Long range planning of radiotherapy facilities in the Netherlands•

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Abstract

The subject of this paper is long range planning or policy development for healthcare in the Netherlands. Especially the co-ordinating function of planning will be discussed. In healthcare different actors or stakeholders are involved. Each of these actors may have their own interests, expectations, goals, and knowledge. The main goal of this paper is to discuss the alleged centralisation versus decentralisation dichotomy in healthcare strategic decision making and planning. The development of facilities for radiotherapy is used as an exemplary case for this explorative research. The radiotherapy case illustrates that a more centralised, comprehensive, and systemic way of planning and strategic decision making might be necessary to take into account and balance the different developments, which are relevant for this specific problem field, at the macro level. This kind of strategic process involves inputs from medical specialists and other experts with various disciplinary backgrounds. All relevant knowledge regarding facts and trends on demographic, social, epidemiological, technological, and therapeutic factors, and also those concerning the basic disciplines (such as biology) should be collected and analysed to obtain the insights needed. This expertise can not be found on a local or even regional level. It requires initiatives from co-ordinating boards like the Health Council, but also professional bodies play an important role, next to initiatives from influential and respected individuals.

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1. Introduction

In the Netherlands, policy development, co-ordination, and decision making in the field of healthcare could be characterised as highly centralised. The Ministry of Healthcare and its advisory boards: The Health Council ("Gezondheidsraad"), the Council for Hospital Facilities ("College voor Ziekenhuisvoorzieningen"), the Dutch Sickfund Council (former "Ziekenfondsraad"), and the organisations of general practitioners and medical specialists were the main actors. They operated primarily on the macro-level. Strategic initiatives were, however, usually taken in hospitals and regional co-operative bodies, on the micro and meso level. The roles of the national government and its advisory bodies were mainly defined by an institutional legal context (esp. article 18 of the Law for Hospital Facilities should be mentioned)[1] and confined by macro-economic conditions.

The responsibility of the Health Council is enacted by law. Its mission is to report to the government on the state of medicine and its consequences for the healthcare system. In practice, this council explores, forecasts, evaluates, and assesses specific new developments on their meaning and consequences for the healthcare system. Generally, these activities result in strategic outlooks and capacity plans for certain specialisms or functions of the healthcare system nation wide. The Council for Hospital Facilities has the function to test if certain individual initiatives of hospitals fit into the national capacity plans (for instance regarding numbers of beds), to test if they comply to conditions of efficiency, and to verify certain legal conditions. The (former) Dutch Sickfund Council has a function in the nation wide assessment of the costs and effects of existing and new medical technology. In the early nineties the roles of these main actors in policy development changed. This was partly caused by the emerging idea that cost containment in healthcare could be better realised by decentralisation, privatisation, and concomitant enhancement of the market function.

The continuous escalation of healthcare costs (in absolute numbers) during the seventies, eighties and nineties is mainly a consequence of the growth in the need for and supply of medical and related services. This growth is caused by a complexity of factors:

ageing of the population, increasing consumerism and growing expectations of patients about the possibilities of modern medicine, reinforced by the development, introduction, and marketing of new medical technologies and drugs (c.f. Mooney, 1994; Dunning et al., 1997). In order to realise cost containment, the Dutch government wants to act primarily as financier (for not insurable healthcare costs), and as price and budget regulator. Its main objective is maintaining a macro-economic goal: the healthcare budget should not exceed (about) 8% of the Gross National Product. The basic idea behind this policy is that the parties involved in healthcare delivery should also be responsible for the implementation of healthcare policy (and strategies). Insurance companies, medical specialists and their professional societies, and hospital management should negotiate and come to agreements within the conditions set by the government. In that way these - mostly - regional and local organised market-parties are assumed to be responsible for their strategic decisions and actions. Cost reductions are supposed to be the responsibility of the market-parties themselves. In this market-oriented view on healthcare, a more decentralised way of decision making and co-ordination is stressed (c.f. Coalition Agreement Dutch Government, 1994). One can observe that the emphasis shifted in this way from a centralised to a more decentralised point of view on policy development. The primary goal for healthcare remains an economic one, realising cost containment and, if possible, cost reduction in healthcare. The rationale behind this policy is also fed by the idea to maintain the prices of the Dutch products and services competitive on the international market. The level of wages is partly determined by the costs of healthcare, as a result of the way the healthcare system is financed in the Netherlands. It is, however, questionable if this ‘paradigm of competition’ really contributes to macro economic goals. There are situations in healthcare in which policy making cannot be performed effectively on the hospital or on the regional level. Because of the interaction between activities, developments, and capacities, a more centrally directed policy development on a higher level (both top down and bottom-up) may be preferred. Especially the assessment of the needs for healthcare facilities with relatively long development periods

and relatively high investments in capital-intensive assets and training may be best performed for a total population on a centralised basis. In that case, a more systematic and holistic approach for the assessment and the balancing of capacity needs and investments is necessary for matching the demands of the population, and for the best use of scarce resources. The interests of individual hospitals and other actors in the policy development can be more effectively matched and co-ordinated by an analysis of epidemiological, demographic, technological, and medical developments on a nation wide level, within an European context. This makes the gathering, analysing, combining and balancing of specific information on the various factors involved necessary. Leaving such an assessment of capacity needs together with allocation decisions, to the 'market mechanism' may lead to different kinds of misfits (too much capacity resulting in under-utilisation or the opposite resulting in waiting lists) and a waste of scarce resources.

The main goal of this paper is to address the seemingly dichotomy between a centrally directed and a more decentralised (market level) strategic decision making and co-ordination of the allocation and development of facilities in the healthcare sector. This discussion will be illustrated by making use of an exemplary case: the long term planning and decision making of facilities on behalf of radiotherapy in the Netherlands. By choosing this case, also some arguments for the value added of the so-called Dutch 'Poldermodel' are presented (c.f. Van Witteloostuijn, 1999).

This paper reflects explorative research and is not based on empirical testing. When in the following the word planning is used, it must be interpreted in the meaning of its co-ordinating function (Alexander, 1992). The choice for the case of radiotherapy is made, because of the fact that the policies regarding this subject are relatively well developed and documented. Moreover, in the last two decades in different developed countries (especially in Australia, the Netherlands, and Sweden) committees manned by leading professionals have developed consensus concerning a set of normative indicators for the use of radiotherapy. These indicators are based on data from clinical empirical

research and cancer registries. They enable needs assessment and capacity planning in a more comprehensive way and on a higher level than before.

In the next section, a few general dimensions of strategic decision making in healthcare are discussed. Subsequently, the case of radiotherapy is elaborated. Radiotherapy is one of the main modalities for the treatment of cancer, besides surgery and chemotherapy. A substantial part of the patients is treated by a combination of these modalities. Because of this, an outline is given of the care for cancer patients with its main diagnostic and treatment modalities and their mutual relationships. Also, a short overview of the history of the development of facilities for radiotherapy and its infrastructure in the Netherlands is presented. Next, capacity planning and allocation in this policy field are discussed. A capacity model is presented and its use for the development of a set of scenarios is demonstrated. This paper ends with some considerations related to this case, a discussion, and concluding remarks.

2. Strategic planning and decision making in healthcare

Strategic decisions are generally characterised by their high impact on the continuity of the whole or on important parts of an organisation or system; they have a high degree of uncertainty and/or are taken under partial ignorance about their consequences; they are focused on the long term direction; they are likely to be concerned with the scope of an organisation's activities, and finally, the idea that generally strategic decisions are mainly taken by the top management is also seen as a characteristic of strategic planning (c.f. Johnson and Scholes, 1997; Wheelen and Hunger, 2000). There are differences between strategic decision making in healthcare and the general characteristics mentioned, which reflect the situation in large machine organisations. In the healthcare system there is often not one body or one integrated system of decision making which determines the whole system (c.f. Mintzberg, 1989). In general, the actors in the healthcare system are professional bureaucracies. Strategic initiatives and decisions regarding the primary

processes within these organisations are taken at the level of the medical professionals in hospitals, in their societies or at an international level by the peers of their scientific communities. There are other strategic problems, initiated by other stakeholders on other levels in healthcare (examples are the initiatives and decisions to merge between hospitals and to construct new hospital buildings). These decisions are often initiated at the level of hospital boards, owners of hospitals or sometimes at the governmental level.

The various levels in strategic decision making or policy setting in the healthcare system are presented in table 1. We use as an example the field of cancer care with its large variety of organisations and stakeholders to show the potential complexity (c.f. Duncan et al., 1998).

Table 1 : Levels of policy and decision making in healthcare

Levels	Organisations	Examples
1. International	World wide	- World Health Organisation
		- Leading centres in science and development
		- International Agency for Research on Cancer
	European	- European Organisation for Research and Treatment of Cancer
		- European Association for Cancer Research
2. National	Parliament	- Different political parties
		- Parliamentary Commissions
	Government	- Department of Healthcare
		- Council for Hospital Facilities
	Professional organisations	- Royal Dutch Medical Association
		- Dutch Society for Radiotherapists
	Charity	- Dutch Cancer Foundation (KWF)
	Advisory boards	- Health Council
		- Dutch Sickfund Council
	Insurance companies	- Nation wide: FBTO
		- Regional: Univé
3. Regional	Comprehensive cancer centres	- Integral Cancer Centre for the Northern part of the Netherlands.
	Regional authorities	- SOOZ (Co-operation in the South-eastern part of the Netherlands between hospitals)
4. Local	Hospitals with sub-specialisation on the care for cancer patients	- Academic hospitals
		- General hospitals
		- Specialised oncology institutes (e.g. National Cancer Institute)
	Hospital departments	- Radiotherapy departments or institutes for radiotherapy
		- Internal medicine sub-specialised in oncology
		- Surgery sub-specialised in oncology
		- Gynaecology sub-specialised in oncology
		- Urology

	Practices of radiotherapy	- Legal partnerships of radiotherapists
		- Radiotherapists as employees of hospitals
	General practitioners	- Individual
		- Organised in group practices

On each of these levels strategic planning and decision making can be initiated and performed (see also Lindblom, 1980). There is a complex of factors which determines these decisions in healthcare. The most important are demographic, epidemiological, scientific and technological, economic, payment systems, and influences of lifestyles. Each change in one or more of these factors will have consequences for the formulation of strategies and their implementation, on the levels mentioned in table 1. When there is no coherence in the policy development between and within the different levels, the conflicting interest of the stakeholders can cause a waste of scarce resources. For instance, initiatives leading to a doubling of the capacities for radiotherapy in a certain hospital can spill over to the region and eventually also to the national capacity in this field, when they are not adapted to the needs of the population as a whole.

Also, when existing consensus on the use of radiotherapy in the leading institutes of the world changes, resulting into new insights on a national level, this will consecutively have consequences for the local level. Such changes, for instance resulting in broadening the indications for treatment, may cause shortages in capacities: in equipment, radio-therapists, paramedics and result in waiting lists.(c.f. Leer, 1999). One may conclude from this example that strategic planning in the healthcare sector involves multi-level and multi-actor decision making and when there is no coherence between them, it may lead to a waste of scarce resources or a shortage of capacities. In this respect, we distinguish the following relevant dimensions of strategic decision making and co-ordination in healthcare:

- Kind of decision: the determination of needs (quantities) and the allocation (where) of medical facilities.
- Level of decision: centralised ((inter) national level) or decentralised (local/hospital and/or regional level).
- Initiatives for decision making process:
  Top down:

- From ministry/advisory board levels to hospital boards (for instance initiatives may pop up at the level of the Ministry of health proposing actions to resolve waiting lists)
- Within institutions (for instance from hospital board of directors to the medical professionals)

Bottom-up:

- Within institutions (for instance initiatives to introduce new medical technology from the professionals to the hospital level)
- From hospital boards to the level of Ministry/advisory boards

The open boundaries between private and public actors in the healthcare domain suggest various relationships between them. The determination of needs for care and the facilities needed for a total population asks for the interaction between the different levels. It may be best performed on basis of a centralised system for co-ordination and decision making. The main reason for this is the need for a more systematic and holistic point of view in this situation. Such a vision should be developed by representatives of the different scientific and professional disciplines involved, and to be used for the assessment of the initiatives in the individual hospitals. In essence, this entails a multidisciplinary approach. In this way the needs of the population for specific care and the initiatives taken can be matched with initiatives in the individual hospitals. This requires both top down and bottom-up initiatives. These forms of co-ordination include associations, federations, or other co-operative frameworks and may be governed by bodies such as commissions, boards, or task forces representing the various involved interests (Alexander, 1992). Although the co-ordination by these bodies result from interaction, consultation, or negotiation of various stakeholders/parties, ultimately, the Minister of Healthcare authorises the resulting plans or decides by means of so-called planning decrees (“planningsbesluiten”). In this respect the Minister is decision maker of last resort.

3. Care for cancer patients and radiotherapy

In the developed countries cancer is a serious public health problem (SBU, 1997). This is primarily due to the high life expectancy, wealth, and life styles. In the Netherlands, it is the second cause of death next to mortality caused by cardio-, and cerebro-vascular diseases (SCC, 1999). Generally, a general practitioner may be the first person to indicate that cancer might be a cause of pain, general illness or misery. The patient subsequently will be referred to a hospital, were cancer as such can be diagnosed. In general, depending on the kind of tumour and its stage and location, cancer can be treated with three modalities: surgery by specialists from all surgical disciplines (surgical specialists, urologists, gynaecologists, neurosurgeons, etc.), chemotherapy (specialists from internal medicine, paediatricians, etc.), or radiotherapy (radiotherapists), or with a combination of these modalities. Between 40-50% of the patients in the Netherlands is treated with radiotherapy, whether or not in combination with one or more other modalities. So, investments in facilities for radiotherapy have a major impact on the possibilities for treatment of cancer patients and have a great strategic impact on the care they need. Medical care for cancer patients, regarding diagnosis and treatment of their tumours is mainly performed by medical specialists and is characterised by a large variety of (sub-) specialisation. The processes of developing standards for diagnosis and treatment, the nursing care for cancer patients, and consultation from the sub-specialisation to the generalist level are in the Netherlands co-ordinated by regionally organised comprehensive cancer centres. These organisations can be typified as network organisations[2].

As stated in the introduction of this paper, the process of policy development, co-ordination, and decision making regarding radiotherapy is used as an exemplary case. We present a closer look on what radiotherapy is and its specific contribution to the care for cancer patients. The objective of radiotherapy is to deliver a defined radiation dose to a specific place in or on the body with the intent to kill tumour cells while minimising irradiation damage of surrounding, healthy tissue. An array of equipment is needed to perform this task: imaging equipment (such as CT-scanners, Magnetic Resonance

Imaging, ultrasound-devices, and nuclear medicine) used for localisation and treatment planning, equipment for treatment (linear accelerators, after-loading devices, and fixation devices). Equipment for radiotherapy asks for special facilities: buildings (radiation shielding) and specialised human resources (radiotherapists, clinical physicists and paramedics). Linear accelerators used for mega-voltage therapy are the most important elements of equipment for treatment. About 95% of all the patients for whom radiotherapy is indicated are treated with one or other type of linear accelerator. The treatment facilities and capital investments in this respect are substantial, necessitating long term planning for building up capacities in equipment and manpower.

As in most industrialised countries, in the Netherlands, radiotherapy is involved in about 50% of all treatments of cancer patients (De Jong et al., 1994; Van Daal and Bos, 1997). In 1995, about 63,000 invasive tumours (males: 33,000 and females: 30,000) were registered in 57,000 new patients, in that same year about 36.500 people died of cancer (VIK, 1998). The incidence of cancer (the number of new patients per year), for all types of cancer, is steady (SCC, 1999: 110). Cancer is a disease that is age-related (70% of all new patients over 60 years). Its prevalence (number of existing patients per year) is very sensitive to demographic trends and geographic variations. Most cancer patients receive more than once during their illness radiation therapy with megavoltage equipment.

In Sweden, radiotherapy accounts for about 5% of the total costs for treating cancer patients (SBU, 1997). This is about $50 mln. For the EU the average costs per treatment of radiotherapy is about 3000 ECU, for surgery it is about 7000 ECU and for internal medicine about 17000 ECU (Van Daal and Bos, 1997). In the Netherlands, the costs for radiotherapy are expected to be in the same order of magnitude[3]. However, AHTAC (1997) in their meta-study state the following: “The costs and cost effectiveness of radiotherapy, surgery and chemotherapy in the treatment of cancer are not very well documented”. Moreover, AHTAC concludes that “costing methodologies vary significantly from study to study, and it is therefore not possible to accurately compare the costs

of radiotherapy with those of other modalities" (p.43). Besides this, the complementarity of the different treatment modalities is also a complicating factor in such studies.

4. Planning for radiotherapy facilities in the Netherlands: a short overview[4]

In the Netherlands, a tradition exists in anticipating and planning for radiotherapy facilities on the national level (this is partly a result of institutional measures, see also the introduction). In 1974 the Health Council published its first report on the use of radiotherapy. This report already showed the relation between the growing number of (expected) cancer patients and corresponding healthcare demands in this respect. In 1984 the Health Council published its second report on radiotherapy, including a (first) discussion about the future development of radiotherapy capacity (HC, 1984). This report indicated a capacity shortage at that moment and a growing shortage in the near future. This report was the first structured attempt to assess and analyse the Dutch radiotherapy usage from different (multidisciplinary) points of view and to forecast technological, medical, demographic, and other relevant developments in the field of radiotherapy and their consequences for the radiotherapy infrastructure (c.f. Postma, 1989). In 1987 the National Scenario Committee on Cancer published its report underlining the main conclusions of the Health Council, it also provided an outlook on the long term of the cancer problem in the Netherlands. This resulted in a policy document for the government (especially Ministry of Health) that presented a capacity-assessment for the period until 1995 and a plan containing the diffusion of radiotherapy facilities across the country. This plan accounted for an increase of facilities of almost 50% in 1995. In 1993, the Health Council published its final report on radiotherapy facilities. This report (HC, 1993) contained an assessment of the need for radiotherapy facilities and two scenarios, called the reference scenario and the quality scenario, indicating the possible development of the need for radiotherapy capacity for the period 1995-2010. Until recently, the national Scenario Committee on Cancer (from 1997 on called Signalling Committee on Cancer[5])

has published, on a regular basis, reports signalling the relevant trends in the field of cancer. The Council of Hospital Facilities acted in this period within the context of article 18 of the Law of Hospital Facilities to translate these plans into detailed capacity plans and tested initiatives of individual hospitals on their relevance and efficiency within the conditions of these plans. In general, the composition and quality of the various committees were of eminent importance for the quality and acceptability of their advisory outputs.

In the due course of these years consensus has been reached about a planning model with which the capacity-needs for radiotherapy on the national level can be forecasted. This model is developed by the input of numerous parties (Health Council, Ministry of Health, the professional body of radiotherapists, the Scenario Committee on Cancer, and many individuals, see table 1). The model boils down to a set of driving forces that determines the need for the capacity and the structure of radiotherapy facilities. The most important driving force in this system is the number of expected cancer patients in need for radiotherapy. Based on that, the number of patients eligible for radiotherapy can be calculated and the capacity that is needed to treat these patients. In this respect international differences show up, see table 2:

Table 2 : Utilisation of radiotherapy for cancer treatment in different countries

Country	**Year**	**% irradiat. new cancer patients**	**Source**
Australia	1995	39	AHTAC (1997)
Canada	1987	54	SBU (1997)
The Neth/ SOOZ-area[6]	1975-1989	56	De Jong et al. (1994)
Great Britain	1979	53	(SBU (1997)
Sweden	1992	30-33	(SBU (1997)
USA	1990	57	(SBU (1997)

Radiotherapy in Sweden is a less utilised treatment modality (SBU, 1997: 90) compared to other developed countries. These figures are sometimes based on surveys, sometimes on subjective estimates. In general, however, they must be considered with care. Differences between countries may be a consequence of differences in the availability of and/or access to modern screening, diagnostic, and treatment facilities (c.f. Berrino et al., 1998). International variations in the application of radiotherapy may be a consequence of different definitions of new patients, demographic differences, differences in access to care, and diverging referral and treatment policies (De Jong et al., 1994). This complicates international comparisons and leads to the conclusion that long range planning of these kinds of facilities might be best done at the national level. Pro-active national planning–initiatives (such as AHTAC, SBU and Dutch Health Council) are therefore the best way to proceed. Although, of course international co-ordination-efforts on the level of for instance the European Community or European Organisation for Research and Treatment of Cancer, international contacts between radiotherapists, radiophysicists, and other disciplines involved are needed and must be stimulated. Learning in policy development, based on the exchange of international experiences, will then be accommodated and possibly accelerated.

Besides differences between countries, there can also be considerable regional differences within a country. For instance, De Jong et al. (1994) discuss demand and supply (differences) in the south-eastern part of the Netherlands. They indicate that the number of cancer patients amenable to radiotherapy may increase, because of the presence of more and better-trained referring specialists or general practitioners. Also, the development of radiation treatment guidelines, the existence of a comprehensive cancer centre and/or an academic setting can influence the supply and demand of radiotherapy facilities in specific regions. Moreover, referral-patterns vary according to the different cancer sites. Some cancer patients can be treated very well in a local hospital, under the guidance of cancer consultants in the context of a comprehensive cancer centre (e.g. patients with prostate cancer). Patients with more rare or complicated forms of cancer and

or possibilities for curation should be referred to a specialised cancer centre in (e.g. patients with Hodgkin's disease). However, one may observe that guidelines for referral and treatment are not always systematically and consistently applied. In this respect, catchment areas of hospitals are ambiguously defined. Finally, the life-styles and working conditions that are prevalent in a region can affect the demand for radiotherapy[7]. Summing up, differences in this way can lead to considerable different patterns of capacity need and capacity usage within a country.

This means that capacity-decisions regarding the need of facilities on a regional or hospital level can lead to under- or over-estimations. The specific interests of medical specialists and hospital management may play a role in this discussion. More centrally directed decision making and co-ordination could prevent or mitigate such sub-optimal strategic behaviour. The choice of the strategic decision making level is therefore important for the development and use of a capacity- or needs model.

A national capacity (needs) model in the field of radiotherapy must take into account the following:

- The causes of cancer and the distribution of cancer in the population.
- The medical views and guidelines (protocols) about radiotherapy treatment (indications).
- The specific modalities and equipment to diagnose and to treat patients (and developments these).

The capacity/needs model will be developed and elaborated in the next sections.

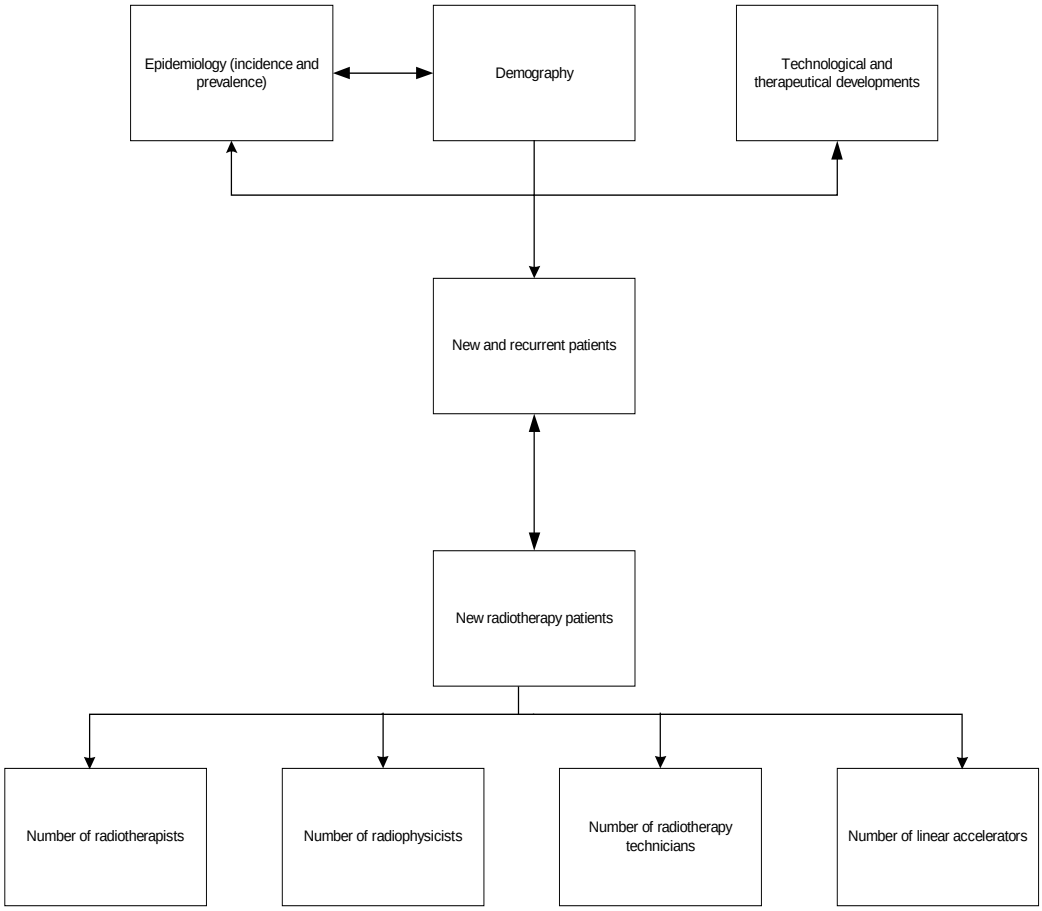
5. Assessment of the need for radiotherapy facilities

In this section a capacity model will be explicated that can be used for the determination of the needs for radiotherapy-facilities on the long term. The capacity model contains the following variables and relationships:

- The annual number of new cancer patients is determined by demography (composition, size of the population, and geographic variations); epidemiology (incidence: gender, age-group, types of tumour); and finally the technological developments influencing the possibilities of cancer treatment (e.g. the development in irradiation treatment equipment or drug application).
- The number of cancer patients that is eligible for treatment with radiotherapy can be calculated as a percentage of the total number of new cancer patients a year. Subsequently, this number must be corrected for the fact that a fraction of these patients will have more than one treatment per year, also some of the patients develop cancer again in a later stadium in their lives and will therefore receive additional irradiation treatment. The number of cancer patients that will be treated with megavoltage equipment is a fraction of this number of radiotherapy patients.
- If the number of radiotherapy patients is calculated the needed capacity (manpower and megavoltage units) can be determined, by using certain norms (established in committees of experts) of numbers of patients treated by radiotherapists and radiophysicists, and norms (standard figures) of sessions per treatment, and based on that calculation the total treatment sessions (leading to the needed number of megavoltage units and radiotherapy technicians). For a more detailed account of these variables and relationships, we refer to annex 1.

In figure 1 this model is presented in a graphical way. This figure also shows the interactions between the different boxes.

Figure 1 : Simplified capacity/needs model radiotherapy



This figure shows the most elementary variables and relationships between these variables. The model can of course be more refined (see annex 1). The variables and parameters are based on empirical studies within the Netherlands (c.f. HC, 1993; Van

Daal and Bos, 1997). The most recent variables and their parameter values are presented in table 3:

Table 3: Variables and parameter values for the Dutch situation based on most recent sources

Variable	**Parameter and most recent Dutch source**
Percentage of radiotherapy patients	40 % (De Jong et al., 1994)
Percentage of recurrence of radiotherapy patients	40 % (De Jong et al., 1994)
Workload radiotherapist (annual no. of new patients)	250 (HC, 1993)
Workload radiotherapy physicist (annual no. of new patients)	575 (HC, 1993)
Workload radiotherapy technician (annual no. of new patients)	1750 (HC, 1993)
Radiation treatment (annual no. of sessions per patient)	17 (survey of Dutch Society of radiotherapists, 1996)
Linear accelerator cap. (annual capacity of sessions)	8500 (HC, 1993)

Based on the capacity/needs model and the parameter values, scenarios can be developed to support long range decision making, planning and development of an infrastructure for radiotherapy.

Multiple scenario analysis is praised for the radically different stance it takes towards environmental uncertainties (Van der Heijden, 1996). Whereas trend projecting forecasting techniques try to abandon any uncertainty by providing managers with only one forecast, multiple scenario analysis deliberately confronts managers with environmental uncertainties by presenting them several fundamentally different outlooks on the future (Schoemaker and Van der Heijden, 1992; Wack, 1985). Generally, a scenario depicts some feasible future state of an organisation's environment and mostly includes the dynamic sequence of interacting events, conditions and changes that is necessary to reach that state (e.g., Raubitschek, 1988). According to Kahn and Wiener (1967), two pioneers within the area of scenario analysis, scenarios focus attention on causal processes and crucial decision points. In doing so, scenarios highlight fundamental uncertainties surrounding the (strategic) decisions managers have to make. The scenario method is a suitable method to handle a few uncertainties in the environment. In healthcare, and especially the field of radiotherapy, the gradually and simultaneous changing of many factors (in a more or less predetermined direction), combined with a few key driving uncertain forces, which interact with each other, underlines the choice for this method. A complicating factor in healthcare, however, is that the external and uncertain environment partly can be influenced by actors in healthcare itself. For instance the demographic changes are partly caused by the healthcare system itself.

6. Scenario development for radiotherapy facilities

Based on the most recent source on demography (of the Dutch Central Bureau of Statistics; CBS, 1999), a group of scenarios with different demographic expectations (low, medium, and high variant) is constructed. The medium variant describes the average expected future development of the Dutch population. The low and high variants correspond with the limits of a 67%-forecast interval of population size. In other words, it is assumed that the probability is 67% that this interval will include the true population

size in a given forecast year (CBS, 1999: 66). Next, the incidence (annual number of new cancer patients per age-group and gender) is determined by using the data of the Netherlands Cancer Registry (VIK, 1998). The resulting group of, what is called the, reference scenarios is based on the most recent Dutch sources and varies according to the three demographic variants. These scenarios show the effects of different assumptions regarding to the development of the Dutch population on the number of expected cancer patients eligible for radiotherapy and the capacity consequences of these numbers of patients.

Table 4 : Three population scenarios: low, medium, and high population variants transformed into expected numbers of cancer patients and numbers of radiotherapy patients (NCP = New Cancer Patients; RP = Radiotherapy Patients)

Patients	**Scen**	**1998**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
NCP	L	60500	62400	72700	85300	95700	98900	95100
	M	60500	62500	74100	88100	100500	105600	103800
	H	60500	62600	75400	91000	105300	112800	113300
RP	L	33800	34900	40600	47600	53500	55200	53400
	M	33800	34900	41400	49200	56100	59000	58000
	H	33800	35000	42100	50800	58800	63000	63300

These numbers of radiotherapy patients can be subsequently used for the calculation of numbers of needed manpower and linear accelerators. See table 5.

Table 5 : Needed capacity for radiotherapy services (Rth = Radiotherapists; Rph = Radiotherapy physicists; Rte = radiotherapy technicians; LA = Linear Accelerators)

Capacity	Scen.	1998	2000	2010	2020	2030	2040	2050
Rth	L	142	147	171	201	225	233	225
	M	142	147	174	207	236	248	244
	H	142	147	177	214	248	265	266
Rph	L	62	64	74	87	89	101	98
	M	62	64	76	90	103	108	106
	H	62	64	77	93	108	115	116
Rte	L	591	610	710	833	935	966	934
	M	591	611	724	860	9828	1031	1014
	H	591	612	737	889	1028	1101	1106
LA	L	68	70	81	95	107	110	107
	M	68	70	83	98	112	118	116
	H	68	70	84	102	118	126	127

Subsequently, by using only the medium population variants, other scenarios can be derived. In table 6 the consequences are shown if the percentage of referrals of cancer patients eligible for radiotherapy rises from 40% to 50%.

Table 6 : Consequences for capacity needs as a result of changing the percentage of referrals to radiotherapy as a treatment modality from 40% to 50%

Capacity	Scen.	1998	2000	2010	2020	2030	2040	2050
Rth	M	178	184	218	259	296	310	305
Rph	M	77	80	95	113	128	135	133
Rte	M	739	763	904	1075	1227	1289	1268
LA	M	85	87	103	123	140	147	145

Table 6 shows that if the referral patterns for radiotherapy increase to an internationally recognised level of 50%, this has serious implications for the needed capacity of radiotherapy facilities. One can also introduce different approaches in radiotherapy, for example more individualised treatment methods, a higher level of quality assurance and so on. Sensitivity analyses on other variables are of course possible. The complexity increases substantially when the various parameter-values all change at the same time. As an input for the strategic decision making and planning process, the results of scenario-planning can be used to enhance strategic learning and the strategic conversation (Bood and Postma, 1997; Van der Heijden, 1996).

7. Considerations based on the Dutch radiotherapy case

In section 2 the various dimensions of strategic decision making planning are discussed, the following remarks can be made:

- The scenarios in section 6 are made with respect to the support of (long term) strategic decisions concerning the needs for radiotherapy facilities (and not the allocation of these facilities) on a population basis.

- These decisions (and their initiatives) involve strategic decision makers at different decision making and planning (esp. centralised) levels. The strategic process involves inputs from specialists and experts with various disciplinary backgrounds. All available knowledge on a national or international wide scale must be used to collect and analyse the needed insights regarding facts and trends into demographic, social, epidemiological, and therapeutic factors, and also those in the basic disciplines (such as biology, chemistry). The needed expertise can not be found on a local or even regional level. This must be organised on the (inter) national level. It requires initiatives from co-ordinating boards like the Health Council, but also professional bodies play an important role, next to initiatives from influential and respected individuals. The input of regional and hospital level data is, however, necessary to plan effectively at the central level. Patient registries can play a significant role as an information provider.
- For the determination of the need of facilities on a population basis, the market as a co-ordinating system can not always offer the optimal solution, especially in cases in which individual hospitals function in the context of an oligopolistic market and relatively inelastic demand conditions.
- The main advantage of centralised strategic decision making is that during the decision making process, problem solving activities are developed, and that all relevant actors participate in the decision making process and have in principle equal access to the same information. In this way the 'garbage can' (March and Olsen, 1976) of this decision making and co-ordination problem has been made more transparant and structured.[8]

A problem related to centralised decision making and co-ordination, however, is the aggregation problem (Bosman, 1977). This means that by aggregating data the possibility exists that detailed differences concerning micro-data on certain referral patterns, demographic trends, availability of facilities, available knowledge of medical specialists and patients, etc. are levelled out. However, it remains questionable if decentralised

decision making and planning of facilities as the alternative solution (as seems to be considered as the best solution to cost containment in the Netherlands) is the best way of proceeding. The case of radiotherapy suggests that it has the risk of arriving at sub-optimal solutions (from a macro point of view), based on the possible casual convergence of these same factors.

8. Discussion and concluding remarks

We are aware of the potential drawbacks of centralised decision making and planning. Too much centralised directed co-ordination may possibly result in Soviet kinds of planning (see footnote 8). Also, Mintzberg (1994) reminded us of the potential negative side-effects of centralised strategic planning. Nevertheless, what we mean by more co-ordinated planning and decision making is not the same as more formalisation, regulation, and centralised healthcare production agreements. We would like to stress more the eclectic function of bringing together experts, information, and knowledge from various backgrounds and disciplines and integrating this explicitly in the policy and decision making processes (both nationally and institutionally).

The question 'which hospital needs what facilities' (the allocation question) is not discussed in this paper. The co-ordination of the nation-wide allocation of the needed facilities is a different story. It depends on local/regional circumstances. The market as a co-ordinating mechanism may be suitable in this case. The allocation of radiotherapy facilities on a regional or hospital basis to meet the expected demand and to optimise the supply of services should take into account the following consequences:

- "Economies of scale" can be realised by concentration of facilities (equipment and manpower). This may result in a more efficient and cost-effective input and use of resources. In general, a certain minimum level of facilities is necessary, because of

operational conditions (think of full utilisation of capacity, maintenance of equipment, training of personnel, learning curve-effects).

- "Economies of scope" can be realised because of the complimentarity of radiotherapy as a treatment modality with other treatment modalities The combination with other modalities (surgery and chemotherapy) asks for a hospital infrastructure in which a certain minimal level of knowledge and diagnostic and therapeutic equipment is present. Also joint diagnosis and treatment of patients may based on sub-specialisation offer advantages, next to the potential positive effects of spill-over of knowledge to other disciplines.
- In-depth knowledge is necessary for planners about the content of this policy area. This implies a concentration of planning specialists with tacit and explicit knowledge about this subject at the (central) planning level. It will also put high requirements on their communication skills.

Future directions of research

The general concern for health planners of course is the question "How should a health-care system be organised and financed to meet the ends of the general public"? In general in economics, the transaction cost economics approach offers a potential fruitful avenue to discuss this subject (c.f. Williamson, 1975, 1986, 1995; Alexander, 1992). This theory states that depending on a set of critical dimensions of a transaction between parties a specific governance system will be chosen: the market, an individual organisation or a hybrid form. Whether a particular transaction is allocated to one of these governance systems is a matter of (transaction) cost minimisation. This approach emphasises that transaction costs (costs of market transactions or costs of internal transactions/management systems) should be taken into account. To make use of transaction cost economics in the healthcare sector, it is necessary to translate it in relevant healthcare sector terminology. The relevant governance forms would be a national planning system (e.g. the national healthcare system of the UK) versus the

market form (e.g. US-system) and in-between (intermediate) forms (e.g. Dutch-system) (c.f. Hurst, 1992). The most critical dimension of a transaction is asset specificity. Asset specificity has reference to the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value (Williamson, 1996). In the field of radiotherapy asset specificity comes especially forward in human-asset specificity (e.g. radiotherapists) and capital intensive infrastructure (equipment and buildings). The effectiveness of their use is based on a high level of sub-specialisation. Their use is essentially single purpose, the treatment of cancer patients. We expect that co-ordination of planning and decision making regarding these kinds of assets, in the way as indicated above, may result in the best possible utilisation of existing or new capacity. This way of co-ordination resembles mostly an intermediate (hybrid) form of governance, from a macro point of view. To get a real picture of the advantages and disadvantages of the various governance forms in the field of radiotherapy, these should be systematically compared (e.g. US-vs.-UK-vs.-Netherlands) on a range of indicators. This, however, asks for systematic comparative research, which might be part of future research. One recent signal that indicates a drawback of the increasing market-orientation of the Dutch healthcare system is the rise of waiting lists for radiotherapy patients (NRC, July 25 2000). Also, to this aim the term transaction costs needs another specification. Indirect costs of a healthcare system may be a proxy for transaction costs. This means that insights are necessary into the indirect costs of hospitals and the health sector to make comparisons. The introduction of accounting methods like Activity Based Costing may enhance the possibilities to get insight into the indirect (overhead) costs of hospitals (Cooper et. al., 1992). However, most hospitals don't use these kinds of accounting systems (c.f. Van der Pluijm, 1998). Also, information about indirect costs related to the management/planning function for the healthcare sector as a whole is not available on the needed level of detail. This approach will be subject of future research.

Concluding remarks

The political discourse on health planning has focused on seemingly contrasts or antitheses, such as centralisation versus decentralisation, cure versus care, individual versus population, and regulation versus competition (Rodwin, 1984). Black (1984) shows clearly that these kinds of antitheses in healthcare are not always fruitful or - even worse - can be false. Centralised decision making and co-ordination at the macro level that involves activities of all relevant participants or parties in fact also must involve efforts and initiatives from decentralised levels (top down and bottom-up). A clear balance needs to be arrived between these various decision making and planning levels. In the Netherlands, advisory boards like the Health Council in principle can play an intermediate and directing role between the different parties and their interests. This is also one of the strengths of the Dutch 'poldermodel'. This model implies a co-ordination based on checks and balances, resulting in consensus between different parties at different decision making/planning levels. In Williamson's words this kind of co-ordination suggests a hybrid kind of solution. This means that the intermediate co-ordinating bodies voluntarily interact, consult, or negotiate with each other to arrive at suggestions or solutions (preferably consensus) with more or less compulsory outcomes. This rather strong position of these intermediate bodies, however, does not preclude that the Minister of Healthcare must be decision maker of last resort (as stated in section 2). This also characterises the typical Dutch situation. An element that may be relevant in this discussion is that because of the sheer size of the Netherlands the co-ordination of strategic decision processes can be organised country-wide in this way. For larger countries, for instance the UK or the US, this way of interaction, however, may not work out. In larger countries the transaction costs of dealing with each other, compared to the Netherlands, may rise as a consequence of decreasing economies of scale. This indicates that there may be a natural borderline between the various ways of organising strategic decision making and planning processes. Also, differences in the preference (based on historical, political, institutional, and governmental conditions) for a market-based co-

ordination versus co-ordination based on discussion, consensus, or negotiation may play a role in this respect.

With hindsight till the nineties the strategic decision making and planning of the capacity and needs of healthcare facilities in the Netherlands can be characterised as centrally directed decision making and co-ordination. From the early nineties a more decentralised (market) and sometimes fragmented picture shows up, where the central government acts as a financier and regulator of the healthcare system. In the field of radiotherapy the continued pivotal role of the Health Council and Council for Hospital Facilities as a link between different decision and planning bodies will pay off in the future. Nowadays the gap between the needs for radiotherapy and the facilities available in the Netherlands is widening resulting in waiting lists even for cancer patients.

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Annex 1

The capacity model accounts for the following variables, calculation rules, and assumptions:

1. The number of new patients (NP) that gets cancer for the first time in a certain year Ti is the function of demographic developments (Dem.), the (expected) cancer incidence (Inc) for that year, and developments in the field of diagnostics and treatment.
2. The percentage of new cancer patients (a) treated with radiotherapy (NPR) can vary, according to technological developments and developments in the field of diagnostics and treatment. NPR = a x NP.
3. To take into account non-melanoma skin cancer and benign tumours, a percentage (b) of NPR must be added to NPR. NPRincl. = (1 + b) NPR.
4. A percentage (c) of the number of this group of irradiated new patients will receive in the same year an extra treatment This results in the corrected number of irradiated new patients: NPRC = (1 + c) x NPRincl.
5. A fraction of the number of corrected irradiated new patients will receive megavoltage treatment. The number of megavoltage patients: NPM = d x NPRC.
6. Assuming that each radiotherapist can handle an annual workload of on average P new radiotherapy patients, the needed number of radiotherapists in a certain year: RT = NPRC/P.
7. Assuming that each radiophysicist can handle an annual workload of on average F megavoltage patients, the needed number of radiophysicists in a certain year: RP = NPRC/F.
8. Assuming that per megavolt patient on average S radiation treatment sessions are required, the total number of radiation treatment sessions is: TR = NPM x S.
9. Assuming that each radiotherapy technician can handle an annual workload of on average N treatment sessions, the needed number of radiotherapy technicians in a

certain year: RP = TR/N. (included also a correction factor of 0.8 for other activities: RLf)

10. Assuming that a linear accelerator has a capacity or annual workload of U radiation treatment sessions, the needed number of linear accelerators in a certain year is: LA = TR/U.

Notes

[1] Law of Hospital Facilities (in Dutch: Wet Ziekenhuisvoorzieningen). This law gave the Council for Hospital Facilities (in Dutch: College voor Ziekenhuisvoorzieningen) an important role in the allocation of capital intensive medical technologies.

[2] Radiotherapy departments often differ in their capabilities to treat various groups of cancer patients.

[3] It should be noted that the costs of radiotherapy are closely related to the cost of surgery and internal medicine in cancer care. For instance the development of intra operative radiotherapy, in which an operated patient receives local radiotherapy, leads to a rise of both surgery and radiotherapy. A combined treatment of internal medicine and radiotherapy also has combined cost repercussions.

[4] This section is largely based on HC, 1993

[5] This is an advisory board of the Dutch Cancer Foundation.

[6] SOOZ stands for Co-operative Association Hospitals in Oncology (Dutch). The SOOZ involves 10 community hospitals in south-east Netherlands. The registry of about 25000 km^2, comprises about 1 million inhabitants or 7% of the Dutch population (Coebergh, 1991).

[7] Also educational differences and access of patients to specialised knowledge in this field might contribute to referral differences.

[8] In our opinion this is an advantage that is not very well recognised by Frissen and Van der Meeren (2000), who only discuss the negative aspects and connotations of centralised planning, suggesting that this resembles too much the ancient Soviet planning model.