

Surgery in Iceland

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Icelandic surgeons provide a wide range of modern surgical services with excellent results. How can a nation of fewer than 300 000 persons accomplish this? The main reasons are a thriving economy, a high standard of living and education, and the training of surgeons. All Icelandic surgeons receive their training overseas, many at university hospitals in the other Nordic countries, particularly Sweden. Others receive training in the United States and Great Britain. Almost 50% of the general and orthopedic surgeons hold PhD degrees from major universities in the Nordic countries. In some other surgical subspecialties, an even greater number possess a PhD degree. This diverse background of training creates a stimulating and international outlook among the surgeons. All types of surgery are performed in Iceland, with the exception of surgery for complicated congenital heart disease and transplantation. Recently a living related renal transplant program was started with promising results.

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HISTORY

According to the Icelandic sagas, the persons caring for the wounded after battle were frequently women. In Snorri Sturluson's *Heimskringla*, a story is told of a female physician taking care of patients with abdominal wounds after a major battle. She gave them onion soup to drink. If she later could smell the onions through the wound, she knew that the weapon had penetrated the gut. Such patients were taken aside to die so that she could better devote her time to others with a more favorable prognosis. Around 1200 a man named Hrafn Sveinbjarnarson became famous in Iceland for his surgical operations, especially those for bladder stones. He came from a line of notable Icelandic physicians and was also unusually well traveled and may have studied at the University of Salerno in Italy. In the eighteenth, nineteenth, and well into the twentieth century, echinococcal disease was more common in Iceland than in any other country in Europe. Many cases are on record in which echinococcal cysts were treated by puncture, cautery, or marsupialization, but laparotomy in the modern sense was probably not done until close to the end of the

nineteenth century. Medical school was established in Iceland in 1876. The teachers were Icelandic physicians educated in Copenhagen, Denmark, since Iceland was at that time under the Danish crown. The University of Iceland was founded in 1911 with 4 faculties (medicine, law, theology, and philosophy). Gudmundur Magnusson, MD, its first professor of surgery (1911-1924), obtained international recognition for his radical operations for echinococcal cysts when he reported 214 operations in a leading German journal, *Archiv fur Klinische Chirurgie*, in 1913.¹ Echinococcal disease has now been eradicated from Iceland, with the last fatal case reported in 1962 and the last known clinical cases in 1989. Operations common today such as appendectomy and cesarean delivery were first done successfully in Iceland in 1901 and 1910, respectively.

ABOUT ICELAND

Iceland is an island in the North Atlantic Ocean about midway between Europe and North America. It is geographically a part of the North Atlantic Ridge. The climate is temperate, with a mean temperature of 10.6°C in July and -0.5°C in January. The size is 104 000 km².

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Figure 1. St Joseph's Hospital, the teaching hospital from the founding of the University of Iceland in 1911 until 1930.



Figure 2. Landspítali, the main teaching hospital since 1930.

Iceland has been an independent republic since 1944. It was settled in the last quarter of the 10th century and the beginning of the 11th century. The settlers came mostly from Norway, although it is thought that they stopped in Ireland and Scotland on their way to Iceland and took some people there as slaves. This has been supported by modern genetic research showing the genetic pool of Icelanders to be a mixture of Nordic and Celtic genes and is also indicated by some local names in Iceland. Icelanders therefore look at their origin as mostly Norwegian but with a blend of Gaelic blood. A republic was founded in Iceland in 930 AD with the governing assembly (called *Althing*) at Thingvellir, a place within an hour's drive of Reykjavik and now a beautiful national park. Iceland became Christian in the year 1000 AD. Slavery was not practiced in Iceland after 1100.

According to a census taken in the year 1096, the population at that time was between 50 000 and 60 000. Because of hard winters, natural disasters, and plagues, it decreased during the coming centuries. After a small-pox epidemic in 1707, Icelanders numbered only about 33 000. Since 1816 the population has been steadily increasing, except for the years 1880-1890, when many people emigrated to North America. At the end of the year 2003, the population was 291 000.

Through the fishing industry, cheap hydroelectric and geothermal energy, aluminum production, tourism, modern technology, and a health care system available to everybody, Icelanders today enjoy a high standard of living and good health. The perinatal mortality rate is the lowest on record and longevity among the very highest.



Figure 3. The Reykjavik City Hospital, which among other activities houses the trauma center for Iceland. It opened in 1967.

HOSPITAL MERGER

When the University of Iceland and its medical school were founded in 1911, a hospital owned by the Catholic Church (St Joseph's Hospital) became the teaching hospital (**Figure 1**). In 1930 the government built a hospital, Landspítali, which since then has been the main teaching hospital (**Figure 2**). In 1967 the City Hospital, owned by the city of Reykjavik, was opened and also became a teaching hospital affiliated with the University of Iceland (**Figure 3**). The City Hospital specialized in trauma from the start. By 2000, all of these hospitals had merged into 1 institution called Landspítali University Hospital, owned and run by the government. The merger provided an opportunity to coordinate the various services and departments. The 3 general surgery departments that once existed have now merged into 1, and the same is true for the orthopedic departments. Special departments exist for pediatric surgery, thoracic and cardiac surgery, urology, plastic and reconstructive surgery, ophthalmologic surgery, otolaryngology, neurosurgery, and vascular surgery. Most of these departments have existed for a long time. The youngest one, the department of vascular surgery, became a special service in January 2000. Within the section of general surgery, subspecialization exists in upper gastrointestinal surgery, colon and rectal surgery, and breast and endocrine surgery. Major operations on the esophagus, pancreas, liver, and rectum are rather uncommon in a small population such as Iceland. To maintain a high standard of care, these operations are performed by just a few surgeons. All hospitals in the country, such as Akureyri Hospital on the north coast, which is the largest outside of Reykjavik, Neskaupstadur Hospital on the east coast, and Isafjordur Hospital in the West Fjords, are owned and run by the government (**Figure 4**).

MEDICAL EDUCATION

Undergraduate

There is 1 medical school in Iceland, and between 30 and 40 candidates graduate each year. Today 44 students are enrolled after a 2-day preadmission test. Medical school

takes 6 years and is similar to medical schools in the other Nordic countries, including both preclinical and clinical subjects. Most students are about 20 years old when they enter medical school. They rotate through the surgical services for 2 weeks in their third year, 6 weeks in their fourth year, and 6 weeks again in their final year. There are similar rotations through the medical services. All students are required to do a research project and present their thesis at a special conference at the end of the third year.

Postgraduate

After graduation, 12 months in a rotating internship are required before getting a medical license. The internship consists of 2 months' rotation in surgery, 4 months in internal medicine, 3 months of family practice, and 3 months in an elective field. All physicians in Iceland have to go abroad for their specialty training. Only the first 2 years of training can be received at home, although the Icelandic authorities recently approved a 3-year program in internal medicine.

Most junior physicians who plan a surgical career spend a year or 2 rotating through the surgical services in Landspítali University Hospital before going abroad. During that time, they learn the basic skills in both open and minimally invasive surgery and learn to treat and manage surgical patients both in the emergency department and in the wards. They also do a 6-month rotation in intensive care and anesthesia. About 60% to 70% of medical graduates from Iceland obtain their specialty training in the other Nordic countries (especially Sweden), 25% to 30% go to the United States, and 5% to 10% go to other countries (especially the United Kingdom). More than 80% of Icelandic physicians return to Iceland after their training. This results in a constant flux of newly trained physicians from both sides of the Atlantic. If physicians have been certified as surgeons in the country where they received their final training (eg, they have passed the American Board of Surgery examination), the Ministry of Health will automatically grant them certification in Iceland. If not, they will have to apply for it and present their credentials. The requirements are similar to what they are in the other Nordic countries.

TRAUMA

There is 1 major trauma center located in Reykjavik as a part of Landspítali University Hospital. Reykjavik, the capital, is situated on the southwest coast of the island. Two thirds of the country's population live in Reykjavik or within a 1-hour drive of the city. The rest of the people are scattered around the coast, mostly in small villages and rural areas. The interior of the country is famous for its untouched natural beauty. Many Icelanders visit the interior in their spare time, as do many of the 300 000 to 400 000 tourists who come to the country every year. At any given time, there are also many fishing boats and other vessels sailing in the North Atlantic Ocean, with Iceland as the nearest land. Many accidents and emergency cases arise in remote places far from Reykjavik, and the trauma service is therefore very dependent on helicopter service. The helicopter trauma service is run by the Icelandic Coast

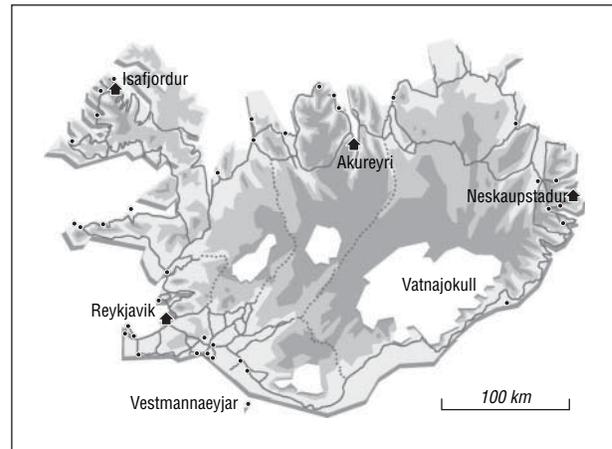


Figure 4. A map of Iceland. Iceland is inhabited only along the coast; 12% of the surface is covered with glaciers, Vatnajökull being the largest one. The arrows show the locations of the hospitals mentioned in the article.

Guard, which can send planes as far out as 290 miles. A physician from Landspítali University Hospital is always a part of the crew. There are also well-equipped voluntary rescue teams in all parts of the country for rescue on land. The helicopter rescue team at the NATO (North Atlantic Treaty Organisation) base in Keflavik has often been of great help in difficult circumstances.

RESEARCH

There is considerable and increasing research activity at Landspítali University Hospital. In 2003, 151 articles were cited in the Institute of Scientific Information database, as compared with 59 articles in 1999. Surgeons are involved in 10% to 12% of this scientific activity. Since 1938, tissue blocks from every surgical specimen as well as from every autopsy have been reserved by the Institute of Pathology at the Landspítali University Hospital. This collection has been the basis for several research projects. Another important source of research data is the Icelandic Cancer Registry, which includes all cancers diagnosed in the country since 1954.

Funding for research comes from a fund run by the Icelandic Centre for Research, which is under the Ministry of Education, Science and Culture, but also from research funds owned and managed by the University of Iceland and Landspítali University Hospital. The annual budget of the hospital also includes some money for research. In addition, there are several other smaller Icelandic funds, and a few research projects have received grants from the European Union and the National Institutes of Health in the United States. When it comes to genetic research, deCODE Genetics, a public biotechnology company with headquarters in Reykjavik, has provided funds to many joint research projects between the company and Landspítali University Hospital and its staff. Early in the last century, scientists realized that Iceland was well suited for genetic research. Over the past few decades, an increasing number of groups are doing genetic research here. This is because the population is relatively homogenous and immigration has been limited because of the isolation of the country through many centuries. Of particular interest is a computerized

database of the genealogy of the entire Icelandic nation going many centuries back in time. Although surgeons have participated in this kind of research, which is aimed at finding disease genes in conditions such as arteriosclerosis or obesity, most research by surgeons is clinical. Every year the Icelandic Surgical Society has a joint meeting with the Icelandic Society of Anaesthesiologists and Intensive Care Physicians. There are opportunities for both young and experienced physicians to present their work. The abstracts are published in the *Icelandic Medical Journal*, a monthly journal written in Icelandic with abstracts of all major articles in English. The journal has been published regularly since 1915 by the Icelandic Medical Association. Outstanding lecturers from abroad are always invited to these meetings.

CANCER

The Icelandic Cancer Society is a nationwide voluntary organization that finances its activities primarily by donations, lottery, sale of remembrance cards, and other fundraising efforts. Another source of income is through an agreement between the health authorities and the Cancer Society, which organizes a Cancer Detection Clinic and carries out a nationwide screening program for cervical (women aged 20-69 years; since 1964) and breast cancer (women aged 40-69 years; since 1987). About 160 new cases of breast cancer are diagnosed per year, of which roughly one third is detected through the screening program. Practically every patient with breast cancer (whether detected by screening or clinically) goes through the Cancer Detection Clinic for a mammogram and needle biopsy before coming to Landspítali University Hospital for further tests and surgery. The Icelandic Cancer Registry, a population-based data bank, is run under the auspices of the Cancer Society. The data bank includes every cancer case diagnosed in the country since 1954. There are about 1000 new cancer cases per year at present, with an annual increase of 1% after correcting for changes in population and age distribution. Since 1954, the incidence of prostate cancer has increased 4-fold and breast cancer 2-fold. Lung cancer has increased 3-fold in men and 4-fold in women. Colon cancer has increased more than 3-fold in men and 2-fold in women. Cancers on the decrease are stomach cancer and cancer of the cervix, the incidence of both being only one third of what it was at the start of the registry. The incidence of skin cancer has doubled during the last 10 years. The Icelandic Cancer Society also runs a Molecular and Cell Biology Laboratory with a main emphasis on breast cancer research. This laboratory played an important role in the discovery of the *BRCA2* breast cancer gene. The Cancer Society also supports a Home Care Service, providing medical and nursing support for patients with cancer in the Reykjavík area who wish to stay at home as long as their condition permits.²

HEALTH CARE FINANCING

Eighty-three percent of the Icelandic health system is financed by the government, either directly from the budget or indirectly through the State Social Security Institute (SSSI). Hospitalization and all in-patient care are free

for Icelandic citizens. The portion of health care services that are not tax financed, making up 17% of the total, is paid for by the patient in the form of partial payments (the SSSI pays the rest) for specialist consultations in the specialist's private clinic, outpatient operations, dental care, and pharmaceuticals. The patient pays fully for many pharmaceuticals and most dental care. Private health insurance hardly exists in Iceland, and there are no private hospitals. The health care system is costly, the total amount being about 10% of the gross domestic product in 2003.³

Surgeons and other physicians are government employees and are on a fixed salary system with compensation for calls. Physicians are considered well paid, with a total income probably in the top 25% of the population, but they work long hours. The general retirement age in Iceland is 67 to 70 years, and this goes for surgeons too. Surgeons are not better paid than other physicians with specialty training. A physician who is fully employed by a hospital gets 2 weeks' leave of absence annually to go abroad for major congresses or other forms of continuing medical education. During that time the physician is on full salary, and travel expenses are paid for by the hospital up to a certain extent. Most fully employed physicians, including surgeons, do not consider it necessary to have malpractice insurance. Many surgeons, on the other hand, are only 80% employed by the hospital and work 1 day a week in their private clinic seeing patients and doing ambulant surgery. The patient and the SSSI then pay them jointly. The surgeons are personally responsible for their private clinics and have to have their own malpractice insurance for that activity. The fee for such insurance is very modest compared with what is common in the United States.

HANDLING OF COMPLAINTS

Patients with surgical complications can apply for compensation through the SSSI's no-fault insurance. For example, patients with infections due to a surgical procedure that keep them away from work may get compensation through this no-fault insurance without going to court. Many complaints are handled in this way, with modest compensations. Patients who are unhappy about their treatment can complain to the surgeon general, who may conduct an inquiry. As a rule, the surgeon general asks a specialty surgeon to review the case on his behalf. Patients may use the case review in their dealings with the hospital. Cases can be settled between hospital and patient. Settlement sums are very modest compared with those in the United States. If a case goes to court, the judge can require a board of impartial specialists, chaired by the surgeon general, to conduct a surgical review. This review is generally in the form of answers to specific questions provided by the court. If requested by one of the parties to a case, the court may appoint a specialist who gives a written expert opinion. In the lower court, assistant judges who may be medical professionals can be appointed by the presiding judge. A minimum of 3 judges review each case that is referred to the Supreme Court. The courts do not permit expert medical witnesses for the defense or prosecution. Lawsuits must be directed against institutions, not physi-

cians, since they are employees. On the other hand, surgeons working in private capacity will themselves be sued. If employed physicians' actions are found negligent, the government or hospital can sue them, but such lawsuits are exceptional. The surgeon general has the power to revoke the licenses of health professionals.

CURRENT STATUS

In Iceland there are waiting lists for certain types of surgery. Today waiting lists exist for eye surgery, tonsillectomies, hip and knee replacements, and major back surgery. There are only normal working lists for other types of elective surgery. The waiting lists have shortened during the last 2 to 3 years, and the aim is to eliminate them completely. All patients with cancer undergo operation within 1 to 3 weeks of their diagnosis. Roughly one half of the admissions to the general surgery wards are on an emergency or urgent basis. Patients with cholelithiasis who seek the emergency department with symptomatic gallstones are as a rule admitted and operated on within 24 to 36 hours. Almost all cholecystectomies and about two thirds of appendectomies are done laparoscopically. Laparoscopic surgery is advanced. Almost all Nissen funduplications, gastrointestinal bypass procedures for morbid obesity, and adrenalectomies are done laparoscopically, as are most splenectomies. Cancer surgery is routinely performed as an open procedure. Esophageal resections are done by the gastrointestinal surgeons. Since we do not have surgical residents beyond the second year, all "major" surgery is performed by experienced surgeons. Interventional radiology is also advanced. The majority of procedures for aortoiliac disease and about 20% of elective procedures for abdominal aortic aneurysm are done through the endovascular route.

Some operations appear to be more frequent in Iceland than in many other countries when presented as a number of procedures per 100 000 inhabitants. Icelandic neurosurgeons, for example, perform about 400 lumbar microdissectomies annually (133 per 100 000 inhabitants); in 1981 they were the first of the Nordic surgeons to start doing dissectomies with the use of the operating microscope. In 2003, the number of coronary artery procedures (percutaneous coronary interventions plus coronary artery surgery) was 806, or 272 per 100 000 inhabitants. For the frequency of some other operations, see the

Table.

FUTURE

The Icelandic surgical training system consists of first- and second-year residents only; senior residents and fellows are missing. Recently, the Icelandic authorities approved 3 years of training in internal medicine; however, there is no intention to prolong surgical training beyond 2 years in Iceland. It is considered important for our junior physicians to train in large academic centers where they will experience more diversity and volume than we can provide here in Iceland. The common labor market in the Nordic countries makes it easy for young Icelandic physicians to continue their training there. The Royal College of Edinburgh (Edinburgh, Scotland) has

Table. Annual Frequency of Some Operative Procedures in Iceland in 2003

Procedure	No. of Patients	No. of Patients per 100 000 Inhabitants
Lumbar microdissectomy	400	133
Laparoscopic Nissen fundoplication	220	73
Laparoscopic gastrointestinal bypass for morbid obesity	100	33
Total hip replacement	300	100
Total knee replacement	400	133
Endovascular surgery*	275	92
Open primary arterial reconstruction	235	78
Percutaneous coronary intervention (85% stents)	624	211
Coronary artery surgery†	182	61
Total open heart surgery	223	78

*Percutaneous transfemoral dilatations, 110; stents and grafts, 115; and thrombolysis, 50.

†On-pump coronary artery bypass grafts, 109; off-pump coronary artery bypass grafts, 34; coronary artery bypass grafts in combination with valve surgery, 39.

undertaken a thorough examination of conditions in Iceland and certified Landspítali University Hospital for basic surgical training, which has opened up possibilities for further training in the United Kingdom. For many years it was possible to take the Foreign Medical Graduate Examination in the Medical Sciences (FMGEMS) annually in Reykjavík. Since 2003, young Icelandic physicians have to go abroad to take this test, making the process more difficult. Passing this test is a prerequisite before getting into a training program in the United States. At present, several promising young Icelandic physicians are doing their surgical training abroad. If most of them return home after training, as their colleagues have done in the past, Iceland will continue to provide excellent surgical care by well-trained surgeons.

Although the merger of the 3 hospitals in Reykjavík has facilitated coordination of services, it is inconvenient to have medical activities spread over 3 separate hospital locations with considerable distances in between. Some of the buildings are also old and in poor condition. The government has therefore recently (in 2005) decided to build a new main hospital for the country, located in Reykjavík. This work is still in the planning stages; construction might start in 2008.

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