Variation in healthcare expenditures from consultations provided by mental healthcare nurses explained by demand and supply-side factors in the Netherlands.

Kortekaas, R. (s1506595)

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First supervisor: dr. H.C. van Beusichem

Second supervisor: dr. P.M. Carrera

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Organisational Supervisors

Organisation: Topicus BV

A. Linthorst, J. Petter, J.W. van der Pol

UNIVERSITEIT TWENTE.

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This report contains the result of my thesis for the master Business Administration, with the specialisation in Financial Management, at the University of Twente. I have been working on my master thesis from December 2017 till November 2018. In this period I performed two master theses; one for the master Health Sciences and one for the master Business Administration, with the overarching topic of mental healthcare nurses. In the master thesis of Health Sciences, the population of mental healthcare nurses was studied. The study was performed at Topicus, which accepted the challenge with me by performing two master theses. Since the start of this internship, they triggered me by finding my own subject for the thesis with the data they gather from their software program.

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I hope you will enjoy reading this thesis.

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Abstract

Since 2012, the position of the mental healthcare nurse (MHN) was introduced in primary care in the Netherlands with the aim to reduce total mental healthcare cost and increase the quality of care. The main function of the MHN is to provide basic mental healthcare in the general practice. Since there is no specific education for MHNs, it is plausible that MHNs differ in their procedure of providing consultations. This is known as practice style variation and is unwarranted since it may cause inequality or inefficiency of care. The objective of this thesis was to explain variation by studying healthcare expenditures from the demand and supply side regarding care provided by MHNs. This quantitative retro-perspective cohort study analysed data from 39,241 patients and 176 MHNs for the years 2016 and 2017. The annual healthcare expenditures per patient for the provinces are significantly different: Noord-Brabant has a median of €50.80 (N=11,929 patients), whereas the median in Limburg amounts €41.56 (N=27,312). The variation is explained for 4.0% by demand factors, i.e. patient-related variables, and 4.6% of the variation in the model is explained by supply factors, i.e. MHN specific variables. Consequently, there was some proof to support the practice style hypothesis. Patient characteristics that were found to relate significantly to annual healthcare expenditures from consultations provided by the MHN are age, which is positively related to healthcare expenditures, being female, which has a positive effect on healthcare expenditures, and a high degree of urbanisation has a negative effect on annual healthcare expenditures. The results are robust.

Keywords: mental health nurses (MHN), healthcare expenditures, provincial variation, unwarranted variation, practice style hypothesis.

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1. Introduction

In this chapter, the subject of the paper is provided. The structure of this chapter is organised as follows: first, the background is given, second the problem statement is defined. Next, the research question is provided, fourth the contribution is discussed and finally, the outline of the study is presented.

1.1 Background

In the Netherlands, the annual prevalence of mental disorders is approximately 17.5% and accounts for a large burden of disease. In fact, 43.5% of the Dutch population gets one or more mental disorders in their life (Veerbeek, Knispel, & Nuijen, 2015). The most common mental healthcare problems are mood disorders, anxiety and depression (de Graaf, ten Have, van Gool, & van Dorsselaer, 2012). Compared to other countries in Europe, the prevalence of mental disorders in the Netherlands is relatively high. For instance, in Italy, the prevalence amounts 8.4% and in Germany, the prevalence amounts 10.9%. Treatment of mental disorders is based on medication, such as antidepressants, or psychological interventions, like consultations for self-help. Patients have a strong preference for psychological interventions instead of medication (Prins, Verhaak, Bensing, & van der Meer, 2008). However, not all patients receive care due to practical or emotional issues. Practical issues, such as high costs of care or a lack of time of the patient, are the most important barriers of not using mental healthcare, while emotional issues, such as anxiety for a treatment or discomfort of talking about problems, play a less important role (Mohr et al., 2006).

Since the cost of mental healthcare is one of the most important factors in the decision of the patient to receive treatment, it is necessary to understand the way healthcare is financed. In the Netherlands, every citizen needs to have a health insurance which covers basic healthcare (Rijksoverheid, 2016). The care which is included in basic healthcare is determined by the governance and is the same for every person. Within the basic healthcare, there are specific types of care which need to be paid by the patient him or herself before the health insurer pays healthcare (e.g. hospital care). This is also known as “own risks” and amounts as minimum €385 in 2018 (Rijksoverheid, 2018b). Next to the minimum of €385 own risk, a patient can choose a certain amount of money (with a maximum of €500 in addition to the €385 obligated own risk) of voluntary deducible to reduce the monthly paying fee. For certain types of care, such as care provided in general practices, the own risk does not have to be paid by the patients (Rijksoverheid, 2018a). This care is reimbursed by the health insurer anyway. Besides basic healthcare, a patient can choose to include additional insurance for certain types of care such as physiotherapy. The care which is included in the additional insurance differs between insurances.

Furthermore, the way a healthcare system is organised should be discussed. In the Netherlands care is categorised into primary care, where the patient does not need a referral e.g. care from a general practitioner (GP) or physiotherapy and secondary care, where the patient needs a referral before obtaining treatment, e.g. hospital care. The GP acts as a gatekeeper for access to secondary care and he

or she gives a referral to secondary care when this is necessary. When a patient visits secondary care, first the own risk needs to be paid by out-of-pocket expenses. The mental healthcare system operates in both systems. Secondary care is only provided when a disease is severe.

In the mental healthcare system, patients with mild psychological problems were treated through GPs before 2014. Only if there was a severe disease diagnosed, patients were referred to secondary care to receive specialized mental healthcare. Of all patients who received mental healthcare, 13% was referred to secondary care (Verhaak, van Dijk, Nuijen, Verheij, & Schellevis, 2012). However, there were several problems detected within this system. First, GPs vary in their ability to detect mental healthcare problems (Bosman, Clement, van Acker, & de Lange, 2004; Zantinge et al., 2007). Communication style of GPs is an example of a factor to detect psychological problems, which is different for every GP. Second, GPs experience more often a lack of time (Bosman et al., 2004; Zantinge et al., 2007). To detect mental problems, the background of the patient should be taken into account. When psychological problems are diagnosed, consultation time increases and the shortage of time of GPs becomes higher (Zantinge, Verhaak, Kerssens, & Bensing, 2005). GPs mention that they cannot satisfy this desire because they simply do not have the time to do this. Consequences of this problem contain for example an increase in wrong diagnosis or the treatment provided by GP is one which saves time instead of what is best for the patient. Due to this, medication is prescribed more often (van den Berg et al., 2009). Thus, GPs do not seem the right profession to detect mental problems.

In 2008, the World Health Organisation (WHO) emphasizes the importance of the integration of mental healthcare into primary care for an increase in accessibility of qualitative good mental healthcare and to decrease overall healthcare costs in a country (Organization, Colleges, Academies, & Physicians, 2008). One of the options to integrate healthcare in primary care is by the substitution of GPs by nurses. In 2001, this was first introduced in general practices with the focus on chronic diseases, like diabetes (Mok, 2016; Nederlandse Zorgautoriteit, 2013). The substitution of GPs by nurses for several conditions of the patient have been investigated quite often and results in the fact that it has a positive effect on patient satisfaction, hospital admission and mortality (Martínez-González et al., 2014). Besides these advantages, other benefits include the decrease of workload of GPs, a decline of direct healthcare costs and the patient can receive care close to their home instead of in a hospital (Dierick-van Daele et al., 2010; Griep, Noordman, & Dulmen, 2016; Laurant et al., 2005). Moreover, if mental healthcare is provided in primary care, patients do not have to pay their own risk to the health insurer anymore to receive care. As mentioned before, the cost of healthcare is an important factor for patients to receive treatment. When the substitution of mental healthcare is implemented, this practical issue can be solved. Next to the advantage on a micro level, there is also an advantage on a macro level, because primary care is less expensive compared to secondary care. This could probably cause a decrease in national mental healthcare costs (Flik, Laan, Smout, Weusten, & de Wit, 2015).

As a result of those shortcomings of the current system and the proposal of the WHO, a change in the mental healthcare system in the Netherlands was made in 2014. The main objective of this reform

was to increase efficiency, decrease healthcare costs and improve the accessibility of care. Due to this reorganisation of the healthcare system, mental healthcare in primary care was stimulated with the goal to decline use of secondary care. Since then, patients with severe diseases can only get a referral to secondary care if they have a psychiatric disorder according to the DSM-IV criteria (Spitzer & Williams, 1987). Additionally, the function of the Mental Healthcare Nurse (MHN, in Dutch Praktijkondersteuner Huisarts Geestelijke Gezondheidszorg (POH GGZ)) was introduced in general practices as substitution.

The function of an MHN is to specify the psychological problem of the patient in the first consultation and provide a treatment plan for short, medium, intense or chronic care (Forti et al., 2014). This specification is based on five main points: (1) psychiatric disorder based on DSM-IV criteria, (2) severity of the problem, (3) level of risk with the psychiatric disorder, (4) complexity of the disease and (5) duration of the complaints. The outcome of this analysis is to refer the patient to the GP or provide treatment by themselves (Verhaak, van Beljouw, & Ten Have, 2010). MHNs do not replace GPs, but provide additional care for mental problems (Magnée, de Beurs, De Bakker, & Verhaak, 2016).

1.2 Problem statement

The percentage of general practices in the Netherlands which uses the service of an MHN has grown from 41% in 2011 to 87% in 2016. This increase is probably caused by the increase in budget availability resulting from the reform in 2014 (Verhaak, Nielen, & de Beurs, 2017a). Still, there is a lack of evidence about the effects, for example the costs of this service (Magnée, 2017). Overall conclusions regarding aggregate healthcare expenses on macro level of MHNs in the Netherlands are known: costs in primary care are rising (from €29 million in 2012, to €138 million in 2015) due to the growing use of the MHN in general practices (Zorgautoriteit, 2016). At the same time, healthcare expenses in secondary care are declining (€4,114 million in 2012, €3,214 million in 2015). However, there are still no conclusions at the practice-level, comparisons at the non-aggregate level or explanation of costs. Since there are no specific guidelines regarding the tasks of MHNs it is likely that there is variation in healthcare expenditures for the service of the MHN in different provinces in the Netherlands (LHV, 2016).

1.3 Research question

The aim of this study is to investigate variation in healthcare expenditures in consultations provided by MHNs in the Netherlands and to study whether this variation is warranted or unwarranted based on demand and supply-side factors. Based on the problem statement, the following research question is answered:

"To what extent is there variation in healthcare expenditures from consultations provided by mental healthcare nurses in the Netherlands and how can this variation be explained by studying supply and demand side factors?"

1.4 Contributions

It is relevant to study the unknown effect of variation in healthcare expenditures concerning MHN consultations in the Netherlands for both scientific and practical reasons.

The subject is relevant from a scientific perspective for several reasons. First, variation in healthcare expenditures is not desirable, because healthcare should be equally divided in a country to ensure all citizens of good and equivalent healthcare. Causes of variation in patient characteristics (demand side) should be detected, so that policymakers can create guidelines to ensure equivalent, effective and efficient healthcare (Corallo et al., 2014; Verhaak, van der Zee, Conradi, & Bos, 2012). This variation is warranted, because not all patients are the same. The results of this study suggest that variation can be explained by demand-side factors and age, gender and place of residence of the patients cause variation in healthcare expenditures. Also, causes of variation in MHN characteristics (supply side) should be detected. This problem is known as practice variation and is unwarranted. It became clear that most of the variation in healthcare expenditures is explained by supply-side variables. The age of the MHN causes most of the variation. In several countries research is performed according to practice style variation, however, in the Netherlands this is have not been performed before, which causes a gap in the literature. This emphasizes the relevance of this study. If differences are known, it could contribute to a decrease in unwarranted variation (Verhaak, van der Zee, et al., 2012). Second, since the reform in 2014, only a few researches have been performed according to the effects. It is necessary from a policy perspective to investigate this to improve the system. Third, if there are differences between healthcare expenditures, there should be a "best practice". By sharing information of best practices, it creates awareness of differences, increase of efficiency (Fontaine, Ross, Zink, & Schilling, 2010) and a decrease of costs (Park et al., 2015).

Besides scientific relevance, the research is also relevant for practical reasons, because the research is carried out at Topicus. The company provides a software program to general practices to structure their data, which focus on (1) healthcare data, provided by Proigia (a subsidiary), and (2) financial data, provided by Calculus (a subsidiary). The two different kinds of databases have not been combined before, which is necessary for this research to obtain data. This is relevant for their customers (GPs) and Topicus will be the first in the sector that compares both databases, which makes them unique.

1.5 Outline of the study

This thesis is structured into five chapters. Chapter two provides a background of the MHN which focusses on international and national evidence. Chapter three elaborates the existing literature and theories based on variation. Additionally, the hypotheses for this study are presented. Next, Chapter four outlines the methodology which is used to answer the research question. Chapter five presents the results of the analyses and these findings are discussed and linked to the current literature. Finally, in Chapter six, the conclusion is presented and an answer to the research question is provided.

2. Mental healthcare nurses

In this chapter, literature about MHNs is provided. First, international evidence about the role of MHNs is discussed. Second, the role of MHN in the Netherlands is explained and finally, research which is carried out in the Netherlands is presented.

2.1 International

The function of an MHN is not entirely new. Worldwide, several countries also use the function of a healthcare nurse to provide mental healthcare in primary care. Those studies suggest that the function of an MHN seems effective and at the same time increases patient satisfaction. In this section international evidence about MHNs is discussed.

In the United Kingdom (UK) a review about the effects of providing mental healthcare in primary care was performed in 2011 (Bower, Knowles, Coventry, & Rowland, 2011). Their outcome variables were mental health symptoms, social functioning, and patient satisfaction. They compared nine studies from the UK based on this subject and concluded that the clinical effectiveness of giving mental healthcare in primary care is significantly better on the short-term compared to usual care given by GPs. However, the results are not significant anymore on long-term. Another article suggests that treatment provided by MHNs have a higher rate in patient satisfaction and is cost-effective compared to mental healthcare provided by GPs (Kendrick et al., 2006). This suggests that the function of MHNs should be cost-effective for the short-term, but when patients have major psychological disorders, they should be referred to secondary care.

In Australia, the Mental Health Nurse Incentive Programme (MHNIP) was introduced in 2007 to improve access for mental healthcare in primary care. This program is quite similar to the reform of the mental healthcare system in the Netherlands. The role of an MHN was introduced to decline costs and improve the accessibility of mental healthcare for patients. Several studies focused on qualitative outcomes regarding this program, but in 2015 a quantitative research was performed based on the effect of the program (Meehan & Robertson, 2015). The outcomes suggest that the effects are significantly better for patients who received mental healthcare provided by an MHN, compared to care provided by the GP.

Finally, a systematic review is performed based on researches which included RCTs with patients who have a somatoform disorder or depressive disorder (van der Feltz-Cornelis, van Os, van Marwijk, & Leentjens, 2010). The outcomes suggest that consultations of mental healthcare in primary care are effective for patients with somatoform disorder and depressive disorders. Effects are most seen in a reduction of utilization of mental healthcare. Freud et al. (2015) mentioned that in the United States, Canada, Australia, England, Germany and the Netherlands the role of the MHN is increasing. This may improve the cost-effectiveness of the healthcare system (Freund et al., 2015).

2.2 National

Since the reform in 2014, the MHN is introduced in the general practice to serve patients with mild psychological problems in the Netherlands. In this section first, the role of the MHN is discussed. Second, literature available in the Netherlands regarding MHNs is provided.

2.2.1 MHNs in the Netherlands

In the Netherlands, the overall healthcare goal is to treat patients in primary care first and refer them, only when necessary, to secondary care. In this way, patients receive care close to their home from their own GP. This is in line with the reform concerning the mental healthcare system, which took place in 2014.

The role of MHNs origins from the existing role of healthcare nurses. This function was introduced in 2001 where the healthcare nurse took over tasks from the GP based on physical disabilities of the patient, which mainly focused on chronic diseases (Mok, 2016; Nederlandse Zorgautoriteit, 2013). Around 2007 the function of MHNs was introduced and in January 2008 the first financing for this function was set (Trimbos, 2014). Since then, the number of general practices which use the service of an MHN has increased substantially. In 2008 approximately 12% of the patients had a general practice with an MHN, in 2011 this amount increased to approximately 34%. After the introduction of the reform and the availability of reimbursement offered by health insurers, this amount increased to 87% in 2016 (Verhaak et al., 2017a). Since then, the amount remains stable. The number of hours an MHN can be deployed differs for each health insurer. For example, the health insurer Menzis offers the opportunity to deploy an MHN for a maximum of 0.222 FTE for a general practice with 2,095 patients (Menzis, 2017). Consequently, larger general practices have more hours available and smaller general practices have fewer hours available to deploy an MHN. Since 2014, there is more financing available to hire an MHN, which causes an increase of GPs hiring MHNs. The employment of MHNs differs: an MHN can be under contract of a GP, he or she can be an entrepreneur or he or she can be seconded. The MHN is a person who works in a general practice and has the task to specify the psychological problem of the patient within a limited number of contacts and advice the GP about further guidance and/ or referral of the patient (Verhaak et al., 2010). Moreover, an MHN can provide short-term treatment to patients by themselves.

However, there is no clear function profile of the MHN, since the role of MHN is a function instead of a profession (LHV, 2015). This means there is no specific graduation required to become an MHN. Examples of different educational backgrounds which are allowed to practice the function of MHN are psychology (university), nursing study or social services (University of applied science) or social worker (secondary education) (Mok, 2016; Verhaak et al., 2010). The Landelijke Vereniging van Huisartsen (LVH), a national umbrella organisation for GPs in the Netherlands, set restrictions to the level of education for MHNs, but there is only mentioned that the MHN should have a thinking level of

at least university of applied science. At the moment, there is being investigated if the function can be rewarded with a certificate of the profession (called BIG-registratie in the Netherlands), which means the function becomes official and it will have its own educational training.

Since the MHN is not a real profession, the GP remains responsible for the patient. There only exists a guidance to perform the function of MHN based on a function profile. The content of the function is described by the LHV and is build-up out of eight main elements: (1) problem clarification and screening diagnostic, (2) drafting and discussing a follow-up plan, (3) providing psycho-education, (4) guiding and supporting self-management, (5) providing intervention to improve the well-being of the patient, (6) indicated prevention, (7) healthcare related prevention and (8) relapse prevention (LHV, 2015). The lack of a certificate of professions results in the fact that an MHN sees patients with a relatively low burden of disease, like symptoms of fear, stress or depressive feelings, compared to the GP, who sees patients with a high burden of disease, like psychological disorders (Verhaak et al., 2017a).

The care provided by an MHN can be given into different kind of consultations: consultations shorter than 20 minutes, consultations longer than 20 minutes, telephone consultation, an e-health consultation, visit the patient in less than 20 minutes, or visit the patients longer than 20 minutes. Looking at the division of contact moments, the most common consult an MHN gives is a consult longer than 20 minutes (81% of the total) (Verhaak et al., 2017a). The least common treatment is a visitation of the patient for less than 20 minutes (0.1% of the total). Moreover, in the first consult an MHN provides to a patient, he or she should specify whether the patient needs short, medium, intense or chronic care (Forti et al., 2014). This is based on five criteria: (1) psychiatric disorder based on DSM-IV criteria, (2) severity of the problem, (3) level of risk based on the psychiatric disorder, (4) complexity of the disease and (5) duration of the complaints. Based on this, the number of consultations which is expected to be necessary for the patient is determined.

The reimbursement a general practice receives from a health insurer for services of an MHN consists out of two parts (Dijkers, Nijland, & in 't Veld, 2016). First, there is a rate which is obtained through the service provided by the MHN itself. In 2018 this amounts €9.59 (<20 minutes) for each single consult €19.18 for a double consult (>20 minutes), €14.38 for a short visitation (<20 minutes), €23.97 for a long visitation (>20 minutes) and €4.79 for a telephone consult or an e-consultation (NZa, 2018). This part contributes for 25% of the total revenues of the MHN. Second, there is an amount that the general practice gathers when they have an MHN in their practice. In 2011, this capitation fee amounts €3.76 for each person register with the general practice and this yields for 75% of the total revenue. In 2013 a research of the NzA suggested that there should become more budget available to strengthen the function of the MHN in the general practice (Nederlandse Zorgautoriteit, 2013). In 2013, 7 million euro was made available by the government, in 2014, 25 million euro and from 2015 each year 35 million euro is made available (Rijksoverheid, 2014).

2.2.2 Researches about MHN

Besides the international literature on the function of MHNs, there is also evidence which is based on a national perspective. In addition, since the reform is already several years ago, there are outcomes available for both the national level and local or region level.

National-level

There is evidence available regarding aggregate data of the Netherlands. Since the function of MHNs was already set in 2008 and the reform was implemented in 2014, there is evidence available for both before and after the reform.

Before the implementation of the reform, an RCT was carried out in the Netherlands in 2009. In this study, they compared a collaborative care program, which includes mental healthcare in primary care with the regular care, i.e. where mental healthcare was provided in secondary care services (van Orden, Hoffman, Haffmans, Spinhoven, & Hoencamp, 2009). Their sample size includes 27 general practices in the Netherlands and provided normal care or the collaborative care program. The study showed that the quality of life of the patient was improved in the collaborative care program and that it is efficient due to shorter referral delay, decline in treatment duration, less consults and lower treatment costs. The effectiveness of both programs is the same, which suggest that the same outcomes can be reached with lower total costs by providing mental healthcare in primary care. Another research suggests that short-term care provided by MHNs can be successful when the problems which are treated are of low or moderate severity (Verhaak, Kamsma, & van der Niet, 2013). Besides this cost-effectiveness analysis, the activities of MHNs in general practices are studied (Verhaak, van der Zee, et al., 2012). On average, patients have four to five consultations of at least 45 minutes with an MHN and more than half of all patients got a treatment by an MHN. Referrals to secondary care occurred in 30%. Almost 70% of the patients are women with an average age of 41 years. The most common problems contain stress, relationship problems and depressive feelings. This is in line with the demographics of patients in secondary mental healthcare, however, the kind of care which is provided is different. The treatment provided by MHNs, such as medication, problem clarification or giving advice, differs significantly among MHNs. There is variation in the dispersion of MHNs in different areas in the Netherlands: urban areas adopted the function of the MHN more often before the reform (Heiligers et al., 2012).

Besides literature before the reform, there is also some evidence after the reform. Trimbos Instituut (a national research institute for mental problems) concluded that it is still not known whether the MHN fulfils the intentions of the reform (Trimbos, 2014). They agree with the conclusion of Verhaak et al. (2012) that there is provincial and local variation between MHNs regarding treatment differences and frequency of consultations. It is expected that through the reform, substitution of mental healthcare from secondary care to primary care will take place (Magnée, de Beurs, Boxem, de Bakker, & Verhaak, 2017). Consequently, healthcare cost will reduce and more patients can be treated, since they do not have to pay out-of-pocket expenses anymore. In addition, the MHN does not seem to replace the GP but

delivers additional care to patients with mental healthcare problems (Magnée et al., 2016). As mentioned before, the GP prescribed antidepressant more often instead of providing treatment. It was expected that through the implementation of MHNs, the prescription of antidepressant will decrease, however, at this moment that is not the case (Magnée, de Beurs, Schellevis, & Verhaak, 2018). Besides the research of Magnée, the Nivel research institute also presented some facts about the MHNs in the Netherlands for the period 2011-2016. The demographics of patients are in line with earlier studies and it appears that GPs see fewer patients with mental healthcare problems and MHNs see more patients with mental healthcare problems, which was a goal of the reform (Verhaak, Nielen, & de Beurs, 2017b).

Regional level

Second, there is evidence available for regional and local level, but those studies contain limitations regarding their limited sample sizes. Still, those articles are discussed in this chapter, to provide an overview of the effect of the MHN on a regional level.

One of the researches which is carried out before the reform in 2014 is the experience of patients with MHNs in "het Gooi", a region in the province Noord-Holland (ter Horst & Haverkamp, 2012). On average, 67.2% is women, mostly in the age between 45-54 years. The judgment of patients about the role of MHN are both positive and negative. Positive factors include the additional value of an MHN compared to the care provided by the GP, the low threshold to receive care and the open attitude of the MHN. Improvement points include the treatment room of the MHN regarding privacy, the information exchange between different stakeholders and the information provided about different treatment options. Overall, patients grade the service of an MHN with a 7.1 out of a scale of 10. These results are in line with Clientenbelang Amsterdam, who also performed a research about the experience of patients with the MHN in the city Amsterdam (Clientenbelang Amsterdam, 2013). Moreover, also a study in Groningen was performed about MHNs (Noordman & Verhaak, 2009). They concluded the same as the previous studies mentioned: patients and GPs are satisfied with the function MHNs, fear and anxiety are treated the most and the demographics of patients are approximately the same: mostly woman in the age of 45-54 years. The average number of consultations is between two and six times.

After the reform, there was only one article found on a regional level. In here, the number of general practices which deployed an MHN was studied. There were differences on province level, for example in Friesland, 66% of the general practices employed an MHN, whereas in Utrecht, 88% of the general practices employed an MHN (van Hassel, Batenburg, & van der Velden, 2016). This difference may be explained due to the different health insurers in the provinces, because health insurers may differ in reimbursement standards. Overall, there are more MHNs in the Netherlands now compared to 2011 and this level became stable at 88% in 2016, as mentioned before (van Hassel et al., 2016). There is a growing role of the MHN in the general practice and both GPs and patients are positive about this additional function (Magnée, Verhaak, Boxem, & Onderhoud, 2014).

3. Variation in healthcare

In theory, patients with the same disease get the same treatment, regardless of factors like treating physician or region. However, the opposite seems to be true. For example, in Canada, the hospital utilization rates are almost 50% higher compared to the United States (US) in 1973 (Wennberg & Gittelsohn, 1973). Apparently, patients with the same disease get different treatments, which means that there is variation in healthcare. This was already mentioned in 1938 by Glover, who described regional differences in the incidence of tonsillectomy by children (Glover, 1938). Despite this research, the topic of variation in healthcare seems to play an important role in research 40 years after the detection of Glover (Wennberg & Gittelsohn, 1973). Most of this variation is not desired, because it raises several questions like: do patients get the best treatment? Is there equal access to health? Is the care provided effective? Variation is not by definition bad, however, it may affect the effectiveness, efficiency, equity and quality of healthcare provided (Evans, 1990; McPherson, 1990). This may have implications for a lot of stakeholders in the healthcare sector, for example for policy makers, patient organisations, physicians and insurance companies.

In this chapter, variation in healthcare is explained based on literature from national and international perspective. Moreover, different types of variation are discussed and a separation into warranted or unwarranted variation is made.

3.1 Variation in the healthcare process

Nowadays, there is recognition for variation in healthcare processes, both on international and national level. In this section, some evidence regarding variation in healthcare is discussed.

3.1.1 International

As mentioned before, the discussion about variation in healthcare is active since 1980. From then, a lot of researches have been performed internationally. Since the healthcare process consists out of different levels, i.e. primary care and secondary care, there may be variation in both of these settings.

First, there can be variation in the primary care setting. Studies have been performed for different countries focussing on different aspects of healthcare. The most important ones will be shown in this sub-section. There is variation in diagnostic tests in New Zealand (Davis, Gribben, Lay-Yee, & Scott, 2002), Sweden (Peterson, Eriksson, & Tibblin, 1997), Austria (Ahammer & Schober, 2017) and the United Kingdom (UK) (Guthrie, 2001). This implies that in these countries GPs differ in the test they apply for patients. Besides, GPs differ in drug prescription in Sweden (Mindemark, Wernroth, & Larsson, 2010; Peterson et al., 1997), meaning that GPs prescribe different drugs and different frequency of drugs for patients with the same diseases. GPs also differ in their referral rates based on a systematic review in the UK (O'Donnell, 2000). The threshold of referring a patient to secondary care differs among GPs in the UK. There are also differences found between the gender of the GP in healthcare expenditures

in Switzerland (Kaiser, 2017). Female GPs have higher total healthcare expenditures on, for example, drug prescription, compared to their men colleagues.

Second, there is variation in secondary care. For example, hospital admission differs for different regions in the US (McMahon, Wolfe, & Tedeschi, 1989; Molitor, 2018) as well as discharge rates (Wennberg & Gittelsohn, 1973). This means that patients will be admitted and discharged differently in geographic regions in the US. Also, geographic variation exists according to the type of surgery which is provided in the US (Weinstein, Bronner, Morgan, & Wennberg, 2004) and France (Reistetter et al., 2015). Different types of surgery will be provided for the same diagnoses. The difference in treatment option provided by the physician also differs in Switzerland (Epstein & Nicholson, 2009) and several other parts of Europe (Heijink, Engelfriet, Rehnberg, Kittelsen, & Häkkinen, 2015).

Overall, most international research to detect variation is based on total healthcare expenditures. Examples can be found in the US (Cutler, Skinner, Stern, & Wennberg, 2013; Newhouse & Garber, 2013; Paul-Shaheen, Clark, & Williams, 1987; Phelps & Mooney, 1993; Reistetter et al., 2015; Zhang, Baik, Fendrick, & Baicker, 2012), the UK (Bindman, Glover, Goldberg, & Chisholm, 2000), Switzerland (Reich, Weins, Schusterschitz, & Thöni, 2012) and a review of Australia, Canada, France, Germany and the Netherlands (Heijink, Noethen, Renaud, Koopmanschap, & Polder, 2008). Concluding can be said that the variation in healthcare research is performed mostly in the US on the basis of total healthcare expenditures.

3.1.2 National

Besides international research about variation in healthcare, there is also some national evidence. However, the research performed in the Netherlands about variation is limited. A systematic review based on medical practice variation in OECD studies shows that of all studies found, the Netherlands contributes with only 2.6% (Corallo et al., 2014). With 38.2% of the research about medical practice variation, the US contributes the most. Literature that was found for the Netherlands is discussed in this sub-section based on the division of primary and secondary care.

First, there is variation in primary care. For example, there are differences in laboratory tests in primary care among GPs (Verstappen, 2004; Zaat, Van Eijk, & Bonte, 1992). There are differences for GPs when they order a laboratory test. This also differs for different provinces in the Netherlands. Next to the variation in laboratory test ordering, there is also variation in drugs prescription for patients in general practices (de Bakker, Coffie, Heerdink, van Dijk, & Groenewegen, 2007; Heins, Hooiveld, & Korevaar, 2017; Sinnige, Braspenning, & Korevaar, 2016; Sinnige et al., 2017; van Dijk, Ohlsson, & Vervloet, 2011). A part of the variation in drugs prescription can be explained by for example patient characteristics, healthcare risks or GP preference (Groenewegen, de Bakker, & Velden, 1992; Meuwissen, Voorham, Schouten, & de Bakker, 2010). However, a part of this variation remains unexplained and a potential cause may be insufficient knowledge of the GP. There is also geographic

variation in referrals to secondary care (NtVG, 2012) and setting of diagnoses by GPs (Marinus, 1993). Also, there is geographical variation in the treatment provided by MHNs (Verhaak, van der Zee, et al., 2012). Moreover, there are differences in healthcare costs in general practices according to a newspaper from the Netherlands (Financieel Dagblad, 2012). Overall, the research which has been performed concerning variation in primary care is in line with international research. However, the research is relatively out-dated and is not that extensive as research performed internationally.

Second, there is variation in secondary care in the Netherlands, for example in the duration that patients stay in the hospital (Westert, 1992; Westert, Nieboer, & Groenewegen, 1993). In some provinces in the Netherlands, the stay is relatively longer than in other regions. As well as in primary care, also in secondary care variation is detected concerning treatment (Heins et al., 2015). Heins et al. performed a research about variation in cancer treatment, which is different for patients with the same diagnose. They argue that differences should be detected and adjusted to make care more efficient and provide a higher quality of care. The main method to detect differences in the Netherlands is based on studying electronic health records of patients who join the NIVEL Primary Care Database (NIVEL-PCD). This database is based on the input of healthcare employees and they may differ in the way they submit information in the system (van den Bosch, Silberbusch, Roozendaal, & Wagner, 2010). Because of this reason, variation may occur. Thus, one should be cautious when analysing data regarding software bases.

Summarizing, there have been performed research about variation in the Netherlands. The results are in line with international evidence, however, to my knowledge, there is no research performed on overall differences based on healthcare expenditures. When this is performed, causes of variation may be detected and solutions may be presented to overcome this variation. This study adds to the literature that variation in MHN may be detected through the analysis of healthcare expenditures and causes can probably be seen.

3.2 Types of variation

As discussed in the previous section, variation exists in healthcare both on international and national level. This variation does not have to be necessarily bad. In this section, there is explained what kind of variation may be warranted in healthcare and which is not.

In 2002, Wennberg was the first who made a distinction between warranted and unwarranted variation in healthcare (Wennberg, 2002). For several years, research has been performed around variation and it became clear that variation exists, even when there is controlled for factors such as patient characteristics or illness severity. This is known as unwarranted variation: the variation cannot be explained by the severity of the disease or patient characteristics. In an interview, Wennberg extends this definition by "*variation that cannot be explained on the basis of illness, patients' preferences or dictates of scientific medicine*" (p. 74) (Mullan, 2004). Warranted variation is the opposite: it can be explained through these factors. This is warranted, because it is impossible that patients are the same

and have the same preferences according to healthcare. It is not preferable to minimise this variation. When the unwarranted variation is detected and handled, the care may become more efficient, equal, effective and higher quality may be reached. Thus, research should be performed to detect the existence of variation and which factors cause this, such that this unwarranted variation can be minimised.

Wennberg defines three categories of unwarranted variation. The first category includes variations in effective care and patient safety. It "*includes services whose effectiveness has been proved in clinical trials or well-designed cohort studies and whose use does not involve substantial trade-offs that depend on patient preferences*" (Wennberg, 2002, p. 962). When a patient has a certain disease, it should be treated according to the treatment which is proved to be successful for that disease, if not, there is an underuse of care, which is unwarranted. The second category includes variation in preference-sensitive care. It "*includes conditions where two or more medically acceptable options exist and choice should depend on patient preference*" (Wennberg, 2002, p. 962). The most important person in the healthcare process is the patient. In the opinion of Wennberg, patients have preferences and these should be used when choosing a treatment. However, in healthcare, doctors determine mostly what kind of treatment is provided, without listening to the patients' preference. In this way, unwarranted variation occurs. The third and last category defined by Wennberg includes variation in supply-sensitive care. In here, "*medical theory and medical evidence play virtually no role in determining the relative frequency of their use among defined populations. The per capita quantity of healthcare resources allocated to a given population largely determines the frequency of use"* (Wennberg, 2002, p. 962). This means that healthcare utilization is determined by the supply of it. This is unwarranted, because access to care and use of healthcare should be equally divided in a country. Besides, it is proven that more use of healthcare does not improve health outcomes or quality of life (Fisher et al., 2003; Hussey, Wertheimer, & Mehrotra, 2013; Wennberg, Fisher, & Skinner, 2002). This leads to inefficiency and is unwarranted. These categories of unwarranted variation are summarised in Table 1.

Table 1. Categories of unwarranted variation

Category	Explanation
Variation in effective care and patient safety	Variation through misunderstanding of scientific relevance about the effectiveness of treatments
Variation in preference-sensitive care	Variation through patients' preferences
Variation in supply-sensitive care	Variation through unequal division of resources

However, there was some criticism on the definition and categories used by Wennberg (Mercuri & Gafni, 2011). For example, Wennberg did not discuss why he chose those specific factors, if they are mutually exclusive and how they can be measured. Based on these points, three more suggestions about unwarranted variation were suggested in the literature. First, Sepucha et al. investigated the unwarranted

variation in cancer care (Sepucha, Ozanne, & Mulley, 2006). They argued that "there are multiple sources" of unwarranted variation including inequitable access to resources, poor communication and role confusion. Moreover, perhaps the most significant source is the misinterpretation of misapplication of the relevant clinical evidence (Sepucha et al., 2006, p. 173). Their definition is consistent on the categories of Wennberg concerning effective care and supply-sensitive care, but they argue that preferences of patients should be warranted. Second, Goodman researched the existence of variation from the Small Area Variation research dimension (SAV) (Goodman, 2009). His definition is: "*the variation in medical resources, utilization and outcome that is due to differences in health system performance."* (Goodman, 2009, p. 5). He agrees with Wennberg, however, the definitions of the categories remain unclear. Third, a definition of unwarranted variation is proposed by Bojakowski (Bojakowski, 2010). He argues that "*unwarranted variations in healthcare services are variations that cannot be explained by public health needs or medical needs"* (Bojakowski, 2010, p. 241). Moreover, he argues that unwarranted variation is a case of judgment and differs for each person. He argues that it is difficult to provide one definition and operationalise this in practice. Overall, the authors agreed about two points set by Wennberg: effective care and supply-sensitive care are unwarranted, however, the definitions remain still unclear. Moreover, they all agree that unwarranted variation should be limited. Still, no clear definition exists (Mercuri & Gafni, 2011). In a later article, Mercuri & Gafni argue that, when studying variation in healthcare, one should concern whether the variation which occurs is warranted or unwarranted. When this is not performed correctly, it can have significant implications for the interpretation of the results and the consequential actions (Mercuri & Gafni, 2017). Corallo et al (2014) argue that: "*in studying medical practice variations, it is important to focus on conditions and procedures that are clinically important, policy-relevant, resource intensive, involve trade-offs among healthcare sectors and/ or have high levels of public awareness"* (p.12). Moreover, they argue that research about variation can lead to insights in the underuse, overuse and misuse of services. Based on this, causes and consequences of this should be detected to minimise unwarranted variation. In this study, the variation among MHNs is studied and because this is a clinically important and policy-relevant study, it is in line with the argument of Corallo et al. when to study variation in healthcare.

As mentioned before, unwarranted variation should be handled to achieve efficient, effective, equal and qualitative good healthcare. One way to achieve this is by setting guidelines so that employees in healthcare all give healthcare based on the same definitions. Doctors agree that unwarranted variation should be limited, but they have their doubts about the solution with guidelines, because there exists resistance among physicians to stick to guidelines, which results in low adherence (Chandra & Staiger, 2017; Cook et al., 2018; Grytten, Monkerud, & Sørensen, 2016). Physicians are concerned about their autonomy, oversimplification of the healthcare process and medicine, conflicting interests, insufficient evidence and potential litigation. Other methods can, in their opinion, reduce variation. Those methods include for example clinical decision support by the use of feedback or the experience of physicians that it improves practice.

3.3 Causes of variation and hypothesis development

In the previous sections of this literature review, it became clear that there is variation in the healthcare processes. The goal of this study is to analyse the variation in practices of the MHN in the Netherlands. To the extent of my knowledge, there is no research in the Netherlands performed based on causes of variation. One way of detecting causes is by an economic point of view. Within economic models, there is typically a demand and a supply side. Skinner (2011) suggested to detect causes of variation in healthcare processes based on the investigation of both the demand and supply side (Skinner, 2011). However, because prices in the Netherlands are fixed and both the supply and demand side pay and get the same amount of money, not a full economic model can be used. In this research healthcare expenditures are used to detect variation with the inclusion of supply and demand factors. Peacock and colleagues gave in 2001 a review of explaining variation in healthcare by factors for the supply and demand side (Peacock, Segal, & Richardson, 2001). As discussed before, variation in patients (i.e. the demand side) is warranted, whereas the variation in MHNs (i.e. the supply side) is unwarranted.

In this section, first, the economic background to detect variation in healthcare processes is discussed. Second, demand factors that may cause variation are presented and lastly, supply factors that may cause variation are presented. Additionally, hypotheses for this study are presented.

3.3.1 Detection of variation

As discussed in sub-section 2.2.1, there are different ways to detect variation in healthcare. One of the methods which are mostly used is on the basis of healthcare expenditures. As mentioned before, this has not been performed in the Netherlands.

Looking at healthcare in general, resources are limited. The government has to make decisions regarding the distribution of resources and services. A key factor in the delivery of healthcare in a country is the financing and reimbursement for healthcare services (Chen & Feldman, 2000). Looking from an economic perspective, there is a demand and supply side. In this case, the demand side includes patients, who try to maximise their utility in healthcare. This is mainly caused by the consumption of healthcare. The supply side includes producers of healthcare. They try to maximize their profit in a normal economic model. Between the demand and supply side, the cost of care is determined. In the Netherlands, the government and insurance companies determine the cost of healthcare. Those costs are rising over the years and different parties try to minimise costs and provide healthcare as efficient as possible. This is one of the reasons why costs are a key factor in healthcare and why it is interesting to study it from this point of view. Besides, a lot of researches investigate the quality and satisfaction of care. This is an important subject, however, the costs of healthcare should still be paid in the end. There should be gathered more revenues to cover healthcare costs. Insight in those revenue streams may help to solve this problem (Collier, 2011). Collier argues that by improving efficiency, money can be saved, but it is not enough to cover all healthcare costs. To diversify how resources are generated for the public,

new revenue streams may occur and this extra money may cover the healthcare costs. Moreover, he argues that more people should consider revenues as a cost-saving method instead of efficiency. For these reasons, healthcare expenditures are studied.

In the researches which have been performed based on healthcare expenditures, geographical differences were detected. Differences in healthcare spending imply inefficiencies and inequities in resource use (Mays & Smith, 2009). As mentioned before, to detect causes, clear definitions should be given and the implication of the variation should be discussed in depth. One way by doing this correctly is to make a distinction between supply and demand factors (Cutler et al., 2013). Looking at this research, the revenues an MHN gathers exists out of two parts: (1) a capitation fee, which a general practice gets when there is an MHN present in the general practice for each patient and (2) a consultation fee, which is based on the frequency of consultations the MHN gives (Kroneman, Meeus, Kringos, Groot, & Van der Zee, 2013). The first part of the revenue is not be taken into account in this research, because it is not related to the service provided by the MHN. The fees are set by the health insurer and may differ every year, depending on the contract with the general practice. A research performed in the UK suggests that there are differences in the expenditures in mental healthcare (Bindman et al., 2000). Due to the literature discussed before, it is likely that there are cost differences regarding MHNs in the Netherlands. This leads to the following hypothesis:

H1: There exists provincial variation in healthcare expenditures regarding consultations provided by MHNs in the Netherlands.

3.3.2 Demand

To detect causes of variation, the demand side is studied in this sub-section. Factors on the demand side include for example patients' demographics, household income and risk characteristics (Heijink et al., 2015). Research about the demand side is studied often, mostly focused on the predictability of healthcare costs. Forecasting of healthcare costs can be important for policymakers and practitioners to detect patterns in expenditures. In this way, forecasts can be made for making budgets for different parts of the healthcare sector (Wang, 2009).

To prove the importance of patient characteristics on healthcare expenditures, Newhouse was the first in studying this subject (Newhouse, 1977). He studied the relationship between healthcare expenditures and income and concluded that income has a positive effect on healthcare expenditure in different regions based on an aggregate level of data. Over the years, different variables of patients were detected in relation with healthcare expenditures based on an aggregate analysis on small area data, for example socio-economic factors like education and income (Gerdtham & Jönsson, 2000). However, several researches suggested that the use of individual data of patients is preferred, because it provides more precise results and analysis based on an aggregate level of patient data washes out the effects of

specific individual patients (Peacock et al., 2001). Examples of demand-side variables which influence healthcare expenditures in non-aggregate data analysis include demography, ethnicity, employment status, health status, social economic status and geographic location (Beck, Trottmann, & Zweifel, 2010; Ellis & McGuire, 2007; Fowles et al., 1996; Geruso, 2017; Lamers, 1999; Newhouse, Manning, Keeler, & Sloss, 1989; Pope, Adamache, Walsh, & Khandker, 1998; van Vliet & van de Ven, 1992; Wynand, de Ven, & Ellis, 2000).

The previous articles described variation in healthcare expenditures by studying the difference of the R^2 of the models. The R^2 is a measure that provides the percentage of explained variation of the dependent variable, which is caused by the independent variables in the model. For example, when the R^2 amounts 80%, the variation in the outcome variable is explained for 80% based on the independent variables in the current model. Consequently, 20% of the variation in the dependent variable remains unexplained based on the given independent variables. Focusing on healthcare expenditures as the dependent variable and adding only age, gender and geographic location as independent variables, the R^2 is between 0.1 and 5% (Cutler et al., 2013; Ellis & McGuire, 2007; Finkelstein, Gentzkow, & Williams, 2016; Wynand et al., 2000). By adding other more specific patient-specific factors, such as patient preferences, the R^2 can increase up to 20% (Ellis & Layton, 2013; Ellis & McGuire, 2007; Newhouse et al., 1989; van Vliet & van de Ven, 1992; Wynand et al., 2000). However, still, a large part of the variation remains unexplained by studying only demand-side factors. There is found one article which is an exception to this statement: in Germany, they found an R^2 of demand-side factors of 79%. This article separates itself from the others by including a lot of demand side variables like morbidity rates based on a risk factor for each patient (Göpffarth, Kopetsch, & Schmitz, 2016). It is known that including a lot of independent variables in the equation will increase the R^2 for sure, also when the variables do not explain the outcome variable well. Göpffarth et al. (2016) included all kinds of healthcare (e.g. hospital care, primary care and ambulatory care), which cover all healthcare expenditures for a patient. From this article, it became clear that adding patient-specific factors, like disease severity or risk factors for the patient to obtain a certain disease, healthcare expenditures can be explained relatively better compared to only demographic factors of patients.

The baseline variables which are included in almost all researches regarding explaining healthcare expenditures are the age, gender and place of residence of the patient. Those variables are included mostly, because they are relatively easy to gather by insurance data and are internationally applicable by comparisons of articles. Considering the availability of the data for this research, those variables are the only ones which can be included in the analysis. Taken into account the literature which is described above, the following hypothesis is answered in this study:

H2: The demand side factors age, gender and place of residence of the patient explain at most 5% of the variation in healthcare expenditures associated with consultations provided by MHNs.

Age

Literature about explaining variation in healthcare expenditures mostly focus on studying the R^2, as mentioned before. Next to that, some studies looked at the effect of specific variables which are included in the analysis (Ellis & Layton, 2013; Geruso, 2017; van Vliet & van de Ven, 1992). For example, Geruso et al. (2017) studied the effect of age and gender on healthcare expenses. They concluded that people in older age categories have higher healthcare expenses (Geruso, 2017). This is also the case for a study performed in the Netherlands, focusing on Type 2 Diabetes Mellitus (Redekop et al., 2002). The higher the age of patients, the higher the healthcare expenditures. Unfortunately, no research has been performed on the relationship between mental healthcare and healthcare expenditures in this sector. A study focused on the MHN in the Netherlands suggested that an increase in age, results in a higher risk to have a consultation of an MHN (Magnée et al., 2016). For these reasons, the following hypothesis is set:

H3: Age is positively related to healthcare expenditures from consultation provided by the MHN.

Gender

Besides age, gender may also have a significant impact on healthcare expenditures. Considering gender, women have significantly higher healthcare expenditures compared to men (Ellis & Layton, 2013; Geruso, 2017). Those studies focused on the total healthcare expenditures of individuals. Another study focused on the effect of gender and age together. They concluded that women have higher healthcare expenditures in the age of 15-40 years, but men have higher healthcare expenditures in the age of 50-90 (Wynand et al., 2000). Focusing on care provided by MHNs, Magnée draw the conclusion that women have a significantly higher risk to obtain a consultation with an MHN compared to men (Magnée et al., 2016). The age category which has the highest risk to visit an MHN is between 19-40 years. Based on Wynand et al, there can be concluded that women treated by the MHN may have higher healthcare expenditures on consultations compared to men. For these reasons, the following hypothesis is set:

H4: Women have a positive effect on healthcare expenditures from consultations provided by the MHN.

Place of residence

The use of healthcare in urban and rural areas varies (Peacock et al., 2001). Reasons for this may be that secondary care is mostly provided in hospitals, which are located in urban areas. When a patient lives in a rural area, this may be a restriction to obtain specialized healthcare, because, for example, the travel distance for a patient may be too long (Peacock & Segal, 2000). This may result in the fact that total healthcare expenditures of patients living in rural areas are lower compared to patients in urban areas, because their access to health is lower. On the other hand, it may result in extremely high healthcare

costs for patients living in rural areas, if the patient does not receive healthcare on time and complicated treatments are necessary to cure the patient.

Those researches are based on specialised care, however, the care from MHNs is provided in primary care rather than in secondary care. Generally, the general practice is close to the home of the patients, which means that there should be no restriction regarding the distance to obtain healthcare. Focusing on healthcare provided by MHN, Magnée concluded that patients living in a very low degree of urbanisation, i.e. living in a rural area, have a significantly higher chance to visit an MHN compared to patients living in a really high degree of urbanisation, i.e. an urban area. Besides, it is well known that there are waiting lists to obtain mental healthcare from an MHN (Huisarts en Wetenschap, 2017). Especially in urban areas, the waiting lists are relatively long (>4 weeks). When waiting lists are long, it may be the case that MHNs refer patients more often to specialised care or only offer a few consultations by themselves, because there are patients waiting to receive care as well. In both cases, the healthcare expenditures per patient caused by consultation from MHNs in urban areas is relatively low, because patients do not visit the MHN that often and thus do not obtain a lot of consultations. For the reasons discussed before, the following hypothesis is set:

H5: Living in a rural area has a negative effect on healthcare expenditures from consultation provided by the MHN.

3.3.3 Supply

Since demand-side factors only explain a part of the variation in healthcare expenditures, the supply side may also play a role. For this reason in it is interesting to study the supply side as well, which is done in this sub-section. Examples of supply-side factors include prices of healthcare, physician-related factors, organizational aspects, policy characteristics and efficiency mechanisms (Heijink et al., 2015; Peacock et al., 2001).

After it became clear that demand-side factors only explain a part of the variation in healthcare expenditures, Wennberg began to consider the physician as a potential source of variation in healthcare expenditures (Wennberg, 1984). He developed the practice style hypothesis, where is stated that variation in physicians specific characteristics explained a large part of the variation in the differences in the healthcare processes. Unfortunately, no clear definition of this hypothesis exists (Mercuri & Gafni, 2011). Overall, practice style is caused by different believes in efficacy of medical treatments for different physicians, which causes a difference in treatment patterns over time and thus results in the fact that there is variation in healthcare expenditures (Ahammer & Schober, 2017). Difference in practice style may occur because physicians are (1) preference centred, meaning that physicians have preferences for certain treatments, or (2) constraint centred, meaning that environmental factors like for example the institutional setting where the physician works play a role in the decision to provide a

certain treatment (de Jong, 2008). This variation may be unwarranted for at least two reasons. First, physician effects may not play a role, because decisions made concerning treatment, should be based only on clinical evidence. All patients should be provided with the treatment that is proven to be effective. Variation in practice style is unwarranted, especially from the patient perspective, because it can be the case that the patient does not get the treatment it should have. Second, supplier-induced demand should not persist in healthcare, because it generates inequalities and inefficient processes. Taken into account those factors, physician-specific factors are unwarranted and should be limited.

However, after Wennberg set the hypothesis of practice style variation, there was discussion whether this really explains the variation in healthcare. There was critique based on for example the methodology used by several researches to detect practice variation (Davis & Gribben, 1995; Davis et al., 2002; de Jong, 2008; Hayward, Manning Jr, McMahon Jr, & Bernard, 1994; Hofer et al., 1999; Krein, Hofer, Kerr, & Hayward, 2002; Molitor, 2018; Sheiner, 2014; Stano, 1993). Davis et al. agreed that there is variation based on practice style, however, still a large part of the variation in healthcare expenditures remains unexplained. Hofer et al. argued that the data used in the analysis are not reliable, because physicians differ in their way of including data in the system they use. This means there is variation in entering the data, but in real practice, this variation will be less. Krein et al. concluded that it is more about the organisational level instead of the physician itself. There are differences between organisations, but within the organisation, this variation is quite small. This is in line with the research of de Jong (2008), Molitor (2018) and Stano (1993) who all argue that non-medical factors play a more important role instead of the practice style. Overall, these critical articles admit that practice style variation exists, but nevertheless, it cannot explain all variation present in healthcare: environmental and organisational factors also play an important role.

On the other hand, research also supports the practice variation hypothesis (Ahammer & Schober, 2017; Cutler et al., 2013; D. M. Cutler & Sheiner, 1999; Epstein & Nicholson, 2009; Grytten & Sørensen, 2003; Henke & Epstein, 1991; Kaiser, 2017; Mousquès, Renaud, & Scemama, 2010; Song et al., 2010). Epstein and Nicholson concluded that caesarean sections in the US differ across regions and is attributable to practice style. They argue that it depends on the educational background of the physicians, which does not change that much after the medical training is finished. Cutler et al. (1999) concluded that the most important factor in explaining variation in healthcare is the practice style hypothesis. Kaiser (2017) argued that gender of the physicians causes variation in healthcare expenditures. All the previous researches focused on specialised care in secondary care. Grytten and Sorensen (2003) were the first to detect practice variation in general practices. They concluded that variation in general practices caused by GPs contributes for a large extent to the overall variation in healthcare expenditures. Age and gender of the patients only explained 1% in the variation in healthcare expenditures, whereas 59-66% of the variation in healthcare expenditures is explained by physician-specific factors. Besides, they concluded that the practice style does not differ when physicians move to another institution, which means that practice style is a deeply rooted behaviour and does not depend on

for example institutional factors. Mousquès et al. (2010) also argued that the practice style hypothesis is relevant for GPs: it explained 70% of the variation. Ahammer and Schober (2017) investigated that there are physician fixed effects which may attribute to the variation in healthcare expenditures of GPs. They found that healthcare expenditures are attributable to GPs and differ in percentage from 0.05% (variation in drug expenses) to 4.29% (variation in screening expenses). GP specific effects included age, gender, the university where they studied and having a pharmacy as well. Also in this research, patient fixed effects explained most of the variation (on average 33.55% of the variation). Variables in these articles which are considered as patient-specific factors include mobility and demographic variables. This is in line with the article by Göpffarth et al. (2016), who concluded that adding specific patient characteristics increased the R^2 substantially.

As a result of this evidence, it is likely that a part of the differences in healthcare expenditures of MHNs may be caused due to the practice style hypothesis. Since MHN is a relatively new function in the Netherlands, there is no literature available on the topic of healthcare expenditures variation. However, there have been some research carried out about the role of a nurse practitioner (NPs), which is in line with the function of an MHN, because the NP operates in the general practice as well. The largest difference is that an NP focus on chronic diseases like diabetes and MHN focus on mental healthcare. Both functions cause substitution of care, also called "anderhalve lijnszorg" in Dutch, where they take over tasks from GPs. There is variation between NPs and the main reason seems the difference in educational background (Blackwell & Neff, 2015; Koren, Mian, & Rukholm, 2010; Mckay, 2006).

As mentioned before, the background of MHNs also differs, since there is no clear educational study which takes care of this discipline (LHV, 2015). Grytten and Sorensen concluded that most of the variation is explained by physician-specific effects when they included a set of variables which covered physician-specific effects (Grytten & Sørensen, 2003). The research which has been performed regarding the supply side does not make a distinction between variables. Those are mostly mentioned as a factor and there is not described what the precise variables are. For this reason, only a broad hypothesis can be formulated and no specific hypotheses can be made for each variable included in this research, i.e. what has been formulated for the demand side. Since the few demand side variables which are included in this research compared to the number of variables in other researches and no patient disease-specific data is available, it is likely that the variation in healthcare expenditures by MHNs may be explained mostly through differences in demographic characteristics of MHNs. If this is the case, the practice style hypothesis can also be accepted for MHNs. Based on this argumentation and the existing literature on this subject, the following hypothesis is set:

H6: The supply side factors age, gender and education of the MHN explain relatively more of the variation in healthcare expenditures from consultations provided by MHNs, compared to the demand side.

It should be mentioned that it is not the intention of this research to describe all of the variation in healthcare expenditures from consultations provided by the MHNs. Only the part which is attributable to the demand and supply side variables mentioned in the hypotheses are discussed. An overview of the hypotheses can be found in Figure 1.

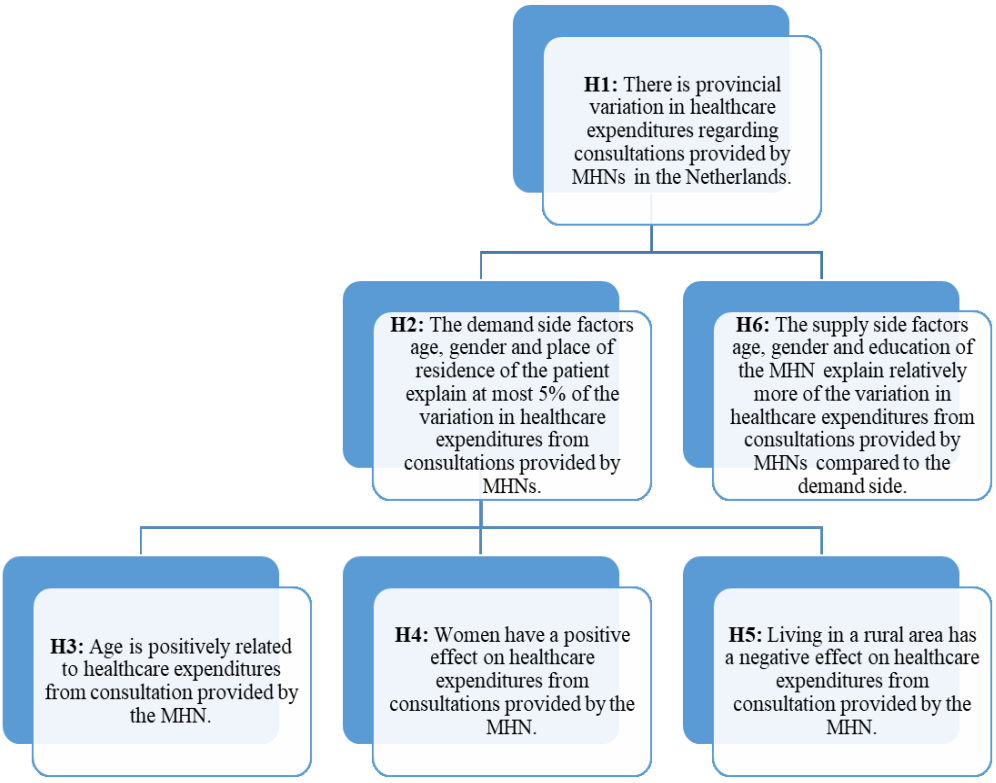

Figure 1. Overview of the hypotheses

4. Methodology

Since the literature has been studied and hypotheses are set, the methodology should be considered. In this chapter the methodology is discussed. The article written by Grytten and Sorenson (2003) is taken as a guide in this research. Grytten and Sorenson (2003) studied healthcare expenditures for both demand and supply side in general practices and since MHNs provide consultations in the general practice, their methodology is helpful.

The outline of this chapter is as follows: first the research design is discussed, second the data which is used to perform this research is given and finally the main data analysis to answer the research question and hypotheses are provided.

4.1 Research design

The research design which is used in this study is a retro perspective cohort study with a quantitative design. In this section, the research design is discussed.

By choosing the design of a research, two types should be considered: a prospective or retro perspective cohort study. In a prospective cohort study, first, a sample is taken out of a population. This sample is followed in time to detect factors which influence the outcome. For example, one can make a sample of patients and follow them in time to see if their lifestyle behaviour had an influence on the development of a heart attack. Because one should wait till the event took place (e.g. a heart attack), it may take several years to obtain data, which makes this type of research relatively expensive. In a retro perspective cohort study the event took already place (e.g. the patient had a heart attack) and one can study the data before the event and check whether certain factors had an effect on the outcome. For example, one can ask the lifestyle of the patients and check if they had a heart attack. An advantage of this type of research is that some data is already available (i.e. if the heart attack took place). A disadvantage contains the introduction of selection- and information bias. The main difference between the two studies is the time element. Within a prospective cohort study, the event did not take place yet, whereas in a retro perspective study it did. In this study, a retro perspective design is used, because patients already had a consultation with an MHN (i.e. the event already took place) and factors which may cause this consultation are studied.

Moreover, the design of the research should be considered. This may be a quantitative or qualitative method. Within a qualitative design, one wants to know why and how certain things happen and theories may be tested. One of the main methods which are used is, for example, interviews or surveys with open questions. In a quantitative design, causes are mostly detected with the use of statistical analysis. One of the methods used is surveys with closed questions or big data analysis. In this research, factors to explain variation in healthcare expenditure were studied, which leads to a quantitative design.

4.2 Data

This research is carried out at the department GPs of Topicus. The software offered by Topicus to GPs focuses on data recording, which becomes more and more important since it is required by health insurances to record this data correctly. When GPs do not do this, they do not receive money for the services they provided. Since MHNs are part of a general practice, they also register their operations in the system offered by Topicus. Overall, 92% of all general practices in the Netherlands use the software offered by Topicus, which provides data for this research.

To draw conclusions about the hypotheses, it should be known which data is available and which data should be generated. Regarding the data to answer H3, H4 and H5, patient-level data is studied. This data is anonymous, so the privacy of the patients is not violated. Since the percentage of MHNs in general practices is stable for two years now, data for 2016 and 2017 is studied. Only general practices which offer services of MHNs and have all data available to answer the hypotheses (i.e. all patient-related factors) are included in the study. Other practices are excluded. For each patient, the annual costs for 2016 and 2017 were calculated, since it is known what kind of consultation the MHN gave. An overview of the data used regarding the number of services and matching fee can be found in Table 2.

Table 2. Overview of types of consultations provided by the MHN
In this table, the types of consultations are presented included with the fee for the years 2016 and 2017. The percentage of the specific consultations to the total amount of consultations is presented in the brackets.

	2016		**2017**	
	Total number	Fee (€)	Total number	Fee (€)
Consult < 20 minutes	3.476 (4.0)	9.04	3.754 (3.9)	9.23
Consult > 20 minutes	69.080 (79.8)	18.08	78.285 (81.6)	18.47
Visitation < 20 minutes	31 (0.1)	13.56	33 (0.1)	11.55
Visitation > 20 minutes	2.454 (2.8)	22.60	2.530 (2.6)	23.09
Consult by phone	8.533 (9.9)	4.52	8.676 (9.0)	4.62
Consult by e-mail	2.976 (3.4)	4.52	2.650 (2.8)	4.62
Total	86.550 (100)		103.030 (100)	

The healthcare expenditures for each patient per year can be calculated by adding up the costs for each specific type of consultation, which is for each type of consultation calculated by the number of consultations the MHN gave, times the specific consultation fee as mentioned in Table 2. Overall, the total healthcare expenditures regarding consultations of the MHN for one year for one patient can be calculated by adopting the following formula:

$$Annual\ healthcare\ expenditures_t: \sum \left(\#\ Consultations_{i,t} * Consultation\ fee_{i,t}\right)$$

Where *t* is the year the consult took place (2017 or 2016) and *i* is the type of consultation a patient had (e.g. a long consult or phone consult). By adding the healthcare expenditure per type of consultation, the total healthcare expenditure for consultations of the MHN for each year is calculated. The total healthcare expenditures for consultations of the MHN in 2016 amounts approximately €1,4 million and in 2017 €1,6 million and in both years they are mostly caused through consults >20 minutes. Since the tariffs for fees are different for 2016 and 2017, the relevant tariffs for the year were used by calculating the healthcare expenditures per patient. Besides the number of consultations, also age, gender and place of residence are known by Topicus for each patient, which means the data for the demand side is already available and complete.

Regarding the data to answer H2 and H6, healthcare expenditures for each MHN should be studied, so MHN-level data is used. By studying this data, it became clear that some MHNs had relatively high annual fees and worked for example the whole year, compared to others who had relatively low annual fees and worked for example only four months in a year. This difference in annual fees may be caused through (1) the month one starts working as an MHN and (2) the difference in contract hours he or she works. An appropriate solution may be to calculate the average monthly cost and correct this for the number of FTE one works. Unfortunately, the FTE an MHN works is not available. For this reason, the method of Grytten and Sorenson (2003) was used: the average healthcare expenditures per consultation per MHN should be calculated for both years. This can be performed by calculating the total fees an MHN got in one year and divide this amount by the total number of consultations he or she gave that specific year. In formula:

$$Average\ fee\ per\ consultation_t = \frac{\sum Healthcare\ expenditures_t}{\sum Consultations_t}$$

Where *t* is the year the consult took place (2017 or 2016). In this way, the average cost per consultation per year can be calculated and the problem regarding the unknown FTE is solved. The MHN specific variables which are included are age, gender and education of the MHN. This information was not available for research yet and to obtain this data, MHNs should be contacted. Since it is not efficient to contact all MHNs separately and explain the goal of the research, care groups were contacted. Care groups are organisations in the Netherlands where GPs can affiliate with. Care groups mostly represent a certain region or province and they, for example, arrange contracts with health insurances. Besides this, care groups may regulate the deployment of MHNs in a general practice. This means they have the data regarding MHNs. For these reasons, care groups were asked to join the research. The ethics committee of the University of Twente gave the approval to contact them. In total, five care groups were asked and three gave permission to share their data regarding MHNs for this research. In total, the sample size of the research contains 177 MHNs with 40,149 patients who had at least one consultation with an MHN in the year 2016 and/ or 2017.

4.3 Analysis

In this section, the analysis which is used to answer the hypotheses is discussed. Since there are different hypotheses, different analyses are used (Field, 2013). First, the analysis which is used to answer the first hypothesis is discussed. Second, the analyses which are used to answer the other hypotheses are discussed. All analyses were performed in SPSS 22.

Hypothesis 1

Before performing the analysis, the data should be cleaned up. In the first place, the descriptive statistics of the healthcare expenditures for each province are given to detect if there are outliers and if the data is normally distributed. The provinces which are included in the analysis are Noord-Brabant and Limburg. First, outliers are detected based on the outlier labelling rule with the interquartile range of 2.2 as a multiplier (Hoaglin, Iglewicz, & Tukey, 1986). When an observation is outside this range, it is deleted for the final analysis. Second, there are different ways to determine whether the data is skewed. When this is the case, actions should be taken so that the data is normally distributed again (e.g. take the logarithm of the data). However, the Central Limit Theorem (CLT) stated that "*when samples are large enough (n >30), the sampling distribution will take the shape of a normal distribution, regardless of the shape of the population from which the sample was drawn*" (Field, 2013, p. 871). When this theory is assumed, the assumption of normal distribution does not matter anymore, since the CLT stated that in large samples, the estimate of confidence intervals, significance tests and parameters come from a normal distribution, regardless of how the population data looks like.

Second, to detect if there is a significant difference in healthcare expenditures over the provinces in the Netherlands, a t-test is performed. Normally, the means of the two provinces are compared. However, when the mean is substantially different from the median, the median is taken as outcome measure instead of the mean. By performing a t-test, two options should be considered: (1) independent-sample t-test and (2) paired-samples t-test (Field, 2013, p. 364). In an independent-sample t-test, there are two independent groups tested for different conditions, whereas in a paired-sample t-test the same participants were included for two different conditions. Since there are two independent groups of patients, an independent-sample t-test is performed. Before performing the t-test, the homogeneity of the variances should be tested by a Levene's test. When this is not significant ($p>0.05$) equal variances can be assumed. When this test is significant ($p<0.05$), equal variances cannot be assumed. In both cases, the SPSS-output gives the significance for the t-test and when this test is significant, it means that there are differences in healthcare expenditures between Noord-Brabant and Limburg. In the other hypotheses, regressions are carried out at the multivariate level. For this reason, it is also interesting to study the variables at the bivariate level by performing t-tests for the variables which are bivariate in relation to healthcare expenditures. Consequently, t-tests are also performed for the patient-level variables gender and place of residence and for the MHN-level variables gender and level of education.

Hypothesis 2, 3, 4, 5 and 6

To answer the remaining hypotheses, regression analyses have been performed. To decide which kind of regression is performed, first the dependent and independent variables should be described. Roughly, there can be made a distinction in the analysis regarding (1) how much of the variation in healthcare expenditures is explained by the demand and supply side and (2) specific patient-related factors that relate to healthcare expenditures. An overview of the variables used can be found in Table 3.

First, variation in healthcare expenditures is explained based on demand and supply-side factors. The dependent variable contains the average costs per consultation for each MHN, which is in line with the method of Grytten and Sorenson (2003). Since this is an average number, also the average of the patient characteristics are added in the formula considering the independent variables (i.e. the percentage of women, the percentage of patients living in an urban area and the average age of the patient in the population of the MHN). Those factors explain the variation in the demand side and answers hypothesis two. Considering the supply side, several independent variables regarding the MHN are added: gender of the MHN (woman or man, woman=1), age of the MHN, educational background of the MHN (university or no university, university=1), number of Health Information Systems (HIS) used and number of practices one works (H6). Besides, control variables were added for the province the MHN works (Limburg or Noord-Brabant, Limburg=1) and the year (2017 or 2016, 2017=1). By running the analysis with those factors, it provides an answer on hypothesis six.

Second, specific factors that may influence healthcare expenditures are considered. Since it was only possible to set hypotheses for patient-related factors and not for MHNs, the dependent variable contains the annual costs of a patient in Euros. The independent variables include gender of the patient (woman or man, 1=woman), the age of the patient (in years) and place of residence (urban or rural, 1=urban) of the patient. The place of residence is defined as number of addresses per km^2 as in the article of Magnée et al. (2016). The number of addresses per km^2 for each place is provided by the CBS (CBS, 2015). As a result, the degree of urbanisation is categorised as urban when there are ≥1,250 addresses per km^2 and rural when there are <1,250 addresses per km^2. There is assumed that people who have their GP in an urban area, also live in an urban area, because it is obligated that a GP can visit a patient within 15 minutes in case of emergency (Nederlandse Patiënten Federatie, 2018). Finally, control variables are added for the province (Limburg or Noord-Brabant, 1=Limburg) and year (2016 or 2017, 1=2017).

Table 3. Description of variables used to detect variation in healthcare expenditures

	Variable	Measurement
	Dependent variables	
Patient-level data	Healthcare expenditures of a patient regarding consultations with an MHN	Total amount of Euros on an annual basis
MHN-level data	Average received fee per consultation for an MHN	Average amount of Euros on an annual basis
	Independent variables	
Patient-level data	Gender of the patient	Woman=1, Man=0
	Age of the patient	Number of years
	Degree of urbanisation of the patient	Urban=1: ≥1,250 addresses per km^2 Rural=0 : <1,250 addresses per km^2
	Province	Limburg=1, Noord-Brabant=0
	Year	2017=1, 2016=0
MHN-level data	Gender of the MHN	Woman=1, Man=0
	Age of the MHN	Number of years
	Highest level of education MHN	University=1, Other=0
	Number of HIS	Number of different HIS used
	Practices served	Number of general practices he or she worked at in a given year
	Gender of the patient	Percentage of women of the patients
	Age of the patient	Average age of the patients
	Degree of urbanisation of the patient	Percentage of patients living in an urban area
	Province	Limburg=1, Noord-Brabant=0
	Year	2017=1, 2016=0

Taking into account these variables, multi-level Ordinary Least Squares (OLS) regressions are performed. This is a multiple regression method where the sum of squared errors is the minimum that it can be, given the dataset. Before using a regression analysis, several assumptions should be met (Field, 2013, p. 310). First, there should be additivity and linearity, meaning that the dependent variable relates linearly to the independent variables. This was checked by making a graph with the dependent variable and independent variables. Second, the errors should be independent, which was tested by a Durbin-Watson test. This outcome should be between 1 and 3. Third, there should be homoscedasticity, meaning that the variance of the residual terms should be constant. Last, the errors should be normally distributed. To test this, plots are made and normality is checked. Finally, multicollinearity between the variables is considered and for this reason, a correlation matrix is performed. Correlations with a value of around 0.1 are considered as a small effect, around 0.3 is a medium effect and around 0.5 is a large effect (Field, 2013, p. 82). When a correlation is ≥0.5, it can be a sign of multicollinearity which influences the results of the OLS. For this reason, the Variance Inflation Factor (VIF) is checked, and when this value is higher than 10 or lower than 0.2, there is cause for concern (Field, 2013, p. 325). Consequently, one of the variables with a high correlation and a doubtable value of the VIF should be excluded from the analysis.

To conclude whether variation in healthcare expenditures is caused mostly by the supply or demand side, several regression analyses are performed. One measure to describe variation in healthcare expenditures is the differences in explained variation by using the difference in R^2 (Grytten & Sørensen, 2003; Magnée et al., 2016). Four regression analyses are performed to answer this question: (1) include control variables, (2) include control and demand variables, (3) include control and supply variables (4) include control, demand and supply variables. To detect the effect of the demand side, the R^2 of model 4 should be subtracted by the R^2 of model 3. Besides, to detect the effect of the supply side and correct for the demand side at the same time, the R^2 of model 4 should be subtracted by the R^2 of model 2. By doing this, H2 and H6 are answered. This analysis is repeated for all individual supply-side variables. In this way, the R^2 for each variable can be calculated and the variable which causes most of the variation can be detected. The goal of the analysis is to determine the R^2 and for this reason, the α of the variables were not studied in depth. In all equations, Y includes the average fee per consultation for an MHN in one year in Euros, β includes the intercept and ε is the error-term.

Model 1. Control variables

(1) $Y = \beta + \alpha YEAR + \alpha PROVINCE + \varepsilon$

Model 2. Demand-side

(2) $Y = \beta + \alpha AGEPATIENT + \alpha GENDERPATIENT + \alpha URBANISATIONPATIENT + \alpha YEAR + \alpha PROVINCE + \varepsilon$

Model 3. Supply-side

(3) $Y = \beta + \alpha AGEMHN + \alpha GENDERMHN + \alpha EDUCATIONMHN + \alpha HIS + \alpha PRACTICESSERVED + \alpha YEAR + \alpha PROVINCE + \varepsilon$

Model 4. Demand and supply side

(4) $Y = \beta + \alpha AGEPATIENT + \alpha GENDERPATIENT + \alpha URBANISATIONPATIENT + \alpha AGEMHN + \alpha GENDERMHN + \alpha EDUCATIONMHN + \alpha HIS + \alpha PRACTICESSERVED + \alpha YEAR + \alpha PROVINCE + \varepsilon$

To answer H3, H4 and H5, a regression analysis with the patient-level data is performed. In this analysis, it is the goal to study the coefficients of the variables (age, gender and urbanisation) based on direction and significance. Consequently, H3, H4 and H5 can be answered. Y includes annual healthcare expenditures for each patient in one year in Euros, β includes the intercept and ε includes the error-term.

Model 5. Patient-level analysis

(5) $Y = \beta + \alpha AGEPATIENT + \alpha GENDERPATIENT - \alpha URBANISATIONPATIENT + \alpha YEAR + \alpha PROVINCE + \varepsilon$

5. Results

In this chapter, the outcomes of the analysis are presented. First, the descriptive statistics of the data are provided. Second, provincial variation in healthcare expenditures is studied and an answer on hypothesis one is presented. Third, the amount of variation explained by demand and supply-side variables is studied based on MHN-level data, which provides an answer on hypotheses two and six. Fourth, the effect of certain patient-related variables on healthcare expenditures is studied based on patient-level data, which provides information about hypotheses three, four and five. Finally, robustness tests are presented. All results are linked to the literature, which provides the theoretical contribution of this thesis.

5.1 Description of the data

The data which is used in this research contains recorded data from MHNs which is stored in the database of Topicus. Since Topicus takes over the task of the GP for the declaration process to the health insurer, there can be assumed that the data gathered from this system is reliable. When they do not register their codes well, the practice will not receive the money they have worked for. This financial impulse is considered as being very important to code precisely.

The total sample size for the patient-level data amounts 40,149 patients. In 2016, 18,001 patients were included, in 2017, 22,148. As mentioned before, first outliers have to be detected. This was done based on the outlier labelling rule, as discussed in Chapter 4. In total, 907 observations are deleted, which is 2.3% of the total dataset. The final sample size after excluding outliers amounts 39,241 patients. The descriptive statistics can be found in Table 4, Panel A. By studying the dependent variable, the mean of the total healthcare expenditures amounts €61.75. However, the median amounts €46.17. Since the median is substantially different from the mean and the distance between the minimum and maximum value is quite big, the data may be skewed. Considering the large sample size of this analysis, the CLT is assumed. Consequently, no adjustments for the data have to be made. Focusing on the data, most of the patients with at least one consultation of the MHN are women (63%) with a mean age of 46 living in an urban area (55%) in the province Limburg (70%). The means and medians of those variables are quite similar, which means this data is normally distributed. Moreover, no outliers in the independent variables were detected.

The total sample size regarding MHNs amounts 177 MHNs. In 2016, 82 MHNs are included, in 2017, 95. Also in this dataset, outliers were detected based on the outlier labelling rule. In total, 1 case is deleted, which is 0.6% of the total dataset. The final sample size includes data of 176 MHN. The descriptive statistics can be found in Table 4, Panel B. The average fee per consultation per MHN has a mean of €15.73 and a median of €15.94. Since the mean is not substantially different from the median and the data looks normally distributed in a graph, there can be concluded that the data is normally distributed. By studying the descriptive statistics of the independent variables, 82% of the MHNs are women living in Limburg (67%) with a mean age of 39 years. The highest level of education is in 66%

of the cases university. An MHN uses on average two different kinds of HIS and works at three general practices. The average population of an MHN includes 64% women with an average age of 45. Besides, 54% of the population lives in an urban area. Considering the independent variables, the means are not substantially different from the medians, which means the data is normally distributed. There have been tested for outliers, but they are not present in the variables.

Table 4. Descriptive statistics patient-level and MHN-level data
This table reports the summary statistics for the data used in this research. Panel A comprises the patient-level data with a sample of 39,241 patients who have had a consult from the MHN in the years 2016 and/ or 2017. Panel B comprises the MHN-level data with a sample of 176 MHNs who provided consultations in the years 2016 and/ or 2017. The definitions of the variables can be found in Table 3.

	Mean	Median	Std	Minimum	Maximum
Panel A					
Total healthcare expenditures (€)	61.75	46.17	49.38	4.52	244.73
Gender patient	0.64	1	0.48	0	1
Age patient (in years)	46	45	18.31	6	102
Place of residence patient	0.54	1	0.50	0	1
Province patient	0.70	1	0.46	0	1
Panel B					
Average cost per consultation (€)	15.73	15.94	1.54	10.55	18.55
Gender of MHN	0.82	1.00	0.48	0	1
Age of MHN (in years)	39	37	10.46	24	65
Level of education MHN	0.66	1.00	0.48	0	1
Province MHN	0.67	1.00	0.47	0	1
Woman in population (in percentage)	64.11	63.69	14.58	0.00	100.00
Urban area in population (in percentage)	53.90	52.34	30.12	0.00	100.00
Average age patient (in years)	45	46	3.81	30	61
Number of HIS	2	1	0.72	1	5
Number of general practices served	3	3	1.90	1	12

5.2 Variation in healthcare expenditures from consultations provided by MHNs

In this section, there is tested if there is a difference in healthcare expenditures for consultations provided by MHNs in the two provinces (which provides an answer on H1), the gender and degree of urbanisation of the patient and the gender and education of the MHN.

The healthcare expenditures for each patient have been separated into the two provinces. Since it became clear that the median (€46.17) is substantially different from the mean (€61.75), a median t-test is performed instead of a mean t-test. In Noord-Brabant (N=11,929) the median of total healthcare expenditures amounts M=€50.80 (Std=€49.65) and the confidence interval ranges from €62.13 to €63.92. In comparison, in Limburg (N=27,312) the median of total healthcare expenditures amounts M= €41.56 and the confidence interval ranges from €60.64 to €61.80. The confidence intervals do not overlap, which suggests that the two groups are different. In addition, the skewness and kurtosis of the data are acceptable (skewness <2.0 and kurtosis <9.0).

To test whether the median healthcare expenditures are different in the provinces, an independent samples t-test was performed. The outcomes of this analysis can be found in Table 5. First, the equality of variances was tested by a Levene's test. It became clear that this assumption was not satisfied with an F-test, F (39,240)=5.51, p=0.019. For this reason, equal variances cannot be assumed. Additionally, the independent sample t-test was significant with t (39,240)=3.37, p=0.001. Taking into account the degrees of freedom, a critical t-value of 1.96 or higher gives a significant effect, which means the t-value of this test (3.37) has crossed the critical t-value. As a result of this outcome and studying the confidence intervals and standard deviations, hypothesis one is confirmed.

This is in line with the results of Bindman et al. (2000) who detected that there is variation in the expenditures on mental healthcare in the UK. The outcomes of this research suggest that this is also the case for the Netherlands, since healthcare expenditures from consultations provided by the MHN are significantly higher in Noord-Brabant compared to Limburg. A research performed by consulting firm Kleynveld Peat Marwick Goerdeler (KPMG) calculated the total treatment costs per patient at the MHN for each province in the Netherlands (KPMG, 2017). They calculated the total treatment costs by adding the consultation costs and the capitation fee for each patient. In this research, the capitation fee was disregarded, which causes higher treatment costs in the outcomes of KPMG, especially because the capitation fee counts for approximately 70% of the healthcare expenditures (Kroneman et al., 2013). The total healthcare expenditures in the research of KPMG in Limburg amounts €274 - €281 (in this research €61.19) and in Noord-Brabant €260 - €267 (in this research €63.03). So, they concluded that the healthcare expenditures in Limburg are higher compared to Noord-Brabant, whereas in this research the conclusion is the other way around. One explanation for this may be that the use of services of MHNs is higher in Limburg, which became clear in the thesis of Health Sciences. Besides, the capitation fee is paid out per patient and if the number of patients is higher, the total capitation fee simultaneously also becomes higher. Consequently, the total healthcare expenditures also become higher. However, this increase is caused by the capitation fee instead of the consultation fee. In this research, the results suggest that the healthcare expenditures for consultation fees are higher in Noord-Brabant compared to Limburg.

Besides the difference in healthcare expenditures for the province, some additional t-tests were performed for both the patient-level data and the MHN-level data. Focusing on the patient-level data, women have significantly higher healthcare expenditures compared to men. Additionally, patients who live in a rural area causes higher healthcare expenditures compared to patients who live in an urban area. Besides, the healthcare expenditures are not significantly different for the years 2016 and 2017. This already gives some information to answer H4 and H5, since there was stated that there is a relationship between healthcare expenditures and the gender of the patient and place of residence of the patient. The results from the independent-sample t-test suggest that there is a difference between the two groups, which may explain that those variables relate to healthcare expenditures in the regression analysis. Regarding the MHN-level data, differences in mean healthcare expenditures were tested instead of the median, since the mean was not substantially different from the median. The results suggest that there

is a difference in the provinces Limburg and Brabant concerning the average annual healthcare expenditures for MHN, which also supports H1. No significant difference was found for the level of education and gender of the MHN, which gives input for H6. For this hypothesis, the R^2 is studied to check if supply factors explain healthcare expenditures. Since already three variables are not significantly different from each other, the R^2 may be relatively low.

Table 5. Results of the independent-sample t-tests
This table shows the results of the independent-sample T-tests which are performed to detect differences in healthcare expenditures in the bivariate variables of patients and MHNs. The data included in the analysis are from the years 2016 and 2017. The description of the variables can be found in Table 3. Panel A includes variables from the patient-level data with outcome measure the median of healthcare expenditures and a total sample size of 39,241 patients. Panel B includes variables from the MHN-level data with the outcome measure mean healthcare expenditures and a total sample size of 176 MHNs.

	Sample size	Median (€)	Difference in medians (€)	Significance
Panel A				
Province				
Noord-Brabant	11,929	50.80	9.24	0.000
Limburg	27,312	41.56		
Gender				
Men	14,709	41.56	4.62	0.000
Women	24,532	46.18		
Degree of urbanisation				
Rural	17,807	50.79	9.23	0.000
Urban	21,434	41.56		
Year				
2016	17,571	46.15	0.04	0.789
2017	21,670	46.19		
	Sample size	**Mean (€)**	**Difference in means (€)**	**Significance**
Panel B				
Province				
Noord-Brabant	59	16.52	1.19	0.000
Limburg	117	15.33		
Gender				
Men	144	16.09	0.44	0.148
Women	32	15.65		
Level of education				
University	116	15.56	0.47	0.054
Other	60	16.04		
Year				
2016	82	15.74	0.03	0.884
2017	94	15.71		

5.3 Variation explained by the demand and supply side

Since it became clear that there are significant differences in healthcare expenditures among MHNs, it is interesting to study variables which could explain those differences. As discussed in Chapter 4, an OLS-regression is performed to detect causes of variation in healthcare expenditures. The dependent variable in this section amounts the average fee per consultation of an MHN, which is represented in the MHN-level data. The independent variables for the supply side include the age of the MHN, the gender of the MHN, highest level of education of the MHN, the number of practices an MHN works and the number of HIS an MHN works with. The independent variables for the demand side include the percentage of patients that are women, the percentage of patients that live in an urban area and the average age of the patients. Additionally, province and year are added to the regression analysis as control variables. The regression models which were used are presented in Chapter 4.

Before running the regression analysis, the assumptions were tested. The correlation matrix of the MHN-level data can be found in Table 6. All assumptions were met, however, a few correlations are ≥0.5. For example, the correlation coefficient between the number of practices an MHN works and the number of HIS an MHN works with amounts 0.57. This high correlation makes sense, since the kind of HIS may be different for general practices and most MHNs work at several general practices. Consequently, this correlation may cause multicollinearity. This may cause problems in the betas of the coefficients, limits the size of the R^2 of the model and makes it difficult to check the importance of a single variable (Field, 2013, p. 325). To determine if those high correlations cause problems in the regression analysis, the VIF-values can be calculated to check for multicollinearity. All values are in the range of 1.041-1.806, which means the correlations do not cause multicollinearity.

The model summary of the regression analyses of the four models is presented in Table 7. The first model is the regression analysis with only the inclusion of the control variables. The second model shows the impact of the patient-specific variables. The third model represents the supply side variables and the fourth model includes all variables. The change in R^2 between model 3 and model 4 represents the variation caused by the demand side and amounts 0.210 - 0.170 = 0.040. This is a significant change compared to the first model according to the F-test. In other words, 4.0% of the variation in healthcare expenditures from MHNs could be accounted for by the patient-specific variables which represent the demand side in this model. This means that there is found support for hypothesis two, which stated that the specific variables included in this research regarding patient-related variables explain to the utmost 5% of the variation in healthcare expenditures. This is in line with the literature (Cutler et al., 2013; Ellis & McGuire, 2007; Finkelstein et al., 2016; Grytten & Sørensen, 2003; Wynand et al., 2000). Since only age, gender and urbanisation are studied, the low R^2 is not surprising. When the number of variables included for the demand side increases, the R^2 will also increase (Ellis & McGuire, 2007). If for example, environmental or organisational factors such as patient severity are added to the regression, the R^2 will increase (Ellis & Layton, 2013; Newhouse et al., 1989; van Vliet & van de Ven, 1992; Wynand et al., 2000). Especially in mental healthcare, this may be an important factor, since disease severity may be a

measure of how many consultations a patient needs. As mentioned before, it is not the goal of this thesis to discuss the betas of the variables of the model in depth, because it is not related to the hypotheses. Moreover, this is also not performed in the articles which are related to detecting factors that explain variation. After contacting some authors who explained variation in healthcare expenditures, it became clear that they even did not study the coefficients of the variables at all. In this research, it appears that age has a positive and significant effect on average fees of consultations for MHNs, which is a contribution to the literature. This means, when the average age of patients increases with one year, the average fee an MHN receives will increase with €0.06. The specific effect on the R^2 for the variables was not studied in dept since this is warranted variation in healthcare. Since supply-side variables may cause unwarranted variation, the specific effect of each variable of the supply-side is studied, to provide more detailed information for future research.

The third model shows the supply side variables. The difference between model 2 and model 4 amounts 0.210 - 0.164 = 0.046 and is a significant change compared to the first model. In other words, the MHN specific variables explain 4.6% of the variation in the average fee in healthcare expenditures. This means that there is support to accept hypothesis six, which stated that supply-side variables explain relatively more of the variation in healthcare expenditures compared to the demand side variables. Since this hypothesis is met, the practice style hypothesis for MHNs can be accepted, since this concept states that most of the variation in healthcare expenditures can be explained by physician-specific factors (Wennberg, 1984). However, the R^2 is relatively low compared to the literature. Grytten and Sorensen (2003) found that around 59-66% of the variation in healthcare expenditures is explained by physician-specific variables from GPs. One of the reasons for the low explanatory power in this research may be that the inclusion of variables was limited, caused through the limited data availability. When there are more variables included in the analysis, the explanatory power of the model will probably increase and the support for the practice style hypothesis for MHNs may be stronger (Göpffarth et al., 2016). For example, Cutler et al. (2013) stated that physician belief' about the treatment explained most of the variation in healthcare spending. In future research, this variable can be included to check if this has a specific effect on healthcare expenditures. Besides, since the function of MHN is relatively new, the specific effect of the old system may be added. This may explain a part of the variation as well.

Table 6. Correlation matrix for MHN-level data.

This table shows the results of the correlation analysis for the demand and supply variables. The first variable is the dependent variable, the next three variables represent the supply side variables, then the three demand-side variables are presented and finally, the two control variables are presented. The definitions of the variables can be found in Table 3. The data included in the analysis are from the years 2016 and 2017 and the total sample size amounts 176 MHNs.

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

	Average fee consult	Age	Gender	Level of education	Number of HIS MHN	Number of practices MHN	Percentage women	Percentage urban	Average age patient	Province
Age MHN	0.036									
Gender MHN	-0.109	-0.321**								
Level of education MHN	-0.146	-0.567**	0.065							
Number of HIS MHN	-0.122	-0.120	-0.084	0.108						
Number of practices MHN	-0.117	-0.083	-0.014	0.045	0.569**					
Percentage women	0.005	-0.080	0.120	0.043	0.006	0.028				
Percentage urban	0.025	-0.095	0.006	0.012	-0.096	0.029	0.056			
Average age	0.042	0.234**	0.005	-0.136	0.213*	0.142	-0.045	-0.273**		
Province	-0.364**	-0.113	0.071	0.175*	0.367*	0.070	-0.151*	-0.294**	0.295**	
Year	0.011	0.073	0.003	0.001	-0.088	-0.008	-0.129	0.037	-0.149*	0.012

Table 7. Results regression analysis MHN-level data
This table shows the results of the ordinary least squares regression to explain the variation in average cost per consultation for MHNs. There have been made a separation in regressions for control variables (model 1), control and demand variables (model 2), control and supply variables (model 3) and control, demand and supply variables (model 4). The definitions of the variables can be found in Table 3. The data included in the analysis are from the years 2016 and 2017.
Dependent variable: average fee of consultation MHN
T-statistics in parentheses
*** Significant at the 0.01 level (2-tailed)
** Significant at the 0.05 level (2-tailed)
* Significant at the 0.10 level (2-tailed)

	Model 1	Model 2	Model 3	Model 4
Patients woman (in percentage)		-0.005		-0.003
		(-0.63)		(-0.46)
Patient urban area (in percentage)		-0.003		-0.003
		(-0.79)		(-0.78)
Average age patient (in years)		0.064**		0.083***
		(2.08)		(2.58)
Age MHN (in years)			-0.019	-0.030**
			(-1.42)	(-2.16)
Gender MHN			-0.438	-0.502*
			(-1.44)	(-1.65)
Education MHN			-0.493*	-0.470*
			(-1.74)	(-1.68)
HIS			0.199	0.165
			(0.98)	(0.98)
Practices served			-0.121*	-0.136*
			(-1.74)	(-1.93)
Year	0.048	0.112	0.100	0.202
	(0.22)	(0.51)	(0.46)	(0.91)
Province	-1.188***	-1.419***	-1.202***	-1.47***
	(-5.14)	(-5.71)	(-4.70)	(-5.41)
Constant	16.494***	14.178***	17.967***	15.275***
	(74.78)	(9.12)	(21.30)	(9.31)
Observations	176	176	176	176
R^2	0.133	0.164*	0.170*	0.210**

Since the supply side variables explain most of the variation, it is interesting to study the effect of specific variables and the R^2 for each variable in depth. As mentioned before, it is not common in this kind of studies to study the coefficients of variables, but it is a contribution to the literature and practice to discuss this. First, the coefficients of the specific MHN variables are studied. Table 7 suggests that the variables age, gender and educational level of the MHN have a significant negative effect on the average fee of consultations. Starting with age, it means that, when an MHN becomes older, the average annual fees of the MHN will decrease with €0.03. This is in line with Ahammer et al. (2017), who concluded that healthcare expenditures of physicians decreased with age. Possible explanations for this decrease in resource use may be experience or recent changes in medical training. Next, if an MHN is a

woman, the average annual fees of the MHN are €0.51 lower compared to a male MHN. The literature on the effect of gender on healthcare expenditures is limited, especially in the case of primary care. Kaiser (2017) investigated the effect of GPs on healthcare expenditures and concluded that the expenditures per visit are approximately the same for men and women, however, the prescribing costs are lower for women compared to men. The results of this thesis suggest that female MHHs have on average lower healthcare expenditures, which is not in line with the conclusions of Kaiser (2017). However, the research of Kaiser (2017) focuses on physicians in primary care instead of MHNs. Since MHNs have different educational background and other tasks compared to GPs, the outcomes may differ compared to Kaiser (2017). Finally, when an MHN has university as the highest level of education, the average annual fees are €0.47 lower compared to MHN with another, lower, educational background. In section 5.2 it already became clear that MHNs with an educational background of university have lower average healthcare expenditures per consultation. In this analysis, it became clear that the educational background of the MHN also relates significantly to average healthcare expenditures per consultation. Most of the literature that focuses on practice style variation focuses on specialisations in secondary care or GPs. Both of those functions have the same educational background, namely medicine. However, for MHNs there is no specific education obligated. For this reason, there can be concluded that MHNs with university as educational background differ in healthcare expenditures compared to MHNs who have for example university of applied sciences. This result is also discussed with an MHN. It became clear that the difference in educational background related to healthcare expenditures is recognised. MHNs who have university as highest education may work more according to the guidelines, because they are educated to perform care in this way. Consequently, the care provided may be more efficient, which causes a decrease in total consultation and thus a decrease in the average fee per consultation for MHNs with university as the highest level of education. This variation is unwarranted and for this reason, it may be effective to provide guidelines for performing the function of the MHN. In this way, care provided by MHNs may be more equally and effective and unwarranted variation caused by the difference in educational background may decrease.

Second, the R^2 of the supply-side variables explain most of the variation in healthcare expenditures. Since this variation is unwarranted, it should be minimised. To provide advice to decrease variation in the supply-side, it is necessary to determine the R^2 of each variable. This has been performed by running several regression analyses and exclude in each model one specific variable. In this way, the change in R^2 compared to the full model can be determined, which represents the effect of one specific variable. Since it is not the intention to minimise the variation explained by the demand-side variables, only the supply-side variables have been split up and studied separately. The results of the analyses can be found in Table 8.

Table 8. Results regression analysis MHN-level data for supply-side variables

This table shows the results of the ordinary least squares regression to explain the variation in average cost per consultation for MHNs. There have been made a separation in regressions for all supply-side variables, to determine the R^2 of the specific variables. The definitions of the variables can be found in Table 3. The data included in the analysis are from the years 2016 and 2017. Dependent variable: average fee of consultation MHN. T-statistics in parentheses

*** Significant at the 0.01 level (2-tailed)

** Significant at the 0.05 level (2-tailed)

* Significant at the 0.10 level (2-tailed)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Age MHN (in years)		-0.022*	-0.017	-0.031**	-0.029**	-0.030**
		(-1.66)	(-1.47)	(-2.25)	(-2.07)	(-2.16)
Gender MHN	-0.264		-0.421	-0.543*	-0.527*	-0.502*
	(-0.92)		(-1.40)	(-1.82)	(-1.72)	(-1.65)
Education MHN	-0.140	-0.396		-0.472*	-0.467*	-0.470*
	(-0.59)	(-1.43)		(-1.69)	(-1.66)	(-1.68)
HIS	0.207	0.221	0.169		-0.058	0.165
	(1.02)	(1.10)	(0.84)		(-0.35)	(0.98)
Practices served	-0.130*	-0.141**	-0.135*	-0.103*		-0.136*
	(-1.83)	(-1.99)	(-1.91)	(-1.79)		(-1.93)
Patients woman (in percentage)	-0.003	-0.005	-0.004	-0.003	-0.003	-0.003
	(-0.44)	(-0.67)	(-0.53)	(-0.41)	(-0.45)	(-0.46)
Patient urban area (in percentage)	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003
	(-0.62)	(-0.76)	(-0.74)	(-0.79)	(-0.90)	(-0.78)
Average age patient (in years)	0.066**	0.077**	0.084***	0.084***	0.076**	0.083***
	(2.08)	(2.40)	(2.60)	(2.62)	(2.35)	(2.58)
Year	0.141	0.184	0.183	0.187	0.170	0.202
	(0.64)	(0.83)	(0.82)	(0.85)	(0.76)	(0.91)
Province	-1.444***	-1.520***	-1.536***	-1.394***	-1.378***	-1.47***
	(-5.24)	(-5.57)	(-5.65)	(-5.48)	(-5.10)	(-5.41)
Constant	14.352***	14.789***	14.401***	15.373***	15.466***	15.275***
	(8.97)	(9.12)	(9.21)	(9.41)	(9.37)	(9.31)
Observations	176	176	176	176	176	176
R^2	0.188	0.197	0.196	0.207	0.192	0.210

In the first model, the age of the MHN is left out and the R^2 of the model amounts 0.188. The change in R^2 compared to the full model amounts 0.210 – 0.188 = 0.022. This means that the age of the MHN explains 2.2% of the variation in healthcare expenditures. This method corresponds to the method used before. The change in R^2 of all supply-side variables can be found in Table 9. Overall, the age of the MHN explains most of the variation regarding the supply side. For this reason, it may be interesting to address this issue first while minimising unwarranted variation from the supply side. There should be investigated why age causes a difference in healthcare expenditures, however, this is outside the scope of this thesis. Future research should address this issue, and if this is known, factors which cause this variation can be addressed and unwarranted variation can probably decline. Unfortunately, the results cannot be compared to the literature since there is no distinction made in variables for studying physician-specific effects.

Table 9. Results change in R^2 for each supply-side variable
This table represents the change in R^2 for each specific variable of the supply side, i.e. the MHN. The results of each model are presented in Table 8. The MHN-level data included in the analysis are from the years 2016 and 2017 and the sample size is 176. The definitions of the variables can be found in Table 3.

	R^2 total model	R^2 model without variable	Explained variation
Age MHN	0.210	0.188	0.022
Gender MHN	0.210	0.197	0.013
Education MHN	0.210	0.196	0.014
HIS	0.210	0.207	0.003
Practices served	0.210	0.192	0.018

5.4 The effect of patient factors on healthcare expenditures

In this section, the effect of certain patient variables on healthcare expenditures is discussed, which provides an answer on H3, H4 and H5. The dependent variable contains annual healthcare expenditures from consultations provided by the MHN on a patient-level basis, the independent variables include age, gender and place of residence of the patient. Besides, province and year are added as control variables.

Before running the regression analysis, the assumptions were tested and approved. The correlation matrix of the patient-level data can be found in Table 10 and the results suggest that all correlations are far below the threshold of 0.5. This means that there is no concern for multicollinearity. Studying the relation of the variables on healthcare expenditures can already provide insight into the direction of the variables. This is necessary to answer H3, H4 and H5: age and gender are significant and positively correlated to healthcare expenditures, whereas place of residence is significant and negatively correlated to healthcare expenditures. To test if those variables also relate to the healthcare expenditures an OLS-regression have been performed. The results can be found in Table 11.

Table 10. Correlation matrix for patient-level data
This table shows the results of the correlation analysis for the demand and supply variables. The first variable is the dependent variable, the next three variables represent the patient variables and finally, the two control variables are presented. The definitions of the variables can be found in Table 3. The data included in the analysis are from the years 2016 and 2017 (N=39,239)
* Correlation is significant at the 0.01 level (2-tailed)

	Healthcare expenditures	Age	Gender	Place of residence	Province
Age	0.041*				
Gender	0.045*	0.027*			
Place of residence	-0.033*	-0.078*	-0.004		
Province	-0.017*	0.064*	-0.005	-0.230*	
Year	-0.005	-0.033*	-0.004	-0.021*	0.001

The third hypothesis suggested that there is a positive relationship between the age of the patient and healthcare expenditures. The coefficient amounts +0.106, which suggests a significant and positive relationship between age and healthcare expenditures. More specifically, when the age of the patient increases with one year, the annual healthcare expenditures increase with €0.11. The positive relationship is in line with the coefficient from the correlation matrix. Overall, H3 is supported. There have not been performed analysis of variation in healthcare expenditures from consultations from MHNs in the literature before. Only one article has been found that focused on the variation in costs of mental healthcare expenditures in Boston and Madrid (Carmona et al., 2018). The coefficient of age was positive, however, no significant effects have been found. More focusing on general healthcare, increasing age increases total healthcare expenditures (Geruso, 2017). The healthcare expenditures are based on total healthcare expenditures of patients in one year, which means mental health is one part of the total expenditures. Since there were no articles found that explain healthcare expenditures in the Netherlands, this thesis suggests a positive relationship between age and healthcare expenditures.

The fourth hypothesis suggested a positive effect of being a woman and healthcare expenditures from services provided by the MHN. The coefficient from the analysis amounts +4.437 which suggest a positive and significant relationship. There can be concluded that if the patient is a woman, healthcare expenditures increase annually with €4.44. In fact, this effect already became clear from the correlation matrix and t-test as well. Thus, there is a positive effect of being a female and healthcare expenditures, which supports hypothesis four. This is in line with the research of Geruso (2017), who found that the healthcare expenditures on mental healthcare increases when a patient is a woman. Next to that, women have a higher risk to obtain a consultation at the MHN, which probably leads to higher healthcare expenditures (Magnée et al., 2016). This effect is confirmed in this research.

The last hypothesis which was set for this research stated that there is a negative effect between urbanisation and healthcare expenditure from services provided by MHNs. The coefficient of the regression analysis amounts -3.603 which suggests a negative and significant effect. This means that if a patient lives in an urban area, the annual healthcare expenditure on services from MHNs decreases with €3.60. This is in line with the negative outcome from the correlation matrix and the outcome of the

t-test. Thus, this analysis provided results to support the fifth hypothesis. This relationship was not studied before, which means this result cannot be compared with the literature. However, since it became clear that the waiting lists of MHNs in urban areas are relatively long, this may be one of the causes of the lower healthcare expenditures in cities. Future research should provide an answer to this question.

Another outcome suggests that the control variable province is also significant. This means that, when a patient lives in Limburg, he or she has lower healthcare expenditures compared to a patient who lives in Noord-Brabant. The control variable year is not significant, which means that there is no difference in healthcare expenditures between 2016 and 2017. Those results are in line with the outcomes of the t-tests performed in section 5.2

Overall, all hypotheses set in this thesis are supported. It is not likely that there is a problem with causality issues, since current articles based on this subject do not make the link with causality. Yet, the impact of the variables studied in this analysis is quite small, together there is only explained 0.5% of the variation in healthcare expenditures. This is in line with the literature (Cutler et al., 2013; Ellis & McGuire, 2007).

Table 11. Results regression analysis patient-level data
This table shows the results of the ordinary least squares regressions to detect factors of patients that relate to healthcare expenditures of consultations provided by the MHN. The dependent variable contains the annual patient healthcare expenditures for consultations with the MHN. There have been made a separation in regressions for control variables (model 1) and control variables and patient-specific variables (model 2). The definitions of the variables can be found in Table 3. The data included in the analysis are from the years 2016 and 2017.
T-statistics are presented in parentheses.
* Significant at the 0.01 level (2-tailed)

	Expected sign	Model 1	Model 2
Age patient	+		0.106*
			(7.742)
Gender patient	+		4.437*
			(7.742)
Place of residence patient	-		-3.603*
			(-7.005)
Year		-0.478	-0.408
		(-0.954)	(-0.815)
Province		-1.837*	-2.982*
		(-3.390)	(-5.362)
Constant		63.290*	58.434*
		(119.454)	(61.147)
Observations		39.241	39.241
R^2		0.000	0.005*

5.5 Robustness tests

Since there have been made several assumptions in this thesis, the results may change if the assumptions were not met. For this reason, two robustness checks have been performed to check whether the results changed if the assumptions were not set.

First, the CLT was assumed concerning the patient-level data, which means that it did not matter whether the data were normally distributed. In fact, after studying the plots and histogram, the dependent variable of annual healthcare expenditures from patients was not likely to be normally distributed. For the first robustness check, the logarithm of the dependent variable was taken and the regression regarding the patient-level data (Table 11) was performed again. The results can be found in Table 12. The results of this regression stay the same in the direction and significance of the variables, which means the answers to the hypothesis also stay the same. Consequently, the results for hypotheses two, three, four and five are robust and the assumption of the CLT was correct.

Table 12. Results regression analysis patient-level data after changing the dependent variable
This table shows the results of the ordinary least squares regressions of the logarithm of annual patient healthcare expenditures for consultations with the MHN. There have been made a separation in regressions for control variables (model 1) and control variables and patient-specific variables (model 2). The definitions of the variables can be found in Table 3. Data included in the analysis are from 2016 and 2017. T-statistics are presented in parentheses. * Significant at 0.01 level (2-tailed)

	Expected sign	Model 1	Model 2
Age patient (in years)	+		0.001*
			(7.916)
Gender patient	+		0.028*
			(7.697)
Place of residence patient	-		-0.003*
			(-8.897)
Year		-0.003	-0.003
		(-0.863)	(-0.762)
Province		-0.015*	-0.025*
		(-3.904)	(-6.134)
Constant		1.668*	1.640*
		(438.334)	(238.956)
Observations		39.241	39.241
R^2		0.000	0.006*

Second, patients included in the patient-level data analysis are treated by a certain MHN. This may suggest that groups of patients are treated differently, because the caregiver is a different person for certain groups of patients. In fact, there are two levels: level 1 contains the patients and level 2, the higher level, are MHNs that treat a certain cluster of patients. If this hierarchical order exists, there is a correlation between the residuals of the patients resulting in the fact that the assumption of independent variables is violated. When this is not taken into account in the regression analysis, the results of the parameters may not be accurate. To correct for this effect, a multilevel linear model may be used. In a normal OLS regression, coefficients are assumed to be fixed, because the observations are independent.

However, when this does not seem to be the case, a random effect model should be used to estimate the parameters randomly. To check whether there is variance between and within groups, the interclass correlation coefficient (ICC) have to be calculated. The ICC shows the variability that is attributable to the higher level, in this case, the MHNs. This score compares the variability within groups with the variability between groups and represents the dependence of individuals. The higher the ICC, the more dependent people within a group are, which means that the variables are not independent anymore. When the coefficient of the ICC >0.1, a multilevel analysis with clustering data should be used to provide the correct outcomes of the regression analysis, i.e. random parameters instead of fixed (Kreft & De Leeuw, 1998, p. 9). The ICC can be calculated by the formula (Field, 2013, p. 818):

$$Interclass\ Correlation\ coefficient = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\epsilon^2}$$

Where σ_α^2 is the variation between groups and σ_ε^2 the variation within groups. As the ICC becomes larger, the variance is large between groups of patients treated by a certain MHN, it may suggest to work with clusters in the regression analysis. The ICC for this dataset amounts: $\frac{120.10}{120.10+2340.12} = 0.0448$. This means that 4.48% of the variation is attributable to the MHNs, which does not cross the threshold of 10%. Overall, there can be concluded that the variability is for the most part not attributable to the groups of MHN and the fixed outcomes of the OLS regression presented before are robust.

6. Conclusion

In this study, the differences in healthcare expenditures from services provided by MHNs are investigated by a quantitative analysis. This chapter answers the research question which was set in the introduction. Furthermore, the limitations and recommendations for further research are presented.

6.1 Main results

In the introduction the following research question was set: *"To what extent is there variation in healthcare expenditures from consultations provided by mental healthcare nurses in the Netherlands and how can this variation be explained by studying supply and demand side factors?"*. In this section, an answer is provided by presenting the main results of the analysis.

There is variation in healthcare expenditures from consultations provided by the MHN in the Netherlands. More specifically, the annual healthcare expenditures from patients in Noord-Brabant are significantly higher compared to Limburg. This variation is mostly explained by the supply-side, meaning MHN characteristics, which provides some support for the practice style hypothesis. Furthermore, the relationship between patient characteristics and healthcare expenditures have been investigated. It became clear that age is positive and significant related to healthcare expenditures, women have a positive and significant effect on healthcare expenditures and urbanisation has a negative and significant effect on healthcare expenditures. The results of the analyses are robust.

6.2 Practical contributions

The theoretical contributions have already been discussed in Chapter 5, but there are also some practical contributions. Those are addressed in this section.

First, it became clear that there is provincial variation in healthcare expenditures from consultations provided by MHNs. Regional differences in healthcare spending may be a sign for inefficiencies and inequality of resource use (Mays & Smith, 2009). It became clear that the supply-side explains most of the variation in healthcare expenditures, which is unwarranted. Specifically, the age of the MHN causes most of the variation in healthcare expenditures. It is outside the scope of this thesis to detect why this is the case, but future research can address the age of the MHN first, since it causes most of the variation in the supply side. Another reason why there may be a difference in healthcare spending concerning care provided by the MHN is the familiarity of the MHN. To solve this problem, the function should be promoted in the Netherlands.

Second, a practical contribution may be the fact that patient characteristics investigated in this research cause higher or lower healthcare expenditures from consultations of the MHN. Health insurers or GPs may react proactively on those factors when they know certain variables are over present in their practice. For example, if there are a lot of women in a general practice, it may be the case that the healthcare expenditures are higher compared to a practice with an equal number of patients, but fewer women. In this case, the MHN may be hired more, to prevent, for example, long waiting lists.

Third, there is a registration problem for MHNs according to disease severity. Since the relatively new role, the codes which an MHN have to register, are limited and mostly focus on tasks of the GP. Diabetes, for example, has specific codes regarding the diagnose. This is not provided for MHNs yet, which results in the fact that there is a lack of clarity among MHNs regarding the way they should register the diagnose of the patients. For this reason, the advice is given to the Nederlands Huisartsen Genootschap (NHG), who is responsible for the coding system of caregivers in the general practice, to come up with new codes for MHNs regarding the disease severity of patients. When this is performed correctly, the influence of disease severity of patients on healthcare expenditures can be detected. This may explain a large part of the variation, since patients with a high disease severity need probably more consultations and consequently have higher healthcare expenditures. A condition of this is that the MHN knows how to register this in the HIS he or she works with. As a result, the different kind of companies that provide HIS should provide a training after the new codes become clear, so that the MHNs know how to register their data correctly.

6.3 Limitations

One strength of this paper is the fact that there have not been performed research about variation in healthcare expenditures in the Netherlands before (Wennberg International Collaborative, 2018). Moreover, international literature focusing on variation in mental healthcare is limited. This thesis provides insight into those gaps. Although these main strengths, there are also some limitations.

First, the variables which could be included based on the availability of data were limited. For this reason, there could only be explained a small part of the variation in healthcare expenditures. As mentioned before, the variables which may explain most of the variation in healthcare expenditures are based on specific patient or healthcare provider characteristics. At this moment, there have been found some proof for the practice style hypothesis, however, the percentage that explains healthcare expenditures based on the supply side factors is still relatively low compared to the literature. If certain specific variables are included, there may be found stronger support for the practice style hypothesis.

Second, the provinces which were included in this research cover only a small part of the Netherlands. Since the use of care provided by MHN is relatively high in the North of the Netherlands compared to the South of the Netherlands, the external validity should be taken into account when generalising the results to other parts in the Netherlands. Hence the strong internal validity, the external validity may be seen as a limitation of this study.

Finally, there is a possibility that there exists a relationship between the GP and the population of the MHN, since the GP refers the patients to the MHN. This may result in the fact that resources are unequally divided into the population. For example, if there is a relationship between the GP and the MHN, one MHN may have more severe patients compared to another MHN, which may cause variation in healthcare expenditures. Unfortunately, it was not possible to detect whether there may be a relationship between the GP and the MHN.

6.4 Suggestions for further research

Taking into account the main findings, discussions and limitations of this research, some suggestions for future research are presented in this section.

Firstly, it is interesting to detect to what extent the practice style hypothesis is the case for MHNs. This is very likely to be true, since the educational background of MHNs is different and there have found some support for this hypothesis already. This can be detected by adding more variables for MHNs like treatment preference or their relationship with the GP. Besides, some patient characteristics may be added as well, because factors like utility, risk, disease severity or wealth may increase the percentage of explained variation. Moreover, if the function of the MHN becomes a profession in the future, one can do a research before and after this change to detect variation in MHN related factors since they will have to work according to specific guidelines when it is a profession. By comparing the variation before and after the implementation of guidelines, one can detect which factors are deeply rooted behaviour and which factors can be addressed to minimise unwarranted variation in healthcare expenditures.

Secondly, this research can be carried out in other provinces in the Netherlands to check whether the results are the same for other parts of the Netherlands. As mentioned before, the use of care and healthcare expenditures is different for different provinces, which may have an effect on the results of the study. However, it may also be the case that healthcare expenditures for patients are the same. Future research should be carried out to find out if this is the case.

Finally, it is interesting to detect if the function of the MHN is cost-effective. This suggestion is based on my own interest instead of the outcomes of this research. Since the goal of the implementation of the function of the MHN was to reduce costs for mental healthcare and at the same time improve the quality of mental healthcare, a cost-effectiveness study should be performed. Still, there is no study that investigated it. To perform this, it is necessary to have data for the use of mental health care in secondary care as well. It will add value to policymakers and the literature when it is known whether the function is cost-effective.

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