

No Place Like home

An analysis of the growing movement away from hospitals towards providing medical care to patients in their own homes





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2016





Summary

Approximately 46% of hospital patients in the Netherlands today could be sent home and receive the care they need remotely, in the comfort of their own homes rather than in the hospital itself. This is possible thanks to numerous technological advances. If managed well, the move of patients out of the hospital and into the home could have significant financial benefits and improve patients' quality of life. At the same time, it will require stakeholders to take on new roles: individuals will be able to collect medical data on themselves and monitor their own health, nurses will take a less active and more supporting role in patient management, and doctors will have to shift their perspective from N=1 to N=infinity. Hospital management will become IT companies, and medical technology companies will become consumer technology firms. Once the movement of patients out of hospitals begins, it will be unstoppable and irreversible, and innovation will spread quickly.

In this study we analyse the feasibility and the impact of moving patients out of hospitals and providing them with the care and treatment they need in their own homes. We begin by looking at the types of activities that could safely and realistically be done at home given the current state of technology, then we go on to assess the impact that such a change would have on the various stakeholders involved.

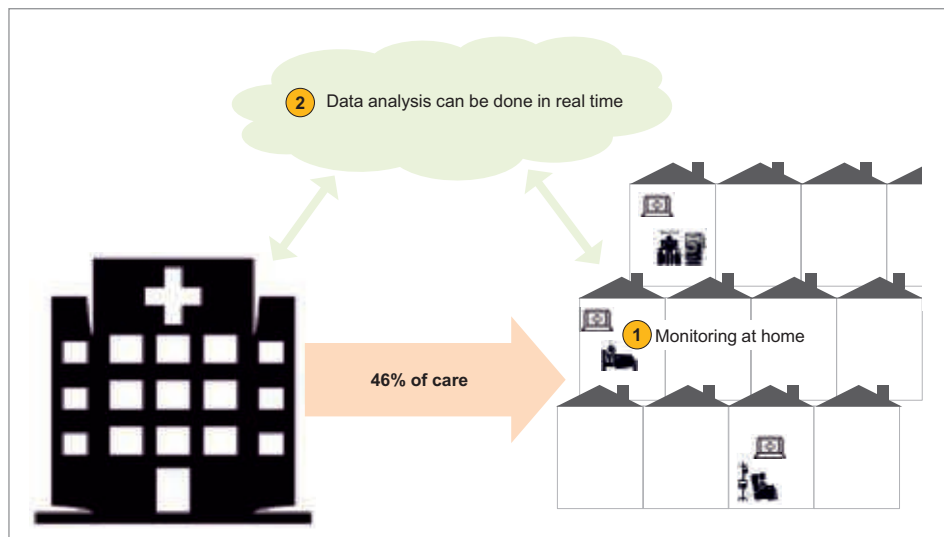


FIGURE 1:

Approximately 46% of hospital care could be moved to the home thanks to remote monitoring and data analysis

Remote monitoring and data analysis enable bringing patients home and growing data availability accelerates it

The past several decades have already seen a sizable decrease in the duration of hospital stays. Although on average the Dutch today live longer than before and disease incidence is rising, every year they spend less time in the hospital. After surgery, for example, people get discharged much sooner today than they did 20 years ago, and many surgical procedures that used to be inpatient are nowadays outpatient. The move away from hospitals will continue to gain momentum in the coming years, and the next big change will be that patients do not even go to the hospital at all, but instead are treated entirely at home.

Remote monitoring and electronic patient records are the two big enablers of moving patient care out of the hospital and into the home, and they are rapidly becoming more commonly used. The availability of large sets of digital data is accelerating the transition to care at home in two important ways. First, doctors are more likely to decide to send a patient home because they can make a good risk assessment about whether the patient is likely to encounter complications when recovering or receiving treatment at home. Second, doctors can closely monitor the patient at home and intervene when necessary. This makes sending patients home safer than ever before.

Drastic changes in stakeholders' roles and responsibilities

Patients as pilots of their own healthcare

While in the past medical data was primarily only collected for people with a medical condition, it is becoming increasingly possible for everyone – whatever their state of health – to collect their own personal medical data, and more and more people are opting to do so. In this way, it is almost as if everyone has become a patient. Yet with access to so much information, it is crucial that people receive the education they need to deal with this data in a constructive manner. Education should be focused on making people aware of the applicability of personal data, ways of dealing with this data and especially the choices one should make with respect to personal privacy. This could be done by the government through high school classes and nationwide campaigns. Even health insurance companies could get involved. Once people are able to understand and make use of their own medical data, it becomes possible to outsource certain tasks from nurses and doctors to patients themselves. Allowing patients to be the pilots of their own healthcare is empowering and results in more efficient care processes and better health outcomes.

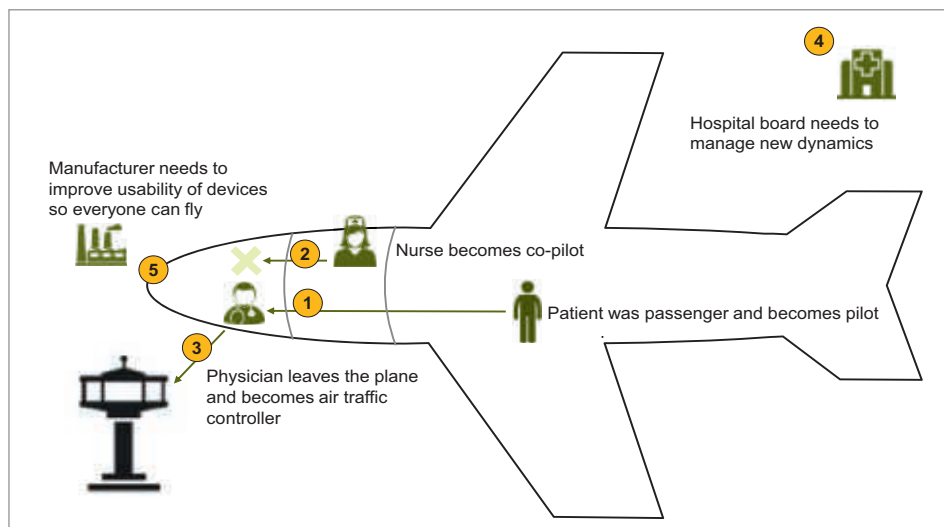


FIGURE 2:

Drastic changes in stakeholders' roles and responsibilities

Nurses become patients' co-pilots

Of course many patients will need assistance in piloting their own healthcare. Nurses will be the first in line to provide this help. As patients' co-pilots, nurses will be expected to jump in and take control in certain situations. Yet in these situations it is important that patients do not lose their status as pilot and aren't relegated back to role of passenger once again.

This will be a new role for nurses and a break from the hands-on proactiveness that tends to define the work of nurses today. Many nurses take great pride in making sure patients get the attention and care they need, but in their role as co-pilots they will have to shift their focus to observing patients and transferring their knowledge to them. Rather than fixing each problem themselves, their aim will shift to ensuring that their patients become great pilots. The impact of this work will be less immediate, and this could be very frustrating for those nurses who thrive on being able to see the instant results of their work. This new work will require a different set of skills from nurses, but they will adapt. Positive patient feedback can accelerate the process.

Doctors' role shifts to air traffic controller

Most doctors are used to interacting with their patients in a one-on-one setting, and their responsibility for each patient is limited to the period that that patient is in the hospital. Once the patient is discharged from the hospital, the patient is on his or her own again. As more and more

treatments are administered by patients themselves outside the hospital, doctors' responsibilities will radically change.

In this new situation, doctors will have to transition to being air traffic controllers while they turn over command to patients, who will have the technology available to them and the training needed to become the pilots of their own healthcare. Doctors as air traffic controllers will be necessary to ensure each individual patient is headed in the right direction. This will be a very demanding job, as the amount of information that these air traffic controllers will need to process and the speed at which they will need to do so is much higher than in the one-on-one situations they are used to. Of all healthcare workers, doctors will be the most capable of making this shift, but not every doctor will be a good air traffic controller.

Hospitals transform into IT companies to help support patients, nurses and doctors in their new roles

We determined that about 40% of hospital buildings will become obsolete as patient care moves to the home. Although this sounds significant, it will only have a budget impact of 1-2.5% of hospital costs. The real challenge will not be how to manage obsolete buildings, but how to manage the technology that enables the new care processes.

In the last 6 years IT-related costs in hospitals already increased by 60%. The recent surge in investment in electronic health records will only accelerate in the coming years. However, the impact is not the cost of IT itself but how it affects other cost drivers. The million-dollar question for hospital management is how to make the business process redesign successful, such that hospitals are ready to outsource care to patients wherever possible and are able to ensure care can be safely provided at home. In addition, hospital management will need to find the right technology companies to partner with to ensure the security of patient data.

Healthcare technology companies become consumer technology companies

While consumer technology goods have developed significantly over the past 20 years into easy-to-use, intuitive devices, medical devices have not. The latter remain as difficult to use as they were many years ago, despite the fact that they are increasingly used by patients instead of nurses and doctors. Therefore, manufacturers will need to invest heavily in research and development to find ways to make devices as easy to use and as intuitive as possible so that patients can use them without intensive training.

In addition, healthcare technology companies' relationship with hospital procurement departments will change. The procurement process will be less technology based and more outcome based. To get the best outcomes, the user interface will be as essential as the technical features. Healthcare technology companies will have to extend their responsibility to make sure that their solutions deliver the promised results.

The innovation gap will close and the slow spreading of best practices will become a thing of the past

The reason why best practices in healthcare travel slowly is that healthcare delivery is people based. Great professionals and good teamwork make the best healthcare. The transfer of knowledge and skills to other teams is often unsuccessful because people themselves cannot be replicated.

The move to a technology-based delivery model of hospital care will make delivery scalable. First, widely available user-friendly technologies will find their way to patients themselves. With these technologies, patients will get uniform knowledge to master their healthcare themselves, and we will become less dependent on the knowledge of individual teams. Second, as doctors move away from one-on-one patient interaction, they can leverage their knowledge to help far more patients.

Putting this study into context

Trend analysis is tricky business. If all trend analyses were correct, the human race would have already died from starvation in a world without heating, cooling or transportation. Although perhaps it is the trend analyses that give us the sense of urgency to act – to put all of our energy together to prevent the predicted outcomes from coming true. This might also be the case for the findings of the analyses we did for this study. Trend analyses have been warning us for years that, without change, we will need more nurses, doctors and facilities, yet we found that the opposite is just as possible.

Our study could easily be mistaken for trend analysis, but it isn't. We assessed the impact that current technology could have on the delivery of care in common practice. There is no speculative part in it. That's why the conclusions of this study are so powerful and should be taken very seriously.



Hospital use has significantly changed and decreased over past decennia

Even though we living longer, we spend fewer years in a state of good health: the average number of years spent with a chronic disease has grown by even more than life expectancy has. Nowadays 5 more years are spent with a chronic disease than 15 years ago¹. One might assume this has resulted in more time spent in the hospital, but that has not been the case. Although people visit hospitals approximately as frequent as they did 30 years ago, the average duration of their stay is approximately 60% shorter (see Figure 10 in appendix).

Thanks to improved technology, recovery time for many surgical interventions has significantly decreased. Due to minimally invasive surgery, wounds are smaller and heal faster, and better targeted radiation for patients with cancer means that fewer healthy cells are damaged and hospitalisation time can be shorter. Ten years ago, after a hip replacement patients had to stay in bed for more than 10 days², whereas today patients can slowly begin to walk again within just a few days. In more extreme cases improved technology has resulted in a shift from inpatient care to outpatient care. In 1995, 35% of surgeries were performed in an outpatient setting and by 2013 this number had already grown to 56%. For certain surgeries, such as cataract surgery, inguinal hernia surgery and angioplasty, the difference is even larger (see Figure 11 in appendix).

These developments have had an impact on hospital building requirements over the past 20 years. The number of hospital beds has decreased, while consultation rooms and inpatient and outpatient operating rooms have increased. In total, the required physical space of a hospital has significantly decreased (see Figure 3), even though the population has grown older and suffers from more chronic diseases. Note that actual hospital space is not always aligned with the required space based on provided care, see Figure 12 in appendix for the mismatch between the number of required and the number actual hospital beds.

The movement from inpatient to outpatient care will continue to decrease hospitalisation time. However, this effect is already flattening out. The next step in the process is from inpatient or outpatient care to actually providing care at the patient's home. The first careful steps have already been taken: patients are discharged earlier when they haven't yet recovered fully from surgery.

¹ Statistics by Statistics Netherlands (CBS) show that the average life expectancy of men grew by 4 years between 1998 and 2013 to reach 79, and life expectancy among women grew by 2 years, reaching 83 in 2013. However, the average number of years spent with a chronic disease for both men and women grew by 5 years, to 30 and 41 years respectively.

² Statistics by CBS.

However, this is mainly driven by financial incentives for the hospital: discharging patients early means fewer costs while the reimbursement remains primarily unchanged since it is based on fixed packaging. Moving the entire care process to a patient's home has limited or negative incentives for the hospital. Haemodialysis, for example, is a highly profitable activity for hospitals. In 2013 in the Netherlands, in only 4.5%³ of cases was haemodialysis done at home, even though the required technology for this is available. Some other countries have much higher percentages of home dialysis, such as New Zealand and Australia, where 10 years ago 25% and 13% respectively of all haemodialysis was already being done at home⁴. Compared to on-site dialysis, home dialysis can save up to 50% of costs⁵ when patients are capable of learning to treat themselves and over 45 hours in travelling time per patient per year, and it gives patients more freedom in their lives. It even results in better quality of life, since more dialysis sessions are possible at home, which in turn results in better health outcomes.

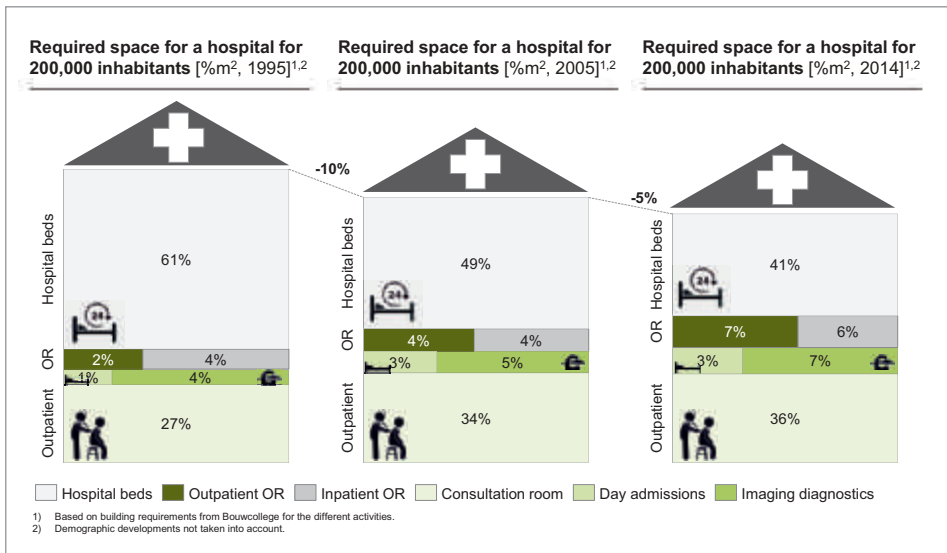


FIGURE 3:

Hospital building requirements in 1995, 2005 and 2014

³ Analyses on Gupta Strategists' database.

⁴ MacGregor, M., Agar, J. and Blagg, C. (2006). Home hemodialysis – trends and variations. *Nephrol Dial Transplant*. Vol 21, pp. 1934-1945.

⁵ This figure is based on the assumptions that the number of patients per nurse will significantly increase, that the reimbursement of taxi rides is not needed anymore, and that materials can be bought at prices comparable to those in Germany and America.

Frame 1: Chemotherapy at home

Nowadays chemotherapy is still administered in the hospital, except for a very small fraction of mainly palliative chemotherapy that is administered at home. For patients, visiting the hospital for chemotherapy is a heavy burden: when patients arrive they are still uncertain as to whether their blood levels are appropriate for chemotherapy; they need to wait at least 2 hours before the administration of the medication starts; and the treatment itself can sometimes take 24 hours or more (see Figure 4).

However, the procedure can be performed safely at home in a way that is more patient friendly. Let us compare the process of chemotherapy without visiting the hospital to the process in the hospital as visualised in Figure 2. The patient could use a self-test at home or a nurse could come to the patient's house and draw blood to send to the laboratory. When appropriate, this could be done the day before the scheduled chemotherapy to timely inform the doctor and patient whether treatment can go forward. Consultation can be scheduled at a convenient time for the oncologist and patient by phone or video call. The preparation and transport is a precise logistical process that needs to account for the preservation time of the medication, which in some cases is limited to only a few hours. However, there is no reason a hospital cannot arrange or outsource this. The administration of the medication can be done by a nurse or even a family caretaker at the patient's home. With good monitoring the nurse can follow the patient from a distance.

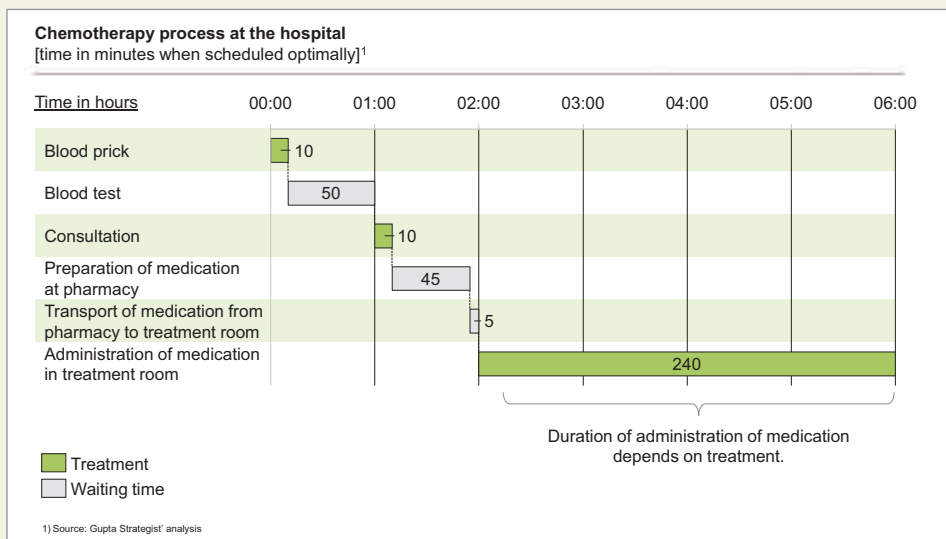


FIGURE 4:
Chemotherapy schedule at the hospital



Radical change in the hospital environment

Approximately 46% of all care activities currently provided in a hospital setting could potentially be provided at home within 10 years. This estimation is determined by analysing which type of activities for each of the ~160 Diagnosis-Related Groups (DRGs) could be safely performed at home with currently existing technology. To this end, all activities have been divided in 7 categories. We have defined specific assumptions for each category:

1. Outpatient visits can be done by video call when no physical tests need to be performed and no difficult message needs to be told. This already happens on a very small scale, for example, for dermatology and diabetes patients. A more extreme scenario would be doctors visiting patients at home. In the latter case, although most outpatient visits would be performed outside the hospital, this would cause so much logistical overhead that we did not consider this scenario in our analysis.
2. Imaging diagnostics consists of ultrasounds, X-rays, MRIs and CT scans. Given the nature of current technology, ultrasounds could be done at home, but X-rays, MRIs and CT scans still require large machines and must be done in specially designed rooms.
3. Surgical interventions should still be done almost exclusively in the hospital building, except for certain low risk interventions, such as inserting a contraceptive device, skin interventions and cataract surgery.
4. Diagnostic activities can be done from home when the activities themselves are not dangerous. Some diagnostic activities are already primarily performed at home, such as sleep studies, where the patient can apply the required patches by following video instructions. Other activities are more complex logistically to arrange at home but can nonetheless still be done there, for example, pulmonary function tests.
5. Other therapeutic interventions consist of a large, diffuse set of activities, where many are part of the surgical pathway and can therefore not be separated from surgical intervention. However, some specific therapeutic interventions, such as haemodialysis, light therapy and chemotherapy, are already performed at home to a small extent and can be performed at home on a much larger scale.
6. Nursing days can take place at home when the main purpose is to monitor the patient, for example, when a patient stays overnight in the hospital to perform a sleep study or is largely recovered from a surgery but the doctor needs to monitor the status of the patient frequently. Also, patients that are stable but still need to recover can, in many cases, do so at home. An example of this is patients with bone fractures. However, patients that are hospitalised for severe conditions, such as older people with pneumonia for example, should probably remain in the hospital.

7. Day admissions are mostly related to surgical or therapeutic interventions. Only when these interventions can be performed at home completely are day admissions in the hospital no longer needed for these patients.

To provide certain care at home within the next 10 years, it should already be proven safe to do so or that the technology will be widely available to bring this care home in the next 10 years. However, it does not mean that all types of this care will be moved to the home, since doing so might not be cost effective or might only be safe or feasible for a certain group of patients. For technology to be widely available within 10 years, it should already exist, but it might still be too expensive, large or cumbersome to use at home. For example, given the chronic nature of kidney failure and the current state of technology, dialysis could be performed almost entirely at home. Patients with diabetes are another example: they don't have to visit the hospital for regular check-up consultations or for blood tests, since this can easily be done using video calls and postal services. However, with complications such as diabetic foot, a patient will still need visit the hospital for a check-up or even surgery.

From the distribution of care that can be provided at home over the different type of activities displayed in Figure 5, it can be seen that nursing days, therapeutic activities, day admissions and diagnostic activities in particular can be done at home. Even though the number of nursing days has already decreased significantly over the past 20 years, the impact of moving care is still most significant for the nursing days due to their high costs and the potential to be moved to patients' homes. This will further impact the way a hospital needs to be organised and the requirements on its building.

Figure 6 displays the distribution of care that can be provided at home over the different diseases grouped by ICD10 chapters, where each of the 20 ICD10 chapters consists of several related DRGs. This shows that diseases of the respiratory system, genitourinary system, circulatory system, nervous system, and digestive system in particular are treated more in the hospital now than they will be in 5 or 10 years. These diseases also differ in the type of activities that can be provided at home. For patients with heart disease a lot of monitoring that happens during nursing days in the hospital can be done from home. On the other hand, for patients with genitourinary diseases, for which kidney failure is a large portion of costs, home dialysis especially has a large impact on the number of therapeutic interventions that can be done at home.

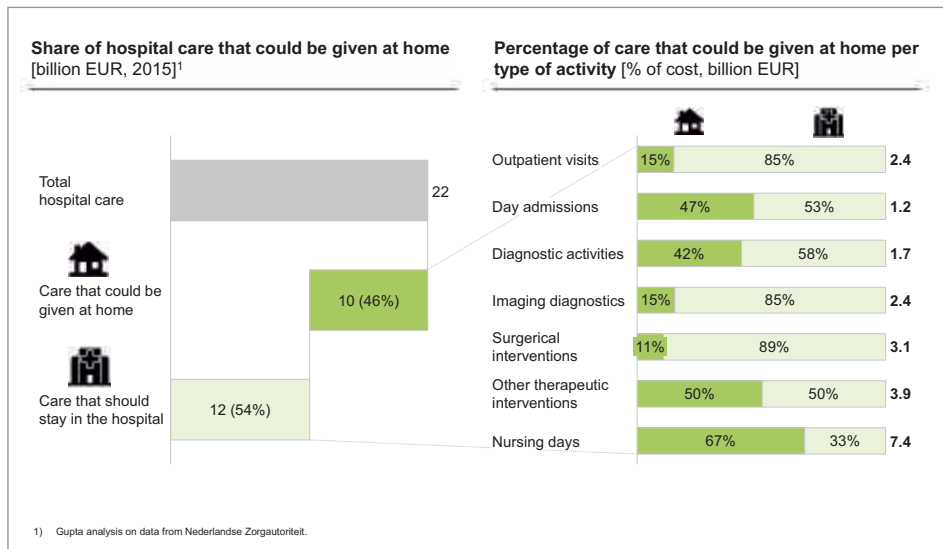


FIGURE 5:
Hospital care that could be provided at home within 10 years

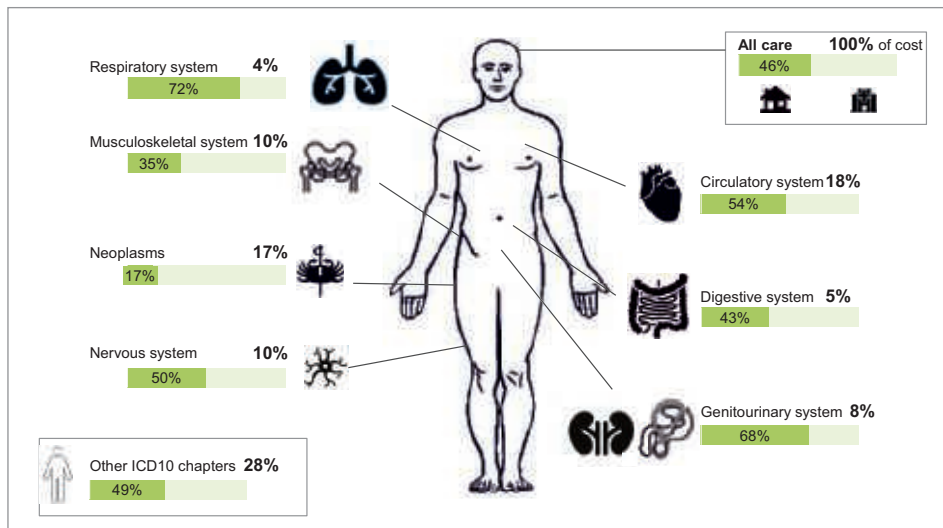


FIGURE 6:
Percentage of care that could be provided at home per ICD10-chapter

When more and more care is moved to the home, it will impact the way caregivers perform their work and the requirements on the hospital organisation and building (see Figure 7). In this article, we describe the effects of taking care out of the hospital setting for the average Dutch hospital. However, due to an accumulation of effects, the consequences can be more severe for rural hospitals than for other hospitals (see Frame 2 for further details).

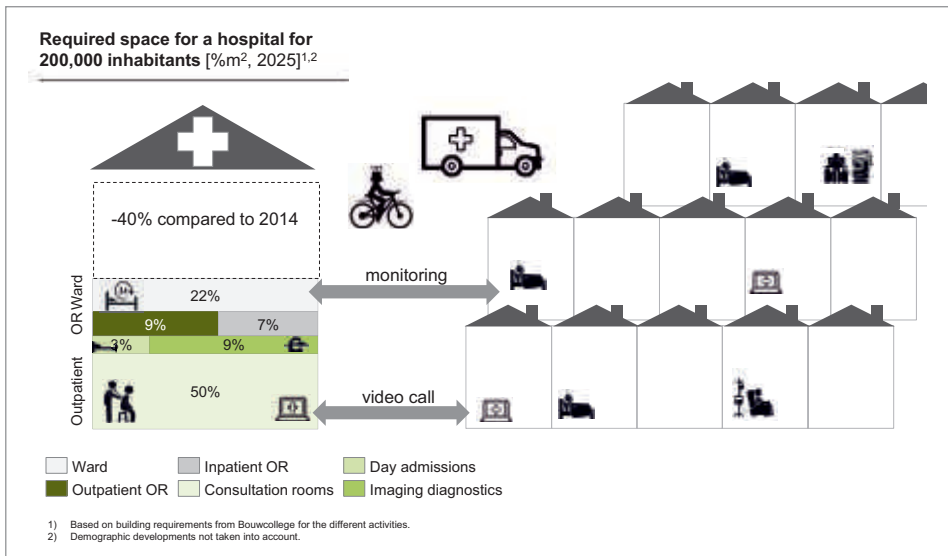


FIGURE 7:

Projected people and data flows in the hospital in 2025

Most patients prefer treatment at home to hospitalisation whenever possible: treatment at home is less cumbersome for patients, prevents hospital infections and saves valuable time. Together with safety considerations, this preference should take priority above all other considerations. Therefore, we believe the development towards less inpatient care is only a matter of time.

Frame 2: The unique case of rural hospitals

For Dutch hospitals in general, building obsolescence is not a substantial problem; the effect is manageable when anticipated and the cost of the building, including equipment, is limited to about 9% of total hospital costs⁶. However, the situation for hospitals in rural areas is different. These hospitals are experiencing a triple depopulation:

1. By 2040, the population is predicted to decline by almost 10% in certain rural regions of the Netherlands⁷ (see Figure 13).
2. Patients are increasingly treated in specialised centres due to the basic treatment mix of rural hospitals. That this development is already taking place is especially visible from the development of the number of hospital admissions for different types of hospitals. Admissions for academic hospitals have grown almost 7% in 5 years, and in large and medium hospitals they have grown about 3%, but in small rural hospitals admissions have fallen by about 3% compared to 5 years ago⁸ (see Figure 14).
3. Care in rural hospitals can be moved home as much as care in other hospitals even though the treatment mix of these hospitals differ significantly. That is, we found that still about 46% of the remaining hospital care in rural hospitals can potentially be provided at home.

Due to all these developments, it is not attractive for rural hospitals to move patients home. Since patient do wish to be treated at home, this presents a new social dilemma. Hospitals most likely won't be able to break even when a significant part of care moves outside the hospital walls, and the government will have to decide whether or not to financially support hospitals so that they can remain open to fulfil their role as care centres for their regions. The other option is to make certain areas especially progressive by either completely closing a hospital or arranging a highly flexible hospital structure for the area. In the first case, care that cannot be provided at home will have to be accommodated by other hospitals in the region, which would increase driving times to the hospital to a potentially unacceptable level. In the second case, a hospital could be further dismantled into an extremely flexible structure that calls off doctors when needed. Most care that can be planned will be performed in nearby hospitals and ambulances will occasionally have to transport patients or doctors last minute.

⁶ Annual hospital reports and analysis on the Gupta database.

⁷ Primos demography prognoses.

⁸ Dutch Hospital Association (NVZ) report 'Zorg toont – brancherapport 2015'.



Growing data availability accelerates the transition to care at home

The main driver for the continuing decrease in inpatient days is improved medical technology. Compared to 5 or 10 years ago, surgical procedures nowadays are less invasive, more accurate and make it increasingly safe to send patients home earlier than ever before. Secondly, wearable technology is emerging that enables performing procedures or treatments at home. This technological progress is accelerated by the increasing availability of (digital) data. Where patient files used to be on paper, they are now mostly digital. Hospitals were relatively late in digitalising data, since they were frightened of harming patients' privacy and dreaded the high initial costs. While lab results were mostly digitalised 10 years ago, patient files, especially X-rays took longer. Besides digitalising existing data, increasingly more data is collected since it is much easier to save. Data is an important driver of care at home since the burden of proof of safety for care at home is many times higher than for any process performed in a hospital setting. Also, with data digitalised in the cloud, decentralised care is highly simplified, since it enables information to be viewed from anyplace.

The increased availability of data makes the shift towards care at home possible in two main ways:

- Improved risk assessment on whether a patient can safely go home after a surgical intervention or during treatment such as chemotherapy lowers the threshold for care at home. Given the high stakes involved in deciding to send a patient home, doctors are logically risk-averse. With unknown chances, a doctor will decide to keep even an almost completely healthy patient in the hospital just in case something might happen. However, the world becomes a clinical trial when a certain scale of data availability is achieved: decisions can be made based on facts instead of intuition. With good risk assessment, the doctor does not gamble with patients' lives but instead takes a calculated risk to send the patient home. Improved risk assessment cannot guarantee that no dangerous or fatal incidents will ever happen when a patient is recovering or is treated at home. However, when risk measures are part of a widely accepted protocol, the doctor will not be liable for sending the patient home.
- Better monitoring at home further lowers the threshold for care at home. When doctors are certain that they will be alerted in a timely manner when the safety of a patient is endangered, the decision to send the patient home becomes easier. By closely monitoring patients, caregivers can intervene when needed and the risks of complications are thereby minimised.

This process of bringing patients home for treatment, which is made possible by technological developments and the availability of data, is further accelerated in a process described below in using two data-driven driving forces (see Figure 8):

- Moving patient care out of the hospital always starts with a pioneer who believes a specific treatment can be given at home just as well as in the hospital. This doctor will send home more patients when first experiences are positive. By increasing the number of patients at home, more and more data is collected to validate the initial hypothesis that care at home can be as good as in the hospital. The collection of this data will convince other doctors to also treat patients at home. Moreover, with the increasing number of patients treated this way, this process becomes the norm and labour intensity decreases, making it increasingly easy to include more patients in the new home process.
- Transparency with respect to quality of care makes it possible to compare the quality of care provided at home to care in the hospital, such that doctors can make a fair, quality-based assessment on whether to shift specific care to the home. Either existing quality of care measures for the hospital setting are applied to care at home or, when they don't yet exist, new measures need to be developed. Good results will convince other doctors to also send their patients home. Eventually health insurers will also consider treatment at home as the default process and will design the buying process accordingly.

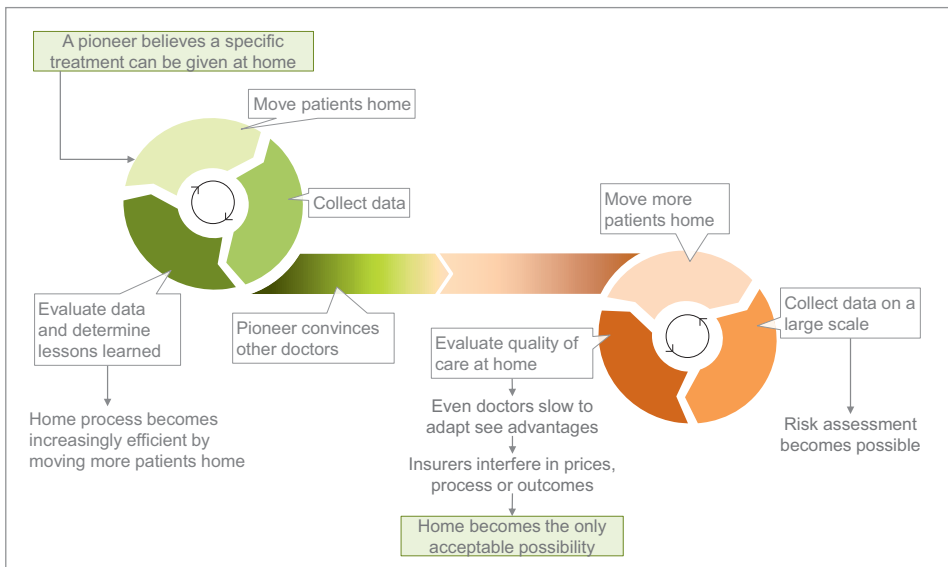


FIGURE 8:

Description of accelerating processes for the shift of a specific care field from the hospital to the patient's home

Transformation of the care landscape is needed

As the development towards less care in institutions and more care at patients' homes progresses, the impact on the care landscape will be enormous. All stakeholders are impacted and need to change their way of working (see Figure 9).

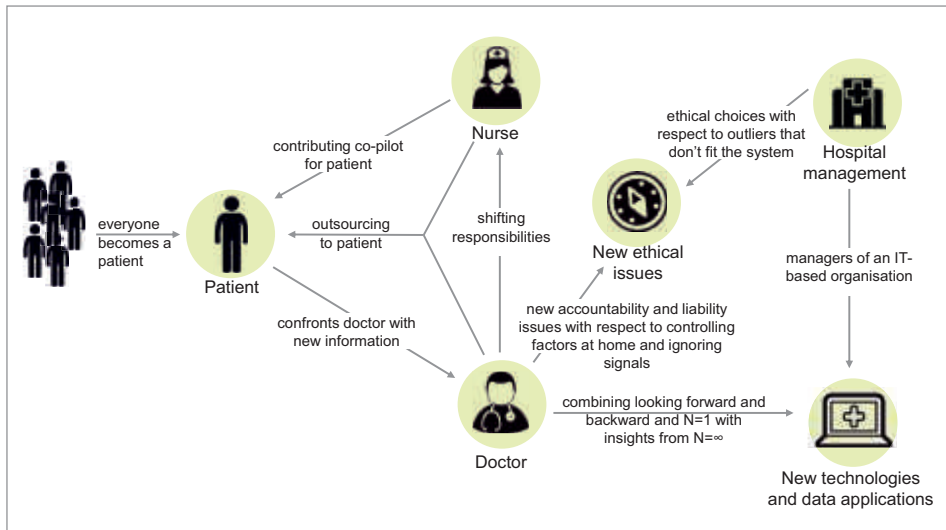


FIGURE 9:

New responsibilities and dilemmas for direct stakeholders when care is shifted from the hospital to the home

Patients

Every person is a patient

Everyone becomes a patient in some way, since everyone – not just people with a specific disease – can collect personal medical data and will continuously do so. Two different extreme reactions to this data are possible: mass hypochondria or collective looking away. Mass hypochondria can result in a substantial increase in doctor visits, while collective looking away does not utilise the potential of this data. To help people balance the new information overload in a constructive way, education is needed for every individual. Education should be aimed at making people aware of the applicability of personal data, the ways to deal with this data and, especially, the choices to be made from it. People should understand the implications of collecting and sharing personal data. For example, with whom – caregivers or family members – does a person want to share personal data and how can that be arranged? The government should also take a role in facilitating the exchange of personal data by, for example, establishing a nationwide file system such as electronic health records.

Outsourcing to the patient: patients as pilots

Given the large availability of technology and data, patients, in a sense, will become the pilots of their own healthcare. Patients can collect medical data and interpret its meaning continuously thanks to readily available technology and information that enables them to easily do so. For example, with a special plaster parents can use the internet to measure the temperature of their children at any given time in real time, and they can find information on how to respond to high temperatures. A quickly growing amount of medical data and information becomes available for whoever looks for it. With patients using devices more and more to measure and treat themselves, these devices need to become increasingly easy to use (see Frame 3).

The common belief is that cancelling out information asymmetry results in more consumption of care, since patients become more informed and want to discuss all information found on the internet with respect to their symptoms or diagnosis with a doctor. Discussing the ins and outs of random pieces of information with a patient is significantly more time consuming than a doctor telling a patient specifically what ails him or her and how to treat it. Also, the increased knowledge of (potential) diseases by searching on the internet for symptoms and preventive body scans is believed to have an impact on increasing care consumption.

However, if people are adequately educated and use their abilities and drive wisely, a significant part of care activities can be outsourced to the patient. One example in which this has already been successfully done is digital auto-anamnesis, where patients themselves report their medical history. Nurses were reluctant to make use of this new method, since they believed patients were not able to do this themselves. However, pilots with this new method were very successful, saving time and resulting in better insight⁹. Outsourcing to the end user is very common in other industries. For example, in consumer banking, up until 10 years ago customers had to visit a bank office for every money transfer or preference adjustment, whereas now nearly 9 out of 10 people¹⁰ do their daily banking online.

By outsourcing medical activities to patients themselves, being sick practically becomes a job in its own right. There is no more passive waiting for the doctor to do something. This might sound frightening, but patients are given more grasp of their own situation, which makes them feel in control of their treatment. Recent studies on patient activation have shown that patient activation is highly negatively correlated to the consumption of care and positively correlated with quality of life¹¹. The group of people that are reluctant to manage their own diseases will be marginalised when this new trend further develops. However, for those that are incapable of self-management, society is responsible for not letting them fall out of the system.

Frame 3: Manufacturers will need to improve the usability of devices

Manufacturers are not discussed as a separate stakeholder in the main text, since they are indirectly connected to the care process, as are insurers, professional and patient associations, scientific researchers, and so on. However, manufacturers will be impacted by the movement of patients to the home, since many of these transitions require medical aid products. Manufacturers even drive the movement to home with new innovations.

Historically, the choice for a specific device for a diabetes patient has been made mainly by the doctor based on medical reasons. However, driven by financial incentives from health insurers, this is changing more and more to prescriptions based on functional requirements. That means that a doctor prescribes which functions a patient needs from a medical device and the supplier will decide which product best fits the requirements. Moreover, the patient also has a say in the choice of product.

While, the influence of usability on the choice of a specific medical device has been only marginal, it becomes increasingly important through current developments. Patients value the usability of a product more highly than doctors do, since patients are the ones using it; doctors are more driven by medical considerations. Also, doctors are better trained to understand new devices and can thereby hardly determine whether patients can also work with the device. What's more, usability is becoming increasingly important, since patients will need to use the devices themselves more often and the complexity and range of functions is growing.

Currently, the interface of medical devices is far behind the current state of technology and what we are used to from consumer devices. Even though the technical complexity of devices is growing rapidly, the interface hasn't developed much (see examples below). To ensure that patients can easily use a new device, manufacturers will need to invest in research and development to design products that are as intuitive to use as, for example, mobile phones are nowadays.

⁹ A large pilot in the Netherlands with over 10 hospitals shows a response rate of 95% on 11,000 patients, with positive feedback from doctors.

¹⁰ Source CBS: 86% of Dutch people aged 12 and above used internet banking in 2014. This percentage is significantly higher among 25-45 year olds.

¹¹ Rademakers, J., Nijman, J., van der Hoek, L., Heijmans, M. and Rijken, M. (2012). Measuring patient activation in the Netherlands: translation and validation of the American short form Patient Activation Measure (PAM13). *BMC Public Health*. Vol 12, pp. 517.

Interfaces of different devices

10 YEARS AGO

TODAY

Medical devices:
Blood glucose meter



Blood pressure meter



Consumer devices:
Thermostat



Activity tracker



Nurses

Nurses as contributing co-pilots

The role of a nurse has radically changed over the last 50 years from a comforting caregiver to the patient's coach. The nurse has a signalling function for the doctor and this function will expand since the nurse will be given the responsibility of monitoring a patient when treated at home. The nurse should teach the patient or family caregiver how the patient must be treated and which signals are reasons to call in a nurse or doctor. The nurse has to activate the patient to take the responsibility for his or her own recovery or treatment. This also demands that the nurse is more flexible in terms of work location, which might change from the hospital to the patient's home. However, it is very difficult for most nurses to let go of tight control and put more trust in the patient and supporting technology. By nature, nurses tend to be very practical, hardworking people that are used to taking care of patients and making them feel as comfortable as possible. However, to successfully support patients in their own care, nurses will need to become less hands on and stricter, for example, by refusing a patient who has not prepared the required questionnaire or who has not recorded specific measurements for a consultation.

The new monitoring function requires different technical skills from the nurse than those currently needed. IC nurses, for example, must already be very capable of working with complex machines. However, monitoring a patient from a distance requires analysing large sets of data, which may be an unfamiliar skill that will need to be developed.

Transferring responsibilities from doctors to nurses

By taking a fact-based approach and making good risk assessments, some work doctors do these days can be shifted to nurses. While doctors are specifically trained to deal with ambiguous patient situations and they have a lot of experience doing so, nurses tend to be less trained in dealing with such situations. Recognizing comorbidities can be more challenging for nurses than for doctors. Nurses should also learn this or leave it to the doctor. For example, a nurse dealing with a diabetes patient that is badly deregulated and losing weight fast is likely to focus on re-regulating the patient's glucose levels, while a doctor may be more likely to consider that the patient could have colon cancer. However, with a high availability of data, more patterns can be recognised and described with protocols. This makes it possible for nurses to follow these protocols and occasionally consult a doctor when the protocol prescribes it.

Doctors

Doctors as air traffic controllers

Doctors will move away from one-to-one patient contact. Patients are more in control of their own healthcare and are supported by nurses. Doctors will have to oversee all these processes as it is doctor who are often ultimately responsible, except in situations where a patient is transmitted to the care of the community nurse. This new role of the doctor reduces the amount of patient interaction for one of the last professions requiring extensive academic education that still has a high amount of one-on-one delivery. The doctor performs less highly specialised mass production work and, instead, the doctor's work is more varied and he or she is confronted mainly with the difficult cases that nurses are unable to handle based on protocol. The coordination of these processes presents a new challenge to the doctor of the future, namely how to control patient flows when patients are not actually visiting the hospital.

Patients confront doctors with new information

The present is an unsure transition period for doctors. They are confronted with an increasing amount of new insights in their field of work, which are impossible to keep up with. It would take 3.6 full-time equivalents of doctor effort to keep up with relevant literature¹². At the same time, patients cherry-pick through these new insights and confront doctors with things they do not know. Doctors need to discuss this information with patients and decide whether it is relevant for the treatment of the specific patient. Also, artificial intelligence will help doctors to process the load of information.

Doctors face new accountability and liability issues

In the home situation, factors influencing recovery or general health are harder for the doctor to control. For example, healthy food might be very important for patient recovery. However, at home the doctor and nurse cannot ensure that a patient eats healthy meals. Yet the doctor is ultimately accountable for the results of patient care through all kinds of quality of care measures, even though the doctor cannot control all factors as much as in a hospital setting.

Distance care for patients also introduces a new dilemma for doctors concerning liability. Is a doctor legally liable when he or she ignores serious signals from a monitoring device? Take, for

¹² Alper, B., Hand, J., Elliott, S. Kinkade, S., Hauan, M., Onion, K. and Sklar B., (2004). How much effort is needed to keep up with literature relevant for primary care. *Journal of the Medical Library Association*. Vol 92(4), pp. 429-437.

example, a patient with diabetes who regularly measures his or her glucose level, which is in turn automatically sent to an online system to which the doctor also has access. The patient has dangerously high levels during a period of time and this results in serious complications. The doctor could have prevented this from happening by checking the patient's information in the system and intervening in the self-management of the patient.

Combining forward and backward-looking approaches and $N=1$ with $N=\infty$ insights

To optimally treat patients with new methods and monitor them at home while, at the same time, using proven methods and technologies when appropriate, doctors should make an accurate segmentation of their patients. With this segmentation, a doctor can use risk assessment based on the characteristics of the patient and his or her health status to determine which patients can be treated safely at home and which cannot. To continuously evaluate this assessment, an agile model is required that combines mechanisms that both look forward to new technologies and backward to existing proven methods and technologies. The same holds for insights from large sets of patient data ($N=\infty$) and what is best for an individual patient ($N=1$). Doctors will have to find new ways to identify outliers that don't fit into the system. According to the system, these outliers could easily be treated at home, while in practice that would not be safe due to factors unaccounted for.

The forward-looking part of such an agile system is continuously trying to integrate new technologies, monitoring systems, risk-assessment factors and insights from increasing data sets to improve patient care and to send patients home whenever safely possible. The backward-looking part evaluates the appropriateness of existing systems and tries to identify outliers. By quickly switching from looking forward to looking backward, it is possible to have a progressive and safe system. Doctors are very well equipped to process high amounts of data and will be able to work in such an environment.

Hospital management

Hospital management runs an IT-based organisation

By all means, it is very important to manage the usage of hospital buildings, especially as they become increasingly empty when care moves to the home. However, the impact of this development

¹³ Annual hospital reports and analysis on the Gupta database.

on the cost structure of the hospital is limited, since only ~9% of hospital costs are building and equipment costs¹³. In contrast, hospitals spend increasingly more money on organising IT; it already holds that more has been invested in electronic health record systems than in buildings. In 2015, total hospital spending in the Netherlands on IT came to above 1 billion euros, which is about 5% of hospital costs¹⁴. This accounts for an increase of 60% over the last 6 years and this amount will continue to sharply increase as the movement of care to the home begins to take off.

Hospital management needs to organise technology and analytics to make care at home possible and safe. This transforms the role of the purchasing organisation from buying commodities as a single hospital to setting strategic alliances with other hospitals and parties that can integrate the devices in the care process. The new position of hospitals requires advanced IT and analytical skills, neither of which are currently core competencies of a hospital. It will be very challenging for smaller hospitals to reach a scale sufficient enough to be able to effectively source IT, manage IT infrastructure and employ data analytics. This could be a further incentive to increase scale for hospitals or unite in hospital groups.

A hospital cannot arrange these technologies alone, since the scale and complexity require alliances with large technological parties. At the same time, it is risky to form an alliance with a single manufacturer that will push its own products to the hospital. When another product is better or a completely new technology emerges, the hospital might not be able to take advantage of it. Take, for example, developments in the diabetes market – if a hospital has an agreement with a current large manufacturer of blood glucose meters, it might miss out on the opportunity to use the new glucose-measuring lens that Google is developing.

The protection of patient privacy also becomes increasingly important when patient data leaves the hospital building. The new European law concerning data leaks makes this a hot topic for hospitals to consider. Privacy cannot be arranged on the level of individual doctors, but needs to be prioritised by the hospital board.

Society faces new ethical choices

An ethical issue that the hospital faces is whether what is good enough for the group of patients is also good enough for each individual patient. In other words, though medical decisions are

¹⁴ Mxi.nl and analysis on the Gupta database.

based on the average patient ($N=\infty$), outliers ($N=1$) that don't fit the system still always exist. A doctor has to find the balance between these two views for his patients, but the hospital management has to set the framework.

A parallel could be made to banking where credit rate scoring has made a significant leap forward. Customers get a score based on factors such as their income, age and historical default rate, and a person with a low score will not get a loan from the bank. The bank takes a calculated risk at not giving a loan to someone that might actually be creditworthy due to factors not taken into account. However, in medicine it is not so easy to accept the responsibility of misjudgement based on a model that is correct for the majority of people. Stephan Gould addresses this topic in his interesting essay 'The Median Is Not the Message', in which he writes about misjudging statistical data and how he turned out to be the outlier that survived.

As a society we have to make sure that we invest enough time in this ethical discussion and adapt our legislation. We have to hurry to keep our legislation in pace with the common practice. Up to date legislation is very important to prevent us to enter a twilight zone that will harm trust and safety in healthcare.



Appendix: figures

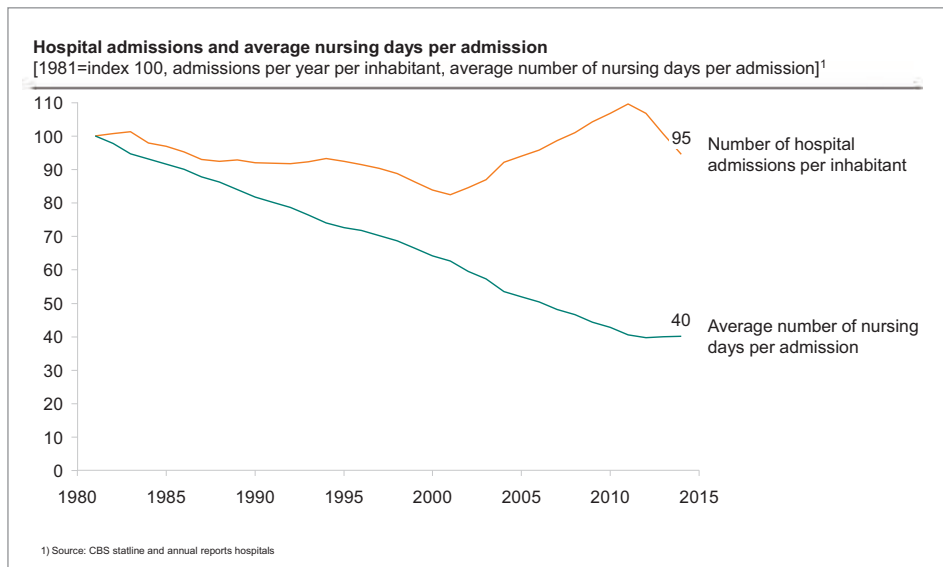


FIGURE 10:

Evolution of the number of hospital admissions and average nursing days per admission – people are admitted to the hospital almost as often as 30 years ago, but they stay in the hospital significantly less time

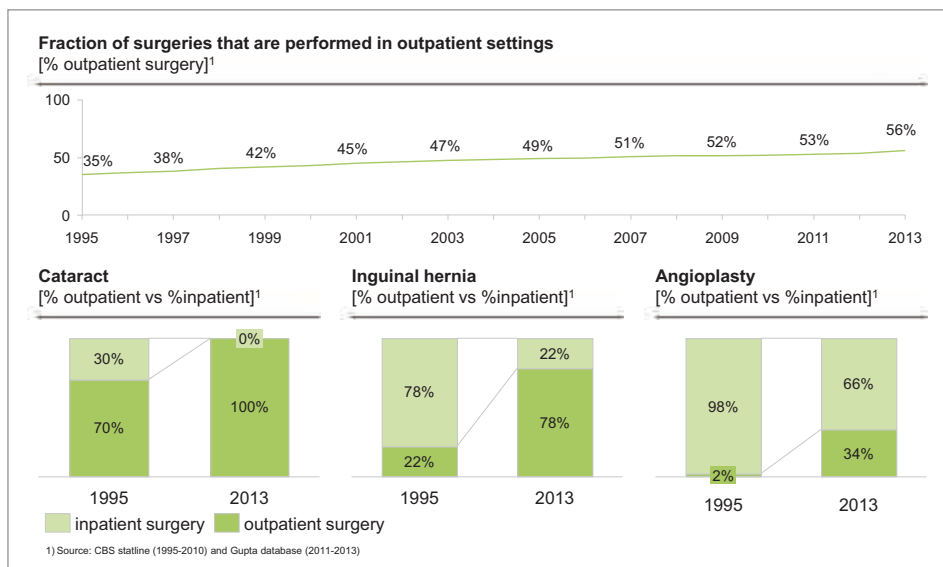


FIGURE 11:

Percentage of inpatient vs. outpatient surgery for three types of procedures – share of outpatient surgery has increased significantly over the past 20 years

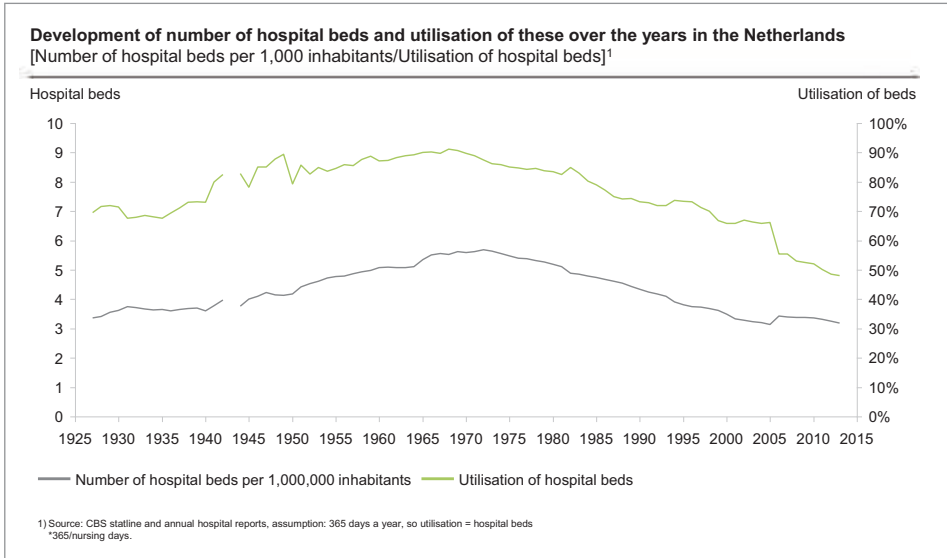


FIGURE 12:

Number of hospital beds in the Netherlands and utilisation of these beds since 1925 – number of hospital beds has slightly decreased over past 40 years, but still exceeds actual demand

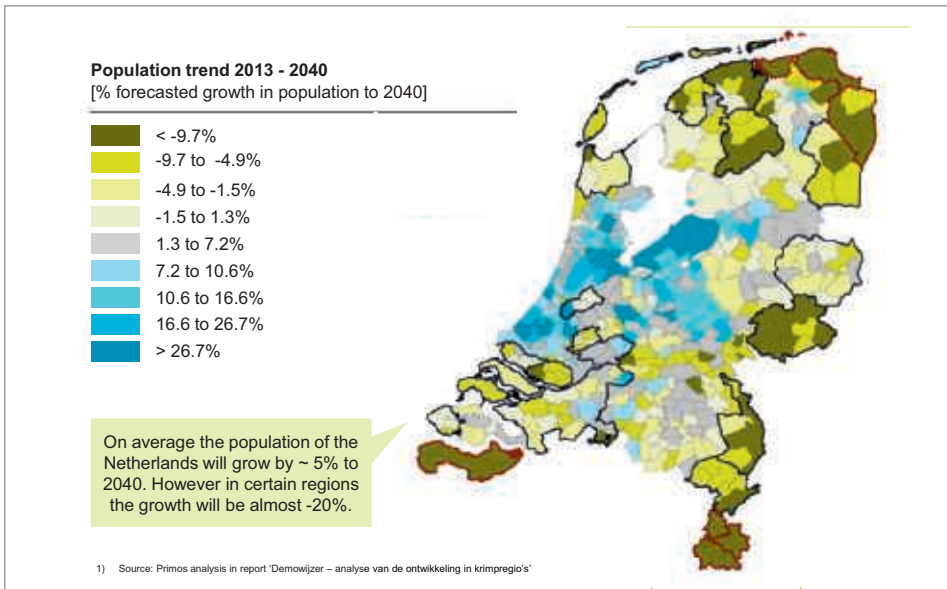


FIGURE 13:

Population development in the Netherlands between 2013 and 2040 – the population in certain regions is forecasted to decline by more than 10%

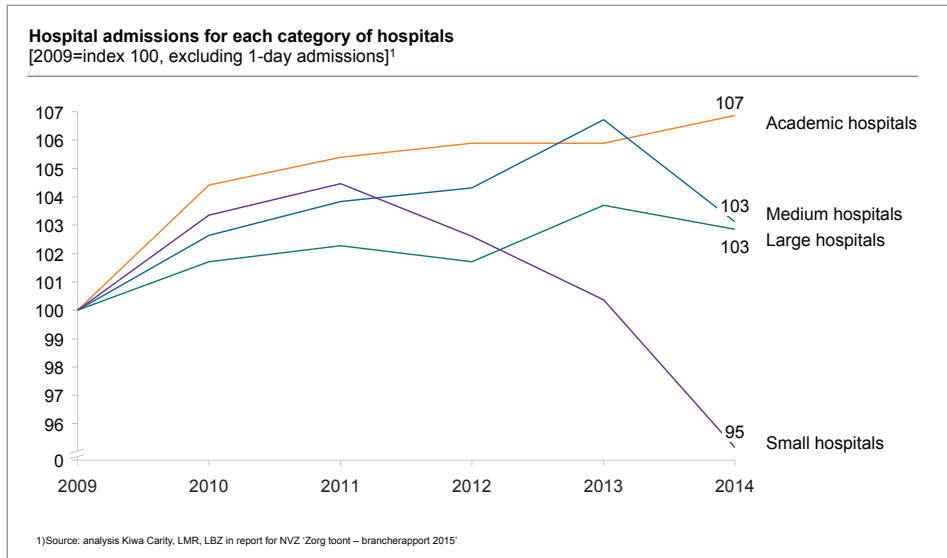


FIGURE 14:

Development of hospital admissions for different types of hospitals, excluding admissions for 1 day¹⁵ – hospital admissions have increased for all types of hospitals except for small hospitals, where they have significantly decreased

¹⁵ The categorization of hospitals hasn't changed over these years; there are 8 academic hospitals and each of the other categories consist of 27 hospitals.