



New Karolinska Solna University Hospital – Goals and Operational Focus

Report from the NKS Administration, March 2011



New Karolinska Solna – Goals and Operational Focus

The New Karolinska University Hospital report - *Goals and operational focus released in March 2011* is a summary of the progress to date of the work relating to future medical operations at the new University Hospital. It is designed to support the process and decisions relating to future of the healthcare system and infrastructure. This report was prepared by the NKS Administration under the leadership of Managing Director Professor Lennart Persson, Medical Director Annelie Liljegren, Medical Director Erland Löfberg and Medical Chief Executive Claes-Roland Martling, in close cooperation with Vice-President Professor Jan Andersson, Dean Professor Martin Ingvar, Professor Jorgen Nordstrom and Director Rune Fransson, at the Karolinska Institutet. Acting on behalf of the NKS Administration's Medical Advisory Board have been Senior Physician Associate Professor Hans Hägglund, Senior Physician MD Sofia Ernestam, Senior Physician Associate Professor Per Tornvall, Senior Physician Associate Professor Magnus Andersson, Deputy Senior Physician MD Alexander Ahlberg and specialist MD Charlotte Bieneck Haglind. About 70 doctors and other staff from the Karolinska University Hospital and other general hospitals in the Stockholm region have also contributed. Union representatives nominated by the Central Liaison Group (CSG) have been informed throughout the investigation.



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1. Executive Summary

The New Karolinska Solna University Hospital (NKS) is one of the biggest investments in the future ever made by the Swedish healthcare system. The vision is that the NKS will be a University Hospital of excellence at the heart of one of the world's leading areas within *life science*, i.e. research, development and innovation in pharmaceuticals, biomedicine, biotechnology and medical technology.

Stockholm County Council has, as a result of the NKS, a unique opportunity to further improve the healthcare services for seriously ill patients in the Stockholm region while improving collaboration and interchange between healthcare, research and education. The facilities with its general design, single rooms for all inpatients, short distances, good logistics and immediate proximity to the Karolinska Institute, create very good conditions for a University Hospital of excellence.

The County Council has directly or indirectly as the result of various decisions over the last decade touched on the NKS mission and operational content and these decisions have formed the basis for determining the size and physical layout of the hospital. It is clear from these decisions that NKS will focus on highly specialized and specialized care and will operate a less extensive basic health care program than is the case at the Karolinska Solna today. The analyses that have now been made have proved that the county's highly specialized care can be accommodated within the NKS.

By concentrating rare and complex medical diseases, better treatment outcomes and improved survival for patients with such conditions will result. Concentrating highly specialized care will put the NKS in the position to be the county's *last resort care* for patients suffering from complex and uncertain conditions where multidisciplinary clinical and academic expertise is essential.

The physical capacity of the NKS is approximately 600 inpatient beds, approximately 100 daycare places, 100 places in a patient hotel and 35 operating rooms. The turnaround capacity regarding inpatients is expected to be lower than that of the Karolinska University Hospital while the number of operations performed and the number of outpatients received is expected to be on the same scale as now.

The report proposes, in brief, the following focus on activities for NKS:

- An increased concentration of highly specialized care in the NKS Stockholm County, while the University's healthcare as a whole is spread out over several hospitals and units.
- A specialized acute service focusing on the most seriously ill and injured patients throughout the county, where even a certain amount of patients requiring basic health care may be cared for by the emergency services.
- A thematically organized patient care, based on patients' needs, perspectives and participation.

The care of patients in the NKS, proposed in line with the County Council's previous decisions and inspired by models abroad, such as the Cleveland Clinic, Cleveland (USA) and Imperial College, London (UK), is based on a number of themes (six) which are driven by the needs of patients and disease states.

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These themes have formed the basis of the work for the physical planning of the hospital and are fundamental for the location of various activities (such as surgery and intensive care) within the facility. The division into themes rings very well with the Karolinska Institute's future plans.

These six themes are:

1. *Children.* Children are an obvious theme for a highly specialized University Hospital particularly as there are many rare and complex diseases in children. At the NKS there should be a complete "Children's Hospital" with a smaller basic case unit than that of Astrid Lindgren's Children's Hospital (ALB) has today. Approximately 20% of inpatient resources at the NKS are expected to be allocated to children's healthcare
2. *Cancer.* Cancer is a highly complex and life-threatening disease, which places particular demand on a multi-professional approach. Our ambition is that an all encompassing *Comprehensive Cancer Center* should be established at the NKS, which is estimated to require about 30% of the hospital's healthcare capacity.
3. *Cardiovascular.* This theme is dominated by acute diagnosis and treatment of severe cardiovascular diseases requiring a great amount of resources including intensive care and it is estimated that about 15% of the hospital's healthcare capacity will be needed.
4. *Inflammation.* This theme has common mechanism as a starting point – inflammation – which leads to diseases in various parts of the body, such as the skin, joints, kidneys and lungs. The treatment of various diseases is similar and multidisciplinary collaboration is therefore essential for the treatment of patients and for the transfer of knowledge within the theme. The inflammation theme will exist mainly as outpatient care, although inpatient care is expected to be around 5%.
5. *Neuro.* Neurophysiology, neurosurgery, neurology and neuroradiology are central elements to this theme. Among other things, the more time-critical and advanced treatment of stroke will be located here. The theme is expected to require about 10% of the hospital's healthcare capacity.
6. *Regenerative medicine.* This theme provides care designed to repair or replace damaged organs and tissues. Contained within this theme is the expectation that the NKS will act as a reference center for really serious accidents, that is, major traumas, within the entire Stockholm region (Mälardalen). The theme is expected to require about 20% of the NKS healthcare capacity.

The main reason for building the NKS next to the Karolinska Institute campus in Solna is to facilitate collaboration between research & development, education and care. Within this context it should be noted that approximately 45% of Sweden's academic medical research is conducted in the Stockholm region and that more than 60% of Sweden's pharmaceutical and healthcare industries (*life sciences*) can also be found in this region. The Karolinska Institute, together with the Stockholm County Council form Sweden's largest educational entity within the healthcare service.

The NKS and the Karolinska Institute will be the driving force for development of the entire life science venture

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in Hagastaden (formerly Karolinska North Station area). Life science is one of the big global areas of the future and ultimately the NKS is also about creating opportunities for new, sustainable jobs in the region. The total investment made in the area by the County Council, Stockholm City, Solna City, the Karolinska Institute among others, amounts to around 50 billion SEK. It is also likely that over time, the Uppsala region will form part of the venture.

The procurement of the new hospital facility was an important step towards realizing the vision for the new university hospital, but much work remains. To achieve excellence clear determination is required. In addition, close collaboration with the Karolinska Institute, great determination and considerable efforts over the next ten years, will be required to realize the vision. It should be noted that competition for excellence, research resources and investments intensify when "new countries" in Asia and South American rapidly and in a goal directed manner move to the forefront within healthcare, research, medical technology, pharmaceuticals, etc.

2. Introduction

The County Council of Stockholm has decided to build a new university hospital in Solna, just off the Karolinska Institute campus, a decisive step to strengthen and maintain Stockholm's leadership role in the long term within healthcare, medical research and training. This requires continued good collaboration with the Karolinska Institute regarding the structure of the facilities and continued and long-term collaboration regarding the planning of the NKS activities.

This report was prepared by NKS administration in close collaboration with the Karolinska Institute. The conclusions reported here are unanimous. Six thematic groups comprising 70 doctors and other staff from the Karolinska University Hospital participated in the preparatory work for this report. The NKS administrative management and the management of the Karolinska University Hospital management together with a joint steering committee have worked on the operational content.

In 2008 and 2010, the County Council made decisions as to the overall operational content of the New University Hospital in Solna. In 2010, the representatives then decided that the NKS healthcare would be conducted in themes. These decisions have guided the general design of the hospital facilities and the detailed design of the premises currently taking place in conjunction with Swedish Hospital Partners AB (SHP). The NKS administration, in line with previous decisions, has carried out a number of calculations and analyses revealing that it is possible to concentrate highly specialized health care within the Stockholm County Council at the new University Hospital in Solna. To achieve the best efficiency from a patient's perspective activities of the new University Hospital should be organized thematically.

The analysis undertaken has revealed that Stockholm's highly specialized care would consume about half of the inpatient resources and less than half of outpatient care at the NKS. This conclusion is based on extensive analytical work whereby the volume of various highly specialized activities, the extent of resources and their relationship with research and education were examined. As various highly specialized and specialized activities are interdependent and also dependent upon different support functions these have been also studied. The analytical work has been performed with the support of McKinsey & Co, and Arthur D Little AB, using quantitative and qualitative analysis and simulations to get an idea as to the scale of the highly specialized care.

Further analysis shows that if advanced specialized care in Stockholm region is included in the calculations, about 80-85% of the NKS capacity will be used. The hospital's remaining capacity can be allocated to specialist care and basic care, which for research and educational purposes are best located at the university hospital, and healthcare requiring extensive investment thus making full use of hospital capacity. Furthermore, it is important that, in consultation with the Karolinska Institute, research intensive is centralized at the NKS. The high technology content and the molecular biology platforms at the NKS will then be used more efficiently.

It should be noted that NKS has great capacity for outpatient care and day care. This is important because an increasing share of the highly specialized care is provided in outpatient care. This trend is expected to continue and may become increasingly important for clinical and patient-oriented research.

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The current activities at Karolinska Solna have also been analyzed to identify basic healthcare that cannot be considered to require the highly specialized university hospital's expertise and resources. Patients requiring basic care should, in principle, be received by other healthcare institutions, which are better equipped for such care and more focused on care and rehabilitation. It is a generally accepted principle that health care is at the lowest effective level of care (LEON). This applies not only from the patient's perspective but also in terms of good management of healthcare resources. Application of the so-called LEON principle is particularly important in the case of highly specialized university hospital health care with its own specialist and resource demanding profile.

The operational content at the new University Hospital in Solna cannot be viewed in isolation but must be seen as part of the entire County Council's medical care, i.e. university hospital and other medical care. Thus, the planning is based on the current health care structure, which means that the university hospital's medical care will be carried out by all medical entities within the County Council, including Karolinska Hospital in Huddinge. It is important to note that the concept of university hospital medical care includes medical care, which regardless of the level of care, is conducted alongside research and teaching. In the case of the NKS, it is proposed that medical care should focus on highly specialized/advanced care, and consequently basic medical care should be on a lower scale than today. This differentiation of medical care is a natural consequence of the decision to build the NKS.

However, it is premature five or six years before the completion of the NKS to attempt to identify the location or dimensions of individual clinics or specialties. There are several reasons for this, medical and technological progress is so rapid that that which is currently considered highly specialized care may be deemed regular specialist care already in 2016-2017. In addition, changes in the structure of health care system in the Stockholm region and the country as a whole may influence the activities of the NKS. Furthermore, scientific achievements, as yet undiscovered, may have a significantly impact on the planning. It is also important to note that the Karolinska University Hospital today is an integrated hospital with highly specialized activities in both Huddinge and Solna. A profiling process of these two entities has been conducted for a considerable period of time and a continued detailed planning concerning the location of various specialties and activities is of importance to the NKS.

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On the other hand, it is important for the County Council's overall planning with respect to the future health care structure and investments in infrastructure to outline activities that are currently regarded as highly specialized medical care, which should be accommodated at the new university hospital, as well as to get an idea of the capacity and the volumes of different types of care that NKS can take care of.

It should be pointed out that it is important that Karolinska Huddinge continue to offer university hospital medical care even in the future, with a sharper focus on the division of medical care into specialist and basic health care. This should allow the Karolinska Institute to conduct undergraduate programs at all levels and to conduct clinical research on common diseases. The NKS administration would also highlight the importance of the County Council's continuing planning of the operational content, organization, information systems, etc. at the NKS in collaboration with the Karolinska Institute in order to increase organizational symmetry between health care and the university.

Activities in the NKS clinical R & D and Education building (research, development and training) should be clearly linked to the NKS medical healthcare task thus enabling clinical researchers and teachers to combine their clinical work with research and teaching. The proposed renovation of Thoracic building and its connection to the existing laboratory block, together with the Karolinska Institute's planned research laboratory, Biomedicum, on Solnavägen, constitute key elements of a world leading university hospital. The R & D and Education building in the NKS and Biomedicum will be coordinated thus optimizing the infrastructure, technological equipment, research excellence and innovation.

To maintain the NKS profile as a highly specialized university hospital with the task to provide extensive regional healthcare, focus on acutely ill patients should also be concentrated on such patients who are in need of NKS collective resources. It would therefore be useful to further investigate the practicalities of treating acutely ill patients primarily arriving by ambulance, special referral or referral through the healthcare information service. The capacity of the NKS emergency department is estimated at up to 60000-70000 visits per year, which means that the emergency clinic will be able to handle more patients than purely so-called "blue light" cases. Specialization also means that the NKS can handle particularly severe emergency cases throughout the county. This is made possible through use of the well-established pre-hospital emergency medical services provided in ambulances, where patients can be diagnosed during transport to ensure the right level of care upon arrival.

In this context it can be noted that the Karolinska Institute is in favor of a reduction in the number of emergency care patients at the NKS compared with Karolinska University Hospital today, as this is in line with a highly specialized university hospital. The Karolinska Institute emphasizes the necessity of access to the flow of emergency patients at the NKS as well as other entities for teaching and research purposes. The flow of both specialized emergencies (at the NKS) and the flow of unselected emergency patients (other enteritis) is of crucial importance for teaching. The Karolinska Institute concludes that NKS organization and management function must be developed in collaboration with the Karolinska Institute in order for the triple mandate, healthcare, research and teaching, to be successful.

3. Background and Previous Decisions

The planning and construction of a new university hospital with a new mission is a comprehensive process that has been going on for a very long time. Below briefly earlier stages in the investigation and the decisions of the Stockholm County Council Board and County Council Delegates took on the new hospital's mission and operational focus.

3:1. Property Development Plan

In 2001, the County Council commissioned a study, which showed that the Karolinska Hospital (KS) was in poor condition at the time and that renovation of the hospital would be very costly and entail significant disruption of the daily activities of the hospital during a long period of renovation.

The County Council thus decided that year to appoint a commission to investigate the possibility of building a new university (LS 0111-0650). The importance of providing an attractive, modern and functional hospital environment for Stockholm area's leading highly specialized care and research in the long-term was pointed out already then. In addition to the provision of medical healthcare, the need for good collaboration not only with the Karolinska Institute, but also other universities and colleges in the Stockholm region was highlighted such that integration of education, research and care would be given the opportunity to develop further.

3:2. SNUS investigation

An investigation into SNUS (Stockholm New University Hospital) was set up in 2001, and a report was submitted to the Stockholm County Council in November 2002. The report concluded that the new hospital must be well adapted to the prerequisites and requirements of medical and technological developments and that the university hospital's operational role and framework is of great importance for the region and for the entire healthcare structure within the County Council. A successful university hospital plays a significant role in strengthening and developing Sweden's competitiveness and attractiveness, primarily within the biomedical and biotechnological fields. The study pointed to a unique role for a university hospital in conducting extensive research and education of the highest quality and suggested that research and education must be carefully balanced with the hospital healthcare mission.

The study suggested that the county's highly specialized care would be concentrated at the new university hospital, partly because it is closely associated with research and education, partly because of the need to amalgamate entities for competence and efficiency purposes. It was suggested that the new university hospital should not offer basic healthcare on a large scale because major investments in advanced expensive equipment or in personnel with specific skills and necessary sub-specializations is difficult to combine with cost-effective care processes within basic healthcare.

3:3. 3S Study

The County Council decided in March 2003 (LS 0201-0049) in accordance with SNUS Committee's proposal to continue investigative work on a new university hospital. The new inquiry, which became known as the 3S study (investigation of Stockholm's healthcare structure) presented a report (LS 0409-1729), in September 2004, with proposals for the new healthcare structure of the Stockholm County Council, and construction of a new university hospital. The County Council Delegates (LS 0502-0309) approved the principles proposed by the 3S Study for the development of the county council's health care structure, in May 2005. At the same time it was decided that plans for a new university hospital would continue.

The County Council Delegates made no decisions regarding the details of operational focus, other than that the highly specialized and specialized care at Astrid Lindgren Children's Hospital would be located at the new hospital. An early decision on this was especially important because a children's perspective had to be given a prominent place in the planning of the new hospital. While special healthcare needs within pediatrics must be met, it was important that the planning covered integration with other functions within the hospital. It was further decided that hand surgery at Södersjukhuset and some of the eye medical care at St Erik's eye hospital should be moved to the new hospital.

3:4. Design Competition

In 2005, the County Council decided to have a design competition for the new University Hospital and the County Council Board held a competition in which the hospital's size, mandate, scope and direction were described. It was apparent that the hospital would be built with a focus on highly specialized and specialized care, and with a smaller proportion of basic healthcare. The winners, appointed in 2006, were the White architects and their proposal of Forum Karolinska, and this proposal formed the basis of the project program approved in 2008 and the hospital procurement that followed.

3:5. Decision to Build the NKS

The County Council Delegates (LS 0710-1039) made the decision on the 8 April 2008 to go ahead with the construction of NKS and on the 10th of June the same year it was decided that the NKS would be procured through public private partnership (LS 0804-0429). The County Council Delegates decided on 8 June 2010 to give the bidders, Skanska Infrastructure Development AB/Innisfree Limited, which formed the company Swedish Hospital, the contract for the PPS task of constructing,

building, organizing and financing the new hospital facilities in Solna, New Karolinska Solna University Hospital (LS 1003-0255).

3:6. Decision on the Operational Content

The County Council's decision concerning the university hospital's mission and operational content which was defined in previous decisions as described above, was confirmed by the Council Delegates in spring 2010 (LS 1003-0255). Briefly, it was decided then that the operational content of the NKS would be planned such that the role of the Karolinska University Hospital in the regional and academic healthcare system would be strengthened, and that activities would be internationally competitive, with the patient perspective and patient safety as the starting point for all activities. Furthermore, the NKS primarily in collaboration with the Karolinska Institute, but also with other universities and colleges in the Stockholm region would contribute in developing a strong integration and collaboration between medical care, education, clinical research and basic research.

The County Council also resolved to adopt, according to the proposed concept, a thematic organization of patient care as a basis for further planning. These themes were: Pediatrics, Cancer, Cardiovascular, Inflammation, Neurological and Regenerative medicine. A number of areas were also proposed, with activities within all the themes, these areas include: anesthesia, intensive care, surgical operations, imaging and functional medicine, laboratory specialties, genomics and proteomics.

4. Highly Specialized Care

In the NKS project, the concept of highly specialized care is of great importance because the County Council's decision from 2001 onwards determined that the new university hospital should preferentially handle high-specialized and specialized care.

4:1. Definition of highly specialized care

There is no clear definition of the concept of highly specialized care. In general terms, the term usually means "a general term for health care that is research based, innovative, modern, investment-backed, or otherwise occupies a prominent position ... and usually with a need for resource concentration" (SoS Ds., 2003:56).

We can thus state that highly specialized care is healthcare that is particularly advanced, research based and investment-backed. In the earlier more descriptive investigation and preparation work on the NKS, the above definition worked well. However, the administration, in the current reporting phase of the preparation work, has seen it necessary to describe highly specialized care in such a way as to give a rough idea of its scope and composition, enabling comparison with estimates of the capacity of the NKS. This has been difficult since it is not possible to retrieve data on highly specialized care directly from the County Council's databases. Indirect methods have therefore been used. The County Council's databases can be used to describe the most advanced care, which then also includes highly specialized care. Using this calculation method, the investigation found that about 17% of the County Council's total number of admissions involves this type of care.

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It should be noted that the "highly specialized/advanced" care involves more care than that which falls within the definition of highly specialized care according to SoS Ds 2003:56.

The NKS administration's definition, like the Ministry of Health and Social Affairs' definition (SoS Ds 2003:56), also describes highly specialized care as "such care that is coordinated with an entity with a healthcare region (regional healthcare) or nationwide (nationwide healthcare) as catchment area, such that high quality care and an economically efficient operation can be ensured". Under such a definition, highly specialized care amounts to approximately 10% of the healthcare costs within a County Council. In this context it should be mentioned that the administration also used the reasoning provided by the Stockholm Medical Council (SMC) that highly specialized care is the healthcare that should be centralized within one healthcare hub in the county.

It is also worth mentioning the state investigation "Region healthcare, the national plan for cooperation in specialized hospital care" (SOU 1958:26), where the link between a hospital and a medical school was established and large catchment areas and regions were created to provide sufficient patients for medical care, medical research and training of physicians in particular. At that time, all specializations were denoted "regional medical care specializations (for example, cardiology, neurosurgery, radiotherapy and thorax surgery) while other specializations were termed county specializations. The report also described intermediate measures. However, it soon became apparent that it would not be possible to categorize all specialties in this way, because regional healthcare also includes a number of activities within the vast majority of specializations. Previously, different terms such as "highly qualified" care and "high quality" care were used, before the concept of highly specialized care was created to describe both direct regional specializations as well as the activities within all specializations, which could be seen as highly specialized and which should accordingly, be centralized in regional hospitals.

4:2. Concentration of highly specialized care at the New Karolinska Solna

It can be concluded from the analysis carried out that the County Council's highly specialized and advanced medical care can be accommodated at the NKS, whatever the definition used. Furthermore, the national and regional healthcare of the Karolinska University Hospital currently offered to patients outside Stockholm County Council and to foreign patients can also be accommodated. It is also important to note that highly specialized care is currently offered at all major hospitals within the County Council, which means that NKS is imperative for the entire County Council. In addition, inpatient facilities will be offered at the NKS not only for regular specialist care/basic healthcare which may be best placed at the new University Hospital for research and/or educational reasons, but also in order to utilize the hospital's overall capacity as efficiently as possible. The extent of this care is dependent, however, on the County Council's capacity to provide aftercare and rehabilitation of these patients at other healthcare centers within the county.

The main arguments for concentrating highly specialized care are well described in the previous ruling by the County Council, but it is worthwhile presenting them again. The new University Hospital in Solna provides a creative environment in Mälardalen for highly specialized care, which facilitates work processes and the hospital's likelihood of success in a growing national and international competitive environment. This paves the way to recuperate the clinical excellence that has dispersed to other parts of the country in recent years. It also enables the Karolinska University Hospital, in close collaboration with the Karolinska Institute, to regain its position as an international leader within highly specialized care.

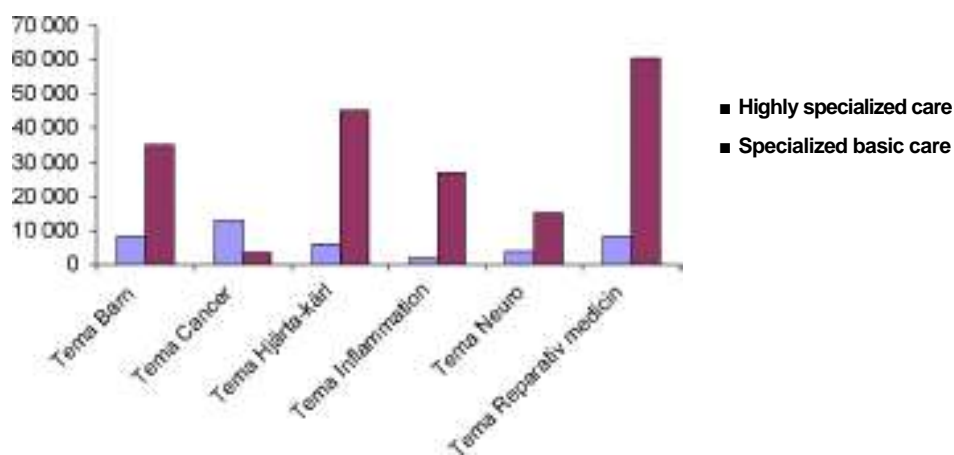
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There is unequivocal evidence that concentrating rare and complex disease states leads to better outcomes and survival for the patients. Serious diseases and injuries require expertise, which is increasingly multidisciplinary and multi-professional, and dedicated resources. It is well known that the concentration of such resources leads to improved quality and patient safety.

Conversely, it is hardly economical to have extensive resources for basic healthcare at a hospital that is best suited for highly specialized and advanced specialized care. There are strong economic reasons to focus on costly, highly specialized care. A concentration of sophisticated medical equipment, other advanced technologies and support functions is advantageous due to obvious economies of scale. Clinical research equipment in close association to patient care is also becoming more expensive and thus it is increasingly important for cost reasons to amalgamate heavily invested research.

It is also important that the county has *last resort care* for patients with particularly complex and uncertain conditions, where there is no obvious diagnosis or therapy and where it is important that the overall clinical and academic expertise provides an opportunity to work together in finding a cure and relief.

Inpatient cases in the County of Stockholm divided by themes in the NKS and between the highly specialized/advanced care and specialized/basic care



Number of inpatient cases in the County of Stockholm in 2009 by theme in the NKS; divided into two groups: highly specialized care/ advanced care or specialized/basic care. Source VAL database 2009, Stockholm County Council.

5. The capacity and design of the NKS

It is difficult to ascertain the medical care capacity of the NKS, partly because the concept of capacity itself is difficult to define, but also the rapid development in healthcare means that diagnosis and treatment could either be simpler or more complex in the future. Traditionally medical care capacity is described primarily in terms of admissions, hospital days, outpatient visits or similar measures. Specific activities, such as number of operations are also used. These concepts are useful in static comparisons, but can easily be misleading when assessing the future. This is because working methods are continually being developed and different approaches: i.e. different number of admissions or hospital days can be used to provided healthcare for a specific disease or a particular medical activity or action. It may be worth mentioning, in this context, that there are interesting initiatives taking place in many parts of the world, especially in the U.S., to evaluate and measure patient benefits of different health interventions, *value-based healthcare*, such that value can be brought to patients in relation to the use of resources, work methods, etc. In such a value-based system, health outcomes achieved are related to the cost of the treatment cycle, not only for individual healthcare cases. The indications are that by the time that the NKS is established, new approaches and new methods will have been developed to measure health outcomes and healthcare production.

Number of inpatient cases within the Stockholm County Council in 2009 split over the different emergency hospitals in Stockholm

	Number of care cases	Number of days of
Karolinska Solna	60 629	246 207
Karolinska Huddinge	43 293	177 600
Södersjukhuset	56 639	200 448
Danderyd Hospital	42 869	156 980
Capio St Görans Hospital	27 409	93 375
Södertälje Hospital	10 891	36 432
Norrtälje Hospital	6 631	24 618
St Erik's Eye Hospital	1 666	3 533
Other clinics	9 893	24 414
Total	259 920	963 607

5:1. The capacity of the NKS

The various tests carried out relating to the capacity of the NKS could be summarized as below. These figures are generally somewhat higher than those reported by the Public Healthcare Services Committee Administration, which made a more cautious assessment. The fact that care at the NKS can be provided more efficiently in facilities that are better adapted to modern methods and care logistics and so on has been taken into account in this report.

- Around 50 000 admissions (+/- 10 %), which is less than at the Karolinska Solna University Hospital today (61 000). This figure is particularly difficult to assess because it is heavily dependent on assumptions about the period of hospitalization, the type of patients, collaboration between health care providers, as well as how outpatient, daycare and inpatient care is used to care for individual patients, etc.

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Around 30,000-32,000 operations, that is somewhat more than at the Karolinska Solna University Hospital today (30,000).

- Around 900,000-1 000,000 outpatient visits, that is roughly the same number as at the Karolinska Solna University Hospital today (around 950,000).

Below are some of the factors that the administration believes are particularly important when comparing the capacity of the NKS and the Karolinska Solna University Hospital of today. In Sweden, not least at the Karolinska University Hospital, where facilities for day surgery are largely absent, there is more inpatient care than other hospitals equipped with day care adapted facilities. The lack of facilities and an organization for daily activities and a patient hotel, leads to a higher number of "admissions" and "overnight stays" than would be the case were these resources placed a day-care adapted environment. This affects among other things, the balance between the number of beds and number of operating rooms.

The trend is toward shorter treatment times even for highly specialized surgery. It is, therefore, believed that the number of operations at the NKS may increase somewhat, while the number of inpatient cases may decrease compared to at the Karolinska Solna today. In the United States, more and more advanced medical care is provided as day care and there is talk that day surgery should be the standard for how surgery should be organized and implemented, with the goal of 70-80% of all surgery being provided as outpatient care, possibly with the following night spent at the patient-hotel. The NKS will have extensive daytime activities and it will also be relatively easy to switch from inpatient care to day activities as and when such care develops.

The fact that NKS has only private rooms, should, given, international experience lead to a higher utilization rate. A conservative estimate of this effect is that the capacity may increase by about five percentage points. Reaching an optimal figure depends on many factors, not least how the emergency department's mission is cut out (the more acute cases, the lower occupancy due to the need for emergency care place).

Another example of how different approaches affect hospital admissions and hospital days and thus resource utilization in general is the so-called "five-day care" (care Monday to Friday, that is, four nights in hospital), which is a relatively common approach to investigations in pediatrics and adult medical care. Access to day care and possibly hotels could replace 5-day treatment to a certain extent. Another problem with the 5-day care is that beds are often empty three days of a 7-day week, leading to low average inpatient occupancy over longer time periods.

With the help of McKinsey, a series of analyses have been carried out showing that about 15% of patients at today's Karolinska University Hospital are cared for more than a week and that they accounted for approximately 50% of care days, in other words, half of the current inpatient capacity at the Karolinska Solna, is used for patients staying more than a week. Another analysis revealed that the patients who received more than 12 days care represented 30% of inpatient capacity at the Karolinska University Hospital. Available healthcare statistics do not permit any detailed analysis of the reason for the long period of care, but one reason may be the time spent waiting for a place within geriatrics, rehabilitation, palliative care or municipality based care. Furthermore, some patients are waiting for support in the home to be organized through home care, or for ASIH

(advanced medical care in the home). Infections as a result of care are a well-known reason for long periods of care. The number of patients with healthcare advice-related infections at the Karolinska Solna is currently about 14%. Several international scientific articles published in recent years have reported that the number of medical care associated infections in patients receiving intensive care is reduced by approximately 50% if care is provided in a private room. The NKS administration has assumed that the medical care associated infections can consequently be reduced if the NKS only has single rooms, reducing treatment time such that around 30-50 beds would be freed for other patients.

The task of the NKS will in the long run, be similar to that of other Swedish university hospitals (regional hospitals), which means that patients no longer needing the highly specialized resources of a university hospital, will in accordance with the LEON-principle be referred to a lower level of care. This will allow an overall better use of a costly and highly specialized teaching hospital. At the same time, more patients will benefit from the hospital's expertise and resources, which would permit the NKS to be a resource for example, the whole of Mälardalen. In practice, the NKS will apply the same principles to the County's residents as the Karolinska University Hospital does today regarding patients from other counties or regions. A large group of patients are currently cared for during a long period of time at Karolinska University Hospital, patients that in other regions would be cared for at the county or county district hospitals.

Sometimes the term "shared care chain" is used to describe care that is shared between two or more hospitals in such a way as suggested above. The idea that such care would be less safe than cases where the patient was cared for in the same hospital has been put forward. There seems to be no empirical studies that support such a hypothesis. Set against this is the successful experience of regional care applied in the rest of Sweden, which means that patients are referred to their local hospital after being cared for at a regional hospital in accordance with the LEON principle. This ensures that a single chain of care can be established for the entire treatment cycle, so that the patient is transferred to a more appropriate level of care, in an organized and safe manner, as soon as he is no longer in need of the highly specialized university hospital's resources. This principle currently applies to the patients outside the Country Council and to foreign patients who are treated at the Karolinska University Hospital, who are sent back to their local hospitals or equivalent, as well as for patients who are returned to Stockholm after care within the realms of national medical care at the university hospitals in Uppsala, Lund and Gothenburg.

A decision regarding the physical capacity was taken after careful analysis of the 3 S-investigation and forms the basis for the building of the hospital facility. The functional capacity can be described as making use of the physical resources, which are largely dependent on the mission of the hospital. It is also important of course, that inpatient care has a high occupancy rate and that admissions are high to optimize the hospital's functional capacity.

5:2. The NKS emergency department

The NKS emergency department is designed for rapid flows of seriously ill or injured patients and has an estimated capacity of 60000-70000 emergency visits per year (children and adults). The emergency departments at the Karolinska University Hospital currently accept approximately 75 000 adults and about 60 000 children per year, of which only about 20% of adults and about 17% of children become inpatients.

Many patients coming to the emergency department require basic health care and would be well taken care of within the walk-in medical care center or other primary care. With the expansion of such resources within the county, the prerequisites for the NKS, with its special character, is to focus on highly specialized care, limiting the number of emergency cases to patients in urgent need of the advanced resources and specific expertise available at the NKS. It is therefore proposed that the planning of the activities of the NKS emergency department should be confined to a limited remit for the entire county's most severely ill patients, that is, those who need immediate and advanced high-specialized care.

It is obviously important that the NKS has a high utilization of its capacity, which is also why basic medical care, to a certain degree, will be taken care of by the emergency department. Directly connected to the emergency unit, there will be facilities that are adequately equipped for a multidisciplinary approach to severe accidents (called a trauma center), acute stroke and heart attacks or other serious disease. The emergency room will be equipped with resources for telemedicine communication with other healthcare entities in other parts of the country providing support. In general, the emergency unit is planned as a natural component of highly specialized health care.

5:3. Adult Intensive Care

Adult Intensive at the NKS, will be a total of 54 rooms (25 sq m) divided into four smaller units that will be coordinated but will have slightly different profiles. This is a slightly higher than currently at the Karolinska Solna University Hospital. Nine special large rooms for special space-consuming intensive care will also be available (35 sq m). These larger rooms can encompass ECMO treatment, thereby increased capacity. The ECMO at the Karolinska University Hospital is already an internationally recognized center where patients are referred from all over Europe. Half of the ECMO activities are dedicated to children including the newborn.

Space dedicated to special space-consuming intensive care will also be used for ordinary intensive care, which means that the NKS will constitute a strengthening of Stockholm's intensive care resources in accordance with the conclusions of the Public Health Services Focus Report from 2003.

Severe accidents (known as traumas) usually require intensive care for a long time. This group of patients is often in need of repeated imaging tests and additional surgery. Therefore, a special intensive-care unit directly adjacent to the trauma unit has been created for this population. Proximity to advanced medical equipment and an adjacent surgical resource were important elements in the planning.

5:4. Surgical Operations

Surgery will be conducted in 35 operating rooms. One of these is located in the maternity ward for urgent caesareans and instrumental delivery at the time of a cesarean. Four rooms will be separately located next to the trauma unit, one of which is an operating room in combination with a radiological laboratory, known a hybrid room. Two additional hybrid rooms will be located adjacent to other surgical and radiology facilities, thus making it physically possible to ensure an intervention center with great impact in the middle of Sweden. Hybrid rooms are likely to

used for more than just radiological intervention, and are thus also designed and equipped for advanced surgery and trauma care. The other 28 rooms, located in six smaller functional units, are designed for elective surgery, where high capacity can be planned. To ensure maximum flexibility and cross-thematic collaboration, the rooms are similarly designed and are all located within the same sterile zone. The number of post-operative rooms is in accordance with the international norm, which provides about two postoperative areas per operating room. Four post-operative rooms are larger and designed for postoperative care (*OIR Overnight intensive recovery*). The postoperative units for adults and children are separated.

The County Council's Operation Investigation in 2006 concluded that the total number of operations and the need for operation time has increased over the past 10 years (1995-2005). A continued increase is assessed as likely partly due to population growth and partly to the medical and technological developments permitting more operations on younger and older patients. The study also revealed that although the need for operation time has increased over time, the number of operating rooms does not need to be greater. Today, there are approximately 42-45 operating rooms at the Karolinska University Hospital, but the reduction entailed by the NKS is unlikely to reduce operational capacity since the room at the NKS can be used, due to the better physical planning of surgeries, logistics and so on.

5:5. Day Surgery

Medical progress indicates that realm of surgery has changed over time. Minimally invasive surgery and interventional radiology is increasing, as is day surgery. So-called short period surgery where the patient is given overnight accommodation after surgery is also increasing. Currently, the proportion of outpatient surgery is relatively low at the university hospitals, but this is expected to increase significantly. For example, the proportion gall bladder operations carried out as day surgery is 11% in Sweden compared to the U.S. where the proportion is 50%. The corresponding figures for anti-reflux surgery (an operation for acid reflux) is 3% in Sweden compared to 31% in the U.S. The number of advanced skill intensive and resource intensive surgical procedures in outpatient or short-term care has also increased. Within blood vessel and thoracic surgery is a significant increase in endovascular surgery (surgery through the blood vessels).

5:6. Maternity Ward

The maternity ward, designed for 3000-4000 births per year and the county's risk deliveries (risk to mother and/or children) is proposed to be concentrated at the NKS. This would enable a viable maternity center that is efficient in terms of personnel and excellence, and also in terms of Research & Development and Education. A highly specialized and nationally prominent intensive care unit for premature and newborn babies with advanced deformities will be available at the NKS. In addition, fetal medicine entities and fertility medicine will be established. Today, around 500-700 pregnancies/deliveries pose risks for children and/or mothers such that they naturally fit within the concept of highly specialized and advanced obstetric care and should be treated at the NKS.

The facility offers a maternity unit with 24 universal rooms. The focus on risk births means that antenatal care will be conducted in these rooms with facilities for shorter or longer periods

(days - months) before birth. It is estimated that about half of the rooms will be used for antenatal care while the other 12 rooms used mainly for normal births with subsequent postnatal maternity care at the hotel. An operating room for immediate Caesarean sections and instrumental delivery during expected cesareans.

5:7. Outpatients

Outpatient care at the NKS will be an important part of highly specialized care and is a necessary component of the patient-related research. The NKS will have compared to today's Karolinska Solna, strengthened outpatient capacity in the form of an increased number of outpatient clinical reception areas and 100 outpatient daycare places. The physical capacity of the NKS facility allows up to 1 million outpatient visits and daycare treatments per year, where the outpatient facilities is used about 12 hours a day throughout the year. It is important to note in this connection that the trend, seen both internationally and nationally, is that even more highly specialized care and clinical research will be carried out as outpatient care. Examples of specialist clinics proposed to be represented at the NKS, and which are strong research areas at the Karolinska Institute, are areas that involve cardiovascular research, obesity, diabetes, neuroscience, pediatrics, rheumatology, infection and cancer.

Skilled, knowledge intensive, research related care is being conducted on an increasing scale even before the patient reached the stage where he or she needs inpatient care. The fact that this works effectively is one of the most important building blocks in the chain of care that will enable the provision of efficient and cost intensive care for serious illnesses. This should be done at an early stage so that patients can maintain and ideally improve their health without having to undergo inpatient care. One consequence of this quest, which is common to the progress of qualified medical care, research and development worldwide, is that increased demands are placed on the diagnosis, treatment and logistics of outpatient care. Conducting outpatient knowledge intensive activities of this kind is thus a key task for a modern highly specialized and research intensive hospital such as the NKS.

The key components within highly specialized and research-intensive outpatient care are:

- Diagnostics using the means of modern biology for diagnosis related to disease mechanisms, not only to clinical symptoms. This requires close access to highly qualified laboratories, imaging equipment (MRI, PET, etc.) and above all a very high level of competence among employees who will interpret the data from these sources in new ways, where diagnosis will lead directly to new kinds of personalized treatments or to participation in clinical trials.
- Treatments are becoming more customized, that is, each patient's diagnosis is identified at the molecular level, providing the basis for selection of treatment. These new individualized therapeutic methods make it possible to quickly, reliably and cost effectively use the many new and expensive drugs which are expected to be introduced in the coming years.

Patients are given the opportunity to take advantage of the latest knowledge in diagnosis and treatment of their disease. The present trend is that patients have more knowledge about their disease and make higher demands than ever before on being able to influence diagnosis and treatment, and having access to expertise.

5:8. Clinical trials

The organizational consequences of these trends are that the level of excellence that patients demand will be dependent entirely upon easy access to research and research based knowledge for both healthcare professionals and patients. Much of the highly specialized and knowledge intensive care will be conducted as outpatient care. This applies to all the intended prioritized operational areas at the NKS, where cancer and inflammation are areas that are particularly fast in rapidly embracing personalized medicine opportunities.

The NKS will be in a good position to conduct clinical trials that constitute an important part of patient oriented, translational research. Clinical trials are carried out partly in collaboration with the pharmaceutical industry and partly in the form of academic study. The development of clinical trials is important for getting more vital information about the properties of different drugs early and for example, the reasons why a tumor disease responds or does not respond to a given treatment. Therefore, the clinical trials unit planned at the NKS will be well coordinated with advanced diagnostic imaging, molecular pathology and biomedical department and of course, pharmacology, proteomics and genomics. Furthermore it will be placed near the intensive care, which is important from the point of view of patient's safety. The GMP laboratory (Good Manufacturing Practice) as envisaged in the R&D and Education building will be an important resource for developing and evaluating new treatments such as stem cell transplantation and gene therapy.

5:9 University Laboratory

Laboratory operations are a central and important function at the NKS. The requirements for the laboratory's planning are such that it must have great breadth, very high knowledge content and extensive flexibility, distinguishing it from a more usual laboratory. Laboratory activities are well integrated in the hospital, which is important for highly specialized care, research, development and education. The NKS University clinical laboratory must therefore be a leader in laboratory medicine through its focus on science, acquiring knowledge and skills. Interaction between the NKS and the Karolinska Institute will be particularly important for the clinical laboratory university, where a bridge will be created between experimental and clinical research acting as a hub for clinical research at the NKS. Advanced laboratory medical services are also a prerequisite for the clinical mission.

The administration proposes that the following activities be included at the laboratory: clinical chemistry, clinical microbiology, clinical immunology and transfusion medicine, clinical pharmacology, clinical pathology and cytology. A Clinical Genetics and Center for Inherited Metabolic Diseases is also proposed at the NKS. The academic integration of laboratory medicine will act as a guarantee of high quality university medical care and enable the progress of the laboratory and

healthcare in a short term as well as in the long term. All samples taken within the NKS, independent the laboratory that supplies them must be as readily available for research purposes. Laboratory medicine is a prerequisite for the ability of the health services to diagnose and monitor various diseases and provide a basis for the choice of treatment. Laboratory medicine includes the analysis of samples as well as consultation, counseling, testing, puncture and patient treatments. The integrated laboratory is characterized by a mainstream of high volumes analyses and strong subject specialties with integrated R&D activities. Communication between the NKS university laboratory and the various care providers includes sample bound diagnostics, treatments, investigations, interpretation & support for decisions, information, education and collaboration between R&D and Education, which together comprise the prerequisites for a patient secure coherent chain of care. In this context it should be mentioned that a special project, "Sample path", conducted jointly with architects and engineers to ensure that the NKS facility will have good logistics regarding transport of different samples from patients for clinical as well as research purposes.

The laboratory's main processes will be integrated to create resource efficient operations. The laboratory will collaborate with the national biobank, and *Science for Life Laboratory (SciLifeLab)* in specific research and development projects. The NKS, through its own laboratory and SciLifeLab, will have access to large-scale analysis of patient samples on, what is for the healthcare services, an entirely new level. Identification of genes and proteins will be possible on an individual level at a realistic financial cost. This will create new opportunities to improve the treatment of individual patients through individualized therapy and studies of various diseases.

5:10. Research and innovation at NKS

In a modern university hospital, the interaction between basic medical research, clinical research and direct patient care, is all the more important. Therefore, it is imperative that more and more cohesive environments are created for the meeting of academic and clinical expertise and the shared use of expensive laboratory equipment. The actual location of the new University Hospital was chosen precisely because of its proximity to the Karolinska Institute campus on the west side of Solnavägen.

The clinical research and training building (R&D and Education building) is strategically located in intermediate care and experimental research (Biomedicum, on the other side of Solnavägen), and will serve as a center for clinical research with direct communication channels above and below ground to both the Hospital and Biomedicum. Most of the R&D and Education building will consist of laboratory space, print locations and conference rooms for clinical research, where research according to the various themes of healthcare at the NKS will be conducted. Through the dense concentration of R&D and Education facilities at the NKS and the KI entities, common "core laboratories" with expensive and sophisticated equipment will be jointly planned and the current duplication and sub optimization of facilities will be avoided. The R&D and Education building has advanced laboratories and equipment for molecular, structural and functional imaging of both humans and laboratory animals including cyclotron, radiochemistry, PET, MRI and MEG. A common biobank on the hospital side for the NKS and the Karolinska Institute is planned. Similarly, a common animal house for experimental research will be built on the campus side. Animals will no longer be kept on the hospital side.

A GMP laboratory will be built in the R&D and Education building, for the development of methods with stem cells and gene therapy.

In this context, Karolinska Institute's own significant initiatives with the already started construction of a new auditorium and a large laboratory (Biomedicum), covering an approximately 75 000 sq m area, physically connecting to the NKS clinical research and teaching building should be emphasized. The new auditorium at the Karolinska Institute will also include a conference center. The Biomedicum laboratory, complete in 2017, will house the Karolinska Institute Solna campus experimental research-research groups and translational research related to NKS activities. In addition, there is Karolinska Institute's venture, along Solnavägen, of the Science Park and a Fitness Health Center. Expertise relating to records research, management of large databases and biostatistics that can be used to develop synergies and improve the quality of health care in the NKS and thus the entire Stockholm County Council.

The Disease Control and the European Centre for Disease Prevention and Control (ECDC) and the establishment of *the Science for Life Laboratory* (SciLifeLab), which will move into the Karolinska Institute Science Park's third major laboratory to be completed in 2013, are located in the immediate vicinity. SciLifeLab is a national high-tech resource center for large-scale research with a focus on biomedicine and systems biology. More in detail, this means a totally unique and large-scale genome and protein profiling, for example, of tissue and blood from specific medical conditions. With the unique visualization and quantification of gene and protein expression and bioinformatics, the Centre can provide a complete analysis chain of complex medical interactions. SciLifeLab Stockholm-Uppsala was formed as a joint venture between the Royal Institute of Technology, Karolinska Institute, Stockholm University and Uppsala University. The University's collective competence forms the building bricks of these knowledge platforms. Methodological development is in an explosive developmental phase, with platforms in genomics, epigenetics, proteomics, image analysis and bioinformatics.

By combining the large and unique patient material collected in biobanks with national data collection from quality registers, research groups within the NKS have the opportunity to engage in top quality international research fundamental for identifying complex disease causes, and developing individualized therapies and new diagnostics. This body of knowledge paves the way for a new industrial development in the country. New and more expensive drugs and treatments are continually being introduced. It is important that testing and implementation occurs in a cost effective and patient-safe way, which is an important and integral task for the new University Hospital in Solna.

5:11. Education

The Karolinska Institute offers Sweden's largest (5500 full time students) and most diverse educational programs (16 initial and 22 postgraduate programs) in medicine and healthcare. The vast majority of the County Council's staff has been or is trained at the Karolinska Institute; the County Council's hospitals and outpatient units are therefore an important arena for professional development for the County Council's employees in healthcare services. Today, more than 1300 students (medical, nursing, physiotherapy and occupational therapy students) go through clinical training at Karolinska Solna. In addition to basic training, comprehensive training (e.g. AT and specialist training of doctors and

specialized training for nurses) and training of medical personnel of all categories is offered.

The new focus with highly specialized care will mean that the educational content of the NKS will be different from that which exists at present Karolinska Solna. It is quite clear that the new health care structure of the NKS will affect the extent and the focus of future training within the county. However, it is important to note that highly specialized care includes many components that also are part of basic healthcare and also some unique components of value for training. Undergraduate courses at NKS will need to be modified and require closer cooperation with other hospital and primary care entities within the County Council and other Universities concerned. This planning must be done in collaboration with the Karolinska Institute.

It should be noted that in planning the teaching facilities at the NKS facility, special attention has been given to modern teaching methods used by the Karolinska Institute (known as Case method), which requires a greater number of small teaching spaces and fewer large lecture halls and classrooms. The special nature of the NKS makes it an obvious choice to invest even more in the specialization mainly of doctors and nurses. Specialist training is an area that is in great need of development and the NKS can play an important role. The NKS Student Centre, in close collaboration with the Karolinska Institute, constitute a unique learning environment where different types of educational facilities, Clinical Knowledge Centre (KTC), The Simulator Center and Library provide opportunities for quality education at both undergraduate and graduate levels.

The Karolinska Institute maintains that the NKS and the other entities within the university health service have a threefold mission - healthcare, teaching and research. To manage this complexity, it is necessary to create good conditions for academic activities and that the medical mission incorporates a clarification of the requirements relating to research and teaching. With the important role the NKS is expected to play in relation to the healthcare provided at the university hospital, it is imperative that the organization and management of activities at the NKS are constituted to ensure that all three tasks are carried out on the best way. It is therefore important to adopt an organizational and management perspective to attain a new way of thinking fairly early on in the planning process.

The healthcare services planned at the NKS - preferably highly specialized and advanced care – need to be carried out in close collaboration between the Karolinska Institute and the NKS, not least to clarify which competencies within the research and teaching field the Karolinska Institute, through its institutions, should place at the NKS. The future planning of the NKS in an organizational sense must therefore include how the Karolinska Institute intends to organize its activities at the NKS, and how best to collaborate with other units within the university health services.

The regional ALF agreement governing the university health services is as follows:

"The parties are in agreement that certain parts of the health services should be designed with particular attention to the needs for research, training and development so as to best support knowledge building and knowledge sharing. Healthcare is denoted as university hospital healthcare. The parties will agree on which aspects of healthcare will comprise university hospital healthcare and formulate the necessary rules for this. The conditions relating to the activities both within the SCC and the Karolinska Institute will thus be regulated. The entities within healthcare, included within university healthcare are covered by the Act (1982:764) on certain positions as physicians at discontinued units, etc., unless the parties otherwise agree. The SCC is prepared to organize and lead the university healthcare services on the basis of this agreement and the directives of the management group will agree on."

The new university hospital with its strong research profile and medical missions, together with the Karolinska Institute, the Royal Institute of Technology and Stockholm University constitute a substantial part of the focus on life sciences around Hagastaden. The link with innovation and business development is important in this context for both Mälardalen and Sweden as a whole. One should also mention the potential for development that the County Council's land and property holdings at current the Karolinska Hospital in Solna constitute.

In summary, the proposal for the new university hospital's mission and operational contents fits well with the vision in the document "Vision 2025", which was developed by the County Council, the County Council Board, Solna, Stockholm, the four universities in the north of Stockholm, and representatives of the pharmaceutical industry a few years ago, which is now being realized with tremendous investment in Stockholm and Solna within the framework for Hagastaden (formerly Karolinska/North Station project).

5:12. IT Architecture at the NKS

With its three-fold mission, highly specialized health care, education and research, the NKS will be dependent on a functioning network for optimal treatment, optimal patient safety, process control and R&D and Education activities. The highly specialized task for the entire county and the goal for the NKS relating to collaboration with other healthcare providers, requires a larger cohesive information system where NKS must be an integral part of the County Council's overall information system.

Greatly enhanced IT infrastructure, with the creation of joint patient chart databases, the possibility for image transfer, and telemedicine conference facilities will lead to greater efficiency and patient safety. The integration with a quality register will create new opportunities to assess the value of treatment to the patient. The transfer of care currently entails patient safety risks due to information being missed in the absence of common database for IT communication.

6. Operational Contents

Modern university medical care requires new models for the organization of patient care to protect the patient's perspective in an increasingly complex healthcare context. This is becoming more multidisciplinary and multi-professional in nature and requires access to increasingly expensive medical equipment, research platforms and inpatient beds. Thematically organized entities are gaining ground in order to meet those needs, replacing traditional clinic structures generally built on medical specialties with solidly associated healthcare resources. Thematic patient healthcare is often organized in a matrix manner in which different specializations and professions cooperate relating to the patient within a theme. Patients needs at different disease stages often require many specialists who in a thematic constellation collaborate in a natural way close to the patient. This not only fulfills patients' needs, but also reinforces the safety of patients where collective expertise is crucial for making correct treatment decisions.

Examples of leading university hospitals that are already engaged in healthcare on the basis of thematic organization, which may serve as examples for the NKS include, in the United States, the Cleveland Clinic in Ohio, Memorial Sloan-Kettering Cancer Center and New York Presbyterians Hospital in New York and Johns Hopkins,

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in Baltimore. In Europe there are also many examples of thematically organized healthcare at Imperial College Healthcare NHS Trust in London and at Leiden University in Holland among others.

It is important to note that a thematic organization of patient care has been the basis for the planning of the NKS e.g. location of various entities, healthcare logistics context, etc. based upon the NKS design being of a strong patient perspective. The NKS will provide many benefits for patients in all themes. Examples of this include private rooms, improved patient flow with short distances to imaging and functional diagnosis, pathology, advanced surgery and intensive care. The design of the NKS building will enable good working conditions for multidisciplinary teams, where the correct diagnosis, appropriate treatment decisions, participation in trials and registration of quality can be achieved in an efficient manner. In this context it should be mentioned that proposals for the themes that should exist at the NKS are based on the County Council's earlier decision from 2005 (3 S), which indicated that the highly specialized care available at the Karolinska Solna should be accommodated at the new University Hospital. A thematic organization of patient care, based on the perspective and the needs of the patient and disease conditions, is imperative for the healthcare organization. The investigative work relating to the thematic structure was based on the assessment of which healthcare, highly specialized/advanced as well as specialized, should be accommodated at the new hospital.

The planning, in accordance with Council's decision, incorporates the following themes: Pediatrics, Cancer, Cardiovascular, Inflammation, Neuro and Regenerative Medicine. Furthermore, a number of medical fields, with operations in all subjects, including anesthesia, intensive care, surgical operations, imaging and functional medicine, and all laboratory specializations were suggested.

Possible volume of highly specialized/advanced care episodes that can be concentrated at the NKS, distributed among themes*

Theme	Number of inpatient cases	Percentage at the NKS
Pediatrics	7 500 - 9 500	Around 20 %
Cancer	11 000 - 14 000	Around 30 %
Cardiovascular	5 500 - 7 000	Around 15 %
Inflammation	1 500 - 2 000	Around 5 %
Neuro	3 500 - 4 500	Around 10 %
Regenerative medicine	7 500 - 9 500	Around 20 %
Total	36 500 - 46 500	

* The overall assessment of several variables (multi-disciplinary care, expensive medicines, technology and research heavy activity, etc.) related to highly specialized care, taking into account the previous studies/reports (3S, long-term investigation, surgical investigation, Stockholm medical advice, etc.).

6:1. Pediatrics

Pediatrics is an important and natural theme for a highly specialized university hospital. At the heart of the medical care is the child's special care needs and a clear trend in recent decades, both Sweden and internationally has been to place pediatrics in larger units, "Children's hospitals," where all the specializations and sub specializations related to children concur around the child. From this perspective, the children's hospital idea can be seen as a model for the thematic organization of patient care at the NKS. There are many rare, serious diseases in children and a concentration of such high specialist healthcare is important from both quality and resource standpoint. In Sweden today there are four major children's hospitals, in addition to Astrid Lindgren's Children's Hospital (ALB) in Stockholm, there is also a children's hospital in Gothenburg, Lund and Uppsala. There is a growing national competition in the highly specialized pediatric care and an increase in national concentration of advanced pediatric care leading to fewer separate entities is a likely prospect. Several areas of pediatric care are now subject to assessment from a national healthcare perspective. It is in this perspective is important that Stockholm has comprehensive and competitive pediatric care with strong links to research in order to compete nationally and internationally.

Nowadays, children with serious illnesses and disabilities often reach adulthood. The transition to adult care is often difficult and cooperation between adult and child specialists is becoming increasingly important. It is therefore important that advanced pediatric care is located close to adult care at the new university hospital and that adult healthcare is invested with well-developed skills and technical resources in the relevant fields of medicine, many of which are highly specialized. Another reason for the close proximity of advanced pediatrics and adult care relates to the care of severely injured children. In such cases where open surgical intervention is required, adult trauma experience is often essential for success. Pediatrics at the new University Hospital should be complete with pediatric skills and sub-specializations in various fields and basic healthcare should be reduced compared to the current acute cases at ALB. At ALB in Solna, there is a local acute clinic currently accepting a large share of less complicated acute ailments, patients are first taken care of at the ALB, where they split among the ALB emergencies (35,000) and local acute clinics (25,000). Of the acute visits to the ALB Solna about 17% lead to admission to hospital. The most common causes of admission are: respiratory problems, fever, nausea only, vomiting, cramps and diarrhea. The administration proposes that emergency pediatrics is redirected towards more advanced care at the NKS and that the easier cases should increasingly be sent to local acute clinics and open specialist care within primary care.

Highly specialized pediatric care will receive increased resources at the NKS compared with currently at the ALB in Solna. A rough estimate shows that pediatrics will take up about 20% of the NKS inpatient resources or around 7500-9500 inpatient cases. Among other things, it has been proposed that neonatal intensive care be increased from 14 to 18 beds, of those 6-9 are needed for births, where 3000-4000 per year are envisaged, of which some will be risk births. In addition, the NKS, and the Karolinska University Hospital today will continue to be a regional center for neonatal intensive care and a national center for highly specialized care for newborns with complex diseases such as rare anomalies in need of neonatal surgery. Pediatric intensive care (BIVA) at the NKS is proposed to increase from 8 to 15 beds compared to today's Karolinska Solna. These will be placed near the eight new child intensive care units planned at the NKS.

6:2. Cancer

Cancer is a complex disease that requires close cooperation between many different professions and specialties. The organization of cancer healthcare has been the subject of numerous investigations both in Sweden and abroad. The investigation of the National Cancer Strategy (SOU 2009:11) proposes among other things a need to develop methods for prevention and early detection of cancer. The study also points out the importance of developing today's organization both in terms of centralized and decentralized cancer care. Furthermore, the importance of strengthening links between basic and clinical cancer research on one hand and the clinical care of the other is pointed out. At the NKS, almost unique conditions can be created to achieve these objectives, and management therefore proposes, as is the case in many other countries, to focus cancer activities at a *Comprehensive Cancer Center* at the new University Hospital.

About 50,000 new cancer cases are diagnosed each year in Sweden and the common cancers are prostate cancer, breast cancer, colon cancer and lung cancer. These four types of tumors account for about half of all cancers. The number of cancer cases in the Stockholm County Council is about 15,000 per year. An analysis of the VAL database showed that in 2009 there were approximately 16,500 inpatient cases in the county treated for cancer (surgery, oncology, pediatric oncology, hematology and stem cell transplantation). For these inpatient cases conducted within the realms of cancer in the County Council, around 11,000-14,000 of care cases relate to highly specialized or specialized care, and should be placed at the NKS, given the hospital's mission. These include 20-30% of the four most common tumor types, breast, colon, prostate and lung cancer, and all other admissions related to cancer, hematological oncology and stem cell transplantation.

Other cases relating to the most frequent tumor types (2,500-4,500 admissions) should be managed by other health care providers in collaboration with the NKS in the future as large number of patients can be cared for outside of the NKS. Given that more and more surgery is performed as day surgery, it is a reasonable assumption that some cancer surgery in the future will be done as day surgery. An example of this is in breast cancer surgery, where it is quite possible that these patients can be cared for in a postoperative unit or the patient hotel overnight after surgery and go home the next day.

An essential task for the Cancer theme is the collection of tumor material and blood samples at all primary diagnostic units and management of multidisciplinary treatment decisions for individual patients. It is of great importance that clinical research is linked with the storage of tumor material and blood samples in the biobank such that these samples are made available for cancer research. Already now, mapping of tumor genetic profiles occurs to tailor cancer treatment. This methodology is developing rapidly and is likely to be routine for all cancers in the future. As the number of cancer cases increases, doubling within the next 10 years, a closely working relationship with all units dealing with cancer is essential. A concentration of cancer care gives rise to obvious advantages in terms of increased patient safety and survival, while the costs can be kept at reasonable levels. The development of new drugs has led to more and more patients living for a longer period of time with cancer, which thus becomes chronic. The continued care of these patients should, according to the administrative management group, be in collaboration with other health care providers in the county, especially using ASIH healthcare (advanced medical care at home) and palliative care.

6:3. Cardiovascular

The cardiovascular theme mainly covers patients with diseases of the chest and the body's major blood vessels. The theme is dominated by acute diagnostic, medical and surgical treatment of cardiovascular diseases. The need for intensive care and intermediary care is prominent, as is the need for imaging and functional medical laboratory with interventional capabilities. Good correlation between surgical and interventional radiological activity is important, as well as critical care resources. Analysis shows that this theme will include approximately 5,500-7,000 inpatient care cases. Highly specialized care within this theme includes thoracic surgery, vascular surgery and advanced cardiology.

In this context, advanced heart failure therapy and other treatments that require complicated electrophysiological and electromechanical devices as well as advanced imaging and functional technologies, such as MUGA, CT, PET and MRI should be mentioned. A strong development of percutaneous interventions (surgical intervention through a blood vessel), for example, heart valve replacement has also been seen. Vascular surgery is becoming more highly specialized because of the increased use of advanced interventional radiological treatment (endovascular surgery), often in combination with open vascular surgery, hybrid procedures. Such operations take place in the treatment of a number of acute and chronic diseases such as large aneurysm of the aorta or in respect of accidents with severe vascular injury with internal bleeding. The NKS facility is designed to effectively provide patient care of the highest quality, through a global environment for complex surgery, interventional therapy and imaging and functional medical diagnostics

6:4. Inflammation

The inflammation theme is based on a common disease mechanism that can affect one or more organs or tissues in the body. Examples of inflammatory diseases are more common diseases such as rheumatoid arthritis, certain chronic intestinal disorders, multiple sclerosis (MS) and several skin diseases, but also less common diseases such as kidney inflammation, inflammatory diseases and certain lung diseases and others. Traditionally, patients with these diseases in a variety of specialties, although patients often have symptoms from several organs and both diagnostics and treatment often coincide. Recent research has led to diagnosis and treatment becoming increasingly sophisticated and complex and thus increasing the importance of bringing together multi-disciplinary expertise relating to the patient, particularly laboratory medical skills. The inflammation area is expected to continue to be a strong research area. Several diseases within the inflammation theme, although they are common diseases, are considered to be highly specialized with respect to the need for multi-disciplinary expertise and advanced diagnostic methods and will primarily be conducted as outpatient and day care. Working closely with primary care is therefore essential. The inflammation theme encompasses around 1,500-2,000 inpatient cases. The Karolinska Institute in Solna, is currently a world leader in inflammation research, and this theme will create good conditions for continued strong health care and research in the inflammation area.

6:5. Neuro

Many of healthcare cases in the Neuro theme consist of highly specialized care. This applies to neurosurgery and neurophysiology as a whole, as well as neuroradiology, both diagnostic and interventional, and parts of neurology. There is now a rapid development of increasingly more advanced treatments for diseases within neurology, such as stroke (stroke), multiple sclerosis, myasthenia gravis, Parkinson's disease and the surgical treatment of epilepsy.

Changes occur rapidly in stroke care and new possibilities for curative treatment are available if medical/interventional treatment is started very early after onset (within hours). The NKS care facility is logistically planned for very efficient execution of diagnostics and treatment of stroke. Based on current knowledge, treatment for patients with suspected stroke should be placed at the NKS for primary diagnosis and treatment, and neurological intensive surveillance for about 12-24 hours, before being sent to another care provider for further care, including secondary preventive measures.

Advanced neurological care occurs increasingly within the realms of specialized neurological intensive care and the NKS administration is proposing that the entire county's neuro-intensive care, with its close links to neurosurgery, be placed at the new university hospital. The Neuro theme has a capacity of about 3,500-4,500 inpatient cases, but neurological care will also take place within other themes, such as pediatrics, cancer and inflammation.

Although the County Council's qualified rehabilitation is located outside the NKS, the administration would like to emphasize the importance of good care chains for rehabilitation of medical and traumatic brain and spinal cord injuries, and other severe illnesses. As the new university hospital will contain the most advanced medical technology and laboratory equipment, etc. this should be accessible to the county's psychiatric and neuro geriatrics entities as a whole. It remains unclear at present as to how this should be done. It is therefore suggested that further investigation needs to be done.

6:6. Regenerative Medicine

The regenerative medicine theme is a generic term for a range of specialties and activities where the purpose is to repair or replace damaged organs or tissues. The theme is multifaceted and encompasses around 7,500-9,500 inpatient cases although there will be additional outpatient care or day care, possibly combined with a stay at the patient hotel. The theme should not be confused with the *Regenerative medicine center*, which the Karolinska Institute and Stockholm County Council are now jointly planning to establish at the University Hospital in Huddinge.

Within this theme there are a range of activities, some of which are mentioned here. Serious accidents, so-called major traumas, are currently cared for at the Karolinska University Hospital and approximately 1,300 major trauma cases are cared for annually. More than 40% of trauma cases require emergency surgery and the NKS care logistics has been planned for this with close proximity to the emergency room and helipad, facilities for advanced diagnostics, and operating rooms with the possibility of angiography and endovascular treatment of internal hemorrhages. The NKS will be able to perform the task of being a reference center for major trauma throughout

Mälardalen and perhaps also for other parts of Sweden. This will take place with the help of advanced telemedicine communication. The administration estimates that the development of traumatology is going towards increased centralization of serious accidents and the NKS will be built to meet this increased demand.

The indications are that further concentration of the Swedish transplant operations could take place over the next decade and the chances are that Stockholm will lose its transplant operations. In Mälardalen, there are currently two transplant centers, the Karolinska Hospital Huddinge and Uppsala. If the enhanced cooperation between the County Councils of Uppsala and Stockholm takes place in the future, a single transplant center should be located at the NKS, thus increasing the chances of maintaining and developing transplant operations in Mälardalen.

Some ophthalmology, ear, nose and throat care, hand surgery and reconstructive plastic surgery, as well as certain highly specialized orthopedics should also tentatively be carried out at the NKS. Major operational activities, much of which is day surgery, will be carried out within this theme. It is important to note that many of these specialist care cases will be carried out within other themes, not least within the pediatrics and the cancer themes.

7. Concluding Reflections

The County Council has in several decisions over the last ten years indicated that the new university hospital's mission is to become a brand new university with a medical mission focusing on highly specialized care and specialized medical care, including care that is research-intensive and investment heavy. The NKS location next to Solnavägen was chosen to further develop cooperation between University Hospital and the Karolinska Institute.

Planning with NKS has involved a very large number of employees, mainly from the Karolinska University Hospital and the Karolinska Institute. The proposals presented here are perceived to have broad support even if differences in individual issues may exist. The Karolinska university hospital leadership has stressed that the implementation of the proposed concentration of highly specialized related care may be problematic and that it is associated with risks. These concerns are of course legitimate, but there remains more than five years before the new hospital is operational and with good planning, thoughtful communication, joint efforts and structured and disciplined implementation, including a detailed risk analysis and risk management, potential problems should be overcome and goals achieved.

By building a new university hospital, Stockholm has a unique opportunity to regain an international position in highly specialized and advanced care and to achieve the vision for the NKS project, that is, *to be a university of excellence at the heart of one of the world's leading life science areas for development in the fields of pharmaceuticals, medical technology, biomedicine and biotechnology.*

The New Karolinska Solna will be a university that puts the patient first, and that faces the future's demands for health care, improved patient safety, and an improved patient involvement in care and with effective treatment flows.

8. GLOSSARY

Antenatal – Before birth

ASIH – Advanced medical care at home

Bioinformatics – collection of blood or tissue and collection of patient charts

CAST – Center for Allogenic Stam Cell Transplants (cells from another donor)

CT - Computer Tomography

Cyclotron – Equipment for the production of radioactive substances

ECMO - Extra Corporeal Membrane Oxygenation, heart-lung machine

Endovascular surgery – surgery through blood vessels

Epigenetics – different gene expressions as a result of environmental impact

R&D and Education - research, development and education

Genomics – identification of genes

GMP - Good Manufacturing Practice, regulations governing the manufacture of substances and drugs

Intermediary care – care in between regular inpatient care and intensive care

Interventional capacity - capacity to perform vascular surgery with radiology technology

Interventional radiology – surgical and medical procedures performed using X-ray technology

Cardiovascular research- research in cardiovascular disease

LEON – Lowest Effective Level of Care

MEG - Magneto Encephalography, (functional examination techniques of the brain)

Minimal invasive Surgery – laparoscopic surgery and arthroscopy

Molecular Biology Platforms – high-tech equipment to map genes and proteins, for example

MR - Magnetic Resonance

Neonatology – neonatal medicine

Pediatrics – the study of child health and disease home in

PET – Positron Emission Tomography, diagnostic method within imaging

Policlinic – transfer to outpatient

Proteomics – the identification of proteins that form in cells under different conditions

Sub Specialization – greater degree of specialization in an area

Translational Research - basic medical research integrated with medical issues where clinical events are translated to molecular mechanisms. By understanding what happens at a molecular level new medicines can be developed.

