to act fast. Due to the limited time and resources of companies, the hospitals have standardized and shortened the contractual process to less than a one month. For spinning-out of technologies, hospitals usually receive licensing fee, royalty fee, milestone payment, sublicense fee as well as exit or IPO fee.

6.5 FUNDING AND COMMERCIALISATION

Commercialisation is the backbone of Israeli hospital innovation and Israeli innovation in general. Israeli hospitals not only focus on the research and development side of innovation but equally on the business side of innovation. Israeli university and hospital Technology Transfer Offices have a remarkable track record for generating more revenue from IP sales than any other country after the US. The Technology Transfer Offices in the hospitals existed long before the innovation centres. Israeli hospitals have been commercialising hospital research for over 40 years. The Technology Transfer Offices were separate from those of the university in order to ensure close proximity to the inventors and reinvestment of income into hospital research and later innovation. The Technology Transfer Offices have since been incorporated as an integral part of the innovation units.

Unlike Danish university Technology Transfer Offices and innovation centres, Israeli Technology Transfer Offices and innovation centres at both hospitals and universities are private for-profit companies owned by the hospital but with separate strategies, budget and management geared more to the business side. The staff of the Technology Transfer Offices are business professionals, some with medical background. Legal matters are outsourced. This setup allows the innovation centres to function in the agile manner required to collaborate with industry. It also allows the office to generate an income with regards to reinvestment and taxes.

Israeli innovation centres focus on more than protecting own IP, becoming a bridge over the valley of death more than a safeguard. One of the unique commercialisation traits of the Israeli hospital innovation centres is the proactive and outward approach in seeking out new inventions with market potential among the healthcare professionals and researchers. This is achieved through meetings with them annually. This approach also ensures translation of ideas and needs by the innovation centre in cases where the inventor has no wish to push forward. The centres have a proactive approach in engaging with industry by creating ties with companies that are willing to advance the inventions as described above under setup. At the same time, the centres have one single point of contact for industry and own innovators, unlike many other innovation centres. Many countries are fast in research but Israel is faster when it comes to deal-making.

Also in commercialisation, collaboration with external partners is extremely important. Israeli innovation centres have established advisory teams of entrepreneurs, technical experts, product design experts, corporates and investors who advice the centre and innovators on development and scaling.

An important principle of technology transfer in Israel is that innovation centres require companies to develop a product from the invention; otherwise, the license is terminated in order to prevent companies from suppressing solutions to gain competitive advantages.

An interesting new trend in Israeli hospital innovation is the establishment of joint investment funds between hospitals and venture capital funds to invest in seed and round A startup companies that have spun out of the hospital. The same trend is emerging at universities. The venture fund and hospital raise the funding in joint effort. Venture funds operate with much shorter windows than hospitals, which is beneficial for increasing the scaling and commercialisation speed. Most recently, Sheba Hospital and Triventures have launched the Triventure ARC fund with USD 45M under management. Sheba Hospital is entitled to 20 percent of the profits. The fund focuses on data-driven solutions. In addition, Hadassah Hospital has established a venture fund through its own private holding company.

7. INNOVATION PROCESS

Israel approaches innovation using the reversed innovation model of understanding the challenge and working towards the solution. Hospitals are particularly well equipped for working with reversed innovation due to the exposure to solution needs. The most common innovation process applied by Israeli hospitals builds on the Double Diamond design thinking and the Stanford Biodesign model. The process encompasses several stages:

For the need research, the hospitals score and compare different internal ideas in order to select relevant ideas for further development. Scoring is done according to six objective parameters: team, prototype, regulation, IP, impact and market. The main principle of the Israeli innovation process is to fail early and fail often to succeed. This requires numerous rounds of validation, which is a main reason for the need of industry to collaborate with hospitals.

8. KEYS FOR SUCCESS IN ADVANCING NORDIC HEALTH INNOVATION

During the masterclass on "Building Nordic Hospital Innovation Models", Danish and Swedish hospital and industry management identified the main challenges and keys for success in driving Nordic hospital innovation and establishing hospital innovation units based on inspiration from the Israeli model. The detailed results of the workshop are found in the appendixes. The participants identified eight keys for success in a Nordic context:

8.1 DEFINING THE WHY

Nordic hospitals need to set clear objectives for innovation activities in order to establish the appropriate setup and engage with the relevant partners. Is the objective to drive internal innovation only or external innovation only or both? Is the objective to spin-out or scale ideas and solutions? Is the objective with external innovation only to collaborate with companies that assist with scaling of internal solutions or also to assist companies with scaling their own solutions by providing access to hospital resources? Is the objective to improve healthcare at the hospital, regionally, nationally or globally?

Previous perceptions and assumptions in the Nordics have been that hospitals should only focus on technologies of interest to the hospital, should keep industry at an arm's length and should not mix public service and business. Considering the Israeli experiences, one might revisit these principles in terms of whether they serve hospitals and Nordic healthcare systems best and promote or hinder innovation. Israeli hospitals have a clear objective of striving to improve healthcare globally, to bring external innovation into the hospital as a motivating factor for internal innovation, to assist industry with scaling and growth and to generate an income in order to ensure sustainable innovation. There is an understanding in Israel that hospitals, as public institutions, have a duty to assist industry with development of industry solutions and advance Israeli competitiveness and growth as these benefit Israeli and global healthcare.

8.2 CREATING A CULTURE OF INNOVATION AND INCENTIVES

The culture of innovation in Israeli hospitals is based on the incentives of prestige and financial reward in addition to a desire to improve healthcare. This derives from and builds on the general ambitious Israeli innovation culture where the rising stars and upper class are no longer the successful doctors and lawyers but the entrepreneurs doing exits of cutting-edge startup companies. Israel has examples of successful, millionaire healthcare professional entrepreneurs, even among hospital directors. These are brought forward as innovation champions at the hospitals driving the motivation of the staff.

As the frameworks for innovation in Nordic hospitals are different, the incentives may relate more to education/training and prestige in the professional setting in terms of improving healthcare. It will be important to understand what intrinsically motivates Nordic innovators and set up structures that enable peer recognition. An important question is whether hospital inventors should share the income from commercialisation as a compensation for the time invested. Again, Israeli experiences do not reflect tendencies of neglect of healthcare functions among healthcare innovators, who are still first and foremost healthcare professionals.

As a general rule, hospital innovators have little skills and experiences in innovation and entrepreneurship. They bring ideas and motivation to the table to improve healthcare. As with student entrepreneurship programs at universities, there is a need for training of healthcare professionals in innovation and entrepreneurship topics to provide them with the tools to innovate and develop technologies. No such programs currently exist in Israel, as systematic development of innovation skills for healthcare professionals has not been a focus. The Israeli hospitals are currently moving in the direction of establishing training programs and have expressed interest in collaboration with Nordic hospitals.

8.3 CREATING A STORYTELLING

Creating a strong storytelling on the value and impact of hospital innovation internally and externally has constituted a main component in the Israeli innovation culture. The storytelling enables hospitals to attract and maintain the stakeholders of the ecosystem and motivate the staff. It must convey all aspects of impact, which go beyond the development of new technologies and a national growth engine. Innovation equally generates competence development of healthcare professionals, smoother implementation of new technologies, ecosystem building, public-private partnerships and international collaborations, all contributors of better healthcare. The storytelling should be adapted and shared by all stakeholders of the ecosystem, including the political level, to create a joint vision and mission and to establish a strong brand/image for Nordic innovation internationally. As all the Nordic hospitals are currently establishing a storytelling, the hospitals should consider creating a joint storytelling as a component of increased Nordic collaboration. The hospitals will stand stronger in motivating innovators, gaining political support and attracting partners.

8.4 GENERATING AN INCOME

In Israel, generating an income from innovation through commercialisation, contracts with companies and establishing joint venture funds has been the tool applied to ensure a sustainable innovation model. The question is which tools Nordic hospitals have at their disposal to ensure the continuation of innovation activities. Until recent years, hospitals maintained industry at an arm's length to secure focus on healthcare provision and ensure objectivity. Israeli experiences have shown, however, that the strong connection with industry has improved healthcare. Sheba Hospital that is perceived as very commercial has entered the list of top ten hospitals in the world since the launch of the ARC. The Israeli innovation centres have been established as private for-profit companies to ensure separation from the healthcare provision (in addition to tax purposes and others). It is worth considering again, why Nordic hospitals and public institutions in general should not generate income to invest in research and innovation.

Another important question to consider is whether hospitals can engage with investors in joint venture funds and generate income from startup equity as long as the hospitals do not have to provide investments to the fund. Considering the quality of Nordic health R&I and healthcare services, international investors will undoubtedly be interested in collaboration with Nordic hospitals. This falls in line with the current substantial increased interest in Danish startups by Israeli investors and international investors in Israel.

Concerning commercialisation of spin-outs, Nordic hospitals and regions may consider establishing regional centres to create resource synergies and enable smaller hospitals to engage in innovation to a larger degree and generate technological developments.

8.5 ESTABLISHING A POLITICAL MANDATE

In Israel, the political mandate from authorities, politicians and government is very strong. Even both the former and current Prime Minister are adamant promoters of Israeli hospital innovation and play an important role in attracting international partners. The government works to promote the framework for innovation at hospitals. Nordic hospital innovation would benefit from a political discussion on the frameworks of innovation in terms of collaboration with industry, incentives, generating funding and access to data. Israeli experiences could serve as inspiration. A strong and joint storytelling of the ROI of innovation across the Nordic hospitals is an important tool in obtaining the mandate. The main role of hospital management is to work towards political support in authorizing innovation as part of the hospital DNA and branding the innovation mission in the ecosystem.

8.6 INDUSTRY COLLABORATION

The purpose of the participation of industry representatives (Novo Nordisk, Roche, Medtronic, AstraZeneca, Healthtech Hub Copenhagen and Leap for Life Sweden) in the masterclass was to initiate a dialogue on strengthening hospital-industry collaboration. From the dialogue, it is clear that there is a need to clarify the purpose of collaboration (are hospitals collaborating to accelerate their own solutions, industry solutions or both) and the needs of each side in the collaboration in order to create win-win partnerships. Nordic innovation will suffer if collaborations are not strengthened. Considering the Nordic strongholds in R&I, the Nordics are in a good position to attract international R&D centres to the Nordic hospitals and ecosystems.

8.7 DATA ACCESS AND APPLICATION

It is critical that hospitals and industry gain access to healthcare data for not just research but also innovation, which is more unpredictable and indefinable in terms of purpose and outcome. It is equally critical to explore how hospitals may function as data providers for industry in order to attract companies for collaboration, which in turn will increase the innovation capacities of hospitals considerably, as is the case in Israel. Numerous Nordic corporates are currently collaborating with Israeli hospitals around data access, which produces additional partnerships and large investmentswith Israeli incubators and investors. Resources that could have been invested in Nordic innovation and that corporates would invest in Nordic innovation

if the options were present. Israel could serve as an inspiration in terms of application of technologies to ensure data access while securing privacy protection.

8.8 INTERNATIONAL COLLABORATION

The increased focus on advanced, data-driven healthcare technologies and treatments emphasizes the importance of participation in national, interregional and international research and innovation, both in terms of joint developments by international healthcare professionals and industry access to international hospital and ecosystem resources for validation and scaling. The international component should be incorporated in the Nordic innovation setups and storytelling from the initial phase. The potential of participation in international collaborations and training should also be utilized as an incentive and motivator for innovators. One of the main strengths of any successful company is diversity. Having doctors and researchers from Israel working alongside peers from the Nordics enables exchange of ideas and the creation of a multicultural environment as the basis for innovation.

9. DANISH HOSPITAL INNOVATION MODELS

This section presents the innovation models and setups of the Nordic university hospitals of Odense, Copenhagen and Karolinska as an inspiration to the Nordic setups that are being developed at Nordic hospitals.

9.1 ODENSE UNIVERSITY HOSPITAL

Neither development nor innovation happens of its own accord or as a natural consequence of general technological advances in society. Innovation and solutions development take determined efforts and dedicated people. For this reason, Odense University Hospital (OUH) has decided toprioritize strategic innovation. The purpose of the hospital is to ensure that our healthcare system is ready for the patient of the future.

Strategic innovation supports and strengthens the hospital's innovation culture, often resulting in greater operational efficiency because the innovation focuses on the issues most acutely in need of addressing. When working strategically with innovation, hospitals create a framework for and actively shape the future.

At OUH, the vision of putting the patient first is guiding both the focus and how the hospital addresses the issues and the innovative process.

9.1.1 SPECIALISED CENTRES

OUH has divided the innovation efforts into three specialised research and innovation centres:

- Centre for Clinical Artificial Intelligence (CAI-X)
- Centre for Clinical Robotics (CCR)
- Centre for Innovative Medical Technology (CIMT), which also holds competencies in Health Technology Assessment (HTA)

The centres are all established in close collaboration between OUH and the University of Southern Denmark.

The specialised centres enable matching of any given project or wish for development from the clinical departments with the right expert. Although the centres specialise in different fields, they share a strong network, experiences and competencies, and cooperate on many different levels.

9.1.2 PUBLIC-PRIVATE COOPERATION

OUH places great emphasis on cooperation with private companies – both corporates and startups. The hospital regularly receives ideas and offers for new products and projects, and channels all inquiries through a digital form. In that way, the hospital makes sure to receive all relevant information at the outset and that they can handle and assess the ideas, products and projects quickly and professionally.

Find the form for CIMT here: https://app.smartsheet.com/b/form/8098edde2f754c4c97003b32fe1ab3a6

Find the form for CAI-X here: https://app.smartsheet.com/b/form/f60010831abd489ea6c5c444fd2ed879

Find the form for CCR here: https://app.smartsheet.com/b/form/81b112a7e7754317aae1933243a90a96

9.1.3 INNOVATION PROCESS

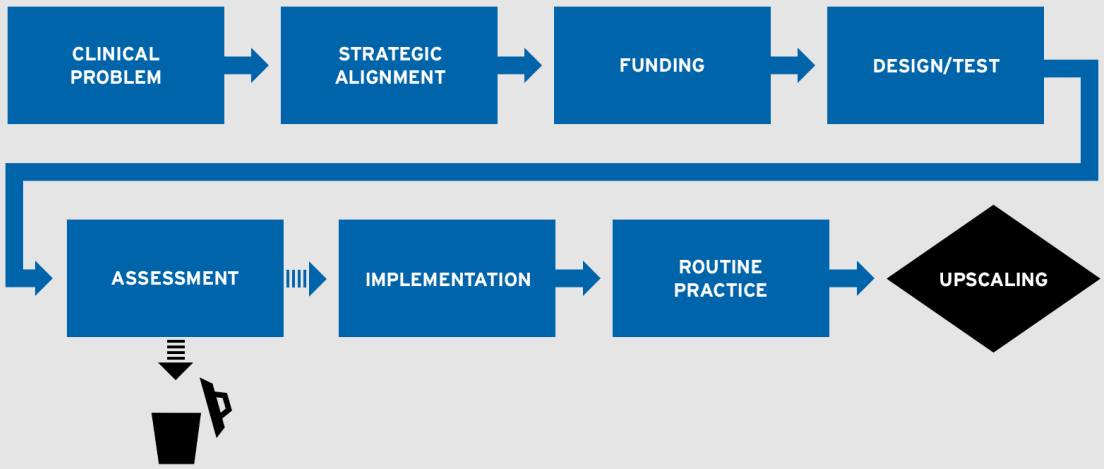
The innovation process kicks off with the scouting of an idea. The idea or problem may take the form of a challenge encountered by clinical staff, or it may be an idea presented by one of the international partners, by researchers or by someone in the health technology industry. The important thing is for the solution to be implementable in the new hospital buildings and aligned with the innovation strategy, and for the clinical departments to see

potential in the project. When feasible and beneficial, relatives of patients are involved as secondary and important users of digital healthcare services.

OUH has developed a flow chart for the innovation process, both to simplify the process for the innovation consultants and project managers and to ensure all necessary steps and detours when relevant.

The flow chart starts with the scouting phase where the idea is moulded into a one-pager, which can be assessed in the centres with regard to strategic alignment and with the scoping and fundraising phases in mind. If approved for scoping, the one-pager develops into a scope statement with the participation of relevant internal and external partners, consultants, researchers, etc. The scoping phase is also where the hospital ensures coordination with strategies, align expectations and ensure that the project is truly innovative. The final phase before project initiation is the funding phase where funding options are identified and applications worked out and sent.

The comprehensive flow chart below covers the first three steps in the model for the innovation process:



This model illustrates the innovation process from scouting and scoping through the actual project phase where the innovation is designed and tested in the clinical setting in close collaboration with hospital staff, patients and project partners. The assessment determines if the project is fit for implementation, if the technology needs further development or if it is possibly not a suitable solution.

9.1.4 WORKING STRATEGICALLY WITH INNOVATION IN-HOUSE

Strategic innovation requires an innovative mindset – not only in the innovation department, but also with management and the clinical departments at the hospital.

The clinical staff need to know where to go and who to contact if they have an innovative idea for new products or better workflows. OUH continuously tries to make sure that the clinical staff encounters innovation as a concept in one form or the other to keep innovation top of mind. Some of the elements used in that context are:

Innovation day: An annual event celebrating innovation at OUH where ideas and experiences are shared. Here, local innovators from all over the hospital can showcase projects and results, and the central innovation department can learn about local projects and meet dedicated innovators.

Innovation prize: Presented at the innovation day to one of the local innovators based on a vote among attendees. The prize consists of a 'statuette' and a small sum of money for the department/team that has implemented the winning solution.

Innovation Fund: OUH's fund for internal strategic innovation projects. The option of seeking funding from the hospital's own fund makes it easier to achieve funding for local projects, but it also serves to show that innovation is taken very seriously. Funding is distributed by the OUH Innovation Council. The innovation unit manages the application process, selection, communication, etc.

9.2 COPENHAGEN UNIVERSITY HOSPITAL (RIGSHOSPITALET)

Rigshospitalet is a leading hospital for patients who need highly specialized treatment. The hospital offers internationally renowned treatment and is recognized for its world-class health research. The healthcare staff is exceptionally dedicated and highly trained. The hospital has some of the world's most ambitious investments in health research and top-class data. This makes it a strong foundation for innovating, implementing and scaling new health solutions for the entire world – from Copenhagen.

The hospital will establish innovation initiatives across Rigshospitalet's highly specialised centres and invite external partners to collaborate on developing future healthcare. The approach is named Innovation PLUS – because great results can only be achieved by reaching out and letting others be part of the equation. The hospital invites patients, healthcare professionals, businesses, startups, knowledge institutions, non-governmental organizations

and municipalities to join the work. Together, they will raise the bar for health innovation in Denmark and make a global imprint on the future of healthcare.

9.2.1 GUIDING PRINCIPLES

The vision of Rigshospitalet is based on four principles, which set the course for innovation at Rigshospitalet.

1) Focus on the **whole person**

As a hospital and healthcare service, the core task is first and foremost to diagnose and treat patients. However, Rigshospitalet also aims to make a positive difference for people's quality of life and support their network, which plays a key role before, during and after treatment. They are dealing with people's lives and therefore insist that future healthcare solutions take responsibility for the whole person – not just the individual treatment.

2) Build on **specific needs**

Rigshospitalet always focuses on of the specific needs of the patients and healthcare professionals when initiating innovation projects. The solutions worked with have clear ownership and are deeply rooted in the clinical environment. Rigshospitalet believes this is crucial if the solutions are to be relevant and practicable.

3) New partners, **new perspectives**

Even though clinicians at Rigshospitalet are among the best in the world, future healthcare challenges are far too complex to be overcome by just one actor. The hospital therefore strives to break down silo mentalities by openly and actively involving relevant collaboration partners as well as the users who ultimately benefit from the efforts.

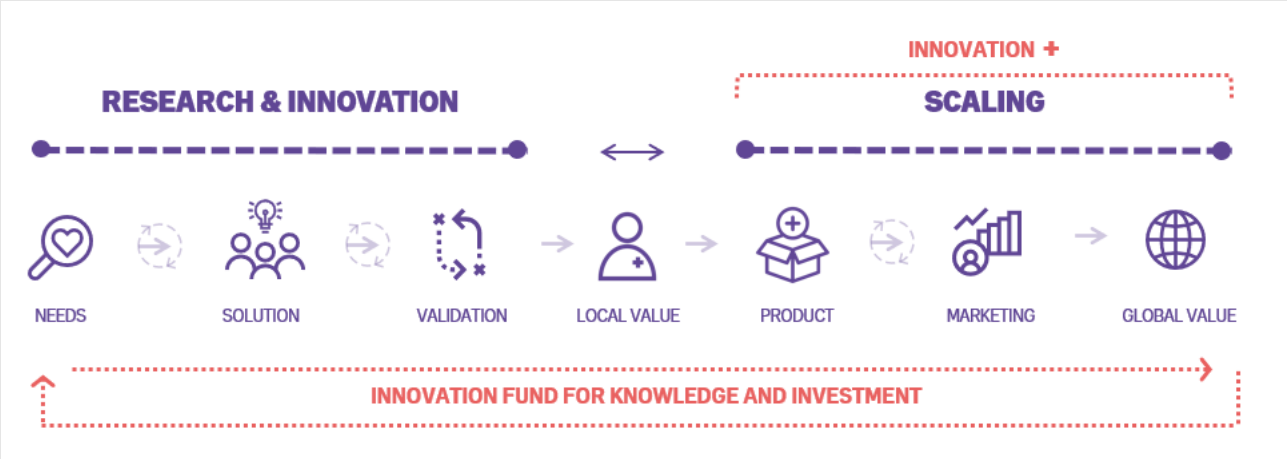
4) Triple impact **value creation**

Rigshospitalet assesses the potential for value creation in three ways. Value for PEOPLE is essential, PROFIT is desirable and value for the PLANET is the goal.

9.2.2 RIGSHOSPITALET'S INNOVATION MODEL

Innovation is about developing new methods and solutions that can be used in practice to make a positive difference for patients and healthcare professionals. To ensure that innovation at Rigshospitalet generates value for as many patients as possible, the hospital has developed a model for accelerating new solutions from local to global value. Each step of the model includes specific deliverables, for example within testing, legal issues, data

and business development. The innovation team, as well as internal and external collaboration partners, provide such deliverables. Sometimes a solution is accelerated throughout the entire process, and in other instances, the hospital helps at individual steps.



9.2.3 PARTNERSHIP STRATEGY

Rigshospitalet establishes mutually beneficial partnerships with organizations and businesses that share the vision and can contribute to creating a strong platform for hospital-driven innovation in Denmark. These partnerships are mutually binding and the contracts typically contain a list of common initiatives that are limited to a specific period of time. This type of partnership steers away from the traditional customer/supplier relationship, and towards a commitment that benefits both sides equally.

In practice, this means that Rigshospitalet invites producers of technology and medical equipment into the clinical setting, so that they are able to see what functions well in practice and develop the solutions together with the clinical personal. The goal is to collaborate with businesses on developing health technology that addresses the most pressing needs in the clinical setting.

9.2.4 DANISH NATIONAL NETWORK OF INNOVATIVE HOSPITALS

The Innovation Centre at Rigshospitalet facilitates the National Network of Innovative Hospitals across Denmark with participation of more than 20 (> 90%) of the largest hospitals. The network aims to exchange knowledge, collaborate on scaling innovative solutions and to mobilise an alliance across individual Danish hospitals to strengthen Denmark's position as a leading clinical innovation hub. The network strengthens the ability to learn from each other's mistakes and successes in developing and implementing new healthcare solutions, as well as encourages collaboration when scaling to new hospitals. This initiative has grown

out of an interest to integrate innovation as a way of work and mentality & culture in hospitals – forming a common language and approach to innovation in healthcare.

9.2.5 BETA.HEALTH – DANISH NATIONAL INNOVATION PLATFORM FOR FUTURE HEALTHCARE

Together with leading university hospitals in Denmark, Rigshospitalet offers a grant program aimed at enabling a more systematic identification, development, validation, and implementation of innovative potential at Danish hospitals. The overall vision is to make clinical innovation a fully integrated part of the Danish healthcare system.

The Novo Nordisk Foundation has granted 128M DKK to the initiative for an initial 5-year project timeline. The initiative will be open and inclusive to other hospitals and build on close collaborations with academia, industry, and expert organisations. As such, the initiative will be an open platform that will enhance and empower current support functions in the ecosystem to accelerate innovation.

BETA.HEALTH will award grants up to a total of 15M DKK each year through open calls during the initial 5-year project timeline to support preliminary or select phases of innovation. Project grants will be made available as BETA2 grants (250.000 DKK) BETA5 grants (500.000 DKK) and BETA10 grants (1M DKK). Besides delivering grants, Beta Health will also support with subject-matter expertise to the cases. Grants will be awarded 2 times per year through call-screen-selection processes governed by a National Review Committee. The composition of the call committee will change to adapt to the subject matter of the project cohorts but will always include a broad representation of key stakeholders from all Danish regions.

In addition, Academy activities will be provided covering classes in various innovation disciplines. The Academy is an open-for-all platform that will provide educational programmes and event activities, delivered in partnership with relevant ecosystem stakeholders as well as the core Beta Health Team. The Innovation Centre at Rigshospitalet has already begun collaborating with the national ecosystem of health innovation in order to build Academy activities together.

9.3 KAROLINSKA UNIVERSITY HOSPITAL

Karolinska University Hospital is Region Stockholm's university hospital with special responsibility for secondary and tertiary healthcare. Karolinska also receives patients from other parts of the country, and from other countries. The assignment also includes primary responsibility for the Stockholm Region's research and student education alongside the Karolinska Institute and other higher education institutions like Royal Institute of Technology and Stockholm University. The hospital employs around 15,400 people, across some 150 professional categories. Operations are mainly run at the hospital's two sites, in Solna and Huddinge respectively. In 2021, Karolinska was ranked 7 among the top hospitals in the world.

Innovation is a prerequisite for the continued development of healthcare and for continuing to deliver world-class care and is imbedded in the vision of the hospital. Innovation must take place where the actual care is delivered, based on the needs of patients. To create the best possible conditions for innovation, Karolinska has further developed the central support available to its departments, *The Center for Innovation*.

Strategic areas have been precision medicine and location-independent care, as well as industry collaboration based on healthcare needs. This year's innovation courses attracted 429 participants from the hospital, the region and Europe. Final reports have been submitted for two EU projects, Nightingale and Live Incite, and the regional I-AID project. These have contributed to the development of remote solutions and the implementation of AI in healthcare.

The Center for Innovation provides support for driving internal innovation activities as well as in collaborations with industry and academia. The goal is to create the best possible conditions for innovation at Karolinska based on clinical and patient needs and to increase the knowledge of innovation management to drive and benefit from innovation collaborations between public and private actors. Below are some examples of innovation activities:

9.3.1 INNOVATION PARTNERSHIPS WITH INDUSTRY

Karolinska University Hospital continues to develop strategic collaboration with companies, including so called innovation partnerships. These partnerships were initially established in connection with procurement of medical equipment and have innovation agreements ranging up to twenty years. These innovation partnerships have different focus areas and cover collaborative research, development and innovation. These collaborations have generated a substantial amount of scientific publications as well as provide a close link between research and clinical implementation. One example is 'Augmented Reality and smart instruments for guiding surgical operations' where new technology is developed based on the needs that the neurosurgeons at Karolinska come across in their daily work. Clinicians and researchers from the industry partner have, among other things, developed a navigation support device, which allows the surgeon to "see" what the patient looks like inside with minimally invasive techniques, through so-called augmented reality. The technique has so far been used for spine surgery but is now also transferred to other types of clinical conditions, for example for specific types of brain tumors. The same team is working on more projects based on surgical precision, including the development of smart instruments.

9.3.2 MATCH-MAKING HOSPITAL-INDUSTRY

Setting up optimal processes for efficient match making between the hospital and the most relevant industry partners is very important. Karolinska are constantly receiving commercial proposals or different forms of requests for collaborations from industry. Activities to address these requests includes matching the demand from the hospital with solutions by industry along with knowledge-transfer from the Center for Innovation internally as well as externally on how to initiate, operate and finalize successful industry collaborations. An ongoing project is aiming to attract startups and SMEs from Israel that can match the

hospital's demands. This aims to test the procedures and processes with the ambition to scale for other companies from other places.

9.3.3 DEMAND DRIVEN INNOVATION

Karolinska is also exploring the possibilities for the hospital to drive innovation through procurement of innovation. A regional project called 'Integrated AI diagnostics' (I-AID) explored public procurement of innovation (PPI) as a tool to accelerate co-development with industry and academia, including delivery and implementation of the AI product in clinical practice, as well as developing a novel risk-sharing business model. New AI-products are now being developed and implemented for MRI imaging of the brain. Also, two EU-funded pre-commercial procurement (PCP) projects have generated knowledge about innovation and purchasing/procurement through international innovation collaborations. The 'Nightingale' project aimed, together with market participants and five other university hospitals in Europe, to develop a solution for an intelligent and advanced digital system capable of continuously monitoring patients' vital values, inside and outside the hospital. The Live Incite project had two main goals: First, to develop digital support for patients to change their lifestyle before surgery in order to reduce the risk of complications and mortality. Second, to explore simultaneously the possibilities of using procurement to influence the market to develop innovations in areas where healthcare sees great needs, but where solutions are still lacking.

The knowledge from the above-mentioned projects and others are now being exploited in the ongoing development of 'PiPPi Community of Practice'. Here, seven European university hospitals have joined forces to develop common ways to identify and address unmet needs and problems in healthcare together with all stakeholders of the life science ecosystem, and to increase the ability to drive innovation through procurement.

9.3.4 STRATEGIC FOCUS AREAS FOR INNOVATION

Precision medicine and location-independent care are two strategic areas for Karolinska. Karolinska University Hospital, the Karolinska Institute and Region Stockholm are working together to increase the pace at which *precision medicine* is introduced into clinical practice. In short, this means diagnostics, treatment and follow-up will happen at the right time, tailored to the patient's individual needs.

In 2021, the Precision Medicine Center Karolinska (PMCK) was established to promote seamless collaboration between academia and healthcare in diagnostics, treatment, development and research. The center will also consolidate and broaden the already successful collaboration, which has developed over several years between the national SciLifeLab and the Karolinska University Laboratory – a collaboration that has resulted in

the implementation of whole genome sequencing for clinical diagnostics of rare hereditary diseases. The long-term aim is to gradually expand into more technology and disease areas.

Within the focus area of *Location-independent care*, Karolinska explores opportunities and challenges for regional coordination regarding distance monitoring of patients with severe chronic disease, such as heart failure, arrhythmia, COPD and endocarditis. Patients who so wish should be able to stay at home to a greater extent without compromising patient safety. Deterioration must be detected earlier and the risk of acute relapse reduced. A total of eight pilot projects are planned to explore the possibilities in the area. Three companies have been selected through an open competitive process to participate in these collaborative projects.

9.3.5. EDUCATION AND COACHING

Innovation training is part of the innovation support for the hospital's activities. New concepts are added continuously and adapted to shifting needs and conditions. The hospital's work with innovation and innovation management is strengthened through the increased ability to develop and implement new processes, methods, and working methods. This in turn contributes to the hospital's mission in highly specialized care and to the overall the vision to create value for patients. The education programsare also being demanded by external parties in Sweden and other parts of the world, including authorities and other care providers. The courses have attracted 429 participants at Karolinska, in the region and in Europe (a total of 743 participants since the start in 2018). Cultural change to create better conditions for innovation has been discernible.

Mindset around innovation has shifted from being mainly high-profile and research focus, to also include more business- and patient-oriented innovation. In addition, targeted effort has provided an increased understanding of innovation work linked to recruitment challenges in the nursing side, through joint training for nursing managers and HR staff recruiting nurses. Karolinska participates in the development of **Healthcare Transformation Academy**, a European Academy of Education initiated by university hospitals and partners. The academy will train health and medical staff in transformative abilities such as innovation management, leadership development, value in care, digital transformation and precision medicine. The educations are tailored based on needs. HTA works on the premise that the healthcare as we know it will need to be transformed to meet the challenges of the future. To succeed in this, employees need to be equipped with abilities in addition to those provided by traditional education. The project is part of the European University Hospital Alliance, EUHA, and is funded by EIT Health.

10. ESTABLISHING A NORDIC COALITION OF INNOVATION

Following the masterclass on "Building Nordic Hospital Innovation Models" and the network that was established among the participants, Innovation Centre Denmark in Tel Aviv recommends continued collaboration between hospitals and industry on the establishment of Nordic hospital innovation through a Nordic Coalition of Innovation.

The purpose of the coalition would be:

1. Creating one voice and joint effort across the Nordic hospitals and industry to eliminate barriers, create a Nordic narrative of health innovation and establish a strong mandate for driving Nordic innovation.

2. Building capabilities in establishing a joint innovation culture across Nordic hospitals, joint programs for competence development of healthcare professionals, joint frameworks for data application and joint funding schemes, such as a Nordic hospital VC, as well as a regional, national or Nordic commercialisation unit and Nordic framework for income generating.

3. Establishing a joint alliance for public-private partnerships and international partnerships.

As the Nordic hospitals are in the same stage of developing innovation initiatives, there is an opportunity to create synergies, strengthened collaboration and impact across the Nordic countries.

11. NEXT STEPS

In order to expand the established Danish-Swedish network and assist with the acceleration of Nordic hospital innovation, public-private partnerships and international collaborations between Danish, Swedish, Norwegian and Israeli stakeholders, Innovation Centre Denmark in Tel Aviv, University Hospital of Copenhagen and Region Halland, in collaboration with Nordic and Israeli partners, will:

a. Run **workshops** in 2022 on creating a joint narrative, a joint mandate and a stronger hospital-industry collaboration.

b. Establish an **international entrepreneurship academy** in 2022-25 for healthcare professionals in Sweden, Denmark, Norway and Israel. The academy will provide training modules for healthcare professionals in entrepreneurship, innovation, idea formation, validation, scaling and commercialisation in order to strengthen their competencies and skills in translating ideas and needs into scalable health solutions. The initiative will build upon the innovation program being established by the university hospitals of Copenhagen and Aarhus.

c. Establish an **international hospital and industry alliance** in 2022-25. The alliance will create a sustainable and continuous platform for increasing hospital-to-hospital and hospital-to-industry collaboration around innovation, development and commercialisation of new cutting-edge healthcare technologies. Through the platform, partners will be able to share needs, ideas and resources and industry will have smoother access to international hospital partners. The partnerships provide access to international technology development, testing, validation, data application and attracting investments.

Nordic health innovation stakeholders are invited to become part of the Nordic health innovation network and participate in the joint initiatives.

12. CONCLUSION

Nordic hospitals are developing into an essential vehicle for advancing Nordic health innovation and the development of cutting-edge and crucial technologies and health solutions. In order to meet the future demands for health innovation, Nordic hospitals are currently strengthening and expanding their innovation models and strategies for internal innovation, commercialisation and external innovation. Israel serves as a key inspiration in building hospital innovation models as Israeli hospitals have years of experience in driving innovation, well-developed innovation setups, impressive results and are operating in a healthcare system similar to the Nordic system.

The Israeli hospital innovation models consist of five main building blocks: 1) infrastructure 2) People 3) open innovation 4) partnerships 5) capital.

In working with the building blocks to establish Nordic innovation models, Danish and Swedish hospitals, industry and regions have identified a number of challenges that need to be managed and a number of keys for success that need to be fostered in order for Nordic hospital innovation to accelerate and advance to its full capacity. These include 1) clarification of the purpose of hospital innovation, particularly in relation to external collaborations and the need of industry to scale solutions 2) clear role and functions of management in driving innovation 3) obtaining a political mandate for innovation 4) creating a culture of innovation with appropriate incentives 5) establishing a sustainable model through income, investments or other means of funding 6) strengthening hospital-industry collaborations that meet the needs of both hospitals and industry 7) enabling hospitals to gain and provide data access as data owner.

It is important that Nordic politicians, authorities and regions provide support, infrastructure and framework for Nordic hospitals to prioritize innovation alongside other key functions, generate income, open doors to industry and other stakeholders, and provide access to protected health data. Israeli hospitals may provide valuable knowledge and potential solutions for these challenges.

As the Nordic hospitals are currently in the same stage of developing and accelerating innovation models, it may be beneficial for hospitals to join forces in finding solutions for overcoming challenges, promoting keys for success and establishing a joint Nordic hospital innovation setup. This will allow for smoother interregional and international collaborations across hospitals and ecosystems, stronger public-private partnerships, increased competitiveness of Nordic solutions and harnessing of resource synergies. A Nordic coalition of innovation would encompass 1) creating one voice and joint effort in eliminating the barriers and establishing a Nordic narrative and branding 2) establishing joint capacities building in training programs, culture of innovation, data access and funding 3) engaging in

joint collaborations with the ecosystem and with international stakeholders as a strong Nordic unit.

As the foundation for Nordic hospital innovation and Nordic health innovation is in place, the Nordic ecosystem, in collaboration with Innovation Centre Denmark in Tel Aviv, will increase the focus on interregional and international collaborations and work towards establishing an international entrepreneurship academy for training healthcare professionals in innovation and entrepreneurship. The partners will also build an international hospital and industry alliance for smoother facilitation of research and innovation with partners in Denmark, Sweden, Norway, Israel and the US. Nordic ecosystem stakeholders are invited to join these initiatives.

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Innovation Centre Denmark is a part of the Ministry of Foreign Affairs, and co-created with the Ministry of Science and Higher Education. It is the official innovation arm of the Danish government. *Innovation Centre Denmark* is located in eight global innovation hubs: Tel Aviv, Boston, Silicon Valley, Munich, Bangalore, Shanghai, Seoul and Sao Paolo. *Innovation Centre Denmark* advises and assists Danish companies, public sector organisations and universities in their innovation activities and internationalisation process according to the vision: Creating Value All the Way. Our work always follows specific procedures and quality guidelines.

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