Balancing supply and demand for dementia care in the Netherlands

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Abstract

Health care in the Netherlands presents a unique mix of governmental and private responsibilities. Costs for long-term care, expensive treatments and uninsurable care for the complete Dutch population are covered by the Exceptional Medical Expenses Act (AWBZ). The administration of care services under the AWBZ is the responsibility of 32 regional offices. In each region the insurer with the highest number of clients is charged with planning and administration of AWBZ care services. At present, health care services are provided by not-for-profit organizations such as hospitals and nursing homes. Every health care provider operates under a contract with the regional administration office and needs to stay within an estimated maximum capacity. Once contracted services are available, insurers are obliged to reimburse providers for these services even if they are not used by clients. In the coming years part of the Dutch health care will be deregulated and several types of care will be offered under market conditions. Whereas costs for care capacity are at present reimbursed by the government, this situation might change in the future. Regional care offices generally have adequate insight into short term developments in demand and supply for care services. Long term developments are however more difficult to predict. In this case a health care insurer feared that current expansions of nursing home capacity might overshoot their target. In effect the insurer wanted to know whether they were constructing nursing homes that would be left unoccupied

in a few years' time. This paper describes a system dynamics study on demand and supply for a specific type of nursing care, dementia, in a single care region. The model shows how feedback between waiting lists and volume of different types of demand for care, leads to fluctuations in required nursing capacity. The feared overshoot in long term nursing capacity did not materialize in model runs under a range of environmental scenarios.

Introduction

Health insurance and health care in the Netherlands are to a great extent regulated by the central government. Health care costs are covered by three categories of insurance that provide access to the following services (Ministry of Health, Welfare and Sports, 2005):

1. The Exceptional Medical Expenses Act (Algemene Wet Bijzondere Ziektekosten or AWBZ) which covers long-term care, expensive treatments and uninsurable care such as institutionalized care for elderly or disabled people, home care, and psychiatric care. This form of insurance covers all citizens of the Netherlands.
2. The Sickness Fund Insurance (Ziekenfondswet or ZFW) which covers acute medical care, private health insurance and specific care for civil servants, including hospital admittance, medical care, medical aids and pharmaceuticals, maternity care and dental care. This form of insurance applies to youths under the age of 18, employed or self-employed persons with lower incomes, certain groups of retired persons, and unemployed or welfare recipients.
3. Private Supplemental Insurance which Dutch citizens may opt to take for other health care costs not covered under the first two categories.

Two thirds of the population are members of a sickness fund; one third carries private health insurance. Direct patient payment and government subsidies play a minor role in covering health expenditures.

AWBZ health care is administered in 32 regional offices. A regional office is managed by the health care insurance company that insures the largest percentage of people in the region. These organizational entities are called 'care offices'. Care offices are responsible for balancing demand and supply of AWBZ care, which is a challenging task. Health care providers contract with the care office and are obliged to remain within an estimated maximum capacity. The care office reimburses a care provider for its total capacity of available services, regardless of the extent to which services were actually used by clients. At present balancing demand and supply of care services is primarily important from the perspective of efficiently spending government money. In the coming years part of the Dutch health care will be deregulated and several types of care will be offered under market conditions. Whereas costs for care capacity are at present reimbursed by the government, this situation might change in the future. In the situation when excess capacity is not reimbursed by the insurer, care providers will be more reluctant to increase capacity if future demand is uncertain. For the insurer on the other hand, capacity that is contracted under present regulations but is not used by clients in the future will lead to costs that are not covered by client fees. At present different scenarios for introducing market conditions in the Dutch health care sector are still being discussed. Even without changing regulations, long-term developments in health care are difficult to foresee. Understanding future developments of demand and supply is however necessary since decisions on health care services have long term consequences. The trajectory from planning to deliverance of new infrastructure for example takes about seven years. Traditional spreadsheet-based planning techniques seem to offer little support for long term planning. Supply and demand of care services are influenced by a lot of factors that are often interrelated. These factors come from a variety of areas like demography, culture and public policy. Interrelations are often nonlinear and subject to different time delays.

Achmea is a large health insurance company that administrates care offices in the Netherlands. In December 2003 the company started a research project with the goal to increase understanding of long term developments in health care supply and demand. The research project explored the possible added value of system dynamics for long term planning of AWBZ care. In order to estimate the added value of system dynamics, the project focused on supply and demand for a specific type of care in a single care region. Dementia care was chosen as the topic of interest, since planning around this type of care had been particularly difficult in the past. Dementia is a prevalent disease among the elderly and accounts for 4.9 percent of Dutch health care costs (estimate for 1999, Polder and Takken, 2002). In addition the number of people suffering from dementia is expected to increase by 40 percent between 2000 and 2020 (De Lange, Poos and Gijsen, 2004). The project was restricted to the geographical area Kennemerland in the north west of the Netherlands. Achmea administrates the care office in Kennemerland, which facilitates access to data. In the remainder of the paper we describe previous applications of system dynamics to health care, the process of building the model, the structure of the resulting model, baseline behavior, validity tests and policy experiments. We close with conclusions and recommendations.

System dynamics and health care

Health care has been an active area of research in system dynamics, as is evidenced by a special issue of System dynamics review on health and health care dynamics (Fall 1999), over 120 references to health care in the most recent system dynamics bibliography and plenary presentations at last year's conference (Wolstenholme et al., 2004; Homer et al., 2004). Group model building projects on problems related to health care are reported by Huz (1999), Royston et al. (1999) and Cavana et al. (1999). In the Netherlands system dynamics has been applied to health care related problems by Vennix et al. (1990), Bronkhorst et a. (1991), Post et al. (1992), Verburgh (1994), Vennix and Gubbels (1994). Most of the Dutch studies focus at the national level. The single exception is the study of Verburgh which builds on the conceptual model of national health care costs developed by Vennix et al. The client in Verburgh's study, a health insurance organization, adapts the model and participates in policy experiments. The number of applications seems to suggest system dynamics can offer useful insights into health care related problems. The present study contributes to research conducted in the Netherlands by focusing at a regional level and one particular type of health care service.

Is system dynamics a useful method in the situation introduced above? On the basis of criteria formulated by Meadows (1980), Lyneis (1980), Post et al. (1992) and Vennix (1996) we feel that this appears to be a the case:

- There seem to be feedback effects; policy makers involved indicated that demand increases when the amount of beds for elderly increases.
- There are delayed relationships, e.g. the construction time for nursing homes;
- The model is aimed at long term prediction.
- There seem to be non-linear effects.
- Variables of multiple areas are taken into account in the model: examples are the processes of building health infrastructure, assigning nursing care to patients and influences of waiting time on decision makers.
- Qualitative variables play an important role; e.g. the action of decision makers will influence the behavior of the model.

Besides checking if system dynamics is an appropriate method in this case, it is important to take a closer look at the way system dynamics is used. Post et al. (1992) described a number of conditions that improve the usefulness of constructed system dynamics models. These conditions are:

- make ‘small’ models;
- model a problem and not a system;
- from the start keep the implementation of the results into account;
- let the future user of the model participate in the model-building process;
- use the model not only for making predictions, but also for structuring a policy problem and creating insight in this problem;
- provide good documentation of the model.

According to the researchers these conditions were met in this project. There are, however, some things that can be improved, as will be revealed by the remainder of the paper.

Process of model construction

The study on supply and demand for dementia care in Kennemerland was conducted in two phases. In the first phase, from January to August 2004, a conceptual model was built. Information sources in this part of the study were documents related to dementia care and expert interviews. On the basis of research papers, policy reports, Internet publications and secondary data provided by Achmea a first conceptual model was constructed. This model was then shown to experts in the field in a series of interviews. Experts were chosen to represent the following fields: care offices, health care insurance organizations, infrastructure, the Regional Assessment Boards (responsible for assigning clients to different forms of AWBZ care), health care training, nursing homes, research and consultancy. The list of interviewees was to include representatives from client organizations and the government. However, in the time period of the research the experts who were contacted turned out to be unable to participate. Experts' comments were used to revise the model and complete the final report of this phase of the research (Bergman and Everwijn, 2004). In October 2004 the experts involved in the first phase were invited to a workshop, in which the report and revised conceptual model were presented. This workshop was also used to present a preliminary quantitative model.

In the second phase of the project the quantitative model was revised on the basis of data provided by the experts, additional documents and databases on health care services provided by Achmea. Data from the expert group were gathered by using a workbook tailored to each participant's role in health care planning. After using the information gathered with these workbooks a final presentation was organized in which the participants could provide feedback on the final model structure and the behavior of the model in various scenario's. This resulted in the final report of the second phase of this model building process (Van der Sanden, 2005) which was provided to Achmea to support them in the use of the model.

Description of the causal structure of the model

In this section the causal structure of the model is described. We will also outline the the results of the data collection of the most important variables. The model is divided into three partial models on clients, infrastructure and personnel. Next, the main feedback loops in the model are described.

Clients

The first part of the model shows the flow of aged people who develop a need for AWBZ care. At the left side of the model people diagnosed with dementia are flowing into the model. Dementia is a slowly developing disease. Depending on the strictness of the criteria applied, the diagnosis 'dementia' is made at a different point in the development of this progressive disease. The incidence of dementia is highly dependent on the age of people. When a person experiences problems due to dementia, he or she can either choose to ask for care, or to try to care for him- or herself, eventually with help from family or other informal care. In the first case, the person flows into the stock of self-supplying aged people. In the second case the person makes a request for indication of AWBZ care. When this request is approved, a person in the majority of cases receives care in a nursing home. However, nursing home care is often scarce because of shortages in infrastructure (buildings, beds) and staff, so people often are placed on a waiting list. Most of the time people receive temporary care to bridge the time they are on the waiting list. When capacity is available, people are assigned to nursing home care. When the nursing care ends, people flow out of the system. Mostly this happens when people die.

When people place a request for AWBZ care, other care than nursing home care may also be assigned. The distribution of nursing home care compared to other AWBZ care is an important variable. It is influenced by the policy of the responsible Regional Assessment Board and by the preferences of the clients. If the waiting time for care in a nursing home increases, clients' perceived waiting time increases and it grows less attractive to ask for this type of care. As a result fewer clients will ask for nursing care and the distribution will change. Formally, the Regional Assessment Board does not take the waiting lists into account in its decision, but there are indications that the perceived waiting time does have an influence on the decision process of the boards.

There are a couple of important time delays. First, there is an information delay in the perception of policy makers regarding the demand for nursing home care, which can cause planning problems. Second, it takes time for the Regional Assessment Board to process a request. Also, when capacity is available, it takes some time to formally assign a person to a nursing home.

Since the people in this system are relatively old, it must be taken into account that in every stock a certain percentage of the aged people will pass away. This is displayed by the flows of mortality. The model is shown in figure 1.

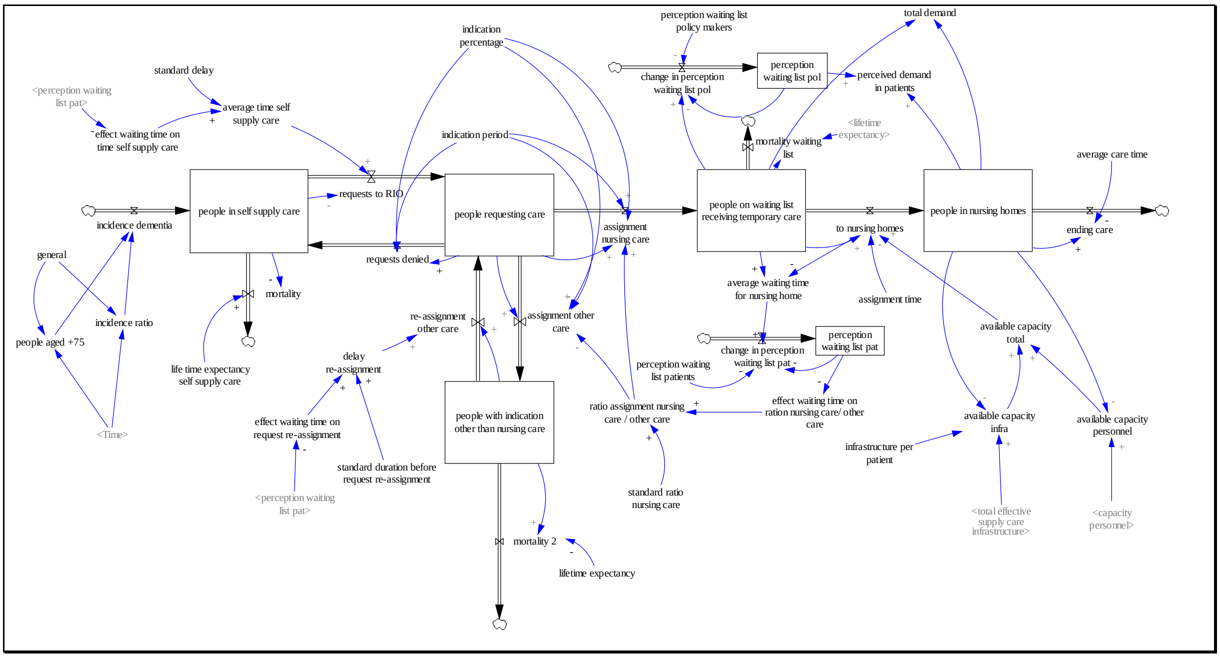


Figure 1. Partial model of client flow

During the data collection process only a number of variables could be filled with data directly (see appendix 1). However, we were not able to quantify a lot of variables in the data sources available. There was simply no data collected on the specific topics that we needed for our model. For these variables we had to make some assumptions before we could use them in the model. In Appendix 2 you find the variables in the client flow with the assumptions we made. The main sources for out data we could use directly were earlier studies from Timmermans and Woittiez (2004) and publications of other organizations (Bureau Lindenhoek and the SCP). The main assumption we had to make for the data which couldn't be used immediately, was the fact that elderly which are being treated for dementia are (almost) equal to the people receiving psychogeriatric care. This assumption was based on the fact that the RIVM reported that dementia compromises 93 % of the total amount of costs made for psychogeriatric care. For the details of data used in this model we refer to appendices 1 and 2.

Infrastructure

In the second part of the model the processes regarding the construction of health care infrastructure (buildings, beds and care facilities) are depicted. Based on the expected demand for health care services, policy makers estimate an expected demand for care infrastructure. The discrepancy between supply and demand of health care infrastructure determines the desired amount of infrastructure to be realized. In its planning process the care office tries to take into account the infrastructure that is under construction. However, estimations of when new volumes of infrastructure become available is not always accurate. In this process of estimating the desired infrastructure to be realized, an information delay is at work.

When additional infrastructure is taken into planning, it takes some time before the plans are approved by the responsible policy makers. If approved, it takes on average seven years to construct the infrastructure. Client demands might change over time and influence the perceived quality of buildings. In the model a distinction is made between modern and aged infrastructure. Clients do not prefer to live in aged nursing homes, and thus in some care regions waiting lists exist although (aged) nursing homes are not used to full capacity. When technically depreciated, the infrastructure flows out of the system.

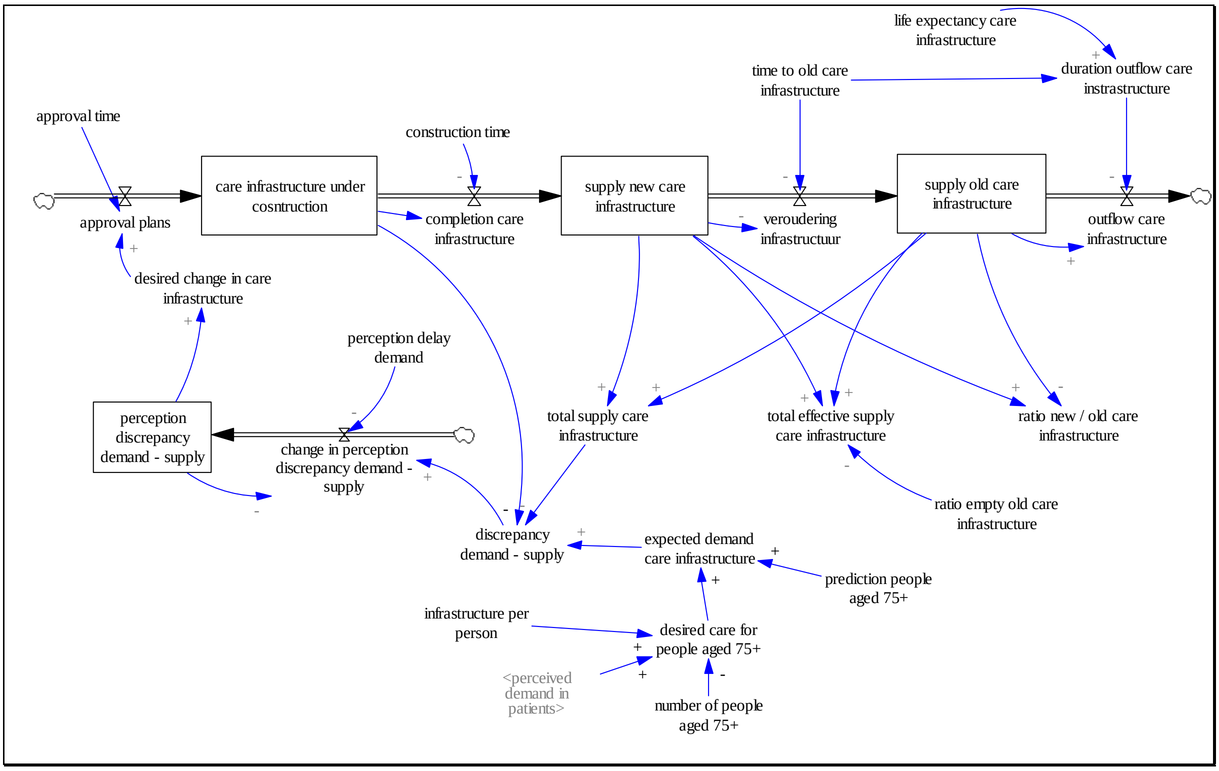


Figure 2. Partial model of infrastructure

For this part of the model we could find a part of the variables directly in the data sources used (see appendix 3). For other variables we had to make assumptions again (appendix 4). Data directly used in the model most often came from experts in the field which were interviewed. The indirect data was calculated with both data from a central database and knowledge from one of the experts.

Personnel

In the third part of the model the processes regarding the workforce in nursing home care are shown. Based on the number of people receiving care in nursing homes and average productivity, the total desired workforce is calculated. Depending on the current workforce there can be a shortage or an excess of workforce. To resolve this discrepancy, employees can be hired or fired. Because of scarcity on the labor market, it can be hard for nursing homes to employ appropriate workforce. This is included in the model by the effect of total demand of workforce for other health care on the hiring time.

Depending on workforce discrepancy of, employees perceive a certain workload. This workload has an effect on the turnover percentage as well as on productivity. So when workload is high, the capacity of personnel is negatively influenced in two ways.

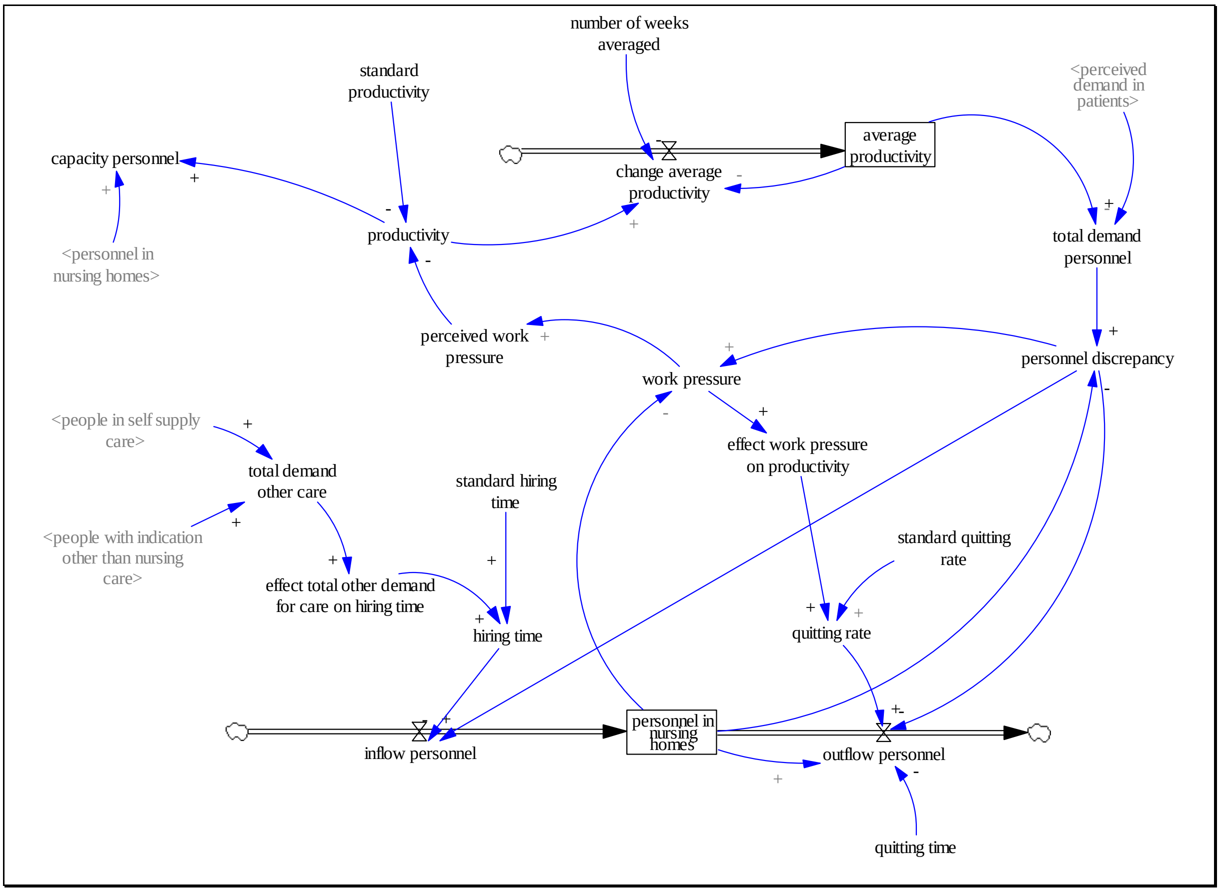


Figure 3. Partial model of personnel

In this part of the model we again had to make some assumptions for a number of variables while others could be directly filled with data (appendices 5 and 6). Directly used data came from the workbooks send to the experts, while assumed data was based upon the LISA-database.

Feedback

In the model, different feedback processes are at work. The most important loops are shown in figure 4. There are three balancing loops involving the waiting time for nursing homes.

If waiting time increases, perceived waiting time will also increase. As a consequence fewer clients will place a request for nursing home care. As described above, it seems that the decision-makers at the Regional Assessment Board informally adapt their assignments to the waiting lists. This leads to fewer indications for nursing home care and consequently to a shorter waiting time. A longer perceived waiting time will also have an effect on the behavior of aged people that receive other AWBZ care. When the perceived waiting time is long, there will be fewer requests for nursing home care. In effect, the waiting list will grow shorter, so over time perceived waiting time will decrease. The perceived waiting time will also positively influence the time that aged people will be self-supplying. As a consequence, fewer people will be assigned to nursing home care and waiting time will be shorter.

Another set of feedback loops concerns the health care infrastructure. When there is a perceived discrepancy between capacity and desired capacity, new infrastructure will be taken into planning. With a material delay, this will lead to more capacity and the discrepancy will decrease.

Finally there are three feedback loops concerning supply of workforce. The effects of an increase in workload cause two reinforcing loops. When workload increases too much, productivity decreases. By consequence, the number of employees needed increases and so does the shortage in workforce. This makes the workload increase. Another consequence of an increase in workload is the effect on turnover percentage. More people will look for another job if workload is too high. This increases the shortage in workforce and consequently increases workload. A final, self-evident balancing feedback loop concerns the hiring and firing of workforce. Existence of a shortage of workforce will, over time, lead to hiring of employees while an excess of workforce will lead to firing of employees. In both cases the discrepancy will decrease over time.

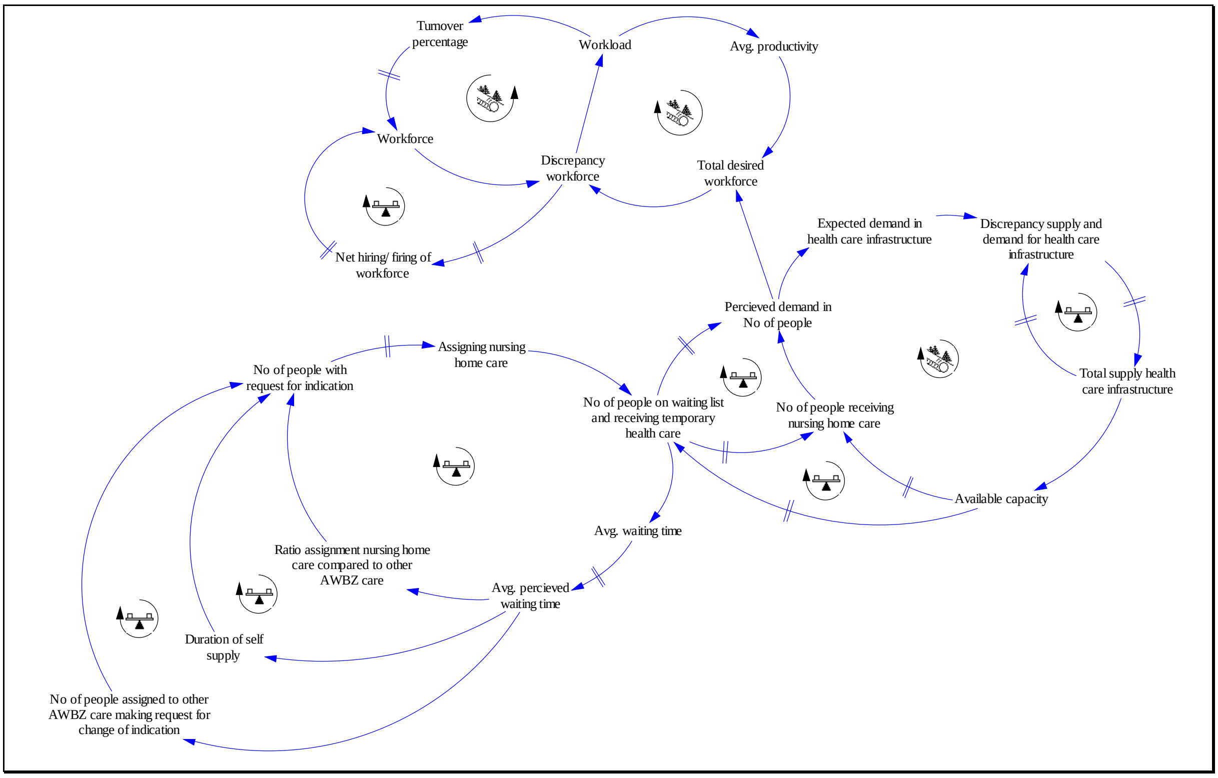


Figure 4. Feedbackloops

Baseline behavior

In this section we describe the behavior of the model under the condition that structural, policy and contextual parameters do not change. Figure 5 shows the incidence of dementia from 2000 to 2020, which is an exogenous input to the model. (ZOïS-database, 2004)

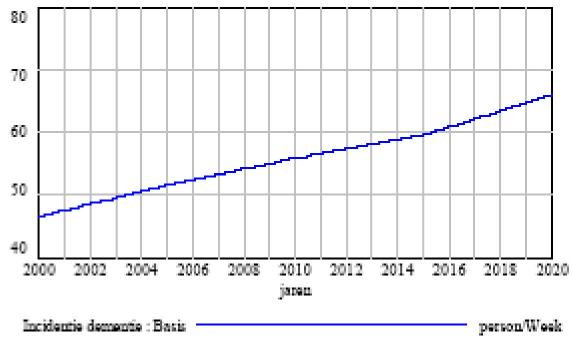


Figure 5. Baseline Incidence of dementia (exogenous input)

Policy makers in health care planning often focus on the number of people on waiting lists and the number of people in nursing homes as the main indicators for the field. Figure 6 shows the behavior of these two indicators.

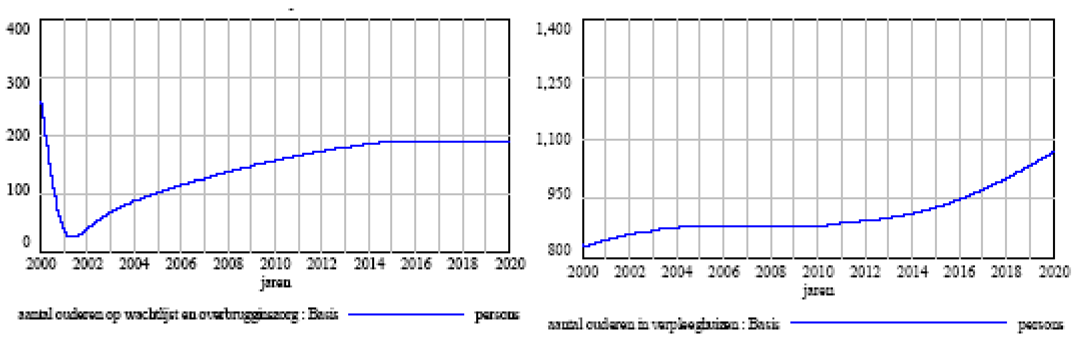


Figure 6. Baseline waiting lists and number of people in nursing homes

The figures show that the increase in incidence rate does not directly result in an increase in waiting lists and people in nursing homes. Two processes are responsible for this. First, the long waiting lists keeps people at home (more people remain self-supplying) and the Regional Assessment Board is less likely to refer people to nursing care. Second, the large construction volumes at the beginning of the simulation run limit the waiting lists and increase the number of people in nursing homes from 2010 on. The volume of infrastructure is shown in figure 7.

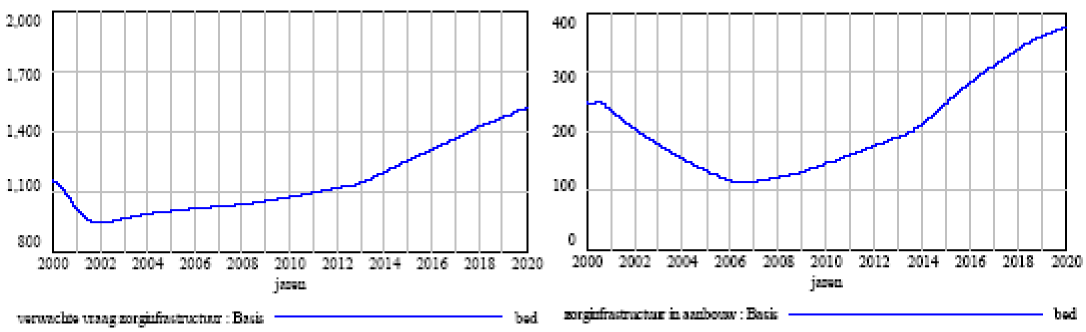


Figure 7. Baseline expected demand for care infrastructure and infrastructure under construction (in number of beds)

Because the capacity of infrastructure is expanded in the first years of the simulation run, waiting lists grow shorter (figure 6). Together with an increase in incidence, this leads to more requests for nursing care. Over time waiting lists start increasing again as capacity cannot be increased immediately, since planning and construction take a number of years.

Validation tests

This model has been subjected to the ten basic tests formulated by Forrester and Senge (1980): the structure verification test, the parameter verification test, the extreme condition test, the boundary adequacy test, the dimensional consistency check, the behavior reproduction test, the behavior anomaly test, the behavior sensitivity test, the changed behavior prediction and the policy sensitivity test.

The model passes most of the tests without any problems. Four tests deserve special attention. The tests that are inconclusive are the structure verification test and the boundary adequacy test. In the first expert workshop, some participants criticized both the structure of the model and the model boundary. In response to these criticisms the model has been changed or choices have been explained. The second workshop didn't give much new criticism. So most feedback was dealt with in a correct way according to the respondents.

The tests that cast some doubt on the model's validity were the parameter verification test and the extreme condition test. This was caused by a known problem in system dynamics (Verburgh 1994; Wolstenholme 2004): problems with the collection of the required data. The researchers have tried to identify the likely range over which these parameter values could vary, and conduct a sensitivity test on the basis of minimum and maximum values. For example, the incidence of dementia is a parameter that is unsure and has large consequences for the behavior of the model. This uncertainty comes from the disease of dementia itself. It is hard to say when people exactly have dementia, because it's a slowly surfacing disease. The difference in the data sources concerning the amount of people that have dementia comes from this characteristic of the disease. This doesn't improve the validity of the model and needs to be kept in mind while looking at the results the model produces. However with all the uncertainties in the parameter values, the behavior reproduction test gave a lot of confidence in the model. The historic behavior was matched closely, which is shown in figures 8 and 9. The left part of figure 9 shows the historic and simulated waiting list that seems to develop along a quite different path. However, in the opinion of several experts historic data on waiting lists are suspect and it may be better to consider the delayed perception of the waiting list. This is depicted in the right part of figure 9.

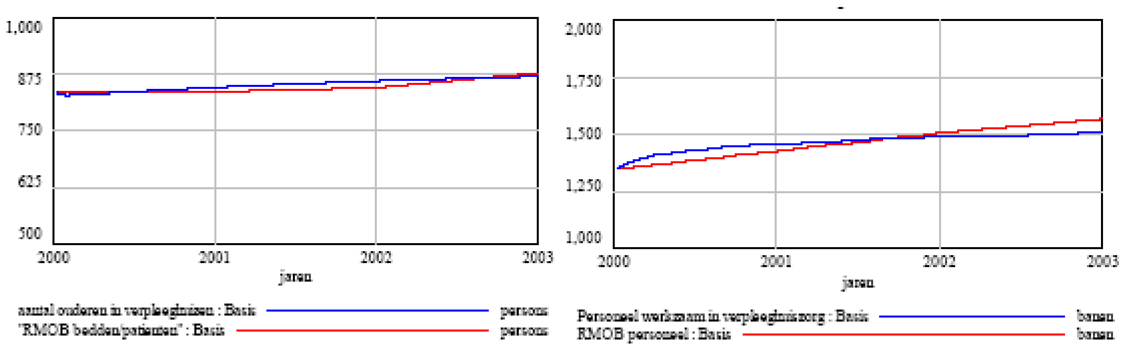


Figure 8. Historical data and model behavior for number of people in nursing homes and personnel

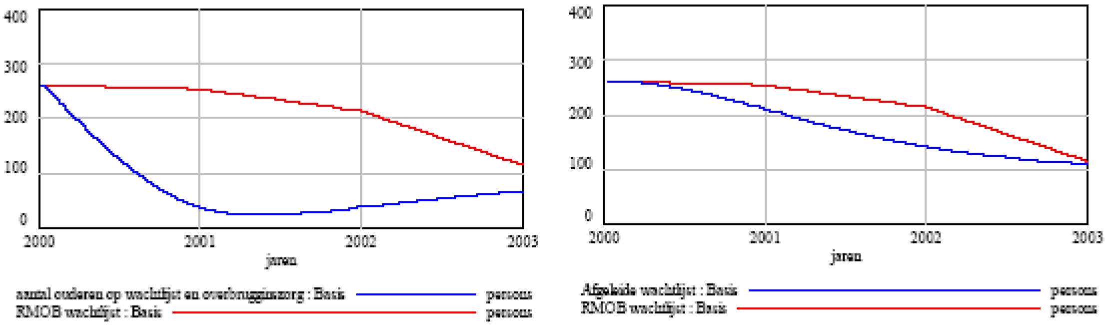


Figure 9. Historical data and model behavior for waiting list and perceived waiting list

The extreme conditions test showed a problem with a part of the mode: the workforce. Due to the adjustments made to the model in the quantification phase, the influence of this part of the model was diminished so much the behavior shown at the extreme condition test was not plausible anymore. When there is no personnel in nursing homes, the model still allows new patients to get assigned to places in nursing homes.

While building the model the researchers chose not to build the model of the workforce in detail, because it was so complex and not strictly necessary looking at the goal of the model. Why was this part of the model not removed entirely from the model? This was done for two reasons: first it gives insight into the workforce that is needed in different scenarios. Second it keeps the attention to an important part of the real system and might give future researchers a good starting point for new research.

All together it can be said that the tests provide enough confidence in the model to continue the research with the model.

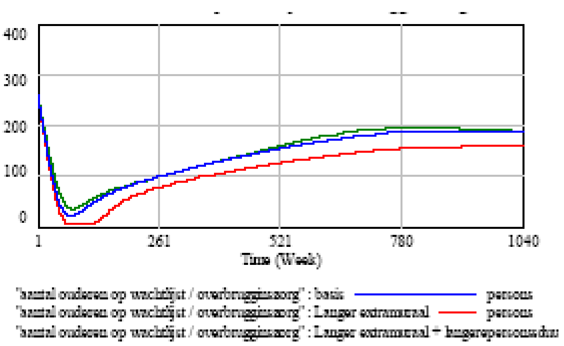
Policy experiments

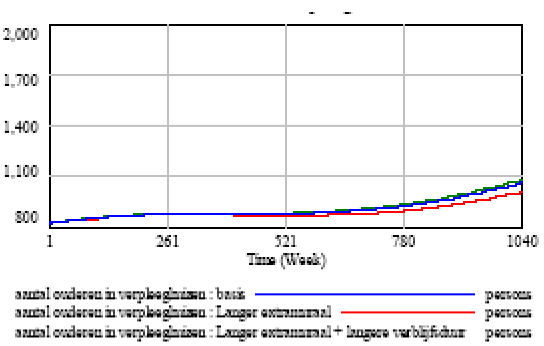
With the model a number of policy experiments have been conducted. The experiments were a combination of changes in policy with different developments of the environment. These experiments were set up in consultation with the clients. The following table shows the combinations that have been run with the implications to the model. We chose these combinations as they came out of our consultation with Achmea as scenario's which could give them additional insight into the system, With these combinations the policy makers expected certain problems to appear. People at Achmea assume that a proper way to deal with overcrowded nursing homes (for example because people in nursing homes live longer) is to give them nursing care outside the nursing homes (i.e. at home) longer. With the second policy-environment combinations (see table 1) it was assumed that there would be a large overcapacity at the nursing homes, because the feedback loop that usually fills up empty spaces gets less strong. The final combination is interesting, because the lower incidence leads to a lower demand in nursing home care. It was assumed that the system would react more efficiently (less overproduction) when construction time was reduced.

Policy	Environment	Changes to the model
People longer outside the nursing care homes	Standard	Standard ratio: 0.1 → 0.09
	No of people in nursing care homes live longer	Standard ratio: 0.1 → 0.09 Average nursing time: 101 → 120
Build more health infrastructure	Standard	Extra inflow: 10*PULSE(261, 60)[1]
	Less strong feedback effects waiting time	Extra inflow: 10*PULSE(261, 60)[1] Help: 1 → 2 [2]
Shorter building time	Standard	Construction time: 364 → 290
	Lower incidence of dementia	Construction time: 364 → 290 Percentage incidence: Till week 260 it stays the same. After that it declines till 80 % of the standard scenario.

Table 1. Overview of policy experiments

By running the above scenarios it was possible to give an answer to the question Achmea was asking: "Are we building the empty nursing homes of the day after tomorrow?" Below the results for the first scenario are shown.





[1] This "Pulse"-function produces from week 261 an extra inflow of 10 beds a week for 60 weeks. This gives a total of 600 extra beds.
[2] In comparison to the baseline parameter setting, the feedback effect is now reduced to .5. In the most extreme circumstance (with no waiting time) the number of people assigned to nursing home care grows with only 10 percent.

Figure 10. Results of scenario ‘People longer outside the nursing care homes’ for number of people on waiting list and people in nursing homes (1. baseline; 2. longer at home; 3. longer at home and live longer)

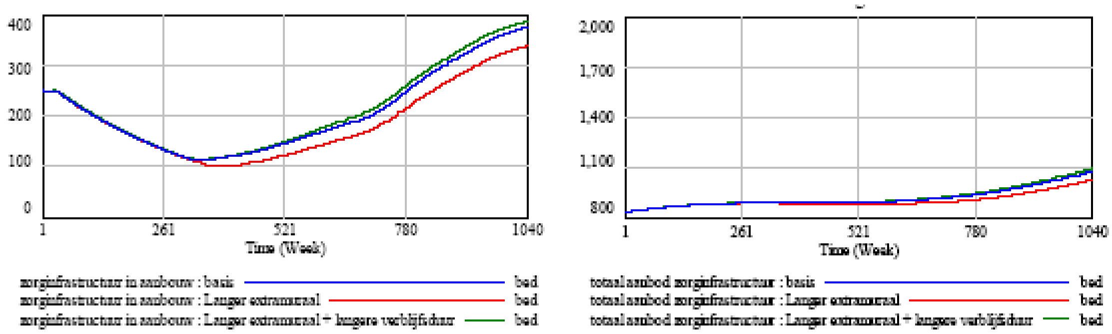


Figure 11. Results of scenario ‘People longer outside the nursing care homes’ for infrastructure under construction and total infrastructure (number of beds, 1. baseline; 2. longer at home; 3. longer at home and live longer)

From figure 10 and 11 it appears that the policy of increasing extramural care (people stay at home longer) is almost completely offset by an increase in life expectancy.

None of the scenarios shows long-term empty nursing homes. Even when we artificially build an extra health infrastructure capacity of 600 beds, they are all occupied by the end of the simulation period. The main reason for this is the feedback effect of waiting time on the duration of self supply, the delay for request for change of indication and the ratio assignment nursing home care compared to other AWBZ care. These influences make sure that when the waiting list gets short and empty homes become a risk, the shorter waiting times make sure people who first took care of themselves now send a request for an indication sooner. People who already receive AWBZ care will sooner ask for a change of the received indication. This leads to a larger number of people requests an indication, so more people will be assigned to nursing homes. In addition the shorter waiting lists will encourage the Regional Assessment Boards to assign people to nursing homes. As described before in the case of long waiting lists this is less likely to occur, because a long waiting list has the effect that people will not get a place in a nursing home anyway. With a greater number of people with a request for indication and a larger percentage of people being assigned to nursing homes, no nursing homes will become empty. It needs to be said however, that definite data on the strength of the feedback effect are not available. The scenario with the weaker feedback effect shows that short term emptiness can occur. Nevertheless the historical behavior pattern suggests that the feedback effect exists and that its strength is considerable.

A policy change that can cope with threatening empty nursing homes is shortening the construction time. The model now responds slowly to changes in demand. So when it becomes apparent that there is adequate capacity, it takes a long time before this is seen in the supply of health infrastructure. With a shorter construction time the system responds faster to changes in demand, because the stock 'health infrastructure under construction' is smaller. This change in policy was also tested with a decline in incidence of dementia by 20 percent and it responded in such a way that no emptiness in nursing homes occurred.

Another way of coping with the uncertainty of the future number of people that needs nursing care is to provide nursing care outside of the nursing homes. New technologies provide alternative ways of doing this. The model shows that when less people get assigned to nursing homes by the indication organization the pressure on the nursing homes gets considerably lower. That this policy will lead to a reduction in problems infrastructural viewpoint does not mean it will be beneficial from other perspectives. In this new form of nursing care personnel is needed as well, so this change in policy can cause a huge pressure on the labor market. To look into this effect further an expansion of the model is required.

All in all it can be said that it is highly unlikely that emptiness will occur with nursing homes. Within certain scenario's it is possible to create this emptiness, but with a shorter construction time these problems will be dealt with. It needs to be said that Achmea can't change this policy on its own, but it needs to cooperate with other organizations in the field to get these results.

Conclusions and recommendations

During this project a number of problems occurred which make using system dynamics in this situation more difficult.

First of all there was the problem with the collection of the data needed for running the model. In summary, the use of system dynamics needs a different kind of data then the data currently collected (which is needed for the current planning methods). This meant that a number of uncertain assumptions had to be made while filling the model with data. The validity tests showed that despite these uncertain assumptions there is reason for some confidence in the results of the model. However, to make the use of system dynamics easier in the future the researchers recommend a change in the sort of data that is collected. This will further increase the trust put into the constructed models.

Secondly there were problems with defining the concepts used in the model. This problem is twofold. First there are the changes in the health care system that makes the indication of nursing home care decrease. To an increasing extent, intensive care for elderly is delivered independent of the home people live in. Although there is a lot of discussion, professionals agree more and more on that distinguishing in the delivery of care and living space increases quality and decreases costs.

There are also problems with definitions of concepts that influence the data. Different definitions lead to different measures and different data as a consequence. An example is the difference in the incidence of dementia that was found in two different sources. Another example is the existence of

self-supplying people that was disputed by different experts that were interviewed during the model-building process.
During the model-building process choices had to be made about what to include in the model and how to include it. These choices can negatively affect the trust people have in the results of the model. However, this also emphasizes a great advantage of system dynamics: the effects of different assumptions can be tested.

While describing the validity tests several recommendations were made about future research for expanding the model. Expanding the following parts of the model would greatly enhance its usefulness: taking other health care into account more detailed, and more precisely modeling the workforce process.
However, there are other, maybe more important questions that can be addressed and which this study cannot answer. One important issue is the quality of care. It would be interesting to know what quality outcomes the different scenario's would have, e.g. with varying waiting lists and varying distribution of types of care. Another important issue concerns the costs of care. One of the criticisms of the AWBZ care is that it is too expensive. Efficiency indicators are not included in the model. It would be very interesting to be able to simulate different policy scenarios, e.g. to calculate what distribution of types of care is the most cost efficient.

A final criticism; the implementation of the model in supporting planning at Achmea is somewhat delayed. Therefore the model has not proven its value yet in supporting the planning process. It is recommended that Achmea would appoint someone who will manage the future use of the system dynamics models.

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Appendix 1

Variabel	Source	Value
No. Of people 75+	IPB oktober 2002 (uit: Zorgweb Haaglanden, Bureau Lindenhoek, 2004)	Graph, pictured in figure 2
standard delay request for change of indication	SCP-rapport "Vragen om hulp" (2004)	104 weeks
Standard ratio	Verpleging en Verzorging verklaard, 2004, Timmermans & Woittiez, Tabel 2.1, Blz 12	0.1 (=10 %)
Assignment percentage	Verpleging en Verzorging verklaard, 2004, Timmermans en Woittiez	0.95 (=95 %)
Delay of indication	Congress "Indicatiestelling op de helling"	4 weeks

Table 1: Variabels in the client flow directly filled with data

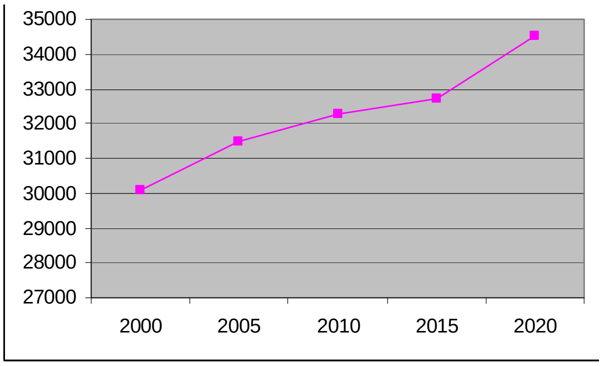

Figure 2: No. Of people 75+ in the Kennemerland-region

Appendix 2

Variabel	Source	Value	Assumption
No of people with dementia in nursing homes (in 2000)	Centraal Administratie Kantoor (uit: ZOÏS database)	835 elderly	No. PG[3] beds in VPH[4] in Kennemerland in 2003 is 877 (of a total of 1520 VPH beds). No. beds in 2000 is 1448. If the share of PG patients stays the same, this means: 835 beds.
Life time expectancy self supply care	CBS bevolkinsstatistiek, Heeren e.a., 1992a	330 weeks	The life expectancy of pleople with dementia is 1,9 times as low as that of those without dementia. (Heeren e.a., 1992a). Of the people over 90 years old only 10 % lives at home (Piet van der Lei) Of the people over 75 years old 90 % lives at home. So the life expectance of this age group is used. This is: 12,074 years (CBS). For people with dementia this means 6,35 years.
Lifetime expectation	Arcares, CBS	220 weeks	Average caring time is 3,71 years for VZH[5] (Arcares). Also people of 75-79 years old (corrected for dementia live 4,71 years (CBS). Life expectancy will be in this range (in a VZH are the relative heavier cases of dementia which live

[3] Psychogeriatric
[4] Nursing homes
[5] Less intensive nursing homes

			relatively short). The average life expectancy of these two groups is 220 weeks.
Avarage nursing time	Arcares, RIVM	101 weeks	The average nursing time for psychogeriatric care is according to Arcares 710 days. We assume psychogeriatric care equals care for dementia, because dementia makes up 93 % of the total amount of costs for psychogeriatric care (RIVM).
No of people on waiting list and receiving temporary health care (in 2000)	Hoeksma, Homans & Menting (HHM)	260 elderly	Tota waiting list for VPH is 450 elderly in 2000. In a VPH 877 people out of 1520 are PG. 877/1520*450 = 260. Again the assumption PG = dementia.

Table 2: variable in client flow with assumptions

Appendix 3

Variable	**Source**	**Value**
Contruction time	Interviews Piet van der Lei and Marcel Garritsen	364 weeks
Average lifetime care infrastructure	http://www.woonzorg.nl/publicaties/media/corpbrochure2003.pdf	2600 weeks
average aging time health infrastructure	Interview Piet van der Lei, and www.woonzorg.nl	1300 weeks
Expected no. Of people 75+	IPB oktober 2002 (from: Zorgweb Haaglanden, Bureau Lindenhoek, 2004)	Graph, seen in figure 2.
Approval delay	Interviews Marcel Garritsen and Piet van der Lei	52 weeks
Percentage of aged infrastructure being uninhabited	workbooks	0 %

Table 3: variables in infrastructure model directly filled with data

Appendix 4

Variable	**Source**	**Value**	**Assumption**
Supply of old and new care infrastructure (in 2000)	Centraal Administratie Kantoor, interview Piet van der Lei	New: 417 beds Old: 418 beds	The total supply of infrastructure in 2000 was 835. Mr. Van der Lei said at the moment about half of the infrastructure is old and half is new.

Table 4: Variable in infrastructure model with assumptions

Appendix 5

Variable	Source	Value
Standard hiring time	Workbooks	10 weeks
Quiting time	Workbooks	8 weeks

Table 5: Variables in personnel model directly filled with data

Appendix 6

Variable	Source	Value	Assumption
Standard productivity	ETIN/ Landelijk InfoSysteem Arbeidsplaatsen (LISA)	0.56 elderly per person in the workforce	The division of jobs over PG en SOM[6] care in nursing homes is equal to the division of beds. This means in 2003 1520 persons in the workfoce took care for 877 patients.
Personnel in nursing homes (in 2000)	ETIN/ Landelijk InfoSysteem Arbeidsplaatsen (LISA)	1344 people	In 2003 there were 2330 people employed in VPH. We assumed PG and SOM patients required the same amount of personnel. Therefore we assume 877/1520 * 2330= 1344 people were employed to nurse the PG patients

Table 6: Variables in personnel model with assumptions

[6] Somatic