



Empathy and high tech

Interim results of the LEV project



REGERINGSKANSLIET

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Introduction: Innovation or provocation

The initial report on Long-term Demand for Welfare Services (LEV) found that the rising health and elder care costs of an ageing population can be paid for if a structured effort to increase productivity is made. While trying to predict the future is always a chancy proposition, one conclusion is fairly indisputable: we cannot produce health and elder care services the way we do now while improving quality, keeping pace with the ageing population and reining in costs.

For the last couple of years, we have been presenting the results of the first LEV report to municipal and county officials, politicians, civil servants and representatives of the various caregiving professions, emphasizing the need to increase productivity in health and elder care. The effort must be pursued at every level. Above all, the relationship between patients/clients and healthcare professionals must change. Because the one thing that we can be fairly certain of is that producing these services in the traditional way is not going to work much longer. The price that patients and clients pay in the form of suffering and inefficient processes is too high. Even from the point of view of the ordinary taxpayer, productivity growth is too slow. Productivity growth refers to patient benefit in the sense of health outcomes per krona spent. A variety of models are needed to spur development and innovation in all of the widely disparate areas of health and elder care services. Some of the current services consist of simple, standardisable processes, such as cataract surgery, which takes less than 30 minutes to perform. Care of chronically ill patients exhibits a different kind of pattern – benefit is generated in a less predictable way, given that access to networks, resources and technology is the key to success. In the case of emergency diagnosis, on the other hand, the focus is on optimizing skills to ensure precision and proper treatment.

A recurring question has been the possible design of a system that would promote productivity and interact with individual patients in a more effective manner. This report seeks to provide one of many possible answers to that question. The report should not be regarded as a vision, a description of a desirable state of affairs – unless somebody specifically wants to. Nor should it be read as a forecast based on scientific methods, which is an apt description of the first report. The only thing that we can be relatively sure about is that anything we say about what things will be like in 2050 is going to be wrong. The report should be viewed instead as a thought experiment and series of observations, a possible source of inspiration for innovation and greater experimentation with alternative means of providing health and elder care services.

It goes without saying that a short treatise on such a complex topic stretching forty years into the future will tend to lack specifics and barely touch upon the real-life problems that arise when such a major, albeit necessary, change is under way. Some readers will no doubt find the report disturbing. It is important to keep in mind, however, that the focus of the report is not the proper way of providing health and elder care services, but the catalysts to which the underlying system is subject.

Also worth remembering is that islands of individuals and organizations have already embarked on new approaches, coupled with thrilling innovations – such a

large system offers a wide variety of attitudes and perspectives. Nevertheless, the brevity of the report requires that such initiatives be treated along with the overall system, which is rarely innovative or amenable to change. We ask for the reader's indulgence in the matter.

A new understanding of health and disease is needed if we are going to meet the challenges posed by health and elder care as we approach 2050. Much of the system must shift its focus from care of the sick to minimizing the risk that disease and disabilities will develop, or at least delay their onset.

The body is made up of complex systems. Disease is a manifestation of imbalance in one or more of the systems. The earlier the imbalances are detected, the easier it is to correct them. Our understanding of these complex systems is far from complete and will remain so in 2050.

Career, family, friends and the community represent another complex system that shapes the health of an individual. For more than one reason, identifying and rectifying imbalances in such systems is even more difficult.

Finally, health and elder care services constitute their own complex system of systems that are readily thrown off balance. Inefficiencies and distorted incentives must be reined in. Monitoring, evaluation, supervision and a culture of continuous learning are required if efficiency is to steadily improve. The unresponsiveness of complex systems to linear measures – rules, guidelines, appointment-based compensation, etc. – must also be acknowledged and understood. The revolution required when it comes to administering and managing health and elder care services is presumably even greater than the changes that many caregivers will face in clinical practice.

Technological progress will serve as the catalyst of innovative health and elder care reforms. Such technology will correct various systematic imbalances in real-time or even before they can occur. Screening and computerized diagnosis will be possible at much shorter intervals than ever before. But health centres and hospitals will not feel an additional burden given that minor maladies will be treated by phone (or the equivalent technology in 2050) and more serious ones will be detected at an early stage when treatment costs and suffering are a fraction of what they would be later on.

Specialist care will continue to evolve rapidly while coordination between clinics and other links in the chain of care will improve dramatically. The findings of translational research will enable the healthcare system to take a holistic approach to patients and their circumstances.

Welfare technology will take over many of the heavy tasks currently performed by elder care personnel. If there are ambitious plans to adopt new, labour saving technology, resources can be set aside for needed empathy instead. The share of tax proceeds that should be earmarked for social contacts will always be a matter of controversy. Construction of social networks among the elderly and activation of those who are still healthy may need greater support. While receiving help may produce a sense of well-being, giving it is even more effective.

Providing stimulation for the various systems of the body is important: muscles through exercise and the brain through intellectual activity. Although the need is particularly pronounced in old age, lack of exercise can cause problems at a much earlier stage. The body thrives on use. Dogs need exercise, as their owners are the first to acknowledge. Meanwhile, a growing percentage of the population is sedentary except when they have absolutely no choice but to get up and move around.

The Swedish health and elder care system is excellent from many points of view, particularly in comparison with other countries. But a long list of improvements is knocking on the door. Many of the tasks that should be institutionalized and computerized are performed manually. As a result, the vital element of empathy is not being prioritized.

The health and elder care systems need more empathy and more high tech.

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Any errors, misconceptions, logical fallacies or invalid conclusions are the responsibility of the authors alone.

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The future is already here – it's just not very evenly distributed

Most of our examples are already around

This report is not a piece of science fiction. In many respects, it takes a conservative approach. Most of the examples we mention have been obtained from the real world. But no system has started to transform its internal processes in the wake of new technologies. American sociologist Benjamin Barber argues that technology is both a catalyst and product of social development. That's why it plays such a central role in the analysis of how various sectors evolve. The bad news is that health and elder care services are fairly low-tech generally speaking. The good news is that they have an almost unlimited potential to be high-tech. Courageous leaders, dynamic professions and supportive systems are needed to unlock and implement that potential. If routines can be institutionalized and computerized, more resources will be available for empathy and for frail patients with more complex problems.

One click of the mouse away from the rest of the world

These days you can do your banking 24 hours a day instead of rushing to get there before the doors slam in your face at 3 pm. You have immediate access to the latest in electronic devices no matter where they have been designed or manufactured. If you can't find them a Swedish store, you can simply order them from somewhere else with a click of the mouse. You don't have to decide exactly where you're going to meet someone until the last minute. Mobile devices are increasingly our window to the world. We keep track of what our friends like and are up to and we know what individual politicians have to say about any number of topics. If your child doesn't show up at school when they're supposed to, the teacher or principal is likely to text you before the day is out.

If you live in the United States, your car can contact paramedics by satellite. Assuming the impact of your collision is above a certain threshold, it reports your exact location that very microsecond. While the rest of the world is living in real-time, it's particularly intriguing to observe how the health and elder care system has managed to preserve its manual/analogue way of doing things.

Higher consumption, lower costs

Will healthcare consumption, measured as the number of examinations and treatments, increase? Probably –and for two reasons: 1) additional and more specialized tests will be available; 2) self-testing will eliminate the patient's greatest cost item under the current system – all the time it takes to make an appointment, get to the clinic, sit in the waiting room and finally undergo the examination. The healthcare system will face dramatically lower costs as well, given that labour is by far the most expensive item under the current arrangement. A win-win situation, in other words.

Better and more frequent screening will enable earlier detection of disease and risk factors. If treatment is also administered by the patient in collaboration with expert systems, marginal costs and morbidity will decline as well. Given that the healthcare system absorbs only one-third of the total cost of illness, the larger community has a lot to gain.

This is the quintessence of productivity growth. You can obtain more of the good or service and pay less all at one time. That's certainly true of food – many fewer working hours go to feeding yourself than was the case just 100 years ago, while you can eat to your heart's content whether or not it is good for you. Not to mention that you have a smorgasbord of dishes old and new from every corner of the world to choose from. So inexpensiveness, quantity, variety and quality can be successfully combined. But a determined effort is required.

Personal responsibility and decentralized health care

Health and elder care services cannot be decentralized in the absence of major systemic changes. Relatives already provide 70% of all elder care. Considering that patients also assume responsibility for much of their own health care, the transition to a new paradigm is not so great from one point of view. But a mental turnaround is needed on the part of the health and elder care systems. Instead of diagnosing and treating patients and clients every time they experience a problem, preparations must be made for jointly exploring the underlying problem and providing active support.

The practice of requiring people with chronic diseases to see a doctor every time their prescription runs out is a good illustration of an inefficient process. Chronic disease is rarely curable. A more productive approach would be to monitor pre-

Examples of what the healthcare winners of tomorrow will do

A number of businesses have already adopted the ways of the future. **23andme** has been offering DNA analyses for the past few years. The benefits for individual customers have been relatively limited. They can find out whether they have elevated risks of developing certain diseases. Most of the time the risks are relatively insignificant – the underlying studies contain very little data. **23andme** worked initially on compiling scientific reports and applying them to the DNA of their customers.

The company's current method focuses more on asking users a series of questions and generating its own research results. 23andme bought curetogether.com, one of the best websites for exchanging experience of symptoms and treatments, in 2012. Along with the combined service, the greatly expanded database will provide new insight into genetically based elevated risks of disease.

patientslikeme.com is another American service at which patients with similar symptoms and medications freely share their experiences. Users can enter hundreds of different kinds of symptoms and therapies. Much of the information is extremely detailed. The company makes no bones about the fact that it sells the information to researchers and others. patientslikeme.com is somewhat of a Facebook site for patients with complex conditions, whether diagnosed or otherwise.

Healthways in the United States takes responsibility for lifestyle changes. The people they take under their wings are to manage their own medication, quit smoking, lose weight or start exercising regularly. Their personal scales and blood pressure cuffs are connected to the system. They text automated questions or words of encouragement. If serious deviations or some other need for contact arises, a nurse phones the patient to motivate them.

Name	Confidence	Risk	Avg. Risk	Comparison to the population
Alzheimer's Disease (APOE4)	99.9%	20.0%	1.0%	4.0x
Alzheimer's Disease (APOE4)	99.9%	10.0%	0.5%	2.0x
Phenylketonuria	99.9%	0.1%	0.0%	1.0x
Phenylketonuria (PKU)	99.9%	0.1%	0.0%	1.0x
Alcoholism (ADH1B)	99.9%	0.1%	0.0%	1.0x
Alcoholism (ADH1B)	99.9%	0.1%	0.0%	1.0x



scription use and screen for other parameters, such as by sending out computerized questionnaires or offering online patient diaries. The data can then be used to offer appointments only when a change appears to be occurring. Type 1 diabetics are a good example. The healthcare system could support them by monitoring when they pick up their insulin prescriptions, digitally recording their blood glucose, and making sure that they regularly measure and have sufficient control of their levels. Such systems could text the patient to remind them to use their meters or encourage them to control their levels more conscientiously. A patient could measure their hba1c (long-term glucose) level four times a year, perform a fundography every other year, monitor their feet, etc. But they would need to see a doctor only if screening revealed an unexpected change. Giving a patient the key to a dialysis unit and letting them use the machine at their convenience is another good example of collaborative healthcare production. The patient would be responsible for all of the preparatory and practical tasks. Such processes are already feasible at the current level of technological progress.

A contemporary “hyperlinked” patient with a chronic disease offers a taste of the future. The patient has a support network consisting of caregivers (doctor, physiotherapist, etc.), Facebook and Twitter, their own blogs, their families, patient organisations, training and virtual patient associations (such as PatientsLikeMe). The patient has multiple channels to the healthcare system and makes their own appointments as needed. A doctor, nurse or mentor can help them mobilize additional resources. A patient who is doing well manages most of their own health care. If their condition deteriorates, the healthcare system automatically assumes more responsibility, and hospitalization is available when serious problems arise. Access to networks, resources and technology optimizes the health benefits that the patient experiences per krona spent. The current emphasis on acute diagnosis and treatment provides no incentives for patient involvement or co-production of healthcare services. The kind of autonomy and collaboration described above cuts costs, creates many opportunities for patient involvement and ensures a high level of patient satisfaction.

Greater co-production for a healthier society and lighter burden on the healthcare system

Given the habit and desire to manage their own services by taking advantage of the technology available from other industries, along with rising disposable income, more traditional health care is now being administered at home by the client themselves. The pharmacies are in the process of launching their new self-testing kits, which is a step in the right direction. While the initial tests will no doubt suffer from both precision and relevance problems, others such as blood glucose meters have long been incorporated into clinical practice. Controversies are certain to arise between patients and the various systems, regulations and healthcare professions. Just like other professionals in similar situations, caregivers will say, “Enormous expertise, training and experience are needed to make this work. It imperils the patient’s safety and legal rights. The lack of financial constraints will cause consump-

tion to rise with no end in sight.” Caregivers will have to let go of their monopoly on data and information and focus on the knowledge and wisdom that is required to provide valuable advice.

Although such objections may be justified at times, they are usually manifestations of insecurity and lack of insight into ways of effectively operating within the new paradigm. The natural human resistance to change must be taken seriously and addressed such that it does not stand in the way. But holding back to assuage such fears is an unacceptable option.

The argument most commonly heard is that the best doctors, when in top form, can perform procedures better, safer and more correctly than a patient who uses the new systems. No doubt that is often the case. The only problem is that the average patient does not see the best doctor in top form. Normally the doctor possesses ordinary skills and is having a typical day. That reality should be the point of departure, not a theoretically optimal situation.

The risk of false positives and associated assessment costs will increase. When that happens, it is important that the systems react quickly and take action (such as contests) to improve biomarkers or devise more complex evaluation algorithms. Offer a million dollars to the person who identifies a better biomarker for the particular indication involved. Considering the costs and suffering associated with false positives, substantial winnings can be offered while ensuring that health care will be better and less expensive.

Computerized decision making for decentralized health care

According to number of studies, people are not particularly good at making decisions. Our brains seem to be wired such that we stop looking for more facts as soon as we come up with a reasonable answer. Despite the high level of safety awareness in the airline industry, three quarters of all incidents are the result of human error. Technical systems account for the rest¹.

Unawareness of the need for improvement

Ninety-seven per cent of American college professors answered in the affirmative when asked whether they belonged to the better half of their profession. Seventy-five per cent of Swedish academicians say the same thing. In a nutshell, people are unaware of their own need for improvement. The problem always lies elsewhere.

A controlled experiment at an American emergency room chose a committee consisting of the best doctors in their disciplines. Their job was to diagnose each patient who arrived. The results were compared with what the emergency room physician came up with. The physician was normally right about 35% of the time. The problem is that the hospital is designed such that people are filtered through the emergency room and assigned to a particular unit along the “right” track. Since most patients were misdiagnosed, however, the system broke down and incorrect treatment was common until the doctors finally got it right.

The next step was to adopt ISABEL, a list-based support system, to help the

physician. With more than 10,000 diagnoses in its database, ISABEL doesn't stop as soon as it finds a reasonable one but asks additional questions to rule out every conceivable alternative. All of a sudden the physician was right 95% of the time. ISABEL currently costs approximately \$75 a month and supports the most common American medical records systems.

Watson makes diagnoses

The best Jeopardy contestant is no longer a human being. Watson, named after IBM's first president, defeated the former national champions in 2010. Jeopardy is a relatively complicated game. A contestant needs not only to be highly knowledgeable, but to work their way through the play on words in which the answer is wrapped in order to formulate the right question. Watson could not be online but was loaded with voluminous reference works, facts, novels and current events. Watson is currently at the Columbia University Medical Center² learning how to make diagnoses on the basis of the way patients describe their symptoms.

Thus systems are already in place that supplement and sometimes improve the diagnoses of which human beings are capable. If Moore's Law is in effect for another 40 years, these systems will have evolved beyond our wildest imagination. Making routine diagnoses does not require a great deal of effort on their part. The model needs to be changed to spur development of automated diagnostic systems and ensure a high level of precision. No incentives for such an improvement currently exist.

Antiquated working methods

Health care is the only industry that sends out notices (appointments, lab and X-ray referrals, etc.) by post to a busy, stressed-out clientele. If you can't make the appointment, you have to wait on the phone for the next available representative to send you a new one, which might be just as inconvenient. If you're one of the lucky ones to receive a hand addressed envelope, you can be sure that a hospital employee spent their valuable time copying the information from a computer screen, printing the referral, going to get it, folding it, putting it in the envelope, sealing it and throwing it into the outbox.

Granted that letters have to be sent to the 10-20% of patients who do not have access to online systems. But the vast majority of cases must be handled differently. Fortunately 90% of Swedish households have access to the Internet. The question is when the health and elder care systems will be fully online. It may not cost so much to post letters in the entire scheme of things, but lack of communication leads to missed appointments, and that can end up costing a lot more. The fact that not even the most elementary step in providing diagnosis and treatment (making the original appointment) has been computerized is a good illustration of the low priority that has been assigned to considering patient-centred health and elder care processes. Relatively healthy taxpayers, who bear the burden of most healthcare costs, have every reason to be outraged by these signs that no progress is being made. At some point things have got to change.

The general population is increasingly well-educated and liable to hold values inimical to blind faith in the authorities. The various “choice” reforms that Sweden has adopted over the past few decades bear witness to that trend. Members of contemporary society place a premium on the ability to choose, above all to reject that which doesn’t fit into their particular lives. Nevertheless, it is wise not to underestimate the complexity of such choices, especially by people who are seriously ill face them. Consumer research has shown that choice can also lead to improvements, provided that an above average or reasonably good default alternative is always available.

For example, assisted living facilities, doctors, physiotherapists, etc., could be listed on the basis of outcome criteria or their ratings in a client survey. The incentive to improve the quality of services provided while satisfying the perceived needs of patients and clients would be considerably stronger.

The technology revolution that is inevitable if the health and elder care systems are going to operate within the financial restraints to which they are subject would be facilitated as well. In the absence of such a revolution, health care will be increasingly the domain of private agreements, leading to higher costs and greater social inequities. The lack of productivity growth also squeezes relative wages in the industry, an unmistakable trend over the past ten years.

Aids and welfare technology

Elder care now has access to a large number of aids, including Phoniro’s automated key management system, which reduces home help service costs by approximately 10% while enabling the night patrol to respond to an alarm much more quickly. Appva recently won the SIQ Quality Innovation of the Year award for a system that relies on easy-to-use IT aids to ensure proper distribution of medication at assisted living facilities.

Innovative aids like Bestic, a robotic feeding device, provides autonomy to users, while Giraff simplifies and speeds up communication between clients, their families and the elder care system. Paro, a Japanese robotic seal, demands attention and activity from the patient in order to supply intellectual stimulation. Reports have maintained that the use of Paro can delay the onset of dementia by a year. Other devices are under development, including Honda’s Asimo, a little humanoid robot that can walk around, go up and down stairs and even run. Asimo is currently able to assist in the distribution of food and medication. Prostheses and exoskeletal machines connected to the brain or nervous system restore a great deal of mobility, increasing autonomy and reducing the need for personnel.

The list goes on and on. Welfare technology is in a vibrant stage of development at the present, and the imagination balks at what it all will lead to by 2050.

Megatrends as catalysts

Competitive intelligence and futurology often refer to megatrends, the major social changes that will transform the world over the next 10-15 years. The various sets of megatrends that have been posited often refer to the same phenomena under somewhat different names. Fighting megatrends is essentially a futile and frustrating battle. A more realistic approach is to ride the wave of megatrends, channel them in desirable directions and divert them from unappealing outcomes. Below is an attempt to list the megatrends that are likely to have a decisive impact on the health and elder care systems.

One frequently cited megatrend that we only touch on is urbanization. The impact on telemedicine, self-care and staffing is obviously significant. The trend will give rise to large regional differences – the parts of the country that are depopulating will have the best and most efficient health and elder care systems in 2050 if they deal wisely with the challenge and focus on progress. They might even be able to hold on to some of the younger generation by offering an attractive combination of intellectually stimulating innovation and experimental projects along with undefiled nature. Due to their younger population and constant access to new inhabitants, the big cities do not have the same imperative for renewal while their monolithic structures suffer from greater inertia. Events will unfold more slowly in the cities, albeit with major differences in health – as well as the quality of care – given that they house the citizens who are most active and have the most abundant resources, who are able to construct their own solutions. Let's hope that the pace of progress picks up.

Demographics and an ageing population

The initial report in the LEV series looked at demographic trends and their likely impact on health, as well as the needs that confront the health and elder care systems. According to the Statistics Sweden population forecast, the life expectancy of a 65-year-old will rise by 2.6 years to 87 in 2050. Although better health will reduce health and elder care costs per capita, the elderly population is set to increase by 30% from 2010 to 2050.

As a result, one-quarter of the population will be 65 or older. The elderly require not only more extensive care, but a level of health services that younger people do not. Meanwhile, the proportion of the working age population will continue to shrink.

Even though health improves at the individual level, care consumption will rise due to the larger percentage of elderly and very old people. The LEV scenarios anticipate that elder care needs will increase by 70% and healthcare needs by 30% for demographic reasons. Adding in the historical goal of 0.8% growth, consumption will be up by approximately 80% by 2050. The proportion of GDP devoted to health and elder care would then rise from the current level of approximately 13% to 16-17%. Such a situation would certainly be manageable – the United States is already there – but it would pose a significant challenge to public policy. Public officials will have to find a way of dealing with the tensions that arise between citizens, patients, clients and healthcare professionals. There is a basic political consensus in Sweden that health and elder care is to be financed by taxes and provided as needed. Our assumption is that no changes will occur in that respect.

Elected officials have essentially three paths to choose from or combine. First, taxes or premiums can be raised. Second patients and clients can learn to live with fewer and poorer services. Third, caregivers can bite the bullet and adopt more efficient working methods.

Ranked by the relative sizes of the three groups, the ultimate combination of measures is fairly easy to foresee.

Progress of knowledge and technology

Health care is largely a matter of managing information. The amount of time spent with patients presumably accounts for a limited number of total working hours. That sets the stage for transforming the industry through the use of leading-edge IT. Right now IT is employed to make existing processes more efficient. As the new era rapidly envelops us, the focus will be on creating processes that can take full advantage of new technologies.

Digital versions of old forms will be replaced by systems that do not require repetition and unnecessary tasks. Key data will be stored such they will be available for analysis and for shaping processes in other segments of the healthcare system.

A large percentage of healthcare cost increases have traditionally stemmed from technological advances and more ambitious goals. The conclusion has often been drawn that technology pushes up costs, which is certainly the case when a technology enables unprecedented methods. But improved technology for the provision of existing services saves money. Laparoscopic surgery offers an excellent illustration. A common observation is that the prices of goods are constantly decreasing, whereas the opposite is true of personal services. Then if you want to relieve cost pressure, you're going to have to replace services with some kind of capital. That's the approach that the agricultural, manufacturing, banking, insurance, etc., industries take. When a service is transformed to a good, cost trends take another turn altogether. This process must accelerate.

Elder care is undergoing a revolution of welfare technology, the most spectacular examples of which are exoskeletal machines and various robotic devices. Given that many countries are in the midst of economic growth and a rapidly increasing elderly population, the trend will become even more pronounced. Progress in the area of medical devices is also easing the pressure on elder care costs. Regenerative care – the restoration or renewal of organs or damaged limbs – is witnessing constant breakthroughs. Mind-controlled prostheses and social robots will ensure greater autonomy without relying on the expensive efforts of personnel.

Everything is online

The exponential growth in IT use over the past sixty years is due to the ability of technological breakthroughs to reach millions of people within a matter of days by means of software updates. Not that things always go all that smoothly, but the difference is enormous when you make a comparison with areas that require physical production and distribution.

The path of development between now and 2050 will be characterized by rapid progress that combines various technological building blocks, such as inexpensive biological sensors and dynamic standards for categorizing and sharing data.

By 2050 all electronic equipment will have some type of radio transmitter or receiver that reports energy consumption if nothing else.

People who like to keep track of their possessions will buy a set of tiny transmitters (smart dust) with which they can be rapidly located.

Medical devices in the home that most people can afford

The long-term assessments of the Ministry of Finance look at income trends.

Assuming positive growth at historically reasonable levels, economic standards will be significantly higher in 2050 than they are today.

If money represents less of a bottleneck for large population groups, households will purchase medical devices not offered by the health and elder care systems. For example, the county pays for a basic hearing aid model and consumers can purchase extra features. Assuming that the basic model offers reasonably good quality, such an approach is consistent with equal access to healthcare services. Important to keep in mind is that technological progress will have a much stronger incentive than if people were prescribed a particular model on the basis of a central administrative decision. While innovation is spurred and individual clients enjoy the benefits of higher quality, excess consumption is minimized in favour of competing needs or the interests of taxpayers.

Acceleration: Faster assessments with private health apps

The acceleration of progress that began with the Industrial Revolution has only intensified with time. People now have more knowledge to cope with, goods and services to produce and consume, possessions to get rid of, information to communicate, objects to transport and people to interact with. The variable is the number of changes that occur per unit of time³. One obvious example is the app market for the Android platform or the app store for iPhones. After only a year or two, people are accosted by a cornucopia of new apps that they never knew they needed. What's so brilliant about it all is the infrastructure that permits just about anybody to develop an app and obtain access to millions of smart phones and tablets around the world – a truly dynamic development.

If the health and elder care systems are open to new devices that ordinary people buy and if a strategy is devised for monitoring their use, new technologies can be evaluated much faster than if a government agency had a monopoly on doing so. New regulations would be needed under which essentially all devices could be connected to the health and elder care systems through open Application Programming Interfaces (APIs)⁴ on the condition of participation in ongoing evaluation and feedback. Users with the desire and financial means to connect their devices would enjoy greater freedom and society as a whole would benefit from the knowledge that was generated – not to mention all the real-time and real world data that manufacturers would obtain

in order to improve their products The responsibility of the central government is to ensure that there is an infrastructure for reporting the results rapidly and automatically while providing consumer subsidies such that better, more secure solutions are favoured and poorer ones are outclassed. Given that all revolutionary developments are powered by data and experimentation, such a strategy would support innovation much more concretely than many others.

Physiotherapy and empathy

The impact of exercise and lifestyle on health is increasingly acknowledged and understood. The relationship of physical and mental wellbeing is undergoing a similar process. Despite exaggerated claims that positive thinking can cure cancer, the relationship is clear and powerful, particularly when it comes to the risk and onset of disease. A safe bet is that lifestyle changes to avoid the need for traditional health care will become much more important. The kind of long-term effort needed will require completely different interfaces between patients and the healthcare system. Continual monitoring, encouragement and motivation will be more essential. Personal, ongoing and empathetic communication will be central. A growing body of evidence points to the effectiveness of psychological methods, and even academic achievement has been shown to be more dependent on interpersonal bonding than the particular used. Attaching major importance to synchronizing contact between individuals and the health or elder care system will be integral to successful prevention.

Production and visits in the home – fewer health centres

Given that patients are able to administer more and more of their own health care at home, on the way to work, and so forth, the need for health centres and for primary care as traditionally structured is declining. The care is needed just as much as ever, but the means by which it is provided are in flux. Health centre personnel report (national data is sorely lacking) that life crises, psychological problems and substance abuse represent a relatively large share of their work. Though quite distinct from that which has traditionally been regarded as the domain of primary health care, such tasks need to be handled better than is currently the case. We propose later on in this report that a mentorship programme be adopted by which people acquire a personal interface with the healthcare system whose basic skills are in the realm of empathy and healing. Their responsibility will include dealing with worry, anxiety and life crises – backed up, of course, by the entire healthcare system. Being specialists in the area, the mentors will be in a better position to address such problems than health centres, whose focus and staffing criteria proceed from the objectives of traditional health care.

In addition to saving money, people will grow accustomed to obtaining health services in the home, administer much of it themselves and receive the assistance of human caregivers on the relatively rare occasion that they are needed. Various kinds of therapy are the most propitious candidates for such an approach, but advanced wound care, certain types of rehabilitation, etc., are also suitable. As mentors concentrate on psychological issues, home or distributed labs perform testing and expert systems

make the majority of routine diagnoses, there will be little need for health centres in their current incarnation. Veterinarians already make home visits, take X-rays, etc. Don't human beings deserve as much? There's no lack of technology.

Rising expectations

Progress in other industries has stemmed from both rising expectations and conscious effort. Films and other new products are released the same day everywhere. Some industries manage to disseminate new technologies instantaneously. As citizens of the out-of-the-way Nordic countries, we expect access to the latest technology, book or consumer product at the same time as everyone else. The one exception is health and elder care, which are subject to long (perhaps longer than ever) lead times before new technologies wind up on your doorstep. Many Swedes subscribe to newsletters from research institutions or patient organizations abroad. We keep track of clinical studies and other information online, finding out about state-of-the-art technologies a couple of years before they hit the Swedish market. For a single industry – particularly the one that deals with life and death issues – to be a technological dinosaur is unsustainable over the long term. The population will eventually revolt. New technologies are often cheaper once all cost factors have been considered, not to mention improved health and fewer adverse effects.

Big data

Processing large quantities of data in a new and efficient manner is decisive to the ability to conduct an ongoing systematic improvement effort. It is also the starting point for a more profound understanding of the ways that the complex systems on which health and elder care are based interact and can be managed.

Citizens want to declare their independence of the healthcare system

Due to trends in all other industries in terms of instant gratification and virtual connection, nobody wants to sit in the waiting room of a healthcare centre along with a bunch of other sick people. It is an ancient institution with painted fibreglass fabric walls where you take a number and wait for your name to be called by a gruff middle-aged woman behind a window. She has no idea how long you will have to wait or even how many doctors happen to be on hand at the moment. Everyone knows that doctors are never on time.

Finally you follow the doctor into her office and explain your problem – let's say you think that you have tonsillitis. "You don't say," the doctor answers, "I guess we'll have to take a little culture, won't we" all of which you already know. Why should you wait an hour to hear platitudes from one of the world's most expensive professionals? But that's only the beginning – now you have to wait for an available laboratory technician, then the results of the test, then for the doctor to find the time to look at them.

The doctor's basic approach is to follow a few simple rules of thumb. When the level of a particular substance in your blood goes above or below a certain point, a prescription is written or discontinued. Many of these processes are uncomplicated and do not require the presence of a doctor. Why can't I swab my own throat, turn the sample in at a kiosk, have the results texted to me and receive a penicillin prescription by post if needed? That's exactly what would have happened if the health centres had seen the light the same way as the banks have.

All industries that have undergone sustained efficiency and quality improvement efforts have used large quantities of data to describe each aspect of the processes and the agents in the systems.

Current regulations and levels of information are holding up progress, perhaps because processing power and statistical methods (image and free text processing, etc.) have not evolved until the last couple of decades. Current attitudes towards information may be easy to grasp from an historical point of view but they are incompatible with the future.

Privacy

Attitudes towards personal privacy are in rapid flux. The practice of sharing relatively personal data in various social networks or otherwise has produced a generation that is taken aback by organizations that lack the structure to present their most important raw material: information. Studies have found that a majority of the population is favourably disposed to joint processing of personal data by government agencies, as well as the health and elder care systems. Meanwhile, the realization is growing that information is not solely a private matter. When it comes to the complex system that health and capabilities represent in the cloth of society, healthcare providers and customs, only a small percentage of information is strictly personal.

Most information emerges in interactions with systems, caregivers or other people. The data, in other words, are under joint custody. Information is used for much more than merely caring for an individual: invoicing routines and automatic appointments in various treatment chains, above all continual evaluation and revision of the methods employed. Most people realize that knowledge can generate real benefit only if everyone contributes to its processing and refinement. A system financed by tax revenues is in particular need of such data.

At the same time, treatment and decision making models are becoming so specific and are based on so many social and biological variables that their particular combination may be unique to the patient in question, which means that individuals have an additional inducement to contribute data on a continual basis. Many people feel that it is unreasonable to base treatment decisions on averages derived from large populations with irrelevant background factors. Realizing that the more precision the better, they enter as much of their personal data as possible.

Given the exponential growth of data that is at hand, certain assumptions – particularly those that concern personal privacy – need to be re-examined. For example, no distinction is currently made between information that is processed by computers only and that which is accessible by human beings. The actual accumulation of data is regarded as sensitive. If that attitude towards information were to persist, it would probably be impossible to bring about a dynamic transformation of the health and elder care systems. Systematic development always requires data.

Nevertheless, current regulations assume that researchers first formulate a hypothesis, followed by applications for funding, approval by an ethics committee and finally data from the agency in charge. The process normally takes months, even years

sometimes. While such research will continue, a growing trend is exploratory data analysis, such as cluster analysis or data mining. The systems identify correlations that had not even signalled the need for an hypothesis earlier. Furthermore, artificial intelligence systems enable ongoing research and improvement efforts. Such teachable systems constantly find new correlations and change the advice they dispense as they are fed new data.

These capabilities will provide one of the most important platforms for a whole new level of dynamic development. Based on such mechanisms, new methods, substances and working methods can be permitted without being preceded by a great deal of human labour. Evaluations are performed on a continual basis, enabling the systems to sound an alarm if security, quality or efficiency are in danger.

Information processing as currently constituted also leaves a great deal to be desired in other areas of personal privacy. Because medical records are often written as free text, a person who is authorized to access the system can scroll through documents and see information that does not belong to the chain of care in question. Better systems that keep track of the care process can filter out irrelevant information. As a result, relevant information at the end of the document that may be important but is easily missed becomes more prominent.

The minority of patients who want their data deleted pose a dilemma given that the data are also owned by the producer, not to mention the interest of the general public in ensuring that the monitoring and efficiency effort can be reviewed and improved upon. Thus, it is far from obvious that deletion of data can be permitted without further ado. Perhaps deletion of search words could be permitted instead – an individual's interactions with the healthcare system would not be available, but a doctor could see that a consultation or appointment had taken place.

New working methods are emerging despite antiquated structures

The growth and development of an industry is increasingly a result of external innovations. The music industry was definitely not behind the transition to digital downloads and was unable to influence its direction. External forces were too powerful.

Similarly we believe that consumers of health and elder care will lead the way to a growing number of diagnoses and treatment methods outside of the formal system. Already an abundance of online products are available for people who are interested in health and fitness.

Other than as part of an occasional study, the healthcare system is not accessible by patients or their devices. However, a promising platform is in the making in connection with the health accounts that the government infrastructure authority will be launching within the next couple of years. The idea is that private data can be exchanged with data from the healthcare system. Given that the interfaces will be simple and open, the private apps will presumably be located earlier in the queue than the healthcare system. A wave of innovation may be activated as a result.

But the infrastructure and culture of the prevailing system is closed in many non-technical ways as well. Patients who are knowledgeable and interested in their

care are regarded as troublemakers and the regulations are not amenable to decentralized decision making. Established collaboration among the various providers, often within a particular provider as well, is conspicuous by its absence. The various professions have completely different working methods and are off on their own tangents. Compensation schemes favour as many appointments as possible, as opposed to the promotion of systems for automated and co-produced health care.

Industries that have undergone changes

Banking

A number of industries have undergone comprehensive changes over the past 15 years. Take banking for example. The switch from paying bills at branches to reliance on the Internet has gone faster than most people could have imagined.

Most banks have benefited from the changes – some banks with inflexible computer systems have had trouble keeping up with the emergence of new services. To start off with, the benefit for customers was far from obvious. Long, tricky OCR codes and poorly designed user interfaces minimized the time savings. Thanks largely to electronic invoices and banking apps in smart phones, online banking has become indispensable as processes and technology matured.

Nobody in the banking industry questions that complete data about a customer should be accessible from one and the same interface. Expert systems are used nearly every time for more difficult decisions, such as credit assessments.

The better the online banks get, the fewer people turn up at the branches. Those that do who up expect fast service.

Telecommunications

The telecom industry has also undergone enormous, occasionally unanticipated, changes. Before the 1980s it was illegal to use a telephone from a company other than the Swedish Telecommunications Administration. Deregulation of land lines and subsequently of mobile telephony has served as a model for many similar efforts (with greater or lesser success) in other industries.

As other technologies were built in, mobile telephones improved at an exponential rate. Each new generation of mobile phones has made other equipment and appliances obsolete: wristwatches, alarm clocks, radios, typewriters and much else.

The role of the central government in the telecom industry has been to set standards and auction off licences. The industry has become modularized and many components are public property. A provider can choose the suppliers that suit it best, most everything is compatible because standards are complied with, and there are relatively few well-defined interfaces between the various parts.

We anticipate similar trends for the healthcare system. Old structures (some of which are analogous to Telecommunications Administration phones) must be called into question. Modularize IT systems. Give patients the opportunity to administer much of their own care.

A glance at what the future may hold in store

Health care

Due to technological breakthroughs and comprehensive organizational advances, the health and elder care systems have experienced just as extensive changes as many other areas of society. The transition from storage of data on paper and isolated computer systems to structured information systems that help users with every task they perform has led to major efficiency strides.

Nevertheless, the health and elder care systems are under greater pressure than ever, particularly in relation to the rapidly growing elderly population. Such services are also subject to rising expectations.

The two biggest changes that have occurred in the area of health care are new technologies that enable earlier intervention to correct imbalances in the body that lead to disease and a holistic approach that mandates a more active role in persuading risk groups to modify their lifestyles.

Instead of going immediately to a health centre, people will start off by self-testing in the comfort of their own home and obtaining an online diagnosis. If the diagnosis is ambiguous or requires additional assessment, the person can get in touch with their healthcare contact (usually a mentor under the new plan) and review the various treatment options.

Healthcare providers that make themselves available to patients online are often in rural areas. Once communication has been established, an attempt is made to match the patient with a healthcare contact on the basis of personality type and clinical picture. Emphasis is placed on easy social interaction. The patient can continually evaluate how well the relationship is working and switch contacts if they feel the need.

Patients whose health problems cannot be resolved virtually at home are visited by healthcare personnel or go to the local emergency room if a serious situation arises.

Complete medical records

The healthcare contact always has access to complete, relevant medical records. The contact is only able to see data applicable to the particular position in the current chain of care. Medical records bear little resemblance to the documents that previously went under that name. Now they are a collection of data and a model of the patient in combination with all the various health and elder care processes. Information about lifestyle, career, social networks and disposition are also included, as well as psychological profiles and preferences when it comes to interactions, food and contacts with the healthcare system. The records can no longer be “read” or “written” in. The function of the records is to generate the information that is most suitable at the moment or to contain analytical tools that simulate the outcomes of specific treatment strategies. The patient and administrative staff devote a minimal amount of time to administration. Because most people have agreed to open their digital calendars to the healthcare systems, appointments are rescheduled automatically at the patient’s request.



The average patient is active, knowledgeable and health conscious. Detailed and relatively easy-to-understand information is made available to everyone free of charge. Health and disease information is presented such that the circumstances of the patient and their family are taken into consideration. Both the diseases that have occurred in the family and their DNA are included.

The expert systems of healthcare providers and the electronic health apps of the general public acquire greater precision the more data they are fed. Information from the user's sensors is merged with data from the formal healthcare system. Diet, DNA, the medical histories of the patient's parents – they are all pieces of the puzzle. The more pieces, the greater the precision.

Many patients take advantage of this detailed information to stay healthy and avoid unnecessary risks.

The biggest innovation is the increase in the number of screenings to manage the risk of disease and disability. The appropriate screenings are determined by an expert system that considers the patient's medical history, behaviour patterns, genetic makeup and environment.

Screening at home

While some screenings are still performed by hospitals, many can be done at home with the latest diagnostic tools, sometimes with body sensors. Labs that offer advanced 3D imaging are located on metro platforms and shopping centres. Commuter trains still suffer major delays at the first sign of frost, but at least you can spend the time keeping better track of your health.

Now that the service society rules supreme, fewer people get the kind of exercise they need at the workplace. The average diet in 2050 has improved and serving sizes have decreased after a series of warnings were issued in the 2010s. Large segments of the population still ignore or are oblivious to health trends.

Groups that do not exercise and have relatively unhealthy diets are heavily over-represented among patients who are treated for the purpose of minimizing their

risks. The average age at which type 2 diabetes is first diagnosed has risen, but more obese diabetics are found at younger ages. The people who stand to benefit from exercising more, as well as the level of exercise that is optimal for them, can be determined with increasing precision. The 20% of the population that does not respond to exercise is not urged to do so.

A large, growing percentage of resources are used for the benefit of vulnerable and at-risk groups, as well as elderly with complex needs or severe diseases. Many severely ill patients have major mental health issues.

Substantial progress had been made in treating mental illness caused by dementia. Immunomodulators for Alzheimer's disease have been shown to be effective, and large projects to provide activities for the elderly have paid off. As a result, more elderly can lead fulfilling lives outside of assisted living facilities with 24-hour care.

Several new vaccines have joined the routine programme, but the area has seen only modest improvement. Most resources have been devoted to the ability to quickly produce vaccine if a pandemic strikes. Rapidly detecting and stopping pandemics in their tracks has acquired greater urgency in the face of growing international travel.

Fewer adverse effects

New technologies and more thorough understanding of the mechanics of disease have shortened treatment periods. The long-term trend has continued unabated until 2050. Even seriously ill patients are rarely hospitalized. Portal medical devices are considerably better, home health care can provide the great majority of interventions and examinations, including 3D scanning. Detailed prognoses of health over the next 24 hours determine whether a person should be admitted to hospital or not.

New medical technology is more expensive, particularly before it has matured and competition has begun to stiffen. Some of the most advanced, expensive treatment methods are offered abroad only because Sweden has such a small population. However, Sweden is the international centre for several highly specialized treatment methods. They employ growing resources and generate a surplus to finance other health care.

Generally speaking, both quality and objectives are considerably higher than they were in 2010.

Preventive health care

Technical advances spurred many industries to restructure around the turn of the 21st century. By 2010, mobile networks had heavier traffic than land lines and consisted of much more data than voice communication. The post office closed its doors for good. People go to their banks only in exceptional circumstances and shoppers increasingly scan their own groceries.

New medical technologies have produced a similar structural change by 2050. Preventive care and electronic health care in the home enable disease to be detected earlier, treated faster or avoided altogether.

Year	Life expectancy in the United States	Life expectancy in Sweden
1850	39	42
1900	48	52
1950	67	70
2000	78	81
2050	83	85

Identifying imbalances in the body and in lifestyles provides a means of preventing disease instead of simply alleviating symptoms. Screening is performed not only more frequently but automatically at home in many cases.

Even cancer and other life-threatening diseases can be detected by means of simple tests. Any positive results are verified with blood tests and MRIs. Assuming the malignancy is found at an early stage, chemotherapy and radiotherapy tend to be highly effective. The later disease is discovered, the greater the risks and costs, usually involving surgery.

Throughout history, prevention has boosted life expectancy a lot more reliably than doctors can ever hope to do. Knowledge of and vaccination against tuberculosis and influenza have done their part to increase life expectancy, but clean water, hygiene, work environment reforms and smoking cessation efforts have made more of a difference.

While technological progress is increasingly responsible for greater life expectancy, the potential for preventive health care remains highly promising. The payoff of investing in preventive measures is often enormous. Two of the leading causes of fatal diseases in 2000 were smoking and overweight combined with physical inactivity.

More men (35%) than women (27%) smoked on a daily basis in the early 1980s. In 2008 the tables had turned and 14% of men smoked, as opposed to 18% women. In 2050, only around 10% of both sexes are smokers. More voices are raised on behalf of banning smoking entirely.

Some preventive measures are difficult to carry out given that behaviour is often socially conditioned. Children imitate their parents when it comes to diet, exercise, smoking and alcohol consumption.

Motivation as an incentive

Both smoking and overweight/sedentary lifestyles are easy to detect but hard to do anything about. Two basic preventive methods, both of which rely heavily on motivation, are used in 2050.

One method involves mentors who communicate with the patient one-on-one, though usually online. Sometimes mentors have access to the patient's logs, including vital signs, diet and exercise. Mentors also take advantage of systems that send motivational messages and raise a warning flag immediately if the patient's weight,

activity level, blood pressure, etc., are outside the limits that have been set for them. If the imbalance continues for another day, the mentor makes personal contact with the patient for the purpose of motivational interviewing.

The other motivational method is software-based. The program contains many different components, but a module based on face ageing software has proven highly successful. It shows the user what their future will be like according to various scenarios based on specific lifestyle changes. The user can see not only the probability that they will develop various diseases, but highly realistic images and animations of both their internal and external appearance. For example, they can simulate the effect of cigarette smoke on lung capacity. The activity planner module automatically checks the calendars of the user's friends, finding free time for them to get together, a vital ingredient of good health. If the level of activity is not up to par, the system suggests times for the user to go for a walk with their friends, etc. It goes without saying that the user can ignore the advice of the activity planner, but it can make a big difference, particularly in combination with peer pressure. Usually one person in a circle of friends wants to take a walk and tries to persuade others to go along.

Apprehensions had arisen that imbalances in the body due to poor diet and lack of exercise are setting the stage for costly diseases to break out, which could deal a death blow to the Swedish welfare system. Although that scenario never panned out, poor diet and lack of exercise still pose a problem in 2050 even though the situation is under control.

The ability to prevent or delay the onset of dementia has proven to be the greatest success scored by preventive care. Thanks to rapid screening for dementia and effective new immunomodulators, more very old people are able to live at home. Some types of dementia can be cured, others delayed through the use of video games and social intercourse. A great deal of effort has been devoted to ensuring that dementia is screened for in a way that cannot be perceived as a violation of privacy.

Technological progress

The focus on preventive care was a product of public policy, but technological strides played a big role as well. A series of advances in the area of electronic health ensured that more frequent screening did not place a burden on the healthcare system.

By 2030, a computer worth 1,500 USD had the same capacity as the human brain. By 2050, a computer can boast of much more capacity than the brains of everyone in the world. Storage space on hard drives is measured in exabytes (one million terabytes). Keeping your health profile on your mobile device is a fairly common practice, particularly when travelling.

Various monitors cover most of the walls and ceilings at home. Most of them have an electricity-saving mode, which uses electronic ink. The screens are always turned on because they do not consume electricity when displaying information that rarely changes, such as the time or a calendar.

While almost everybody has some equipment for electronic health at home, how

much they have varies substantially. Pulse meters and thermometers are standard on mobile devices. The devices that once served as telephones and cameras provide access to advanced microscopy, image processing and diagnosis. A simple photo discloses data about a person's body temperature, blood pressure or potentially dangerous skin changes. An ordinary toilet regularly scans for changes in harmful or beneficial substances and signs of biological imbalances. People with special interests add equipment for analyzing breath and performing microscopic blood biopsies.

Many elderly and chronically ill patients have more advanced analytical equipment. Very few elderly have routine appointments at hospital and the intervals between analyses approach real-time.

An ongoing challenge is to maintain security when everyone is online. Much of the security is based on physical authentication through the mobile device.

Businesses with poor IT systems are edged out of the market. There is little tolerance any more for complicated systems and processes. Consumers can switch providers with the click of a mouse. Business starts go faster because much of the service is outsourced and virtual.

Software development has not proceeded at breakneck speed the way hardware has. Many old systems are still running. But most of them are integrated with new systems and acquire a glossy new surface.

Given that innovations are closely associated with user involvement in the processes, the most complex systems are open source solutions. Hadoop, Cassandra and Hbase, for example – the open source clones of Google's data storage architecture – ensure cheap, infinite scalability. But the model for designing complex systems is complicated in itself.

Those who can't afford or don't want equipment at home have access to it at shopping centres, workplaces and pharmacies. The wealthiest people have scanners capable of analyzing the health and vitality of each and every cell of their body.

More frequent screening and automation of routine health care has freed up resources for the benefit of people at greater risk and with more complex diseases.

Improved options for performing measurements and analyses at home do not only make for more efficient resource utilization as the result of early detection. The chronically ill have many more opportunities to manage their conditions by virtue of fewer appointments at hospital and shorter reaction times to changes in their clinical picture.

The holistic approach to public health has spurred a number of confrontations with the food and drug industries. The healthcare system is under growing pressure to prescribe dietary modifications and exercise programmes instead of medications, whose effectiveness is often questionable.

Special resources are earmarked early on for populations of patients who are or likely to become seriously ill. Children of people with a number of specified diseases constitute one of those populations. They are screened as soon as possible to ensure early detection.

The goal of preventive health care is to start virtuous circles. Besides the imme-

diate suffering that they cause, conditions like diabetes and hypertension can lead to dementia, stroke and other secondary diseases.

Whether people with lifestyle-related diseases should enjoy the same right to care and treatment as those who look after their health has been a hot political potato for many years. More than ever before, patients are required to make lifestyle changes before they are considered for certain expensive therapies.

Position: known

All mobile devices are equipped with navigation software. One purpose is to plan driving routes and use of public transport. You can see not only when the next bus will be leaving, but when it is starting to get full, in which case the device automatically proposes an alternative. The elderly have sensors that have either been inserted surgically or that they wear on their clothing and that issue warnings about falling and automatically send the person's position to the healthcare system. You can easily share your position with friends and family. Elderly can also choose to share their position and vital signs with electronic health service if anything happens.

A smaller percentage of people drive in the big cities than before. A large proportion of cars are driver-less, and the line between public transport, cars and taxis is increasingly blurred.

Augmented reality apps warn of hidden danger, such as children on the side of the road. A warning symbol pops up on the windshield long before the children are visible with the naked eye. Deaths and serious injuries in traffic have declined dramatically but have not been wholly eliminated.

By 2050, machine-machine communication has evolved to what is known as a semantic network. All data are packaged with metadata, which identify and describe content. As a result, all information that has been generated can be processed by any other system. The exact location at which information is stored does not make as much of a difference as it once did.

If you have this technology, you can ask the following question: how do my pulse and time compare with other runners in the same city if I take part in a 10 kilometre race? Your computer will identify runners in your city, locate data about their pulse during the race, access the user's own data from races, select information that has been labelled as pulse and draw a graph of both.

Data are utilized more efficiently

Even more interesting is the ability of a doctor to ask what a patient's blood levels and general health were like three days after treatment. That the doctor can obtain answers to such questions without having to program or search for data represents an enormous change from the time that only research projects were granted that kind of access. Caregivers can quickly find other patients with similar genetic characteristics and health conditions that produced the symptoms under consideration, as well as quickly seeing the kinds of treatment methods that have proved effective in the past.

This type of outcome can also be used to evaluate the efficacy of medications for various patient profiles. Everything from basic facts to complex analyses are accessible with a few clicks of the mouse or voice commands.

Thus, the education system needs an overhaul for the sake of both society in general and the healthcare system in particular. The new focus of training is nudging employees to take initiative over and over again for the purpose of promoting improvements. Despite all the revolutionary changes that the healthcare system has witnessed, many improvements still beckon.

Genome, proteome and metabolome

DNA is analysed on a regular basis in 2050. RNA and the proteome may also be analysed, but to varying degrees depending on the patient's medical history and the outcomes of previous analyses. The technology for processing the extremely large quantities of data that analyses generate was immature until 2025.

Analyses of the genome, proteome and metabolome make for more precise diagnoses, along with better prognoses of treatment results, evaluations and outcome analyses.

In 2050, DNA analysis data yield much more information about the implications for the patient. Data from a very small number of patients were available in early stages of research. As the quantity of data increased, studies could be performed concerning correlations for additional combinations of genes and the probability that a particular disease would develop. The reference group in initial studies consisted of everyone of European origin. The more data that were acquired, the more accurately elevated risks of disease could be estimated for a particular individual. Similarly, it is now possible to determine the medications that are suitable or not.

The access to more data permits an estimate of the probabilities and risks associated with various diseases based on other patients with comparable DNA (such as relatives) instead of an average. With a few exceptions, DNA analyses do not generate exact prognoses for a person's health but rather the percentage of elevated risk.

The results are used to construct a model of the patient's body. In combination with other vital signs, diagnoses – as well as short-term and long-term health prognoses – are much more reliable than before.

Doctors and other caregivers

A large percentage of a doctor's traditional responsibilities have fallen by the wayside to one extent or the other in 2050. Diagnosis of minor ailments, administration and consultations about the impact of ageing and lifestyle on health have decreased dramatically.

Expert systems in the home make most diagnoses. Mentors are usually involved in initial communication with the healthcare system.

Caregivers who feel that the diagnosis of an expert system is erroneous may ignore it – but only under exceptional circumstances and with an explanation. Any flaws in expert systems are quickly corrected. Because the computerized diagnoses are not subject to human frailties, they are more accurate than what caregivers are able to

come up with. They don't prescribe an extra bottle or two because they feel sorry for the patient. And they don't cave into pleas for medication when lifestyle changes are in order.

More specialists

Given that the need for treatment of ordinary uncomplicated conditions has decreased while the number of known diseases has sharply increased, more doctors will have specialist practices in 2050. As soon as a breakthrough is made in curing a disease, it turns out that the real culprit was a syndrome instead. While cures for the most common disease in the syndrome have often been found, many others remain. One speciality that you see a lot more of these days involves designing and monitoring individual treatment regimens for patients with complex clinical pictures. Doctors are also more likely to be engaged in advanced research and development aimed at further improving the healthcare system.

For a number of reasons, specialities are even narrower than before. Due to the greater focus on detecting disease early on, more difficult-to-treat conditions are diagnosed at a point where prospects for a successful outcome are better. As a result, rare diseases are increasingly treatable. The list of conditions that are amenable to treatment has grown by leaps and bounds in the wake of better data and laboratory methods.

Specialists, who have full access to the electronic medical records of their patients, spend more time online than ever before. Specialists are frequently engaged from abroad. Patients in other countries return the favour with respect to Swedish doctors.

Despite all the knowledge that specialists have acquired, very few treatment regimens in 2050 involve only one specialist or one clinic. The causes of the complaint are discussed with previous caregivers, and routine coordination with any concurrent regimens is done automatically.

Many patients have access to expert systems, often the same ones that doctors use. Not only that, but they have taken the time to become acquainted with their own bodies in a way that a doctor could never aspire to. In addition to a complete diary of their vital signs and medications, patients have access to lists of their food purchases, activities and sociograms generated by their credit cards. They draw conclusions about their diet and other factors that affect health in ways that would have been very time-consuming and tricky earlier.

Electronic health services outside of the established system have increased exponentially. Doctors and nurses take advantage of data obtained from such services and integrate them with information generated by formal health care.

As always, caregivers support patients in difficult circumstances. The expert systems may make extremely accurate diagnoses and propose treatment regimens, but many patients still want to talk with another human being.

The corollary of the rapid increase in the number of known diseases is that fewer people have each one, which means that state-of-the-art knowledge is handled manually for the most part. Because the statistical basis for decision systems is thereby quite narrow, there is a greater need for import and export of medical data from one country to another.

Some patients don't want to have anything to do with the technological wonders offered by electronic health and let the healthcare system diagnose them just as it always has. Because doctors can use their own expert systems to obtain test results much faster than before, even these patients can look forward to prompt diagnoses.

Patients who make appointments are sicker

Now that people go to emergency rooms and health centres only when a visit or appointment is deemed necessary, they tend to be sicker at that particular point than they were in the past. Not even patients with serious or chronic diseases make appointments as often as they once did. A caregiver is warned if a patient's clinical picture changes and decides whether to schedule an appointment. The patients may be either at home or hospital. Expert systems make automatic diagnoses and propose treatment based on test results. The sensitivity and prognostic accuracy of the systems often permit measures to be taken even before the patient realizes that their condition has changed.

However, one tendency points in the opposite direction. A small number of patients over-analyze their test results. They call the healthcare system a disproportionate number of times but not so often as to significantly strain available resources. They are handled by mentors, who specialize in dealing with worry and anxiety.

Hospital administration is highly efficient in 2050. IT systems are designed to ensure that all vital information remains correct and up-to-date. Medical records are in order. A doctor can easily obtain the patient's current control chart and previous diagnoses from the expert systems.

Once treatment has been completed, an automatically generated report recommends a rehabilitation programme and ways to minimize the risk of future disease. The report discusses the aetiology of the current condition, including lifestyle factors. Many patients receive assistance from their mentor or a caregiver to make sure that rehabilitation is effective.

Thanks to simulations, constant evaluations and the use of process control software, healthcare procedures are much more refined than before. Specialists in management and process control are recruited and trained more consistently than they once were. Pure medical knowledge is not as important for top positions in these areas.

Focus on user benefit

Administrative tasks are minimized by means of systems that prioritise user benefit. Many traditional healthcare processes have been redesigned in response to the opportunities offered by new technology. Most data entry is fully automated or performed with the help of computerized assistants.

Computers and expert systems are good at regulating individual diseases, such as type 1 diabetes without further complications. Many type 1 diabetics have implants that regulate their insulin automatically without the need for major dietary restrictions. Although many types of diabetes have been cured, it turned out that there were a lot more than anyone had imagined.

New hydraulic equipment, exoskeletons and aids with increasingly sophisticated ergonomic features are easing the heaviest tasks that orderlies and nursing assistants need to perform.

The role of mentors

New technologies and healthcare structures create many opportunities for people to attain better health. Active, healthy people benefit most from these technologies. A mentor system has been adopted to ensure that more people become aware of the new options that the healthcare system is offering them. The mentors, who may specialise in any number of areas, are also specially trained to deal with worry and

anxiety in connection with illness and other traumatic events such as divorce or unemployment. Empathy and the ability to motivate are the fundamental qualities of a successful mentor.

The mentor is involved in all communication with publicly financed services or decisions concerning transfer payments.

Three mentors

The goal is for each person to have no more than three different mentors over the course of a lifetime: one until they turn 35, a second one until they retire sometime between the age of 65 and 80, and a third one until they die. In practice, however, it is hard to find the right person of a suitable age. The matching process is particularly important given that mutual trust and respect are decisive to a well-functioning system. The mentor and mentee must be willing to accept each other. While the substance and focus of mentorship vary from one of the three periods to the other, the common key to success is getting to know each individual as well as possible in order to motivate and support them when crises and difficult situations arise. Some people want and need a great deal of support, others not so much. Mentors have an average of 50 mentees each. The need for support is greatest and most time-consuming at the beginning and end of life. Thus, mentors of children and the elderly have fewer mentees than those who are responsible for the working age population.

A mentor serves as a school counsellor, school nurse, study and career adviser, social insurance officer, primary care doctor, employment officer, public assistance assessor, physiotherapist and personal trainer all wrapped up in one. It goes without saying that nobody can be an expert in so many different fields. This is where the expert systems come in. The task of the mentor is to interpret the wishes and needs of each individual on the basis of their particular circumstances. For that reason, many mentors tend to combine the skills of those who were previously referred to as counsellors, psychologists and nurses. Most decisions about support or treatment measures are made by the mentor, who uses expert systems as a guide to ask the right questions, perform a thorough assessment and make an accurate diagnosis. The mentor is able to succeed in that endeavour 87% of the time. Otherwise the true specialists are brought in. An uncommon disease, serious crisis or severe mental illness (or one or more of the above) may be involved.

Considering that mentors know their mentees extraordinarily well and mentees fully trust that their mentors want what is best for them, sickness compensation and other benefits are barely regulated any more. An infinite number of evidence-based treatment options that have been continually evaluated are built into the decision support process. They cannot be handled by means of traditional regulations, which may have the same scope and dynamic. They form the basis of the joint decisions that a mentor and mentee make about the most appropriate treatment option at any particular time. Sophisticated but readily accessible simulation models are available for picturing what will happen if a particular choice is pursued – regardless of whether it is a matter of income, friends, health, appearance, you name it.

One of the most visual and powerful models is based on face ageing software, which shows you what you will look like in ten years based on choices you make now about smoking, exercise, alcohol habits, etc. The task of the mentor is to provide guidance and bandy various options, offer support so that realistic ones are chosen and offer continual follow-up and motivation to ensure that the decision is adhered to. Automated systems follow what is going on and encourage the mentees, as well as notify mentors if somebody needs extra support in dealing with specific situations that arise.

A small percentage of the population do not want to have a mentor. Most of them have a special need for personal privacy. Those who are mentally ill or have criminal backgrounds are nevertheless required to maintain continual contact with an assistant or some type of expert on their particular situation. Those who are neither mentally ill nor have criminal backgrounds may decline the offer of a mentor even if their average health and general prospects for success in life are also poorer than the rest of the population. However, they will pay deductibles to the healthcare system and receive lower transfer payments. Because no mentor can act as a gatekeeper to the transfer systems while providing motivation and checking job openings, compensation will be reduced by 30%.

The trouble with trying to change your habits is that the problems caused by unwise lifestyle choices emerge long after you first start to practice them. It may seem like a big sacrifice to give up certain habits when you aren't experiencing any problems and don't expect to do so within the next 10-20 years, even if you know that the impact will be severe later in life. Human nature is such that people are generally unable to integrate their short and long-term goals.

Rural-based mentors

Many mentors are based in rural areas where fewer jobs are available. Their job is not limited to normal working hours. Much of their communication is electronic and independent of the time of day or night. Some mentors and patients communicate under more formal circumstances, but short, informal messages are increasingly common.

People with severe or rare conditions often join support groups, mostly online. They share advice about lifestyle choices and alternative medicine. The support groups operate both in and outside of the traditional healthcare system and do not stop at national borders. They frequently share data about DNA and blood levels in hopes of identifying new correlations.⁵

Disease and medications

Ordinary medications improve

"Doctors are men who prescribe medicines of which they know little, to cure diseases of which they know less, in human beings of whom they know nothing."

– Voltaire

Medicine and pharmaceutical production made rapid progress in the 20th century. The design of drug trials became standardized and robust. The paradigm was increasingly called into question in the early 21st century. Earlier studies are difficult to repeat, casting doubt on their findings.⁶ Another problem is that the drugs currently prescribed are based on studies that drew their conclusions from the median effect. Plavix, which reduces the formation of blood clots and myocardial infarct, racked up sales of USD 9 billion in 2010, more than any other medication. The FDA required a warning label to the effect that Plavix was ineffective on certain types of genes. It turns out that 30% of the population cannot metabolize the drug to its active form. A common abnormal variant, liver enzyme CYP2C19, cannot activate Plavix but increases the risk of blood clots by 300%. Moreover, some people have an extra effective gene that requires a double dose to ensure optimum protection against clots. Thus, it is crucial that pro-drug activating genes can be analysed (pharmacogenomics).

Drug discovery and development took a groundbreaking step in the 2010s. In 2010, Walgreens, an American drug store chain, sold a saliva test to analyze your sensitivity to Plavix, Warin, statins, caffeine and other substances. The test stirred up a great deal of controversy at the beginning and the authorities conducted raids and confiscated it. Pharmacogenomics are here to stay, and tests are now available from the four largest drug store chains in the United States.⁷

By 2020, pharmacogenomics have made their great breakthrough and doses are routinely individualized. Progress was rapid, and in the 2030s and 2040s everybody received drugs that had been individually manufactured at the molecular level.

Targeted medications cause fewer adverse effects.

The most important new development is that the success of previous treatment regimens is continually evaluated, objectively if possible by means of vital signs, as well as in terms of patient perceptions.

All pills contain a unique ID number. Anybody who wants to (as is the case with many elderly) can obtain automatic feedback from the healthcare system about their consumption of various medications. If a patient forgets to take their medication or overdoses, an alarm goes off. Initially the systems issue a reminder or ask a question; later on or if the situation is more serious, the mentor becomes involved. In emergency cases, a team of paramedics is sent to the person's home.

New types of medications

Although gene therapy is used fairly often, it has had unforeseen consequences time and again. Patients develop cancer after treatment. The trend is for gene therapy to be developed for one disease at a time. Conditions associated with more than one gene or with other factors continue to defy treatment.

The use of nanoparticles for medicinal purposes is highly limited. Cancer treatment accounts for most use of the technology. Nanoparticles are used more often as contrast agents in order to focus radiotherapy in an extremely effective way and treat many types of malignancies before they are barely visible during screenings.

Nanorobots

Nanorobots are used to deliver medication to specific organs for the treatment of a handful of diseases. One of the main reasons they were developed was to detect and repair injury and infection.

Nanorobots have a circumference of 0.5-3 micrometres in the blood, allowing them to pass through the capillaries. The robots are made from carbon composites (diamond/fullerene). The activity of the robots can be followed with MRIs. After being injected, they head off for the destination organ or tissue. The doctor activates them after having confirmed that they have arrived.

Medication and surgery can only encourage tissue to heal itself. Molecular machines can actually repair damaged tissue by using the same information that their living counterparts already do. Cells can be accessed, given that biologists are able to insert needles without killing them. Molecular machines can enter the cells the same way.

Most Swedes whose vision needs correction wear a new type of glasses and lens. The lens refocus in response to distance. They also project information about the world or interpersonal messages.

Diseases that have been eradicated, shown up for the first time or changed
Cancer is detected much earlier, often even before it endangers the patient's health. People with life-threatening cancer live longer than before. A few types of cancer are still difficult to treat, but the great majority can be treated without surgery. Additional vaccines have been detected for specific types of cancer. They are administered to people with elevated risks.

Imitating nature

Biological society has made deep inroads in our way of being by 2050. In the post-IT revolution era, we can handle complexities on a level with nature. After the first tottering steps at the beginning of the century, biometrics – the imitation of nature's design solutions – are widespread. But imitating nature is not good enough. We also control and recreate nature. We built von Neumann machines, which are able to reproduce. Some machine that were around at the beginning of the century were capable of creating new ones, such as advanced microprocessors, but now the next stage has been reached. True biological functionality would require much greater complexity than an individual could handle. Groups of people can deal with greater complexity, but those as small as 10–15 members create an administrative burden that is greater than the benefit gained from each new member. The centralizing trends of the late 20th century were reversed in favour of decentralization in pace with our ability to construct IT support that coordinated the increasingly complex processes. Particularly in health and elder care, still the most advanced processes that human beings have invented, the new logistical and decision support technology supplied invaluable forward momentum.

No longer is there any doubt that individuals are incapable of handling these complex interactions without using IT-based tools such as simulation models and decision support.

The problems and challenges facing the health and elder care systems, which are complex in themselves, must be addressed by complex methods. Nor is it obvious that the woes of complex systems have only one remedy – or have a remedy at all.

Medical science knows a lot more about the aetiology of migraines and other headaches. Gene therapy has substantially reduced the symptoms of many types of migraine.

The common cold has still not capitulated to human ingenuity. The reason is that one or more of upwards of 200 different viruses may be involved every time it strikes. To make things worse, they are always changing their structure. Colds may be an expensive proposition for both businesses and society as a whole, but there's not much that can be done about them.⁸

Resistant bacteria are still a threat. New antibiotics have been developed but bacteria have mutated just as fast. Hopes are high for the design of synthetic viruses that attack bacteria only, but they are only in the experimental stage.

Global warming has given dengue and malaria a new lease on life. They have even shown up in parts of the United States and Denmark.

Earlier treatment

More people are diagnosed with disabilities and mental illness than before. Treatment commences earlier – sometimes ten years before symptoms are likely to appear – and more consistently. Matching behaviour with genetic information makes for

Sweden's primary export

Sweden is one of the few countries in 2050 that can boast of sustainable development when it comes to health and elder care. Many countries offer highly advanced care for a minority of the population and poor care for the rest.

Swedish society is more suitable than many others for the new type of health care. Few other countries accept modern technology with such open arms. Swedish society also has the advantage of containing relatively few authorities and hierarchical structures. Some countries have trouble transitioning to a system in which many patients are more knowledgeable about their condition than the doctor is. The main reason is that many of the patient's blood levels are generated outside the healthcare system.

As before, many countries in 2050 offer limited preventive care. Many people who are less well-off and lacking health insurance are unable to schedule an appointment before they fall seriously ill. Many such diseases are a heavy burden on the health care system.

As before, some of Sweden's exports in 2050 are of medications and medical equipment. The industry took off in earnest after the telecom sector peaked around 2020.

Another export consists of care facilities and clinics to be run in other countries according to Swedish standards. Swedish health care has a good reputation and Swedish companies can successfully compete in procurement processes. This export is not problem-free: cultural differences and complicated laws make it difficult to run care facilities in other countries.

Most of the export consists of consulting services for preventive care and treatment processes, as well as sale of IT systems for the healthcare system, advanced aids and welfare robotics.

Countries that have not yet implemented preventive care will benefit from the Swedish experiences. As opposed to demand for mobile phones and telecommunications networks, there is a constant demand for innovative and cost-effective care.

The export of technology and processes generates economies of scale that permit further efficiencies in Swedish health care.

more effective treatment. In the past, diagnosis and the prescription of medication for mental illness and disabilities have been less accurate than for many other conditions.

The education and healthcare systems are more observant of symptoms of mental illness and disabilities and start screening at younger ages. The more society understands these diseases, the less stigma is associated with them.

But the decrease in physical interaction and dependence on machines that are always online take their toll – people are overstimulated and the positive trends lose some of their force.

Drug abuse is about as widespread as in 2010 – a debate is raging about whether to legalise synthetic Euphoria, a cheap substance that neither is addictive nor causes any adverse effects.

Healthcare system

In the past, IT systems used by caregivers were designed first and foremost to process financial data, such as ensuring that the right account is debited. They had not been optimized to keep track of patient processes or medical histories. Newly formatted information for patients had often caused problems in existing systems.

The IT system used by caregivers in 2050 is based on entirely new premises. The overall system consists of shared management of interfaces and security. The remainder of the system is a set of rules for the mechanism and interaction of underlying systems.

Technological advances have enabled several new functions, above all much faster quality control. The user can tell whether health and elder care have been provided as scheduled and can assess their quality in comparison with previous occasions and other clinics.

Financial control has improved as well. Budgets and services can be monitored much faster now that various treatments have been classified in a standardized manner and most information is available in real-time.

All underlying systems must follow guidelines for data about patients and finances. In that sense all data are transparent between systems.

Some underlying systems use traditional databases, but most information is stored in structured data warehouses. All data, including blood levels and disease information, are classified in accordance with newly established standards.

Many types of information

Dictation and film are also categorized automatically so that expert systems can interpret them better. All types of information are collated – X-rays, allergy tests, old handwritten prescriptions. Data from non-healthcare systems can be incorporated to complete the patient's clinical picture. Family trees and information from genealogical research sites can be linked in to better identify hereditary factors.

When new process control systems are being designed, impulses are sought from similar systems both in and outside of health care.

Inspiration is also obtained from government budget systems when it comes to design that affects budgeting processes, as well as monitoring and controlling finances. The government budget system has three primary components: budgeting, appropriation documents and outcome reporting. The new community care system has the same structure with respect to financial control but is much more complex by virtue of the fact that so many more actors are involved. Essentially the system consists of only several hundred agencies, all of which are funded primarily by the government budget.

Impulses for control at the macro level, including utilization of equipment and other assets, are taken from industrial and logistical business systems. They are also the source of inspiration for the central control panels that provide quick information about the location of problems in the systems. The problems and breakdowns detected in this view concern cost and quality exceptions for various clinics. Pressing problems such as sudden loss of personnel or epidemics among patients can also be discovered here.

Faster implementation

Computerization of the overall healthcare process greatly facilitates implementation of new policies. Resources can be reallocated and treatment instructions adopted more or less instantaneously. Reforms and changes can be simulated in advance. As the systems begin to assume all the complexity associated with both biology and healthcare systems, however, the need and ability to govern processes administratively decreases. Clinical guidelines in their previous guise are a thing of the past. Instead the systems suggest treatment options and processing steps based on the best available information at the moment.

Some of the inspiration for routine processes at the micro level comes, believe it or not, from fast food restaurants. They are masters at creating processes and making sure that they are followed. The processes are optimized for easy learning, and an automatic alarm goes off if a step is skipped. Once the routine processes, such as personal hygiene and ordinary sampling, have been performed as efficiently as possible, more time is left for listening to what patients have to say.

Indoor navigation is available for new hospital employees, as well as patients and robots. Augmented reality is used to instruct equipment and various treatment procedures.

Standardized treatment manuals and national guidelines have fallen by the wayside, replaced by algorithms that stored in decision support systems and updated automatically as soon as new discoveries are made. The caregiver receives an indication of a treatment that departs too much from best practice and must enter a justification so that the system can learn or demand a second opinion.

Decision support systems

An advanced decision support system designed for more complicated processes is used for various caregivers, even patients as well. The system contains complete medical

records of patients, along with case notes of relatives. Confidentiality is highly sophisticated, and only authorized caregivers can see information that the patient regards as sensitive. For the last 20 years or so, patients have had the right to open their medical records in order to speed up, and reduce the costs of, medical research.

Twin correlation increasingly supplements statistical methods. The method involves examining positive outcomes for patients of the same age who have similar DNA; symptoms, living environments and habits.

The expert systems proceed primarily from statistical methods. The systems are based on a thousand times more data than their 2010 counterparts.⁹

Minimizing suboptimization

A series of technological and organizational advances have powered social development in recent centuries. New technologies have shrunk bureaucracies and speeded up processes. Sweden has been a pioneer in many areas when it comes to efficient use of new technologies.

Progress accelerated in an unprecedented manner from 2010 to 2050. Previous technological advances had been preceded by slow processes involving the replacement of hardware and software and training of personnel.

Things are more sublime these days. The user interface has been in place for more than a decade so that new training is rarely required. Fresh functions and improved processes are adopted as soon as an advance is made.

The introduction of GPS navigation in the early 2000s serves as a good illustration of the kind of acceleration we are talking about. Now ordinary drivers could find where they were going, even when abroad. In the next step, GPS navigation moved over to mobile devices. The first navigation software for mobile devices had the same functionality as freestanding GPS devices. Before long the software was upgraded such that drivers could receive real-time information about traffic jams and suggestions for alternate routes. Another upgrade included indoor navigation, while a third one showed photos of streets and roads. Such rapid software development took a toll on sales of freestanding GPS devices.

Information tools for healthcare purposes emerged in the same way during the years before 2050.

Major advances on the macro level

Despite rapid productivity growth at the micro level, the greatest achievements occurred at the macro level.

Total socioeconomic costs are much higher than can be gleaned from municipal and county budgets. Only one-third of costs associated with illness were borne by traditional healthcare budgets in 2010¹⁰.

Such costs do not include loss of production that affects employers, social insurance systems and society as a whole.

An integrated system for most components of health care enables an estimate of the external impact of various types of measures. Some of the positive external

effects are used in the form of monetary incentives to encourage such measures. The estimates are not limited to basic measures such as vaccination or more frequent monitoring of risk groups. The system also devises incentives for better allocation of services among various caregivers – for example, the point at which a patient would benefit by transitioning from medication to a mentor who can help them modify their dietary and exercise habits.

By the same token, measures that are deemed to generate negative external effects have financial implications. A quintessential measure of this type is casual prescription of penicillin with the consequent risk of resistant bacteria. Overconsumption of health care, which can aggravate the patient's condition, is another example. Studies in the United States have shown that a great deal of cardiac surgery on patients with few or no clinical symptoms causes more harm than good.¹¹

Many parties in the healthcare process

The number of parties involved in the healthcare process poses a major challenge to efficiency efforts. Caregivers may be employed by the financier or by a for-profit business. They have to walk a fine line between loyalty to the patient and the client.

Adopting the greatest possible level of transparency is a powerful tool for dealing with such a complex structure. All contracts and microdata aggregated to key ratios of cost, quality and efficiency are available for inspection. Transparency permits irregularities to be detected sooner and new providers to make faster decisions to set up shop if supply is inadequate. Compensation is based on health outcomes throughout the process, but it is still difficult to fully allocate the contribution of each caregiver to the final result.

Trying to formulate optimal contracts with caregivers poses difficulties in this connection. A doctor has a contract with their employer. But the two parties do not always share common goals. The employer might be the county or a private company whose interim goal is to earn a profit but that has also set a goal of producing high-quality health care.

Such a contract with the doctor can distance their decision making process from that which is socioeconomically optimal. Another complication is that the doctor primarily represents their patient, who is in a vulnerable position, rather than their employer.

The situation does not contain a mechanism that would ensure that optimization for the patient is synonymous with optimization for society. Efforts to do something about suboptimization for this reason have concentrated on the need for expert systems to be optimal in their ability to consider such multidimensional problems.

Complexity

A complex system and a complicated system are two completely different things.

From Wikipedia:

“Complexity theory is a branch of science that deals with systems that have the following characteristics: they are complex (many independent units interact, for example a human community or the living cell); interaction within the system causes spontaneous self-organization (for example birds that adapt to other birds and thereby create a flock); the self-organizing systems are adaptive (they attempt to turn events in their surroundings to their advantage, for example a species evolves towards better adaptation to its surroundings or a company learns from experience); such complex, self-organizing and adaptive systems have a dynamic that distinguishes them from static objects such as computers, which are simply complicated, as opposed to complex. Complex systems are more spontaneous, more disordered and more living – they are on the edge of chaos, where they possess enough stability to be sustainable but are also capable of transformation. The edge of chaos is where complex systems can be spontaneous, adaptive and living.

Complexity theory, which originates from physics, biology, chemistry and economics, is closely related to chaos theory. Complexity theory is used by research in widely diverse areas, from organization and communication to computer science and mathematics.”

Massive complexity

Most diseases are due to multiple genes, epigenetics, the proteome, the bacteria flora and other underlying causes, such as habits, social patterns, accidents and new alien substances to which we are constantly exposed. Complexity is massive and increasing.

Pharmacology was previously based on simplified assumptions about the cause/effect relationship between medication and disease. When researchers begin to understand an area, such as DNA; they often discover that it is based on interaction with other components that exhibit relationships between cause and effect that are increasingly complicated.

Everything is related

Personal empowerment also affects health. People who have more control over their lives experience better health than those able to affect their circumstances to a limited extent only. Putting public health, fitness care, diet, social interaction, work environment, health and elder care production into separate compartments is way off base from that point of view. They are related. I'm happy if I'm healthy, but being happy makes me even healthier. The reason for the compartmentalization is that individuals have been perceived so far as able to make decisions about diagnosis and measures. Considering that individuals have a highly limited ability to deal with this enormous complexity, they are compelled to organize such that not everyone has to think about everything.

The dilemma of such a highly specialized and drain-

pipe-oriented organization is that it always leads to a certain number of atomistic errors. That which might be correct given the limited information and science in a drainpipe can lead to treatments or measures that are wrong from the total perspective of the individual or system. Health and elder care production also represents a complex system.

Traditional reorganization methods – bigger or smaller municipalities or counties, privatization or nationalization, economic incentives or five-year plans – can alleviate or aggravate but not eliminate this dilemma. Differences may be noted, but none of these factors appear to play a particularly decisive role in the total results when countries with different organizational approaches are compared. Organizational discussions are only one more example of atomistic fallacies. The complexity is so great that it is impossible to consider even a fraction of the most important parameters or predict the results of an organizational change. It is not surprising then that the various reorganizations of recent decades have not appreciably affected waiting times, medical outcomes or efficiency – only after the introduction of more dynamic control systems such as financial incentives did certain changes occur. This is also why guidelines, regulations and legislation have such a limited impact. These control methods are linear and static, whereas the systems they address are complex, ergo nonlinear and dynamic.

Complex problems are never amenable to simple solutions. What is needed are complex solutions that learn from their mistakes and dynamically optimize.

Continual evaluations

Health care has always relied on evaluations. New technologies and the emphasis on continual improvement have increased the scope and frequency of evaluations.

The early Internet boom saw the introduction of systems of Like buttons, five-star grading scales and comment boxes. The evaluations were linked to essentially anything online – a photo, a personal reflection on a purchase, etc. Although the evaluation usually took a fraction of a second, the option of writing long comments was available as well.

The new approach to informal evaluations has been incorporated into all aspects of health care by 2050. When it comes to elder care, the client, a relative or an impartial representative can grade services or report those that were not provided. Most importantly, patients can regularly evaluate their health, as well as how various treatments are going. Evaluations that produce abnormal results trigger escalation to find out whether problems remain to be addressed.

Caregivers can continually evaluate equipment and treatment. The evaluations are used to locate faulty equipment and to serve as a basis for future purchases.

Elderly patients wear bracelets that measure their stress levels and provide constant feedback about the quality of the care they are receiving. As a result, even those with severe dementia can make their voices heard.

Biometric meters complement the evaluations of mental patients because they produce more objective results.

Mobile devices are used for authentication and evaluation. The software in the devices continually identifies connections and what may be worthy of evaluation at the moment, minimizing the effort required of the user.

Evaluations are also used to find other flaws in the healthcare process, such as:

- Unnecessary transport of caregivers, patients and equipment
- Shortage or redundancy of personnel or equipment
- Poor capacity utilization of critical equipment or personnel
- Poor treatment results

Payment for healthcare services is partially linked to the results of evaluation, though primarily to quality of life outcomes. A concerted effort is made to ensure that evaluations do not show distorted results due to manipulation, questionnaires filled out by unauthorized persons, etc. Scheduled services that are not performed, such as daily walks as part of elder care, are automatically included.

Countless nursing home scandals have spurred legal reforms demanding greater accountability at the highest levels when neglect and improprieties are discovered. New tools for quality control and the more serious consequences of cheating have substantially reduced the irregularities.

Ultimate responsibility

The Swedish healthcare system has long had systems to deal with drug-drug interac-

tions. The systems are working well in 2050 given that the various IT systems are more fully integrated and more knowledge is available about the effects of such interactions.

Many obstacles that prevent patients from receiving optimum care from those in the best position to help them have been removed. One such obstacle consisted of confidentiality requirements as the result of which doctors could not obtain an overview of the patient's medication regimen. The great majority of medications in 2050 are prescribed by the AI system, which has turned drug-drug interactions into a moot question.

In difficult cases that involve a large number of caregivers, the patient can request that a single doctor assume ultimate responsibility for all of the various treatments. The doctor is responsible for seeing to it that the treatments and medications do not conflict with each other. The main purpose of the method is to ease worry, given that expert systems coordinate most steps in the healthcare process and treatment regimen.

Patients are matched with caregivers on their own terms. If more than one caregiver is involved, the patient helps decide which one will assume overall responsibility.

The best caregivers

- Teach healthy patients how to stay that way
- Teach patients about the consequences of ageing
- Teach seriously ill patients as much as possible about their condition such that they are in an optimal position to either cure or live with it

A learning organization

The goal is for every treatment to be logged and the outcome analysed if at all possible. Stored information is coded clearly such that other subsystems can easily interpret it.

The goal is to gradually develop a complete clinical picture for each individual patient showing the progress of their health and the efficacy of various treatments. Combining empirical data with the subjective assessments of the caregiver and patient ensures the greatest possible amount of information.

A parallel goal is to acquire knowledge about the efficacy of specific treatment methods for various patient profiles. Based on the patient's genetic makeup, medical history and a number of other factors, each examination increases the knowledge of the medical profession.

This kind of learning is nothing new, but it was less explicit in the past. Doctors accumulated knowledge about the efficacy of the methods they administered throughout their years of practice, but could never share it so quickly and effectively. The working method represents an expansion and enhancement of the healthcare system's quality registers. New technologies make it easier to conduct studies based on multiple registers. The new system is more uniform, features more detailed classifications and proceeds from much more empirical data.

Dynamic new generation of evidence

The systems used by caregivers rely increasingly on single person studies to generate evidence. The studies randomize each user to specific treatment options that fluctuate over time in hopes of identifying the optimal regimen for the particular patient. The results are collected and aggregated to generate new generalisable evidence that can be used immediately by the next patient. Such studies can be conducted by the healthcare system, patient forums or various combinations of the two. Like the human genome, this information is immediately available online to anyone who is interested. Evidence is much more dynamic and constantly in flux. The static controlled studies of the 20th century are conducted much less frequently. Everybody has direct access to information online and many small specialist companies are involved in various parts of the studies.

Laws to prevent unauthorized use of personal and biological data are stricter.

Data from healthy people

The amount of information available about healthy individuals has increased dramatically. The ability to monitor and compare the health of people who are essentially healthy provides new perspectives on how disease develops.

New laws establish criteria that scientific methods must meet but do not assign tasks to specific people. As a result, pharmaceutical companies and medical device manufacturers can find out more easily and less expensively how well their drugs, methods and equipment are working.

Focus on deviations

The basic strategy in 2050 is to systematically track a patient's wellbeing throughout their life, not only when they are sick. The Swedish Meteorological and Hydrological Institute has stored all available weather observation data ever since 1812, and not only when it's raining out.

Variation is always a sign of poor quality, whether we're talking about an individual from one year to the next or the treatment outcomes produced by different regions of the country.

The new methodology is very much an extension of the weight and length curves that child health centres once had for newborns. In 2050, the most common blood levels and other parameters of health are monitored for the rest of a person's life.

Caregivers use this historical data as a point of reference in combination with recommended intervals. Major deviations that lack an obvious explanation trigger an automatic analysis by expert systems or a caregiver. If serious deviations are detected, your mentor gets in touch with you right away. Rarely does a person's health decline so precipitously without the expert systems detecting it that they call a caregiver on their own initiative. Unless they are an offline person (somebody who has turned down the benefits of the Internet and a mentor), a commission of inquiry is appointed to identify the predictors that should have set off an alarm.

Continual, consistent monitoring provides just-in-time care, which is both cost-effective and capable of ensuring healthier lives. Patients who have various chronic diseases can live at home more than ever before, often able to return to work by relying on mobile sensors that continually monitor their vital signs. The more complicated the disease, the more the sensors are a godsend for patients and caregivers alike.

Priorities

All the productivity improvements notwithstanding, healthcare resources are still scarce, particularly in view of the relative decline in the working age population.

Stricter lines are drawn between various types of health care, as well as their importance for society and the individual.

Financially intelligent health care – prevention, therapy for chronic conditions, treatment of infectious diseases, etc. – has the highest priority. Greater resources are devoted to preventive health care for the purpose of minimizing the risks of disease, and caregivers encourage patients to perform sophisticated screening at home.

Such care mitigates the impact of an ageing population. Everyone who possibly can returns to work or enjoys a healthier, longer life. Screening and prevention of chronic conditions must be prioritized in national and local healthcare budgets to ensure that short-term economic concerns do not overshadow long-term benefit.

The next level of priorities has a strong social component. These priorities include treatment methods that prolong life, diseases for which no medication has yet been discovered and groundbreaking clinical research and practice.

This type of care is still a headache for elected officials and other decision makers. How much value should be assigned to extending the life of a person with terminal cancer by six months? There are still no simple answers to such questions. Nevertheless, there is much more consensus about the importance of devoting socio-economic resources to early detection of cancer than was the case back in 2010.

Minor conditions, cosmetic surgery and premium care are given the least priority. Patients still pay some of the costs for such care, which is often provided outside of the publicly financed system.

Empathy and elder care

Training in empathy and communication

From Wikipedia:

Empathy is the capacity to recognize feelings that are being experienced by another sentient or fictional being. Empathy is closely related to sympathy and compassion. Empathy is the psychological ability to understand and experience with another person, wither they agree with you or not. For example, a psychologist can have empathy for a criminal without being like or sympathizing with them.

Researchers broadly agree that empathy is a complex phenomenon that eludes easy definition. Empathy is studied by social psychologists, cognitive psychologists and neuroscientists.

Cognitive psychology and neurolinguistics scored major advances in the early 21st century. The ability of people to change their behaviour and feel better was established. During the 2010s, medical science learned a great deal about how the brain works. The discovery of new types of neurons and understanding of epigenetics spawned individual training programmes providing constant feedback to improve communication and empathetic skills. Participants in the programmes receive continual feedback from colleagues and software about how well they are communicating. Communication profiles are created that provide second-by-second monitoring of cortisone levels, both in oneself and in the recipient. Well-functioning technology is discovered in the 2040s that can predict the people who have compatible communication systems and can thereby quickly bond with each other. Mentors are more effective as a result. Advanced simulators that emerged in the 2020s tested and refined the behaviour and communication skills of participants in increasingly difficult situations. The “communicators of excellence” spawned by the technology can command large fees for their services.

Rules and decisions are followed

Most previous elder care scandals had involved the denial of food, hygiene, medication or other basic rights. The problem is no longer significant in 2050.

Each step in daily routines is automatically documented and verified against previous computerized support decisions. The assistance received by the elderly is not checked off by staff only. A great deal of information is obtained from bracelets that measure stress and dehydration, beds and other furniture that measure weight, activity sensors, medication, nutrition and exercise.

Monitoring the tasks that have been performed may appear to violate the privacy of the patients and staff, but the technology has long been used in other areas.

Improved logging of basic activities makes it easier to detect whether the facility is understaffed. Along with qualitative surveys of each day's events, such monitoring provides a clear overview of the patients and staff are doing. Personnel who do not work under pressure have more of an opportunity to demonstrate empathy.

Many small ergonomic improvements make it easier to work in elder care than before. Portable exoskeletons (mechanical reinforcement of bones and muscles)



Photo: Elliot Elliot/Johnr

and specialized robots are available for certain kinds of heavy lifting. The early exoskeletons of the 2010s became more flexible and compact in the 2030s. Robots that look just like people are not in use yet, although Honda's ASIMO and other Japanese humanoids help activate the elderly and distribute food or medication.

Industrialized ground service

The cultural difference between the social services and the healthcare system has not gone away. For example, there is a lot more inertia at the social services when it comes to increasing its capital intensity. Sensors and automated surveillance had long been the norm in the healthcare system before the social services fully embraced them. The assistance of machines was regarded as antithetical to the responsibility of human beings to take care of each other. Only when research on the sources of client satisfaction gained currency did the realization hit that the sense of comfort and security increased dramatically when the new methods of producing elder care were employed.

The human need of privacy and autonomy has powered the wave of welfare robotics over the past few decades. Robotic aids perform most cleaning, cooking and personal hygiene tasks. Old apprehensions about runaway costs due to demographic changes were swept away amidst evidence of significant savings. The freed-up resources have been used to arrange activities and a dignified existence. Whereas empathy at the beginning of the 21st century was automated and repetitive tasks were manual, empathy has now become a manual skill and repetitive tasks have been automated. Most of the freed-up resources, which are channelled through a long-established, jointly owned company, go to research and development of better aids. The central government provides infrastructure for research and for monitoring systems, as well as basic financing of the development company. Municipalities, business and individuals supply the remaining resources. Many of the technological breakthroughs have been the result of x prize competitions. The systematic, empirically based improvement effort constantly discovers new bottlenecks and welfare traps. Prizes to be awarded to those who can show a working prototype are announced as a means of eliminating such traps.

Clients who actively participate in the development effort frequently donate all or part of the prize money for the discovery of an innovation that will solve the problem they have detected. But the central government defrays infrastructure costs.

The old walkers that find their way home if the client or patient gets lost and provide assistance when going uphill have gradually been replaced by motorized exoskeletons over the past few decades. They also maintain balance, as well as perform the entire task if the person lacks the ability or motivation to do so. But even then the body remains in motion, which is good for the joints and circulation. Exoskeletons can communicate with each other, which enables them to gather their owners together for group walks. The troops of elderly that make their way across city parks are popularly known as "senility buses." Somebody who is unable to make the last stretch home can fold out the built-in seat of the walker and sit the rest of the way.



Photo: Rex Bionics

Aids become pets

Using pets as aids is nothing new. Sheepdogs and seeing-eye dogs are two examples among many. As far back as the 2010s, complex drug molecules were obtained from the milk of genetically modified goats. That represented a big step forward. But now aids are becoming pets and that's something that has never been seen before.

Just like a dog, your walker or exoskeleton whimpers at the front door and begs to be taken out for its daily walk. Of course, it's all a ruse to activate the elderly. Walking aids learn from experience which people their masters get along with best and subtly steer their pace and route like solicitous matchmakers. Built-in cameras and direct links let you share your walking adventure or the first robin of spring with friends and family. If you skip your walk even though the sun is shining, your walking aid will let your family know so they can check up on you.

The network of sensors and aids is like living in a virtual version of a 19th century farmstead – generations interact constantly and keep track of each other. At least you can crawl back into a solitary existence now if you so choose. Geographic distance is somewhat of an antiquated concept now that holographic telephones are all the rage. But they still can't convey a sense of cosiness and physical intimacy, so people still get together for real. Nevertheless, they share their daily lives effortlessly and unpretentiously through social media, to which sensors and aids are also linked. Lights go on and off, curtains flicker and countless other common objects and respond to virtual visits by your friends and acquaintances.

Death has become an equal opportunity employer. Men once tended to die with their boots on while women wasted away at institutions. Constant interactions with friends and family, along with subtle pressure to be physically active and medical breakthroughs, have pushed life expectancy higher than ever – above all, the number of years that people remain in good health has increased significantly. More people are healthy when they die, still bustling about as they always have, and the change is most noticeable among women. The need for assisted living facilities has declined dramatically, replaced by a growing number of nursing homes associated with hospitals and intended mostly for care at end of life. Now that women and men have approximately the same life expectancy, elder care is not needed as much as before. Because there are fewer widowers and widows, spouses are still around to help each other out – and the biggest benefit is that people can look forward to social interaction in their homes right through their final years.

Residential patterns

Globalization trends have continued unabated and more people than ever work abroad at various times in their lives. Still, only a small percentage of the population is affected. Urbanization proceeds on its millennium-long march, having reached the point that the various generations are reunited in the big city and can more easily spend time with each other again.

The earlier effort to remove some of the physical obstacles posed by the big city has been dropped now that the new aids can easily handle long stairways and other

once-formidable hurdles of modern life. Poor snow removal services were a big headache when motorized walkers were the only aids on the market, but such problems are a thing of the past now that exoskeletons are here to stay. Not to mention the fact that snow removal robots have revolutionized the occupation.

For a while people had to adapt their homes to the demands of welfare robots for space and design. Now almost every home has been adapted and the new aids have little to complain about. They move around like athletes at the top of their game regardless of the terrain. Thus, housing units adapted to the special needs of the elderly are no longer needed. People of all ages demand places to live with built-in household services, another boon to the developers and manufacturers of new aids.

Financing

As always, evaluating an individual's need for public assistance is a matter for discussion. Although formal assessment instruments and criteria are available, there is still a need for human decision making. Elder care is more productive than it once was, but municipal budgets are still stretched to the limit. The controversies do not centre on simple, inexpensive aids like exoskeletons for going up and down steps. The primary issue is how to set priorities for cognitive aids, as well as the extent to which the network of aids and services should compensate for human frailties, provide social benefits and reach into every corner of people's lives.

Towering above it all is the question of how to finance the rapid, intensive advance of the new systems and increasingly sophisticated aids. Many municipalities refuse to subsidize the development of new services and aids on the premise that it is the natural responsibility of the central government. The sluggish bureaucracies of the big-city municipalities make it particularly hard for them to keep up with the times. Given their shorter chains of command and early realization of the need for productivity gains to attract promising employees, the rural municipalities are still leading the way when it comes to innovative solutions. Such trends are increasingly regarded as an economic policy measure to create more jobs in sparsely populated areas.

Automatic evaluations

The infrastructure for automatic evaluations of experiments that was built by the jointly owned development company was the main force behind the fairy tale-like growth of the industry. There had always been a large legitimate variation in the way that elder care was provided, but the natural, ongoing experiment had never led to higher quality or productivity for the simple reason that it remained under the radar screen. Knowledge of what was really going on increased after a national system for monitoring and client surveys was adopted. The new systems for automatic evaluation made it easy to experiment with various types of organization and collaboration with other parts of the safety nets, as well as the social networks of individual clients. The opportunity for a true systematic effort had finally arrived. Brand new professions and research disciplines have emerged in the wake of these trends. In addition to the more established psychohistorians and mathematical biologists, algorithmic

psychoanalysts and mathematical social workers have ascended to the vanguard of the systems design effort.

By simply clicking their way through the centralized system for monitoring and quality, they can start working in an entirely new way, as well as providing a brief description of the process and the participating people, units and clients. An individual employee can do the same thing if they want to test a new method or insight. The system then shows whether there are any total quality, cost or benefit differences. Now that everyone can become involved in micro-improvements as part of their daily routines, a kind of revolution has taken place. Getting the system to work required a great deal of change and a lot of hard work.

They started by merging the rudimentary social networks (Facebook, etc.) with the rough administrative registers and the quality registers. Data from sensors and aids were added as they became more sophisticated and a terminology and communication standard emerged.

The old method of manually agreed terminology before entering data soon turned

Joy, grief and pain

Physical wellbeing is not the be-all and end-all of the health and elder care systems. Just because you're healthy doesn't mean that you're feeling better than somebody who is sick but blessed with a greater measure of happiness.

The healthcare system of 2050 offers far-reaching programmes to help both healthy and unhealthy people experience more happiness. Some of the programmes are implemented through mentors, others by the healthcare system itself. Computers help you remember and encourage you to participate in certain activities.

Most of the efforts have to do with positivity:

- A good laugh extends life, reduces stress, improves the immune system and social interaction
- Music has a similar neurological effect as sex and food
- Affirm your faith, meditation and prayer reduce stress, anxiety and tension
- Help somebody else, let those who have the strength to help others do it
- Visualize happiness and focus on positive thoughts Human beings have the unique ability to visualize and daydream Visualize positive thoughts instead of thinking negatively and attracting anxiety
- It's never too late to try something new

Special measures are also taken to process grief. The deaths of relatives or friends often have profound consequences, primarily for older people. It is important that the healthcare system be better prepared to offer assistance in difficult situations. The mentors can provide vital support under such circumstances.

Pain management is an area of growing interest. Methods of measuring pain have been developed, including real-time sensors in severe cases. Medication has become more of an exact science and can be administered when pain is peaking. The following alternative methods are also performed:

- Massage and chiropractic
- Exercise and yoga to increase circulation and improve general wellbeing
- Therapy to change movements that cause pain

out to be hopelessly slow, incapable of changing fast enough to survive in such a dynamic industry. Instead teachable algorithms and neural networks were developed that quickly learned from context and the identities of those involved in order to interpret the continual streams of knowledge generated by the systems. This has led to a genuine, systematic improvement effort.

Occasional voices were raised, warning that such data flows threatened personal privacy, but it was hard to deny any more that all extensive improvements in health and quality of life rest on this foundation. With the exception of mentally ill people, these admonitions are gone with the wind.

The service sector has taken the same route as financial systems, which became incomprehensibly complex in the minds of the average person when the industrial revolution was still in its cradle. Each and every service is now so complex that it can no longer be replaced by work processes that do not have all input data at their disposal. If computers were to suddenly disappear, the financial system would collapse immediately. Paper and pen would be powerless to revive it – an entirely new architecture would be required.

The health and elder care systems have reached the same point of no return. No individual can understand the whole thing, but not even the range of services designed for a particular person is fully transparent. A special project would be required to review all the interacting algorithms that control the production of health and elder care for each individual. In biological society, people construct the systems that subsequently design goods and services of insurmountable complexity. The concept of privacy falls apart in practice – there is no way of grasping what might encroach on privacy among the massive flows of data.

Despite – or perhaps because of – that, certain enclaves of Amish sects insist that people live their lives outside these flows. Some people go even further and argue that nobody should have access to the free energy generated by cold fusion. Such groups are treated with benign neglect, but many people are worried about the few children who grow up in these subcultures. Setting aside their poorer health due to having been denied access to advanced medical technologies, they have suffered cognitive damage in the absence of virtual worlds and all the complex and problem solving skills that this type of education provides. An increasingly vociferous choir is demanding that children forced to live outside the data flows that define contemporary society be regarded as victims of abuse.

Focus on communication in elder care

By 2050, every elderly person has witnessed the Internet Revolution – e-mail, IP telephony, social media, etc. Most, if not all, of them have been active participants. A few clicks of the mouse put you in touch with friends near and wide. High-resolution 3D communication is commonplace. A sense of physical intimacy may not be too far behind.

Elderly who rarely see friends and family benefit most from hyperrealistic video-conferencing.

Digital communication is still no substitute for human contact. Elderly people in good health are urged to support those who are not. Studies have shown that those with the responsibility of taking care of a pet or another person remain more active and enjoy significantly improved health.

Other activities for pensioners, often organized by their peers, are also growing in scope and popularity. Due to the emphasis on preventive care, people enjoy more healthy and active retirement years than was the case earlier.

Some of these activities are computerized games – everything from Alphet to war simulations – which have been shown to retard the progress of dementia.

Health-conscious pensioners engage in elite exercise much more than they once did. Some people in their 70s and 80s achieve better results than the previous generation did in their 50s.

Animals as therapy

The therapeutic potential of animals is receiving a lot more attention in 2050. Many assisted living facilities and nursing homes have a dog or cat that provide physical warmth and devotion. The clients of some of the facilities run a dog care centre.

No machine can supply physical warmth and devotion, although a few robotic animals come close. Many elderly do not have any family members who can visit them on a daily basis.

Fortunately, a pet can provide much of the friendship and intimacy that all people need.

Taking care of a pet gives many people a reason to live, which is an incredible boon to health.

The unconditional love of an animal is the icing on the cake.

On a purely medical level, surveys show that pets have a positive impact on blood pressure and cholesterol levels.

Care by relatives

Because formal elder care has decreased by 2050 thanks to compensatory aids and improved health care, care by relatives has risen from the 70% level around the turn of the 21st century. The elderly tend to be healthier and less prone to dementia – as a result, they are more capable of performing their daily activities with a minimum of assistance.

Relatives are increasingly allowed to prescribe their medications in collaboration with expert systems. Automatic monitoring of medication by sensors substantially minimizes the risk of wrong doses. Sensors and microlaboratories reduce the number of medical appointments.

Healthier pensioners can babysit for their grandchildren and great grandchildren more often, which relieves parental stress. And the more they are needed, the longer they are motivated to stay healthy. Housing adapted to multigenerational households is easier and easier to find.

Conclusions

The health and elder care of the future is already here but in very small doses and unevenly distributed. Powerful forces will transform the systems. Similar forces have revolutionized telecommunications and banking. Current processes and bureaucracies will not remain intact. Patients will increasingly manage and monitor their own health care. They will not put up with poor service and inefficiency. More and more disease will be detected before they manifest, saving a lot of money due to less expensive treatment regimens and fewer secondary diseases. The savings will be devoted to financing more dignified care for the growing elderly population.

Despite the central administrators, the change will be a bottom-up phenomenon, led by individual patients, clients, caregivers and businesses. They will have abundant resources, be well informed and purchase their own medical devices and aids. As a result, gaps between different demographic groups when it comes to health and elder care will inevitably widen during rapid transitional periods. If central systems, organizations and businesses decide to participate in the change, they can focus on three main areas below.

Computerized improvement efforts

The only method that human beings have come up with to pursue systematic improvements is to measure, evaluate, rethink and implement. Everything needs to be measured, and all aspects of life and the system must be described by means of continual data flows.

Failing more and failing less

The healthcare system badly needs to fail less in providing clinical services. Meanwhile, some parts of the organization must be allowed to experiment and develop new solutions. If you're seriously into development, you will inevitably fail from time to time. A culture that allows experimentation and failure is crucial.

Connect the population

A successful organization is easily accessible online and permits patients, clients and their relatives to connect the devices and apps of their choice to its computer system in order to read and write its data, as well as to change their own data models.

The most successful organizations and systems will fully realize that complex systems cannot be controlled by linear means, such as guidelines, general training programmes, regulations and appointment-based compensation. The most successful organizations will develop complex procedures for managing their systems in order to simulate organizational changes and new compensation models. They will not start or phase out operations at random. They will pretty much know how health and cost-effectiveness are going to change before making a decision.

Examples of measures that can facilitate and fuel progress

Free care reform

Rules and regulations reflect the past. Rules always get in the way when the times call for rapid progress because they are based on the very paradigm that is no longer sustainable.

A free care reform would eliminate all rules except two:

- It must be possible to scientifically evaluate the results in medical and productivity terms, as well as in real-time
- The experiment must be discontinued immediately if patient safety is poorer than the lowest 1/10 of a percentile. The supervisory authority can monitor this rule in real-time.

The reason that the safety requirement is not higher than the lowest one-tenth of a percentile is that experimental activities always have start-up problems. Because the reference is based on what ordinary health care performs, it would be unreasonable to demand more than that which the worst is already accomplishing. If we think that the quality they are delivering is unreasonably low, we should discontinue the activity, at which point the lowest one-tenth of a percentile will increase as well. It is important to monitor cost so that a proper basis for evaluating productivity can be established, setting the stage for real learning and genuine innovation.

Development companies

Innovation is based on stimulation and inspiration – and often as not by perspiration. Failure is every bit as important. If you always succeed, you must know exactly what you're doing. That's exactly where you want to be if you're operating a system or organization. But if you're innovating – creating an unknown situation – failure must be an option. Preferably not every time though. Of course, the risks will be higher. The greater the innovation, the higher the risk.

When a useful innovation has been found, our first impulse is to disseminate it as fast as possible to every nook and cranny of the health and elder care systems. If the innovation were privately financed, it would have to charge by means of licensing, etc. Implementing new ideas is notoriously difficult, even for free utilities; if it cost extra to switch organizations, etc., little implementation would ever happen. That's why it is difficult or impossible to commercialize this kind of risk-taking. The subsequent danger of market failure means that the public sector may have to bear the costs of the activity. Or not. It is not happening enough today, even in countries with extraordinarily well developed market mechanisms, suggesting that it is a market failure.

Welfare technology

Society has a great deal to gain from more and better aids and welfare robotics. First from the client's point of view. We know from research that autonomy is integral to perceived welfare and happiness. A person would much rather make up for their

disability with systems that they monitor on their own than to ask for help. The other reason is that greater capital intensity is the basis of productivity development, and replacing personnel with capital allows more to be accomplished at a lower price. In other words, there are three winners from more and better welfare robotics: The client obtains greater autonomy, the taxpayers don't see costs rising so fast, and personnel receive higher wages in the wake of improved productivity.

A type of organization must be allowed that is conducive to rapid alliances with people or businesses with good ideas that deserve to be tried. Procurement, government agencies and big business are not usually associated with dynamism, creativity and tolerance of failure. Perhaps some type of company or foundation can serve as the groundwork. Maybe it can be jointly owned/started by the central government in collaboration with municipalities and counties. The foundation must have people with multidisciplinary education, plenty of time, abundant resources and more than a touch of madness.

Simulation institute

If you want to truly learn to handle the complex systems that make up the body – or that the health and elder care systems consist of – computer simulation is your only option. Systems of that complexity are beyond the scope of human understanding. Any attempt is dead in the water. Human beings are incapable of designing holistic solutions for these systems. This elementary truism is the source of the eternal complaint by politicians, administrators and rule makers that you can't change the system. But all is not lost – people have the ability to design systems of their own that can produce solutions for these endlessly complex systems. Perhaps experiments can be performed with process engines and decision support systems unless the development company is going to do it.

Review prescription rules and regulations

Pharmaceutical prescriptions represent an important key to understanding how the healthcare system works. Permit algorithm-based research. If a medication cannot be prescribed simply because the patient has high blood pressure, measuring blood pressure at the pharmacy would suffice to resolve the issue. Viagra may be that kind of medication. Because it is not subsidized, it does not represent a cost for the system. Antibiotics and the results of cultures may be a second type, blood lipids and statins a third. Many caregivers, such as nurses, other than doctors should be able to prescribe certain medications more than they do today. Many people who take care of relatives with uncommon conditions know a good deal more about treatment than the average doctor they encounter. Delegate prescription rights to them for certain medications. Eliminate the two-year limit on prescriptions for people with chronic conditions, monitor the prescriptions they pick up and schedule an appointment if their pattern changes.

Such a reform will no doubt meet opposition. The argument will be heard that the risks are too great, that people who lack a medical education can never assume such a responsibility. Presumably that is true for certain medications but not for others. Experiment – that's the only way to know for sure. A quick note – medications are not currently handled in a satisfactory manner: rehospitalisation, drug-drug interactions, 10% of hospital admissions are due to drug complications, etc. A change is crucial. If algorithms can deal with basic medications, doctors will have more time for complex cases. More time is exactly what doctors need, and patients stand to benefit as well.

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Today's health and elder care systems are badly in need of more empathy and high tech. That is one of the conclusions drawn by this report from the LEV project, which studies long-term demand for welfare services.

We cannot continue to produce health and welfare services the way we do now while improving quality, keeping pace with the ageing population and reining in costs. To provide health and elder care in 2050, the systems must shift their focus from disease to reducing the risk that disease will develop in the first place.

New technologies will serve as the catalyst that enables innovative approaches by the health and elder care systems. Patients will be able to treat mild illnesses by phone, while screening and automated diagnosis at health centres and hospitals will allow more serious conditions to be detected in time. New technologies can take over many of the heavy tasks that are required in the elder care system.

Once technology is being used properly, savings will emerge that can finance more dignified care for the growing elderly population. Then we will have the ability to prioritize badly-needed empathy.

This report contains observations of health and elder care that can serve as inspiration for new ways of thinking and hopefully persuade more people to start experimenting with alternative methods of providing these services.



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