

ORIENTATION OF NOVEL APPROACHES REGARDING IMPROVING HEALTH AND SELF-RELIANCE OF ELDERLY WITH DIABETES 2 IN FRIESLAND

Advice report for GGD Fryslân and Zorgbelang Fryslân

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Prologue

Here, I would like to thank everybody that has helped me with the establishment of this report. First, I would like to thank my supervisors Klaus Boonstra and Pepi Wadman for their sweet welcome into their organization. You have helped me throughout the whole process with much patience and time. Besides serious conversations we have also had good and cosy informal conversations. I have had a lot of fun. I also would like to thank my SBP supervisor Michiel Berger for his good advice and support. You have helped me a lot with my report, and you have shown me that I can do more than I thought I was capable of. In addition, I would like to thank Gertjan van Dijk for his scientific view and his advice on my report. Lastly, I would like to thank my buddies Channah and Ninke for their time and support almost every morning at 9 o'clock. I would not have succeeded without you.

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Samenvatting

Het is de uitdaging om een passende aanpak te vinden voor GGD Fryslân die zich focust op het helpen van ouderen met diabetes 2. Deze aanpak focust zich op het zelfstandiger worden en het verminderen van de afhankelijkheid met betrekking tot de gezondheidszorg. Daarom is de hoofdvraag: “Wat is de beste aanpak om de algemene gezondheid van ouderen met diabetes type 2 in Friesland te verbeteren door middel van leefstijlinterventies?” Onderzoek vanuit verschillende invalshoeken zal een middel zijn tot het vinden van een aansluitende aanpak.

Resultaten laten zien dat nieuwe methodes met betrekking tot een gezonde levensstijl effectief lijken te zijn voor het stabiliseren van veroudering en het verbeteren of stabiliseren van het ziekteverloop van diabetes 2. Veroudering en diabetes 2 worden geassocieerd met disfuncties van bepaalde mechanismen in het menselijk lichaam. Deze disfuncties verhogen het risico op andere gezondheidsproblemen. Toepasbare interventies die effectief zijn bij het tegengaan van veroudering en diabetes 2 richten zich op integratie van Positieve Gezondheid, integrale aanpak, scholing, fysieke activiteiten, voeding, sociale betrokkenheid en recreatie.

Verdere resultaten zijn dat gemeenten in Friesland, GGD Fryslân, Zorgbelang Fryslân, zorgverzekeraars, zorgprofessionals, ouderen verenigingen en inwoners van Friesland interessante partners voor deze aanpak voor ouderen met diabetes 2 zijn. De meeste relaties worden al nauw onderhouden. De relatie met gezondheidswerkers, ouderen verenigingen en inwoners van Friesland moet worden geïntensiveerd om hun mening en ervaringen te integreren in de nieuwe aanpak voor ouderen.

Tenslotte laten de resultaten zien dat GGD Fryslân is toegerust om een leidende rol te spelen bij de totstandkoming en uitvoering van de nieuwe aanpak voor ouderen. De gedeelde waarden, structuur en strategie van GGD Fryslân sluiten namelijk goed aan bij de nieuwe aanpak. Tichtby Minsken, de pilot die onder meer door GGD Fryslân is uitgevoerd, laat de potentie zien van GGD Fryslân als leidende rol voor de ouderenaanpak.

Uit de resultaten kan worden geconcludeerd dat GGD Fryslân zal werken aan het opzetten van een breed netwerk dat leidt tot een integrale aanpak zowel binnen het sociale als ook het medische domein omtrent ouderen. Dit brengt het sociale en medische domein dicht bij elkaar. Uiteindelijk kan een breed netwerk de druk op het zorgsysteem potentieel verminderen, doordat zorgprofessionals uit verschillende domeinen elkaar leren vertrouwen en daardoor eerder willen samenwerken. Verder zal GGD zal evenementen en projecten ontwerpen en uitvoeren gericht op preventie bij ouderen. Positieve Gezondheid wordt geïntegreerd in evenementen en projecten. Het geeft een brede visie op gezondheid en verbetert de sociale interactie tussen burgers. Het zal de onafhankelijkheid en zelfredzaamheid vergroten door iemands kwaliteiten en mogelijkheden te verhelderen. Het kan uiteindelijk leiden tot een verminderde vraag naar zorg. Ook zal GGD Fryslân mogelijk extra personeel moeten inhuren om de aanpak voor ouderen vorm te geven en uit te voeren. Zij zullen expertise op het gebied van ouderen nodig hebben en zullen scholing volgen van Positieve Gezondheid. Dit stelt hen in staat om met Positieve Gezondheid te werken en aan anderen scholing over Positieve Gezondheid te geven. Hierdoor blijft de werkdruk behouden en verbetert mogelijk de integrale aanpak.

Executive summary

The challenge is to find the best suitable approach for GGD Fryslân to help elderly with diabetes type 2 to become more self-reliant as it reduces dependency on healthcare and health professionals. Therefore, the main question is: “What is the best approach to improve the general health of elderly with diabetes type 2 in Friesland by means of lifestyle interventions?” Evaluation of results will bring the answer.

Novel interventions related to healthy lifestyle seem to be effective for the maintenance of aging and to improve or maintain the course of disease of diabetes 2. Aging and diabetes 2 are associated to certain dysfunction of mechanisms in the human body. These dysfunctions increase the risk of other health conditions. Possible interventions effective for aging and diabetes 2 focus on integration of Positive Health, integral approach, frame events related to education, physical activity, nutrition, social engagement, recreation and more.

Interesting partners for an approach for elderly with diabetes 2 are municipalities in Friesland, GGD Fryslân, Zorgbelang Fryslân, health insurers, health professionals, member associations, and citizens of Friesland. Most relationships are already maintained closely. The relationship with health professionals, member associations, and citizens of Friesland should be intensified to integrate their opinion into the design of the new approach for elderly.

Potential for GGD Fryslân to have a leading role in the establishment and execution of the new approach for elderly. Shared values and strategy are in line with the values and strategy of the approach. Structure and skills will be well used for the establishment of the approach. Solely, time will be necessary to perform the extra tasks related to elderly and prevention. Tichtby Minsken, the pilot study among others executed by GGD Fryslân, shows already high potential for GGD as leading role for the approach for elderly.

GGD Fryslân should work on the establishment of a broad network that will lead to an integral approach within social and medical domain as well as in the environment of GGD Fryslân. It will bring the social and medical domain closer together. It will also improve relations between GGD Fryslân and other organizations. Eventually, a broad network potentially reduces pressure on the healthcare system as health professionals from different domains will be able to rely on each other.

GGD Fryslân should design and execute events and projects focused on elderly and prevention. Positive Health will be integrated in events and projects. Positive Health establishes a broad vision on health and improves social interaction between citizens. It will eventually increase independency and self-reliance by enlightening someone’s qualities of and possibilities. It could eventually lead to reduced demand for healthcare as it improves self-reliance.

GGD Fryslân should hire extra personnel to design and execute the approach for elderly. They will require expertise in elderly and will follow schooling of Positive Health. This will enable them to work with Positive Health as well as give schooling of Positive Health to others. This will maintain work pressure and possibly improve the integral approach.

1 Introduction

1.1 Introduction to aging issues

Worldwide the mean age of people increases (Fried et al., 2015). Constant improvement of healthcare has resulted in better treatments for age-related diseases that improve the quality of life and often delay death. In many developed countries, like the Netherlands, one of the consequences of increased mean age is aging of the population (Van der Gaag et al., 2017; Van der Horst et al., 2017). **Aging** of the population and increase of elderly cause **increased requirement for healthcare in the Netherlands**. One of the reasons is that aging of the human body is related to deterioration of the body, which can result in age-related diseases and chronic diseases. Elderly require therefore more medical attention (Van Vliet et al., 2020). They also have difficulties with learning new skills and finding their way in the digital world. This results in long learning trajectories and relatively low independency on disease management, which is time consuming for health professionals.

Aging is associated as increased risk of chronic diseases. The prevalence of chronic diseases has increased the last years as well. Chronic diseases also require often more medical attention. Periodic checks are necessary to monitor the progress of the disease to take steps in time. Specifically, **diabetes 2** is one of the chronic and age-related diseases that requires relatively much medical attention with for example appointments with the GP every six months. As aging is related to increased risk for diseases like diabetes 2, it costs relatively much time for health professionals like GPs and dieticians to maintain their patients. Prognosis is that the increased requirement for healthcare **increases pressure on the healthcare system** and will eventually result in the inability to help every citizen, also elderly, with health-related problems.

Specifically, non-industrial and relatively sparsely populated areas in the Netherlands are experiencing problems due to the aging population. The province of Friesland is one of these regions. Therefore, the challenge is to find an approach to help elderly in Friesland to become more independent and increase their self-reliance to reduce dependency on healthcare and health professionals. As elderly with diabetes 2 need extra attention from health professionals and are broadly represented, this is a target group that could be given more attention.

1.2 GGD Fryslân

Gemeentelijke Gezondheidsdienst (GGD) Fryslân is translated as municipal health service and is responsible for the public health of all citizens of all connected municipalities. In this case, it means that GGD Fryslân is responsible for all citizens in the province of Friesland. The main task of GGD Fryslân is to protect, guard and promote the public health of citizens in Friesland. This is also referred to as public healthcare. The fields that GGD Fryslân is focused on are among others infectious disease control, youth healthcare and environmental advice. The tasks related to public health originate from municipalities. Therefore, one of the main tasks of GGD Fryslân is to advise municipalities within Friesland regarding health of citizens. The purpose of GGD Fryslân is to work client oriented, locally and close to the citizens. This is managed from within three regions, the policy team and the department Central Service and Support, also known in Dutch as Centrale Dienst en Ondersteuning (CDO).

The four main tasks of GGD Fryslân are: monitoring, signalling, and advising regarding public health, managing executive tasks regarding health protection, supervision by means of inspections, and guarding the public health during disasters and crises (fig. 1). Monitoring, signalling, and advising is executed within specific departments, like youth healthcare, epidemiology, and health promotion. The executive tasks for health protection are directed to infection control, sexually transmitted infections (STIs), travellers' vaccinations and more. Furthermore, inspections are held regarding day-care, Wmo and technical hygiene care. At last, guarding of public health during disasters and crises are performed within the department of social crisis support, forensic medicine, and youth healthcare.



Figure 1 - The tasks of GGD Fryslân

As GGD Fryslân has the responsibility to maintain public health, they are an excellent partner to help and put extra attention on elderly with diabetes 2 to improve their health. With the right approach they will be able to improve independency and self-reliance of elderly with diabetes 2, which potentially will reduce the extra required attention of health professionals like GPs and dieticians. If the aim of improved health would be achieved, it could also reduce the requirement of medication or other treatments, which could reduce healthcare costs. Working together with other actors that are related to elderly with diabetes 2 and citizens of Friesland like Zorgbelang Fryslân and De Friesland health insurer will have potential to design a suitable approach to improve independency and self-reliance of elderly with diabetes 2.

1.3 Positive Health

Positive Health is a novel approach that potentially can help to formulate and implement an approach for GGD Fryslân that focuses on the independency and self-reliance of elderly with diabetes 2. Positive Health is an integrative approach that focuses on a broad vision on health and is also a conversation method. Physical functioning, mental wellbeing, meaning of life, quality of life, participation in society, and daily functioning are the six aspects of Positive Health that create the broad view on health (Institute for Positive Health, n.d. b). The conversation method is also developed within the six domains of health. By focusing on these domains, it improves the ability of people to deal with their physical, emotional, and social challenges with the goal to take control of your own body and life. Another aspect to use Positive Health is to improve collaboration between different domains. Regardless of the positive and promising results of Positive Health it is important to keep in mind that a solution has both up and down sides. Measurements of Positive Health regarding health improvement are difficult as Positive Health focuses on many aspects of health. There is no scientific evidence yet that unanimously proves that Positive Health is the solution to the problem.

Altogether, scientific research shows promising results with potential to improve health in several ways. Positive Health is used within different sectors and enables to move the view from the problem and the inabilities to the solutions and the abilities. As independency and self-reliance is encouraged by a positive approach by looking at the positive aspects of life, Positive Health has potential to be integrated into the novel approach for GGD Fryslân.

1.4 Underlying problems

Aging, and chronic diseases are not the only problem related to increased pressure on the healthcare system. Other underlying causes are **increased healthcare costs** and current **approach of health professionals**. Quality of healthcare increases constantly as result of rapid development regarding new technical opportunities. Costs rise with these new developments. As increased requirement for healthcare also results in increased costs, healthcare costs will keep rising the upcoming years (Van der Horst et al., 2011). In addition, current approaches of health professionals in primary healthcare are often only focused on curing the disease only leaving out other aspects of wellbeing. In general, this approach can be effective enough but in more complex cases this approach it is not. It lacks an approach to find the root of the problem which is often necessary to solve the problem. Consequently, patients undergo multiple treatments without the desired result.

Another underlying cause is the location of Friesland. Regions located further away from the Randstad with less densely populated area especially experience that increased pressure on the healthcare system becomes more severe. Besides aging of the population, there are also other causes related to increased pressure on the healthcare system in Friesland. One of the problems is **dejuvenation** of Frisian citizens. Dejuvenation means that the number of young citizens decreases in contrast to the number of elder citizens in the region. One of the reasons is that the birth rate declines in Friesland. Another reason is that young people leave the region to find better or more suitable opportunities regarding work in a more urban environment, like the Randstad (Fries Sociaal Planbureau, 2020). **Labour shortage** in Friesland is one of the consequences of dejuvenation. Specifically in the healthcare sector, labour shortage has already been a problem for years. More citizens become old without new young citizens to take care of the elderly. As the healthcare sector already struggles with lack of healthcare workers, pressure on the healthcare system keeps rising.

Novel approaches like Positive Health described in chapter 3.4.1 Positive Health show potential to improve health by means of focusing on more aspects than the disease alone. The use of Positive Health by health professionals like GPs and dieticians, and integration into GGD Fryslân and other organizations will broaden the current view on health within Friesland. Recent studies show decrease of second line referral, medication prescription, and other improvements that could result in decrease of healthcare costs, improvement of health, and reduction of load on health professionals like GPs and dieticians (Jung et al., 2018; Morley et al., 2014).

1.5 Formal framework

The Science, Business and Policy (SBP) track is a track within several masters of the University of Groningen. The track teaches business and policy related subjects that you should be able to apply in your SBP internship. The internship will last 24 week and has the purpose to help you make connection with business and policy related aspects in the sector of your master's degree. My master study is Biomedical Sciences. The SBP internship will be a means to connect my science background with business and policy. My job is to translate scientific knowledge into understandable language to make others able to understand. Subsequently, it is my task to form a strategy or help other to form a strategy based on the obtained scientific knowledge. I also must take others' opinions and perspective into account as well as situations that can influence the scope of the scientific knowledge. Combining these aspects will form suitable advice for GGD Fryslân.

Name	Institute	Function	Role in supervision
Drs. Pepi Wadman	Zorgbelang Fryslân	Policy writer and project leader	Daily supervisor
Drs. Klaus Boonstra	GGD Fryslân	Advisor and project leader	Daily supervisor
Prof. dr. Gertjan van Dijk	University of Groningen, Biomedical Sciences	Professor Biomedical Sciences	Science supervisor
Drs. Michiel Berger	University of Groningen, Science Business and Policy Master's track	Senior Lecturer	SBP supervisor

1.6 Goals and research questions

The challenge is to find the best suitable approach for GGD Fryslân to help elderly with diabetes type 2 to become more self-reliant as it reduces dependency on healthcare and health professionals. Therefore, the main question is: “What is the best approach to improve the general health of elderly with diabetes type 2 in Friesland by means of lifestyle interventions?”

To answer the main question, sub questions are formulated as well. Understanding what aging and diabetes 2 exactly is, is key to finding the right lifestyle interventions. Therefore, scientific literature will be used answer the following questions:

“What are the physiological aspects and consequences of aging?”

“What are the physiological aspects and consequences of diabetes 2?”

“How is lifestyle related to health?”

“What are currently best practices regarding interventions for aging and diabetes 2?”

All questions will help to get a clear image of aging and diabetes 2 and the successes of previous interventions focused on these two subjects.

Identification of the external environment of GGD Fryslân will help to understand what possibilities are for GGD Fryslân. It is important to know:

“Which actors are involved with health of elderly with diabetes 2?”

“How should the (potential) relationship between actor and GGD Fryslân be maintained?”

It is also essential to know what is going on within GGD Fryslân. Therefore, the following question will be answered:

“What is the current strategy of GGD Fryslân to improve general health of elderly in Friesland?”

“To what extend is GGD Fryslân equipped to improve health of elderly with diabetes type 2?”

Answering these questions will give an image of GGD Fryslân and their ability to make a change on health improvement of elderly with diabetes 2 regarding independency and self-reliance.

Altogether, the answers to the questions will formulate a suitable scenario for GGD Fryslân to improve the health of elderly with diabetes 2 by means of increasing their independency and self-reliance. It will highlight the health conditions and physiological problems of aging and diabetes 2 to clarify the most important aspects of aging and diabetes 2, which will potentially become priority to improve them. It will also demonstrate interventions that have potential to improve health of elderly with diabetes 2. These interventions will be used to find the best suitable solution for GGD Fryslân by looking at what fits best with the strategy and vision of GGD Fryslân. As the analysis of GGD Fryslân will elucidate the strategy, vision, and other important factors within GGD Fryslân, this analysis will be necessary to find a suitable approach. Mapping actors will subsequently indicate which relations are important for the project and how to maintain these relations. Combining all this information will help to find a suitable approach for GGD Fryslân and its actors to improve the health of elderly with diabetes 2 by means of increasing their independency and self-reliance.

1.7 Approach

This internship is organized by GGD Fryslân to find a new and suitable approach to improve health of elderly with diabetes 2. To write a report information has been obtained from multiple sources. PubMed and other electronic databases that have access to scientific knowledge are the main source of scientific information. These databases hold scientific literature, like literature reviews and research articles. Websites of rijksoverheid.nl, rivm.nl, and other national institutes with high reliability have also been used to obtain both scientific knowledge, policy related information, and regional and national information regarding the Netherlands and Friesland. Another source of information is the conducted interviews. The interviews have provided information from different domains like scientific related information, actors involved with the topic elderly with diabetes 2, and GGD Fryslân. Altogether, information has been obtained from many directions that has been of good use to provide suitable advice for GGD Fryslân.

1.8 Reading guide

Scientific context of aging and diabetes 2: The scientific analysis will give an overview of knowledge of aging and diabetes 2 regarding physiology, health conditions related to aging and diabetes 2, lifestyle, and current interventions related to aging and diabetes 2. It will conclude with the most useful obtained knowledge. This knowledge will be useful for the construction of an implementation plan for GGD Fryslân regarding health improvement of elderly with diabetes 2.

Actors related to elderly with diabetes 2 in Friesland: Gives an overview of actors involved with elderly with diabetes 2, and how their relationship should be maintained within the approach that is focused on elderly with diabetes 2 and prevention.

The organization of GGD Fryslân: The organization of GGD Fryslân is described to show the current equipment of GGD Fryslân regarding the role in health improvement of elderly with diabetes 2.

The organization of Zorgbelang Fryslân: The organization of Zorgbelang Fryslân is described to show the current equipment of Zorgbelang Fryslân regarding the role in health improvement of elderly with diabetes 2.

Pilot study Tichtby Minsken: Describes the pilot study Tichtby Minsken. This study focuses on novel approaches regarding health education and improvement of independency and self-reliance. Positive Health has a leading role.

Integration of obtained knowledge: Puts together the scientific research, information on GGD Fryslân, and the information regarding the pilot study Tichtby Minsken. It gives an overview of the findings and are put together to give a good and structured overview of the gained knowledge.

Scenarios for GGD Fryslân regarding elderly with diabetes 2: By means of a Multi Criteria Analysis (MCA) the costs and benefits of four scenarios for GGD Fryslân are compared to see which scenario is the best for GGD Fryslân.

Conclusions: Answers the sub questions and main question of the report.

Discussion: Elaborates the possible consequences of the chosen scenario, the uncertainties, and the limitations of the project.

Advice: Elaborates the best strategy for GGD Fryslân regarding health improvement among elderly, with specific attention for diabetes 2.

Outline of implementation: Gives a structured overview of the advice by means of multiple steps, which GGD Fryslân can follow to implement the new strategy.

2 Scientific context of aging and diabetes 2

The lead role of the project is elderly with diabetes mellitus 2 (diabetes 2). The goal is to strengthen their independency and self-reliance. In order to design a suitable implementation plan, it is necessary to know more about aging and diabetes 2. Therefore, I have prepared questions that will help to elucidate essential aspects that will help to create the eventual implementation plan for GGD Fryslân and Zorgbelang Fryslân.

“What are the physiological aspects and consequences of aging?”

“What are the physiological aspects and consequences of diabetes 2?”

“How is lifestyle related to health?”

“What are currently best practices regarding interventions for aging & diabetes 2?”

By answering these questions, I want to find evidence for the right manner to help elderly with diabetes 2. By gaining knowledge of aging and diabetes 2 in general and to find the strengths of best practices, I hope to find the aspects that make an intervention successful. Combining this knowledge with knowledge gained from within and outside GGD Fryslân and Zorgbelang Fryslân, it will be the start of an implementation plan that wants to strengthen independency and self-reliance of elderly with diabetes 2.

2.1 Aging

Worldwide, the life expectancy of the human population is increasing (Fried et al., 2016). Becoming older means that more citizens are aging. Aging of the Dutch population started in 1965 and was measured as 1 out of 8 citizens (12,5 %) were with an age higher than 65 years. (Van der Gaag et al., 2017). Estimations show that aging of Dutch citizens will increase with 1 out of 4 citizens (25 %) being older than 65 years in 2033. But what is aging exactly? Aging is a complex phenomenon. This chapter describes the definitions of aging and explains what type of changes are found in the human body to give clarification of several aspects of aging.

2.1.1 Definition of aging

In general, aging is described as decline of the human body. Aging is however a complex process and therefore, there are multiple ways to define the term. Often, aging is defined as the progressive decline of the ability to maintain the physiological homeostasis of the human body and would eventually result in death (Broskey et al., 2019).

Broskey et al. describe aging as a complex set of lifespan-associated declines in molecular, cellular, tissue, and organ fidelity. It means that there are multiple ways of human decline from very small as molecular pathways to very big as organs (Broskey et al., 2019). A separation can be made of the mechanisms involved in **primary and secondary aging**. Primary aging is related to age-associated decline in physiological homeostasis. In other words, internal influences that result in deterioration of the human body. Whereas secondary aging is related to external influences, like environmental exposures and behaviour.

Zooming in on primary aging, decline in physiological homeostasis is related to high energy expenditure and increased oxidative stress (Broskey et al., 2019). According to The Rate of Living Theory, organisms with higher energy usage have a shorter lifespan. Moreover, The Free Radical Theory of Aging states that oxygen consumption in the human body as result of energy usage generates free radical superoxide, which means that high energy expenditure results in more **reactive oxygen species (ROS)** (Sacher & Duffy, 1979). Overproduction of ROS can lead to **oxidative stress**, which can cause damage of mitochondrial DNA, proteins, and lipids (Rehman & Akash, 2017). These types of damage lead to dysregulation of multiple processes in the human body. Eventually it leads to problems with homeostasis of processes in the human body (Anton et al., 2015, Broskey et al., 2019). As production of ROS is an accumulative process, aging is related to these processes. Anton et al. confirm that there is a direct link between certain biological mechanisms and the physical function of the human body like **oxidative stress**. Other concerned mechanisms are **mitochondrial dysfunction and altered dynamics, chronic inflammation, changes in muscle composition (sarcopenia), hormonal factors, and neurodegeneration** (Anton et al., 2015).

2.1.2 Physiological aspects of aging

Cellular senescence is one of the characteristics of aging. The term cellular senescence means that a cell is in a permanent state of cell cycle arrest (Calcinotto et al., 2019; Hernandez-Segura et al., 2018; Waltson et al., 2006). In other words, the cycle of the cell is stopped and therefore, will not duplicate the genome or divide into two cells anymore. This property has both positive and negative effects on the human body. On the one hand, cellular senescence is involved in embryogenesis and the development of human life and is essential for proper tissue repair (Calcinotto et al., 2019). It is also known as a protection mechanism against factors that cause cellular stress. It is activated by DNA damage response, cyclin-dependent kinase inhibitors and proinflammatory and tissue-remodelling factors and more similar mechanisms that put stress on the cell (Hernandez-Segura et al., 2018). By means of suspension of the cellular processes, stress factors are not able to cause cellular damage. Cellular processes like duplication of the genome are quite sensitive for cellular damage with the consequence of not properly working cells. By suspending these processes by means of cellular senescence the human body wants to prevent damage. On the other hand, cellular senescence is associated with pathological processes like remodelling of tissue and aging-related disorders (Calcinotto et al., 2019; Hernandez-Segura et al., 2018). The positive properties of cellular senescence do not always have a positive outcome as it leads to cells that do not become apoptotic (Waltson et al., 2006). Eventually, senescent cells accumulate in the human body, which result in multiple negative effects. It can result in proinflammatory responses that eventually lead to chronic inflammation. Chronic inflammation can eventually lead to age-related diseases (Sharpless et al., 2015).

Mitochondria are one of the most important sources of energy of the human body. Mitochondria are responsible for the production of adenosine triphosphate (ATP) in all multicellular organisms (Annesley & Fisher, 2019). ATP is also known as energy carrier because it can deliver energy to almost every cell of the human body. Therefore, mitochondria are involved with metabolic pathways and are also involved with the intracellular signalling networks that regulate diverse cellular functions. Another responsibility of mitochondria is the plasticity of skeletal muscles and the supply of enough energy on demand of the muscle cells.

In other words, mitochondria play essential roles in multiple pathways in the human body. **Disfunction of mitochondria** as result of extensive ROS accumulation for example, results in dysregulation of energy distribution. Eventually it can lead to increased risk for multiple conditions, like muscle atrophy, Parkinson's disease, diabetes, and obesity (Annesley & Fisher, 2019; Anton et al., 2015). Multiple studies see a relation between aging and mitochondrial disfunction with oxidative stress as one of the main drivers (Annasley and Fisher, 2019; Anton et al., 2015; Broskey et al., 2019). Besides mitochondrial damage, oxidative stress also causes more DNA damage. Moreover, according to Fried et al., the decreased mitochondrial function and the resulted decreased production of ATP, have a negative influence on tissue that have a high energy demand. As skeletal muscle, heart and nervous system require a lot of energy, these types of tissues are affected as consequence of aging. It can eventually lead **sarcopenia**, which results in alterations of **muscle composition**. Not only the ability of physical exercise reduces, but also the risk of obesity, diabetes, fatigue and (chronic) inflammation increase (Coen et al., 2013).

Sarcopenia is a definition used to describe reduction of muscle mass and quality in relation to aging (Larsson et al., 1987). Reasons for the reduction of muscle mass are progressive atrophy, loss of type II muscle fibres and loss of motor neurons. Atrophy is also known as morphological changes in the muscle that lead to the reduction of muscle mass. One of the aspects of atrophy is for example increased extracellular space that subsequently become filled up with other cells and tissue, like adipose and connective tissue (Brooks & Faulkner, 1994). Loss of muscle mass together with loss of motor neurons means reduced cells available for signalling pathways and execution of movements, which leads to physical functional decline (Fried et al., 2016; Janssen et al., 2002). Consequences are the loss of independency and subsequently elevated healthcare costs (Anton et al., 2016). Related to sarcopenia is **dynapenia**, which is loss of muscle strength. The phenome is in association with sarcopenia as it is characterized by loss of muscle quality and loss of muscle control on neurological level (Manini et al., 2013).

Another estimated contributor to aging is **autophagy**. Autophagy is a controlled pathway that removes damaged organelles by lysosomal degeneration (Twig et al., 2008; Singh & Cuervo, 2011). As aging is associated with reduction in efficient cellular processes, as repair and cell division, it can result in accumulation of cells and organelles (Wohlgemuth et al., 2014). Autophagy pathway activation prevents this type of accumulation; however, aging is also related to impairments of autophagy pathways. Eventually this will result in accumulation of damaged organelles. Specifically in mitochondria, it can result reduced energy levels in the cell and decreased muscle strength (Anton et al., 2016).

(Chronic) inflammation is a symptom registered as underlying factor for aging (Fried et al., 2016; Kennedy et al., 2016). It seems that basal inflammation response and activation increase over the years and can eventually lead to low chronic inflammation (Kennedy et al., 2016; Anton et al., 2016). Inflammation is initiated by means of activation of common molecular pathways in several interactive physiological systems (Tracy, 2003). Examples are clotting cascades, the immune system and endothelial cells that have an active role. The increased basal inflammation as consequence of aging results however in overactivation of these systems. Consequently, circulating inflammatory mediators increase initiating loss of total body cells mass especially in case of an inflammatory disease (Walston et al., 2006).

(Low) chronic inflammation and its decreased body cell mass is a risk factor for disability, impaired mobility, and slow walking speed (Anton et al., 2016). It is also linked to chronic diseases by multiple studies (Salvioli et al., 2013; Wyss-Coray et al., 2016; Anton et al., 2016; Burch et al., 2014; Fried et al., 2016). Similar to other symptoms of aging, (chronic) inflammation is not related to aging by its individual pathways, but it is a coherency of multiple pathways of multiple symptoms.

Neurodegeneration is another interesting and concerning aspect of aging. It is already established that aging is associated with reduction of neurological processes (Manini et al., 2013). Chronic inflammation and oxidative stress are two of the factors that can contribute to decline of nerves (Di et al., 2006). Neurodegeneration means that neurons of the human body lose their function and/or structure as consequence of changes within the environment or the neuron itself. Neurons are responsible for transmission of signals from brain and periphery to all other parts of the human body and therefore, are essential for communication within the body. As neurodegeneration results in loss of functional neurons, it can result in defect or change of certain types of communication in the human bod. Neurons are not only present and functional in the brain but also have important functions in the periphery of the human body. The effects of the loss of neurons depends on the location and function of the neurons.

Neurodegeneration in the brain as result of aging is characterized by morphological and functional alterations (Satoh et al., 2017). At first, it is only neuronal atrophy (Manini et al., 2013). It already starts at middle age in multiple areas of the cerebral cortex, specifically the prefrontal cortex and the hypothalamus, and the primary motor cortex (Satoh et al., 2017). Evidence grows on age-related differences between grey matter volume and length of myelinated nerve fibres (white brain matter), showing reduction of brain size as result of aging (Anton et al., Manini et al., 2013). Altered communication and structure of the human brain is associated with reduced mobility and movement deficits. Reduction of neurogenesis and neuroplasticity also alters during aging. Less neurogenesis is related to neurodegenerative diseases, and reduced neuroplasticity results in loss of neuronal networks and consequently, results in loss of cognitive function and emotion (Sotah et al., 2017). Also, amyloid plaques and neurofibrillary tangles can be developed both inside and outside neurons and is associated with promotion of neuronal cell death (Satoh et al., 2017). Presence of these plaques and tangles, as well as Lewy bodies are often found in the aging brain but are also related to Alzheimer's' disease, Parkinson and Multiple Sclerosis. It is difficult to find the origin of the deficit in the brain and it is also difficult to find the difference between an alteration in an aged brain and a diseased brain. Despite the lack of evidence for a causal relationship between neurodegeneration and aging, these results show that aging is related to neurodegeneration (Wyss-Coray, 2016). Overall, neurodegeneration in the brain results in reduced mobility and movement deficits.

Peripheral neurodegeneration as consequences of aging results in alterations and impairments in both motor and sensory nerve systems (Di et al., 2006). Nerves are clusters of neurons and form a communication system through the human body. Degeneration of motor neurons results in reduced nerve conduction velocity, which is linked to reduced signalling in nerves and increases apoptosis, controlled cell death, reducing functional capacity of the human body (Anton et al., 2016). Degeneration of sensory neurons results in reduced or impairment of sensation in part of the body, especially in limbs.

This reduces the ability to feel the degree of grip of hands and the ability to feel the ground. Consequences are lettings thighs fall but more severe is the decline of balance and walking speed which increase the risk of falling. In short, damage to peripheral nerves interrupts communication between brain and other parts of the body and therefore, can impair muscle movement, reduce sensation of body parts, and can even cause pain.

Hormonal regulation seems to change as we become older (Anton et al., 2016; Fried et al., 2016). The secretion of hormones decreases over the years, like gonadal steroids, oestrogen, testosterone, cortisol, oxytocin, and growth hormone. As consequence of decline in gonadal hormones in combination with low chronic inflammation, bone mass and mobility of the human body is affected (Fried et al., 2016). Lower levels of oestrogen appear in the postmenopausal period of women and is associated with increased risk of reduced nerve conduction velocity as it influences nerve structures. This is a risk factor for nerve problems. As low chronic inflammation is often prevalent as result of aging, this is a relatively common phenome. Decline of hormones also initiates transcription of inflammatory mediators maintaining the process. Moreover, age-related hormonal changes impact on multiple physiological systems and evidence grows that hormonal dysregulation also affects the muscle, brain, and immune system (Anton et al., 2016).

Altogether, above-mentioned dysfunction of mechanisms is associated with a certain decline of the human body. The type of mechanisms declining, and the rate of decline differs per individual. The interplay between dysfunction of mechanisms and rate of decline determines the process of aging. Aging is associated with neurodegenerative disorders, diabetes, obesity, sarcopenia, fatigue, bone mass, pain, and physical disability. From a scientific aspect, these age-related problems as result of deterioration of the body should be focused on to improve health or maintain health of elderly. Aging is an irreversible process and therefore, age-related problems cannot be solved completely. Nevertheless, healthy lifestyle and other methods can help to reduce the rate of decline and therefore, have potential to influence problems related to aging.

2.1.3 Health conditions related to aging

The physiological changes in the human body are not only notable on a molecular level but are also present on physical level. There are multiple aspects related to aging, like the general known wrinkling of the skin, reduced sight, and reduced hearing. But there are also diseases related to aging like the frailty syndrome, obesity, cardiovascular diseases, and Alzheimer's disease (Burch et al., 2014; Fried et al., 2016; Kennedy et al., 2014; Anton et al., 2016). These diseases are elaborated to increase understanding of aging and to find points of interventions for interventions related to aging.

Multiple studies describe aging to be associated with **the frailty syndrome** (Anton et al., 2016; Broskey et al., 2019; Coen et al., 2012; Fried et al., 2016; Morley et al., 2013). The frailty syndrome is a state of the human body that is vulnerable with an increased risk of adverse health outcomes and can also result in death as consequence of exposure to certain stressors (Morley et al., 2013; Waltson et al., 2006). Aging increases the risk of the frailty syndrome. The type of stressor is dependent on the type of person and the type of present symptoms regarding the frailty syndrome.

Not only physical aspects are related to the frailty syndrome, also the mental state has a role in it. Frailty can be seen as a phenotype that is not a single (age-related) chronic disease, but has several characteristics related to chronic diseases, like muscle weakness, low physical activity, low energy levels, unintentional weight loss. It is also seen as a predictor of mortality dependent on the prevalence and graveness of symptoms (Burch et al. 2014), Fried et al., 2016).

Obesity is a disease that is the result of accumulation of fat in the human body which cause risk factors for negative effects on your wellbeing. Obesity is a chronic disease with the consequence of functional decline. Loss of skeletal muscle mass and more accumulation of fat mass are typical characteristics of obesity (Barbat-Artigas et al., 2014). One of the characteristics of obesity is increased size of fat cells. Fat cells are also known adipocytes. Adipocytes have the property to communicate via endocrine pathways. That means that adipocytes can secrete peptides that are able to signal themselves, autocrine signalling, or signal cells nearby, paracrine signalling. The peptides secreted by adipocytes are called adipokines. The increased size of adipocytes, fat cells, means more secretion of inflammatory adipokines causing an imbalance between proinflammatory and anti-inflammatory adipokines (Colaïanni et al., 2017). General inflammation consequently increases and could result in chronic inflammation. As aging is also related to increased inflammation pathways in the human body, health problems are increased by obesity in elderly. Moreover, obesity is also associated with sarcopenia. Fat and muscle cells under pathological conditions have similar pathways that cause damage in the human body (Zamboni et al., 2019). Therefore, obesity is related to an increased risk for physical disability and functional decline (Figaro et al., 2006). As aging in general already is related to sarcopenia and increased fat mass, obesity is a threat to health of elderly.

The causal relationship between aging and disease can be difficult to determine as multiple factors play a role in aging of the human body. Nevertheless, it is important to keep focusing on age-related diseases to help improve or maintain health of elderly. Multiple studies show promising results on interventions and health maintenance or improvement of elderly (Broskey et al., 2019; Cosco et al., 2013; Fried et al., 2016; Munt et al., 2016; Philips et al., 2020). Therefore, it is important to focus on these types of interventions to improve and maintain health of the population, and in specific elderly.

2.2 Diabetes 2

Diabetes is one of the most common chronic metabolic disorders in the world (Galicia-Garcia et al., 2020, WHO 1). Numbers show that more than 1.2 million citizens in the Netherlands are diagnosed with diabetes and there are even more people but without their knowledge (Diabetesfonds, n.d. a). 1.1 million of the 1.2 million citizens with diabetes have diabetes mellitus type 2 (diabetes 2) (Diabetesfonds, n.d. b). There are approximately 1.1 million citizens with prediabetes, which is a phase just before getting diabetes 2. Diabetes 2 is a serious disease with multiple complications and increases the risk of other diseases like cardiovascular diseases, eye disorders, renal disorders and more ((Diabetesfonds, n.d. a)). To find an approach to help citizens with their disease and to find prevention methods, it is important to know what diabetes 2 is. Therefore, this chapter describes the definition of diabetes 2 and its physiological aspects.

2.2.1 The definition of diabetes 2

Diabetes 2 is a disease that is characterized by **high blood sugar levels, insulin resistance and relative insulin shortage** (Tan et al., 2019; Galicia-Garcia et al., 2019). Under normal conditions, insulin is produced by beta cells within the pancreatic islets. Insulin production starts as response to glucose in the blood stream. Glucose levels in the blood increase after consumption of (sugar-rich) food. Secretion of insulin enables the human body to convert excess glucose into glycogen to store energy-rich glucose. It also signals to the body to reduce the release of glucose. By the time the human body needs energy, insulin levels are decreased, and glucagon levels increase (Weyer et al., 1999). Stored glycogen will be converted into glucose under the presence of glucagon to be used as a form of energy (Roden & Shulman, 2019). With diabetes 2 bodily tissue have become insensitive to insulin and/or the body does not secrete enough insulin (Roden & Shulman, 2019). Insensitivity means that the function of reducing glucose levels by means of insulin signal pathway does not response to insulin anymore, and therefore the body keeps releasing glucose. If the body itself does not produce enough insulin, the body is still able to respond to insulin, but does not produce enough to activate the signal pathway that reduces glucose release. Both ways, blood sugar levels elevate which result in hyperglycaemia and metabolic disbalance (Zengh et al., 2018). Diabetes 2 is the result of metabolic disbalance. This disbalance results in risk factors for other problems. The elevated blood sugar levels for example can lead to cardiovascular diseases, problems with eyes, kidneys, and nerves (Galicia-Garcia et al., 2019). Risk factors of diabetes 2 are overweight, unhealthy or food or high food intake, low physical activity, and smoking (Diabetesfonds, n.d. c).

2.2.2 Physiological aspects of diabetes 2

Diabetes 2 is like aging, related to **mitochondrial dysfunction**. Beta cells of pancreatic islets are more vulnerable to ROS and oxidative stress than other metabolic tissues (Rehman & Akash, 2017). Oxidative stress can be induced in multiple ways but within the pancreatic islets are hyperglycaemia, hyperlipidaemia, and inflammation most common pathways to induce oxidative stress. Subsequently to oxidative stress, pathways of inflammation are activated that suppress IRS-1, which is responsible for the production of insulin from beta cells of pancreatic islets (Rehman & Akash, 2017). ROS production can be activated via several pathways.

One of these pathways is related to high food intake and low physical activity, which is also one of the risk factors of diabetes 2. ROS production is elevated when excess electrons are present in the mitochondrial respiratory chains. Especially, when the proton gradient is high and oxygen consumption, which is ATP demand, is low (Kim et al., 2008). This occurs when energy intake is high while energy expenditure is low. It results in transformation of oxygen into superoxide and hydrogen peroxide, which are ROS variants.

As mentioned in chapter 3.2.1 Physiological aspects of aging, mitochondria are responsible for the energy production by means of ATP synthesis. Besides that, mitochondria have also other responsibilities, like maintenance of the ion homeostasis, clearance of ROS and integration in other signalling pathways to regulate them. As diabetes 2 causes disruption of energy release, a disbalance will occur between energy intake and mitochondrial energy production. This results eventually in dysfunction of mitochondria, characterized by reduced ratio of energy production and respiration (Galicia-Garcia et al., 2019). Consequently, ATP synthesis lowers and therefore, production of ROS increases as well as the **oxidative stress**. Accumulation of ROS in mitochondria is associated with insulin resistance and therefore, related to diabetes 2 (Sergi et al., 2019; Roden & Shulman, 2019).

Under normal conditions, the production of ROS product O_2^- is generated under guidance of NO. However, under pathological conditions, ROS product O_2^- neutralizes NO production, which eventually results in increased production of oxidation of proteins, carbohydrates, and lipids. The products of these auto-oxidative reactions are associated with increased production of ROS. The disbalance between oxidant and antioxidant levels leads to pro-oxidative condition, also known as oxidative stress (Rehman & Akash 2017). One of these pathological conditions is diabetes 2. The over-activation of NADPH oxidase as result of high blood glucose levels decreases the bioavailability of NO and this leads to a disbalance that increases ROS production and therefore, increases oxidative stress (Rehman & Shulman, 2019; Umegaki, 2009).

One of the frequent characteristics of people with diabetes 2 is obesity or a high body fat percentage. The (excess) adipose tissue cause activation of **inflammatory** pathways (Galicia-Garcia et al., 2019; Umegaki, 2009). These inflammatory pathways promote insulin insensitivity and therefore, are involved in the pathology of diabetes 2. Not only (excess) adipose tissue is one of the associated factors with production of ROS and increasing the oxidative stress. Also, elevated levels of glucose are associated with oxidative stress, known as glucose-induced oxidative stress (Rehman & Akash, 2017). This stress is especially elevated in the beta cells, which subsequently cause insensitivity of beta cells. Besides insulin insensitivity, (chronic) inflammation is also associated with neurotoxic consequences. As the inflammatory pathways are already elevated because of normal aging, diabetes 2 in combination with obesity is an increased risk factor for neurodegenerative diseases (Umegaki, 2009).

Diabetes 2 is associated with **neurodegeneration**. As mentioned before, neurodegeneration is means that neurons of the human body lose their function and/or structure as consequence of changes within the environment or the neuron itself. Neurons are responsible for transmission of signals from brain and periphery to all other parts of the human body and therefore, are essential for communication within the body.

As neurodegeneration results in loss of functional neurons, it can result in defect or change of certain types of communication in the human body. Diabetes 2 has an increased risk of cognitive decline and dementia (Stewart & Liolitsa, 1998; Umegaki, 2009). Associations are estimated between hyperglycaemia, that results in osmotic insults, and oxidative stress as it can result in toxic effects on neurons in the brain. Hyperglycaemia is also responsible for advanced glycation endproducts, which also are related to toxic effects on neurons. As diabetes 2 is related to (chronic) inflammation, the excess of inflammation is also associated with potential neurotoxic effects. Therefore, the risk of neurodegeneration is increased with diabetes 2. On top of that, aging is also associated with these above-mentioned symptoms and therefore, is diabetes 2 in combination with aging a relatively high risk of neurodegeneration.

Neuropathy is a complication present in diabetes 2 as result of neurodegeneration (Gordois et al., 2003; Hicks & Selvin, 2019). Diabetic peripheral neuropathy is associated with nerve dysfunction and cell death. It is estimated that oxidative stress and chronic inflammation are one of the causes (Hick & Selvin, 2019) Hyperglycaemia, and insulin resistance are involved in the disruption of mitochondrial pathways, which causes excess formation of ROS and subsequently, activate inflammation pathways. According to Tesfaye & Selvarajah, the Toronto Panel on Diabetic Neuropathy defined diabetic neuropathy as 'symmetrical, length-dependent sensorimotor polyneuropathy attributable to metabolic and micro vessel alterations because of chronic hyperglycaemia exposure and cardiovascular risk covariates' (Tefaye & Selvarajah 2012). It means that both vascular and metabolic pathways within the neuronal system are involved in neuropathy. One of the characteristics of neuropathy is sensory loss with the increased inability to feel the lower limbs (Cameron et al., 2001). Reasons for this is defects in vessels, which are basement membrane thickening, endothelial cell proliferations, hypertrophy, and lower gas tension of oxygen in blood. Moreover, arteries and veins surrounding nerves show microvascular deviations and reduced blood flow (Newrick et al., 1986; Tesfaye et al., 1993). Besides sensory loss, also pain is one of the consequences of neuropathy.

An increased **risk of trauma**, like bumping and falling over with the result of open wound or bone fracture is also related to diabetes 2. The rate of healing a wound or fracture is however reduced in diabetes patients as capillaries are lost or have reduced capacity to transport blood. Symptoms related to muscle weakness start in later stages of neuropathy (Tefaye & Selvaraja 2012). Other complaints associated with neuropathy are pain, foot ulcers and lower limb amputation (Margolis et al., 2013). Eventually, neuropathy will cause not only physical inability but also reduced quality of life, which could result in depression (Vileikyte et al., 2005).

Renal disorders are one of the consequences of diabetes 2. Glomerular hyperfiltration is one of the hallmarks of renal dysfunction in diabetes (Chagnac et al., 2019). Diabetes is related to increased renal plasma flow, filtrations fraction, and glomerular filtration rate. The increase in glomerular capillary perfusion pressure and the difference of pressure between the glomerular capillary and Bowman's space creates tensile stress, which causes increase of glomerular basement membrane length. The length of the foot of the podocyte increases while the filtration slits keep their length. Consequently, the foot process cytoskeleton will alter to maintain the right coverage of the glomerular basement membrane.

Eventually, it will result in adaptive podocyte hypertrophy and cell hypertrophy to adapt to the increased length of glomerular basement membrane. In and outflow change, which cause more stress on podocytes and eventually leads to podocyte detachment, denudation of the glomerulus basement membrane and more, that result in segmental sclerosis. Also known as development of scar tissue on the kidney. This is one of the processes related to renal disorders of diabetes 2. Multiple processes are a vicious circle that cause further impairment of renal function (Braunwald, 2019).

Altogether, this chapter provides an overview of physiological aspects that are related to diabetes 2. The physiology of diabetes 2 is complex and every human body is different. Therefore, there are multiple disease courses in case of diabetes 2. The interplay between dysfunction of mechanisms and rate of decline are determining factors of the process. From a scientific aspect, there are multiple aspects for diabetes 2 to focus on to improve health or maintain health of people with type 2 diabetes. Diabetes 2 is an irreversible process and therefore, problems cannot be solved completely (Roden & Shulman, 2019). Nevertheless, healthy lifestyle and other methods can help to reduce the rate of decline and therefore, have potential to influence problems related to diabetes 2.

2.2.3 Health conditions related to diabetes 2

Diabetes 2 is an established risk factor other health conditions and diseases (Sarwar et al., 2010). The dysfunction of mechanisms mentioned in chapter 3.2.2 The physiological aspects of diabetes 2, like mitochondrial dysfunction and oxidative stress, are also associated with other (chronic) diseases and health conditions. Therefore, dysfunction of mechanisms regarding diabetes 2 can eventually lead to other health conditions and problems. The other way around, other health conditions can also be a risk factor to develop diabetes 2.

Obesity is known to be a risk factor to develop diabetes 2 (Calcinotto et al., 2019; Chester et al., 2019; Galicia-Garcia et al., 2020). As mentioned in chapter 3.1.2 The physiological aspects of aging, obesity is a disease that is the result of accumulation of fat in the human body which cause risk factors for negative effects on your wellbeing. Obesity is a chronic disease with the consequence of functional decline. Loss of skeletal muscle mass and more accumulation of fat mass are typical characteristics of obesity (Barbat-Artigas et al., 2014). Obesity is also associated with activation of inner mitochondrial membrane protein that leads to hypoxia (Roden & Shulman, 2019). Hypoxia means that transportation of oxygen to cells and tissue is reduced and consequently activates adipose dysfunction and inflammation. (Chronic) inflammation is also increased in aging human bodies and therefore, obesity in combination with aging results in an increased risk for health conditions. Aging and obesity are two of the major risk factors for diabetes 2 and therefore, the combination seriously increases the risk of diabetes 2 (Calcinotto et al., 2019; Herzog et al., 2008).

Diabetes 2 especially in combination with obesity, increases the risk of development of **stroke** (Sarwar et al., 2010). The risk of stroke is also associated with arterial hypertension and atherosclerosis, which are common characteristics of diabetes 2 (Asfandiyarova et al., 2006; Tesfaye & Selvarajah, 2012). Elevated triglycerides correlated with loss of myelinated fibres suggesting that hyperlipidaemia might be involved with neuronal loss. Therefore, it might be an increased risk for stroke and neurodegenerative diseases.

Diabetes 2 is related to **Alzheimer's disease** (Umegaki, 2009). In specific, high blood glucose levels are related to neurodegeneration as it seems to have a toxic effect on the neurons in the brain. High glucose level affects the osmotic homeostasis and cause oxidative stress. Disbalance in osmotic homeostasis means that cells have to alter their water balance as well, which eventually can lead to cell damage. As amyloid plaques and neurofibrillary tangles can be developed both inside and outside neurons and is associated with promotion of neuronal cell death, neuronal cell damage is associated with Alzheimer's disease (Satoh et al., 2017).

There is also a strong association between diabetes and **heart failure** (Rydén et al., 2007). As mentioned in the previous paragraph, diabetes 2 increases the risk of hypertension (Braunwald, 2019). Hypertension in combination with dyslipidaemias, which means deviation of the amount of lipids in blood, develop faster and earlier in combination with diabetes 2, and subsequently, play a role in acceleration of atherosclerosis. The combination of diabetes and heart failure is a harmful prognosis with the risk of cardiovascular mortality, specifically in patients with left ventricular dysfunction as result of ischaemic heart disease. The chance on survival decreases as well (Sarwar et al., 2010).

As diabetes 2 causes increased risk for several health conditions, it is important to keep a close eye on diabetes 2 and other health condition to prevent worse. Multiple interventions to maintain chronic health diseases like diabetes 2 show potentially positive results to reduce symptoms of health conditions and to improve the quality of life (Chester et al., 2019; Kirwan et al., 2017; Ojo, 2019; Wang and Hu, 2018). Therefore, it is important to focus on these types of interventions to improve and maintain health of the population, and in specific elderly with diabetes 2.

2.3 Lifestyle and health

Lifestyle is related to the health of the human body. There are multiple ways to define the word lifestyle. Here in this study lifestyle is interpreted as the pattern of how an individual person decides to spend their time regarding several subjects like physical activity and nutrition. Studies show that lifestyle, diet, and exposure to toxins including abuse of drugs, can affect the health span and longevity. Health span means the period of human life that is spent in health. The health span of the human body is therefore related to the behaviour of a person and the exposure to the environment. Besides longevity of human life and the health span, there are other factors that are affected by the type of lifestyle, like neurodegenerative diseases and other chronic diseases (Wyss-Coray., 2016; Anton et al., 2016). Recent studies show that lifestyle also is of influence on aging and diabetes 2 (Cosco et al., 2013; Fried et al., 2016; Ojo, 2019; Wang and Hu, 2018). This chapter will elaborate on physical activity and nutrition as aspects of lifestyle related to health, with specific attention for aging and diabetes 2.

2.3.1 Physical activity

Physical activity is seen as one of the factors that helps to maintain a healthy body (; Nowak et al., 2019; Sjøgaard et al., 2016). It also decreases health risks, improves the ability of physical activity, and potentially reduces healthcare costs. In specific, these positive effects are achieved because of the improvement or maintenance of certain physiological mechanisms related to a healthy body and improvement of health conditions. Dysfunction of multiple physiological mechanisms related aging and diabetes 2 are also can also be improved by means of physical activity. A few examples are given.

Physical activity is responsible for the production of a peptide called irisin, which is associated with **fat burn** and **muscle growth** (Zamboni et al., 2019). Both muscle and fat can secrete peptides by means of autocrine and paracrine signalling pathways. Muscle tissues secrete myokines as result of physical exercise. Irisin is one of these myokines. One of the properties irisin is associated with, is the conversion of with adipose tissue into brown adipose tissue. Brown adipose tissue is a known as the 'good' variant of fat as it can produce warmth for the human body. It increases energy synthesis meaning that the body burns stored forms of energy like glycogen and fat. Irisin is not only associated with converting white adipose tissue into brown tissue, but also with stimulation of muscle cell growth. Muscle cells are also known as myocytes. Physical exercise is also associated with the stimulation of myocyte differentiation and growth, which result in more and bigger myocytes. It also down regulates myostatin levels by means of elevated levels of insulin like growth factor 1. Myostatin is a myokine that inhibits the myocyte growth (Colaianni et al., 2017). In other words, physical exercise **stimulates muscle growth** and increases the **burn of fat** and other type of **fuel** of the human body. Multiple studies show that regular physical activity or exercise **reduces all-cause mortality**, including decreased risk of **age-related diseases** (Philips et al., 2020).

As mentioned in chapter 3.2.2 Physiological aspects of diabetes 2, diabetes 2 is associated with high fat percentage which stimulates chronic inflammation, therefore, physical activity is associated as a healthy lifestyle for persons with diabetes 2.

In addition, physical activity is associated as part of a healthy lifestyle to maintain healthy aging as it stimulates muscle growth. This is confirmed by another study by Waltson et al., stating that physical activity is important to improve the **muscle mass and strength** and therefore, physical function of elderly (Waltson et al., 2006). Multiple types of physical activity are effective, from strength and balance to endurance and resistance exercise training. It improves **gait speed** and **self-reported functioning** of elderly. Altogether, these studies shows that physical activity is associated with healthy aging and improvements of diabetes 2 maintenance.

Other studies also see a positive relation between physical activity and physiological aspects and health conditions related to aging and diabetes 2. A review study by Hertzog et al. shows that there are various studies that show a positive correlation between **cognitive function** and physical activity (Hertzog et al., 2008). As neurodegeneration is associated with both aging and diabetes 2, physical activity could potentially slow the neurodegenerative process. Besides cognitive health, a study has shown an association between physical activity and **decrease of the general cause of mortality** as well as the risk of many chronic diseases like **diabetes 2, cardiovascular disease** and many **cancers** (Francesconi et al., 2019; Pontzer et al., 2018). In other words, physical activity potentially slows the process of cognitive decline and brain function, a characteristic of both aging and diabetes 2.

Moreover, **no or lack of physical activity** is a risk factor of multiple chronic diseases (Burch et al., 2014). It is associated as risk factor of obesity and diseases related to frailty and aging. If the human body does not perform enough physical activity or exercise, the earlier-mentioned production of irisin will diminish (Zamboni et al., 2019). It means that muscle growth as result of higher myostatin levels may decrease. Also, the conversion of white adipose tissue into brown tissue may decrease and result in less burning of stored fuel of the human body. It means that body fat mass might increase, and body muscle mass might decrease. As a result, no physical activity or exercise is associated with increased the risk of obesity and age-related diseases (Burch et al., 2014; Zamboni et al., 2019). As obesity is a risk factor for the development of diabetes 2, it is of interest to intercept this process. Furthermore, the increased risk of several pathological health conditions is associated with progression of sarcopenia, the loss of muscle mass (Anton et al., 2016). As loss of muscle mass is related to decline in physical functioning, it is therefore, another reason for interception of the process, as physical activity and functioning has positive effects on aging and diabetes 2.

In conclusion, physical activity improves mobility of elderly and therefore, **improves self-reported functioning**. Self-reported functioning is related to the degree of independency and therefore, improves indirectly the quality of life of elderly and people with diabetes 2. Increase muscle mass and strength also positively influences the life of elderly and the pathology of diabetes 2 as it improves **mobility of elderly** and reduces fat mass of people with diabetes 2 (Francesconi et al., 2019; McPhee et al., 2016). Nevertheless, there are influences like medication and diseases that attenuate the effect of physical activity. In addition, there are also other interventions related to nutrition for example that are associated with healthy aging and diabetes 2 control. It is therefore important to look at multiple aspects than physical activity alone (Anton et al., 2016).

2.3.2 Nutrition

Both nutrition and physical activity are factors that play a role in a healthy body and life (Koehler & Drenowatz, 2019). Nutrition interventions and counselling can have a positive impact on weight, blood pressure, serum lipids and glycated haemoglobin, which are mediator for a healthy body (Slawson et al., 2013). Optimal nutrition and nutrition interventions have shown to be preventive for chronic diseases like obesity, and diabetes 2 (Slawson et al., 2013; Goday et al., 2016). Nutrition and dietary habits are also one of the important factors that affect the maintenance of healthy aging (Kiefte-de Jong et al., 2014). According to Kiefte-de Jong et al., high intake of fruits, vegetables, fish, grains and legumes/pulses, and potatoes are essential in a diet related to **healthy aging**. These foods have been associated with **lower risk of mortality, cardiometabolic disease, and adverse cognitive outcome** in middle-aged and older people (Kiefte-de Jong et al., 2014). Aging is associated with alterations in the human body that result in increased percentage of fat mass and decreased percentage of muscle mass. Therefore, restriction of products with high fat content is of interest for elderly as it **reduces excess adiposity** and prevents excess storage of fat. (Anton et al., 2016).

In addition, a study by Vasto et al., shows the positive effects of a Mediterranean diet on the longevity and health of life. This type of diet is associated with **improvement of longevity** and protection of cardiovascular **issues**. The diet **improves the lipid profile**, meaning that the low-density lipoprotein concentrations lowered as well as the cholesterol, and triglycerides, and high-density lipoprotein concentrations maintained or increased. These improvements are related to decreased risk in diseases related to atherosclerosis and cardiovascular diseases. The diet also **reduces blood pressure, blood sugar levels** and therefore, is related to improved diabetes 2 control. Lastly, the diet also contains antioxidants present in many of the foods, that potentially play a role in the prevention of cardiovascular diseases and aging.

Moreover, dietary restriction for the purpose of weight reduction has also positive effects on both aging and diabetes 2. It **decreases the pressure on joints**, which is often combined with pain reduction and increased ability of physical activity. On a physiological level, dietary restriction has **anti-inflammatory properties**, promotes to maintain **healthy mitochondria, reduces oxidative stress**, and can **stimulate autophagy** on a healthy basis (Anton et al., 2016, Broskey et al., 2020). Reduction of oxidative stress promotes maintenance of healthy mitochondria and reduces DNA damage. As mitochondria are responsible for the energy production of the human body, it also improves the general energy level. All improvements help to improve physical performance as it improves the general health of the human body (Anton et al., 2016). Dysfunction of these physiological processes are related to aging and diabetes 2, and therefore, dietary restriction to a certain extend could have a positive result on healthy aging and control on diabetes 2.

Altogether, healthy nutrition and dietary restriction are interventions that are related to a **healthy lifestyle and body**. Improvement or maintenance of physiological aspects related to aging and diabetes 2 are related to healthy nutrition and dietary restriction. Physical activity has similar results. Therefore, combining of physical activity with a healthy diet or dietary restriction would be a good intervention for healthy aging and diabetes 2 control (Koehler & Drenowatz et al., 2019).

2.4 Best practices

Aging and diabetes type 2 are irreversible processes. Eventually you will become older with and eventually you will need (more) medication to maintain diabetes type 2. Both accompanied with the associated physiological aspects and with increased risk for several health conditions. It does not mean however that it is not possible to reduce processes. There are various promising ways to reduce rate of decline as mentioned in the paragraph regarding lifestyle. Here, several types of interventions will be mentioned that have been introduced as potential successful interventions for people with diabetes type 2 and elderly. First, we will start with a short introduction of Positive Health. Namely, are aging and diabetes 2 do not only have an impact on the physical wellbeing, but they also influence the quality of life and the ability to participate in society and, loneliness.

2.4.1 Positive Health

Positive Health is a relatively new integrated approach and has the potential to help formulate and implement an approach for GGD Fryslân that focuses on the independency and self-reliance of elderly with diabetes 2. Positive Health is founded by Machteld Huber (Institute for Positive Health, n.d.). The lack of a well-defined definition of health encouraged Machteld Huber to find the definition of health. As it differs from the perspective of patient and health professional, she founded Positive Health. A broad vision on patients with six different dimensions (fig. 2). Physical functioning, mental wellbeing, meaning of life, quality of life, participation in society, and daily functioning are the six aspects of Positive Health to create a broad view on health (Institute for Positive Health, n.d. b).

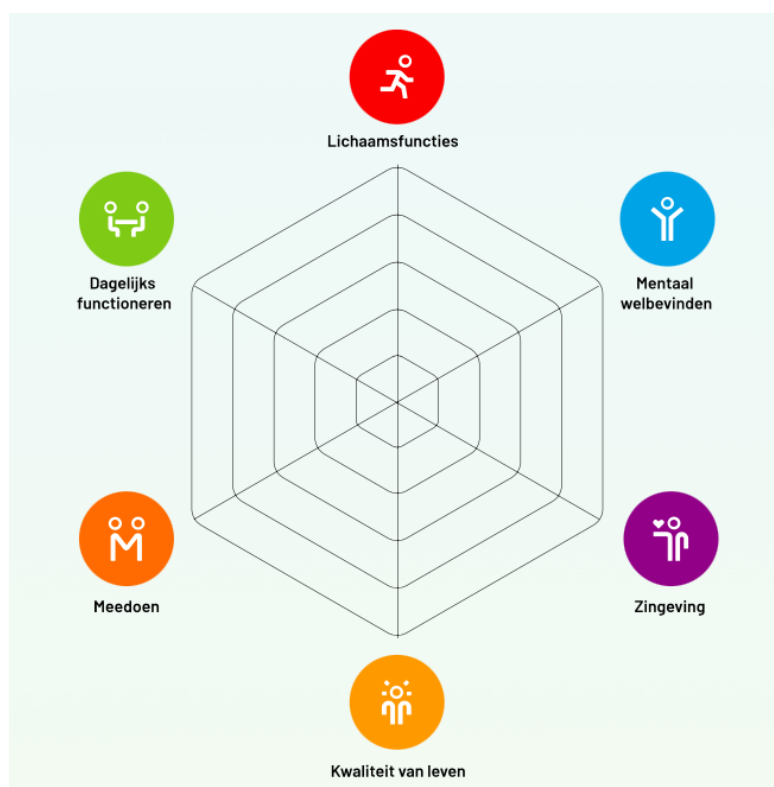


Figure 2 - The web of Positive Health

Meaningfulness of life is the central point of the concept and is being shaped by asking people what they would like to do or what they would like to change. It is believed to be the source of resilience and motivation, which is a key factor to find the strength to execute your goal(s) (Institute for Positive health, n.d. c) By focusing on these aspects, it improves the ability of people to deal with their physical, emotional, and social challenges with the goal to take control of your own body and life.

There are two different aspects of Positive Health (Institute for Positive health, n.d. c). One aspect of Positive Health is the broad vision on health. Health is more than absence of illness or a goal to achieve. Positive Health defines health as resilience of people to adapt to life and its changes. It is a dynamic approach that can help people within different aspects and therefore, helps to see what important is to them and to help them maintain this. The other aspect of Positive Health is the conversation method developed within the six domains of health. The six domains come from the opinion of people regarding health, which is more than only physical wellbeing. Figure 2 is used to map the health from the perspective of the client or patient. It is also used as tool to start a broad and customized conversation regarding health and wellbeing. Besides method for conversation and vision, Positive Health is also used to change an organization. Goals are to change or improve health outcomes, experience quality of healthcare, job satisfaction, and/or control or decrease of costs. Another aspect to use Positive Health is to improve collaboration between different domains. Specific to the health care sector, both vision and method of Positive Health move the view of the health care professional from the disease to the patient. By summoning their resilience and exploring their meaning of life exposes new perspectives to treat someone and to help feel healthy within the view of Positive Health.

Regardless of the positive and promising results that are also mentioned below, it is important to keep in mind that there are always both up and down sides. For example, Positive Health is associated as an undefinable term. It is used to broaden the view and definability would mean demarcation and therefore, reduction of the broad view. In addition, it seems that will be difficult to make Positive Health measurable (Van Vliet et al., 2020). Like definability would measurability demarcate Positive Health by means of putting aspects into boxes. Another downside related to the immeasurability is the scientific proof that shows a causal relationship between Positive Health and the positive outcomes found by people and organization working with Positive Health. It is also important to keep in mind that there are also other good working methods that have similar approach and ideas as Positive Health.

Nevertheless, people feel optimistic about working with Positive Health according to professor Yaron. Health professionals like GPs and organizations have positive experience with both vision and method of Positive Health. There is potential as several GPs show positive results after starting to use the method and ideas of Positive Health. In case Positive Health seems to be not a solution to a certain situation, it is also possible to look at other similar methods that could also be of help. All taken together; Positive Health has high potential to make a change as it looks at multiple aspects of health. By looking at these different aspects, it shows people the positive sides and their possibilities. Therefore, it will have potential to trigger independency and self-reliance by showing what people are capable of.

2.4.2 General practice in Afferden

Healthcare in the Netherlands is of good quality. Nevertheless, there are slight differences between provinces. The province of Limburg scored relatively low regarding subjects as health and participation (Institute for Positive Health, 2018; Limburg Positief Gezond, n.d.). Limburg showed relatively high trend of aging among citizens, chronic ill citizens, and participation on the work market fell behind. The efforts to decrease health inequalities of citizens with a low social economic status (SES) on national level were also unsuccessful. Therefore, the province of Limburg made the decision to make a change to form a cross-domain approach. Positive Health was taken as new starting point to realise their goal on the social agenda to improve the health of citizens in Limburg. The broad approach of Positive Health is used to work together with everybody, including citizens of Limburg. Special attention was put on inspiration, drive, and connection.

One of the first general practices in Limburg that started with the change to use Positive Health was huisartsenpraktijk Afferden. General practitioner (GP) Hans Peter Jung and his colleagues Hylke de Waart and Saskia Benthem started working with Positive Health in their general practice in 2015. All practice employees were schooled in Positive Health by means of a class that enlighten the aspects of Positive Health and its key factors to success. To create time to start a conversation the size of the general practice was reduced from 2300 patients to 1810 patients. The 1810 patients were divided over the three GPs and the remaining patients were received by a locum. Weekly discussion moments with colleagues were organized as well. In addition, GPs worked together neatly with the social team of the municipality. This team of social workers were also schooled in Positive Health. Finance was provided by VGZ health insurer. Eventually, GPs started conversation orientated on the concept of Positive Health. On appropriate moments, GP and patient worked together to find a solution in the social domain or elsewhere. Conversation techniques, leaflets, and meetings organized together with the social team of the municipality were tools to start this conversation. Results of this novel method have been published in *Huisarts en Wetenschap*, a Dutch scientific journal for GPs (Jung et al., 2018). The main conclusion states that reduction of general practice, weekly case discussion, and working according to guidelines of Positive Health results in 25% decrease of second line healthcare referral. Comparisons with other studies showed that only reduction of general practice is not enough to reduce the number of referrals to second line healthcare. It is however unknown which changes in the general practice is the success factor to referral reduction (Jung et al., 2018).

The reduction of referral to second line healthcare is an excellent result concerning the current pressure on the healthcare system. Even though the specific cause of the result is not known yet, speculations may be made that the combination of factors could be the result to the success. The extra available time for patients and other tasks as result of size reduction of the general practice, having a broad conversation guided by Positive Health schooling, and weekly discussion with colleagues are all aspects that potentially have had a part in the referral reduction. Meanwhile, the social agenda of the province has been translated into an execution program that focuses on vitality of neighbourhoods by means of an integral approach (Institute for Positive Health, 2020). High priority is put on prevention. Positive Health has the lead in the design and execution of the integral approach. This is based on the successes of Positive Health in Limburg.

2.4.3 Bas van de Goor foundation

The Bas van de Goor foundation started in 2006 with helping people with diabetes to move their life to a higher quality of life by means of physical activity. It is general known that physical activity is good for your health but for people with diabetes, especially because of the positive effects on the blood sugar and (reduced) use of medication. It can however be difficult to exercise for people with diabetes. Therefore, the Bas van de Goor foundation organizes sportive activities to let people with diabetes see what their many possibilities are regarding physical activity and what the positive effects are on your body and maintenance of diabetes (Bas van de Goor foundation, n.d.)

Their method is to let people experience what the effects are of physical activity and to share stories without the many hours of theoretical talks without any practical aspect. Examples are that children join a sport camp where they learn that they are not the only one with diabetes and learn how to regulate diabetes independently for example. Also, adults are challenged in many ways, from walking in the Netherlands to cycling in the Spanish Pyrenees. By means of organizing these activities, the foundation wants to stimulate people with diabetes to have a sportive lifestyle and a healthy life. In addition, are these events a great form of refresher training for health professionals related to diabetes. By experiencing from up close what the consequences of diabetes are in combination with looking at the effects of physical activity is educative for the health professionals and knowledge is applicable straight away (Bas van de Goor foundation, n.d.).

The approach of the Bas van de Goor foundation is successful for both diabetes patients and health professionals. Scientific investigation has proven that physical activity by means of walking evidencable improve blood sugar levels. Especially, poor blood sugar levels improved significantly. In other words, science shows that physical activity is good for your health and blood sugar levels. Altogether, the Bas van de Goor foundation one of the effective approaches to help people with diabetes (Goor, B., 2018).

2.4.4 General practice in Bakkeveen

Jon Brouwers is GP in general practice Bakkeveen since 2008 and is passionate to help people in the best way possible with their request for help. She noticed however that there were still struggles and therefore, got stuck on certain fronts. Regardless of the trajectories of some patients to solve the problem, no process was noticeable. In the search for solutions, she came across Lifestyle Medicine.

Lifestyle Medicine states that knowledge alone is not sufficient to address the challenge of healthiness and healthy behaviour. This method focuses on motivational interviewing, health coaching, patients making choices with their own reasoning, establishment of small realistic goals, team-based holistic and adaptable care for patients, and more. Jon Brouwers has done the Lifestyle Medicine Physician Board exam and has made her a lifestyle doctor. Lifestyle Medicine resembles the ideas of Positive Health. Today, she still uses her new insights of her exam to help people in her practice to assist them in their way to a healthier lifestyle.

Together with the foundation for social work in Bakkeveen a 'denktank' was founded. This is an organization of advisors, scientists, and/or commentators that gather information on a certain topic that they are interested in and publish about it. The goal is to focus on social and political problems and to formulate advice on possible solutions. Positive Health became the source of inspiration for the new founded denktank in Bakkeveen for the development of activities. Focus points are connection, for and by the village, use of talents within the village, support of initiatives, and most important collaboration. The goal is to create a blue zone which is a region, town or village that shares a lifestyle that contributes to people life healthier and longer in that area. The ideas of Lifestyle Medicine and Positive Health are not only used within the general practice in Bakkeveen. Also, other organizations and citizens are enlightened about the ideas of Positive Health. Over the years, several projects have been started to increase awareness of citizens and organizations within Bakkeveen regarding health and the importance of a healthy lifestyle. Examples are organizing events that help to improve physical activity, and exercise, workshops to prepare healthy meals, going to films, planting flower bulbs and more. These events help to improve the awareness of healthy lifestyle and helps to transmit ideas to others.

There is no scientific proof for success yet, but Jon Brouwers gets many positive responses within and outside the general practice and this motivates her to continue her new strategy and to work on the goal to make Bakkeveen a blue zone.

2.4.5 GLI: gecombineerde leefstijlinterventies

A gecombineerde levensstijl interventie (GLI) is a translation of combined lifestyle intervention and is specifically organized for people with overweight or obesity. In specific, this means that people with a Body Mass Index (BMI) higher than 25 and increased risk of cardiovascular diseases or diabetes 2, and people with BMI higher than 30 can participate (Zorginstituut Nederland, n.d.).

A GLI focuses on a healthy lifestyle and maintenance of it by means of behavioural changes. One GLI lasts two years consists of both group meetings and individual contact moments. The amount of group meetings differs between programs but is in general 12 times. In addition, there are one or two individual meetings with the care provider of the GLI (Zorginstituut Nederland, n.d.). The goal of a GLI is to change your lifestyle and behaviour in a positive way. This is established by focusing on subjects like physical activity, nutrition, sleep, and recreation.

Research has investigated operative elements of a GLI (Bos et al., 2019). There are several aspects that are of interest. One is that treatment regarding weight reduction works best when treatments is a combination of three aspects. A healthy diet, physical activity, and application of behavioural change techniques. Also, is initial weight loss related to education of a healthy diet. After losing weight, it is important to maintain the weight loss. Therefore, a GLI should consist of both a weight loss phase and maintenance phase of weight maintenance. From practice, there are also some additions. Participants should have a good motivation at the start of a GLI. Another point of interest is to educate people to persist the healthy behaviour by means of self-regulative behaviour for example.

As obesity increases the risk of becoming diabetic with diabetes 2, and the interventions focuses on recommendations that are also applicable for people with diabetes 2, like physical exercise and healthy food habits, GLI would potentially also be a good solution for people with diabetes 2.

2.5 Conclusions

- Aging is related to multiple dysfunctions of mechanisms in the human body
- Diabetes 2 is an irreversible disease with increased risk of other health conditions
- Multiple studies show promising results on interventions and health maintenance or improvement of elderly
- Multiple interventions to maintain chronic health diseases like diabetes 2 show potentially positive results to reduce symptoms of health conditions and to improve the quality of life
- Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, involve citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example).
- In the Netherlands different domains already focus on prevention with promising outcomes

Both aging and diabetes 2 are characterized by multiple physiological aspects that have relation with deterioration of the human body. Some of the aspects are related to both aging and diabetes 2. Therefore, aging in combination with diabetes 2 is an increased risk for acceleration of aging processes. It also means that the human body should be taken care of carefully to keep it in good condition.

Some physiological aspects of aging and diabetes 2 are also related to several health conditions. It means that the process of aging and diabetes 2 will eventually result in increased risk of several of these health conditions. This is another indication that it is important to take care of the human body to keep it in good condition.

Lifestyle is related to the extent of health of the human body. A healthy lifestyle means a higher probability on a healthy body. An unhealthy lifestyle is related to an increased risk for health conditions. Some of these health conditions are related to aging and diabetes 2. It is therefore of interest to have a healthy lifestyle as it decreases risk for health conditions. Moreover, a healthy lifestyle is also related to smaller risk of chronic diseases like diabetes 2 and slows the process of aging.

Best practices show that lifestyle interventions indeed have a positive influence on the human body. Both healthy bodies and chronic diseased bodies seem to have a positive influence on behaviour related to a healthy lifestyle. Not only a healthy lifestyle is important to be and feel healthy. Key factors that make these interventions successful focus on personal and patient related help. Health professionals have a broad view regarding health. It means that they take time for the patient to listen and look at multiple aspects of health. For example, not only physical health is discussed, but also mental wellbeing, meaning of life, and quality of life are subjects that are discussed with the client or patient. All aspects focus on prevention.

In other words, prevention is the main key factor to success. In combination with the other key factors, it becomes a successful intervention. As lifestyle interventions and other interventions with similar methods are potentially successful regardless of the health condition, it is not necessary to focus specifically on elderly with diabetes 2. Therefore, this project will focus on finding the best approach for GGD Fryslân to improve health of elderly in general with specific attention to prevention by means of lifestyle interventions.

3.2 The government of the Netherlands

The national government makes policy, enacts laws, and monitors compliance. In addition, the central government is preparing plans for the government and parliament. And it carries out these plans. The Ministry of Health, Wellbeing and Sports is part of the government of the Netherlands. The department is important as they design plans and approaches regarding the healthcare system in the Netherlands. They want people to be able to trust the Ministry to preserve availability and affordability of health care. As healthcare costs rise and people are getting older, it means that change within the current policy of the Ministry is necessary to keep this promise. The Ministry works hard to keep this promise and therefore, works together with healthcare providers, patient health insurers and other organizations to keep healthcare available and affordable as well as maintain its quality. To execute their tasks, The Ministry implements new or innovative policies with themes. These policies are guidelines for municipalities and other organizations for their new policy plans and documents to maintain and improve public health.

The Law of Public Health for example stands for all activities that are related to preventions and promotion of public health. Looking at the responsibilities, the government is responsible for the establishment of the range of the Law of Public Health. Municipalities are initially responsible for the local interpretation and implementation of projects regarding public health. Subsequently, health professionals and other professionals are responsible for the quality of healthcare. Lastly, citizens are expected to observe and take responsibility for their own health. When citizens are not able to preserve their own health, government, municipalities, or professionals are to step in and help.

GGD Fryslân is an organization with certain responsibilities that origin from national policy. The tasks origin from a national law called the Law of public health, in Dutch known as *Wet publieke gezondheid (Wpg)*. This law is active since 2008 and arranges the organization of public health care, control of infectious diseases crises and isolation of persons and vehicles that could cause international health hazards. Besides that, the law also arranges youth and elderly healthcare. The law is characterized by the public request for healthcare. There are various organizations responsible for public health, but in general the GGDs in the Netherlands are responsible. In some regions the medical care at home do also perform some of these tasks. The Law distinguishes collective prevention, infectious disease control and youth healthcare.

The Ministry of Health, Wellbeing, and Sports is mostly focused on national policies. The execution of regional projects organized by GGD Fryslân, municipalities, and other organizations are therefore, not directly influenced by the government. In fact, an approach for elderly with diabetes 2 in the region of Friesland is responsibility of regional organizations. One of the few factors the government and its Ministry of Health, Wellbeing, and Sports influences is the focus on regional level regarding health will be on. Therefore, it could influence the subsidy from both national and regional government agencies. As the Ministry of Health, Wellbeing and Sports new policy puts extra attention on elderly, this will not have influence on the design of the novel approach to help elderly with diabetes 2 in Friesland. There is no (extra) effort necessary to maintain the relationship regarding the new approach.

3.3 Municipalities in Friesland

Here is the introduction to the municipalities in the province of Friesland. Municipalities in the Netherlands have the ultimately responsibility for public health. They are responsible for the local interpretation and implementation of public health guidelines written by the Ministry of Health, Wellbeing, and Sports. This is executed by the college of major and aldermen, who decide how to preserve the continuity and coherence within public health. Every four year the Municipal Health policy is determined per municipality.

Dutch municipalities have however also given the responsibility of public health maintenance to a GGD in the Netherlands. In Friesland this means that all municipalities in Friesland have given the responsibility to GGD Fryslân. In other words, both municipalities in Friesland and GGD Fryslân are responsible for their citizens to be healthy and are helped in case they have difficulties regarding their health. To be successful, GGD Fryslân and municipalities in Friesland work together intensively and therefore, have a close and neat relationship. GGD Fryslân helps with this responsibility by means of advice and support regarding the protection, guarding and fostering of health of all citizens in Friesland. There are also other forms of cooperation, like execution of projects regarding public health. Zorgbelang Fryslân and De Friesland health insurer also collaborate with both GGD Fryslân and municipalities in Friesland on various of these projects. Zorgbelang Fryslân is often the representor of citizens in Friesland and helps to manage projects and write reports. De Friesland is often the representor of healthcare within these projects.

With new policy guidelines from national government, municipalities in Friesland will be asked to put extra attention on elderly regarding public health. It does not mean that they will therefore specifically focus on elderly with diabetes 2 but it will increase the possibility to gain support from municipalities in Friesland for the new approach. Municipalities in Friesland are responsible for the financial support of many projects regarding public health and therefore, can give extra financial support to a project. As municipalities in Friesland have responsibility for public health and financial support regarding public health, they have both a high interest and high power in the new approach for elderly with diabetes 2. Therefore, the relationship with municipalities in Friesland should be maintained closely to form a new approach for elderly with diabetes 2.

3.4 GGD Fryslân

GGD Fryslân has the responsibility to maintain and improve the public health in the province of Friesland. Together with municipalities they carry this responsibility. Within GGD Fryslân, municipalities connected to GGD Fryslân are responsible for the design of guidelines regarding public health for GGD Fryslân. All aldermen of municipalities in Friesland with Public Health in their portfolio, also known as the College of GGD Fryslân, decides which themes will be highlighted at GGD Fryslân. The MT of GGD Fryslân makes sure that the guidelines determined by the College will be followed. Even though municipalities in Friesland determine guidelines for GGD Fryslân, policy officers of GGD Fryslân do have relatively much freedom to execute their job.

GGD Fryslân has multiple tasks as mentioned in chapter 2.2. GGD Fryslân. One of the tasks that is of interest for the approach for elderly with diabetes 2 is their advising role. In general, GGD Fryslân advises municipalities in Friesland on their policies regarding public health. In projects it means that they also provide knowledge and advice on topics related to public health. This means that GGD Fryslân has access to important knowledge and data that is also of interest for the approach of elderly with diabetes 2. Another point of interest is the collaboration with municipalities, Zorgbelang Fryslân, De Friesland health insurer, and other organizations. GGD Fryslân has a relatively broad network that can be used for the approach for elderly with diabetes 2.

Altogether, it means that GGD Fryslân is an excellent partner for the approach for elderly with diabetes 2 as it has a close collaboration with municipalities in Friesland, which are also responsible for the public health, and have financial means for projects. Other important factors are the access to knowledge and the relatively broad network, which will make it easier to find support for the approach for elderly with diabetes 2.

3.5 Zorgbelang Fryslân

Zorgbelang Fryslân is an association that helps to look after the interests of all citizens and particularly those in need of (health) care in the province of Fryslân. They are part of the organization Zorgbelang Nederland and together with other regional Zorgbelang associations, they look after the interests of all citizens in the Netherlands.

Zorgbelang Fryslân is an advice centre for healthcare users by providing information, advice, and support regarding multiple subjects, like long-term care, healthcare, and youth care. They also have independent client support (OCO), confidential counsellor and complaints officer. Zorgbelang Fryslân works also together with the province and municipalities in Friesland to help improve healthcare in the region. With their expertise and broad network of member associations, they are good in representing the needs of citizens. Furthermore, the province and municipalities in Friesland work together with Zorgbelang Fryslân to translate the needs into a relevant project and/or policy. One of the purposes of Zorgbelang Fryslân is to keep improving healthcare for every citizen in Friesland. Therefore, they work together with health professionals, care providers and home care regarding elderly to serve the interests of elderly. As Zorgbelang Fryslân has a close relationship with member association, they are the ideal association to brainstorm with organizations that want to help and improve healthcare by taking the opinion of clients and patients into account.

All taken together, Zorgbelang Fryslân is an actor of elderly and focuses on prevention. As they are closely involved with member associations and citizens and have the goal to improve healthcare for every citizen, Zorgbelang Fryslân is closely related to the approach for elderly with diabetes 2.

3.6 Health insurers

Every citizen of the Netherlands has the right to receive healthcare. The Healthcare Law arranges that a broad basic health insurance package is available for everybody. Dutch health insurers execute the Health Care law for their insured and are therefore, responsible to provide healthcare with good quality. The general goal of health insurers to have healthy insureds. To reach this goal, healthcare is offered to those that need it. Health insurers notice however that the request for health care increases. Not only the demand for health care increases, also the healthcare costs rise. Change is necessary to keep health care affordable.

There are various ways to keep healthcare available for every citizen. A subject that has gained more attention is prevention. One of the aspects of the prevention strategy is focused on offering help to make healthy choices to become a healthy and vital population. To set up a strategy that helps to decrease healthcare demand and costs, health insurers need help. Therefore, health insurer De Friesland started to collaborate with other organizations like GGD Fryslân, municipalities in Friesland and Zorgbelang Fryslân. As De Friesland can provide reimbursement for certain treatments within projects, they are valuable to a project that is accessible for every citizen in Friesland or for every citizen in the concerned region.

Altogether, health insurers would be a good partner for the approach for elderly with diabetes 2. They have a high interest in the health of their insured making them willing to invest in new projects and approaches. They are also able to provide accessibility for every willing participant to participate in these projects as they can provide reimbursement for certain treatments. Therefore, they have both a relatively high power and interest in the approach for elderly with diabetes 2.

3.7 Health professionals in primary healthcare

Health professionals is here defined as professionals that work with elderly with diabetes 2 in primary healthcare. This means GPs, practice, dieticians, physiotherapist, and other professionals with medical background. Health professionals have the responsibility to help people regarding their health. Their goal is to keep everybody healthy and to prevent worse. Depending on the type of profession, they look at physical problems, mental problems, or other underlying problems that cause health issues. Their task is to find the problem and subsequently help the client or patient to find a way to improve the situation or solve the problem.

Health professionals have close contact with client and patient and therefore, they can provide knowledge on health of their patients and the issues of the inability to become healthy or maintain the disease. Elderly with diabetes 2 are specifically in close contact with GPs and dieticians. They require periodic checks from GPs for example. In addition, health professionals can advise on the approach by means of highlighting problems or points of interest of elderly with diabetes 2. As health professionals want their patients to be healthy, they have relatively high interest in the approach for elderly with diabetes 2. In general, often the right help is offered making health problems relatively easily to control or cure. It can however be difficult or impossible to find the right type of help. Based on interview with practice nurses one of the problems regarding diabetes 2 is motivation to maintain the disease. Problems often arise from underlying causes. If the cause of a problem cannot be found, it can result in long treatment trajectories. Another problem is the inability of client or patients to stick to guidelines given by health professionals. This makes things difficult for health professionals as they are responsible for help but may not impose treatment.

Altogether, it means that health professionals could have a relatively high interest in the approach for elderly with diabetes 2. As they are in close contact with clients and patients, they also are of value as source of information and could offer contributing advice.

3.8 Neighbourhood teams

Neighbourhood teams origin from municipalities and are therefore, one of the executing departments of municipalities regarding public health. They and certified institutes offer help and support to citizens within their municipality. The teams help with finding solutions for problems related to the social domain and are therefore, connected to the Participation Law, Wmo and Youth Law. The Participation Law applies to work, income, and social benefits. Wmo applies to independent living and participation in society. Youth law applies to help and care for children, youth, and parents. Depending on the type of problem, these laws help to find the right arrangements for problems with the goal to solve the problem eventually.

To help citizens in the municipality, social workers of a neighbourhood team are in close contact with citizens. They contact citizens on a regular basis to monitor the problems and to offer the right help. As neighbourhood teams are in close contact with citizens, they can provide insights into problems of citizens. Their help and knowledge will have potential to contribute to the new approach for elderly with diabetes 2. Their interest for public health gain is relatively high as they want their clients and patients to be healthy.

3.9 Patient, client, and elderly associations

Member associations represent their members by means of making their voice heard. Patient associations for example want to help to improve healthcare for their members. For almost every type of disease a patient association is present. It can be a general association for a type of problem or an association specific to the disease. One of their main goals is to help and improve healthcare specific to the disease the association represents. They try to help by means of listening to the experience of others and, letting them give their opinion. Information of patients and members is important as it can help to improve and personalize help offered from hospitals or other organization. Besides improvement of healthcare, they help by means of providing information and advice regarding the concerned disease. They also organize meetings or provide contact with associates to find support within the group. Like patient associations, client and elderly associations want to help their members. Depending on the type of needs, they help to find a way to represent them to the right organizations that can help and fulfil the needs.

As citizens play an important role in the perception of public health, it is important to keep them involved with the approach for elderly with diabetes 2. Moreover, associations do have relatively high power with their voice because they represent many members that agree with them.

3.10 Citizens of Friesland

One of the most important actors that we tend to forget are the citizens of Friesland and in specific, elderly with diabetes 2. Often approaches are designed without involvement of citizens with the consequence of disappointing results. After all, their perception of public health determines to a certain extent the success of the approach. Therefore, elderly with diabetes 2 should be involved with the new approach. Involving citizens helps to reveal key issues and could help to design new and innovative projects. It increases potential success of projects because it will improve the connection with citizens. Altogether, the interest of citizens is of high as it involves their own health. Citizens of Friesland in general do however not have much power as they do not have a representative.

3.11 Conclusions

There are multiple actors involved with the subject elderly with diabetes 2. Each relationship is different and has its own characteristics. The type of relationship with the subject and the type of maintenance is related to the involvement with elderly with diabetes 2. Based on the information above an overview of the type of relationship has been developed. Actors closely related to elderly with diabetes 2 are municipalities of Friesland, GGD Fryslân, health professionals, member associations, and citizens of Friesland. Actors that are less closely related are the national government and neighbourhood teams. An overview is given in figure 4.

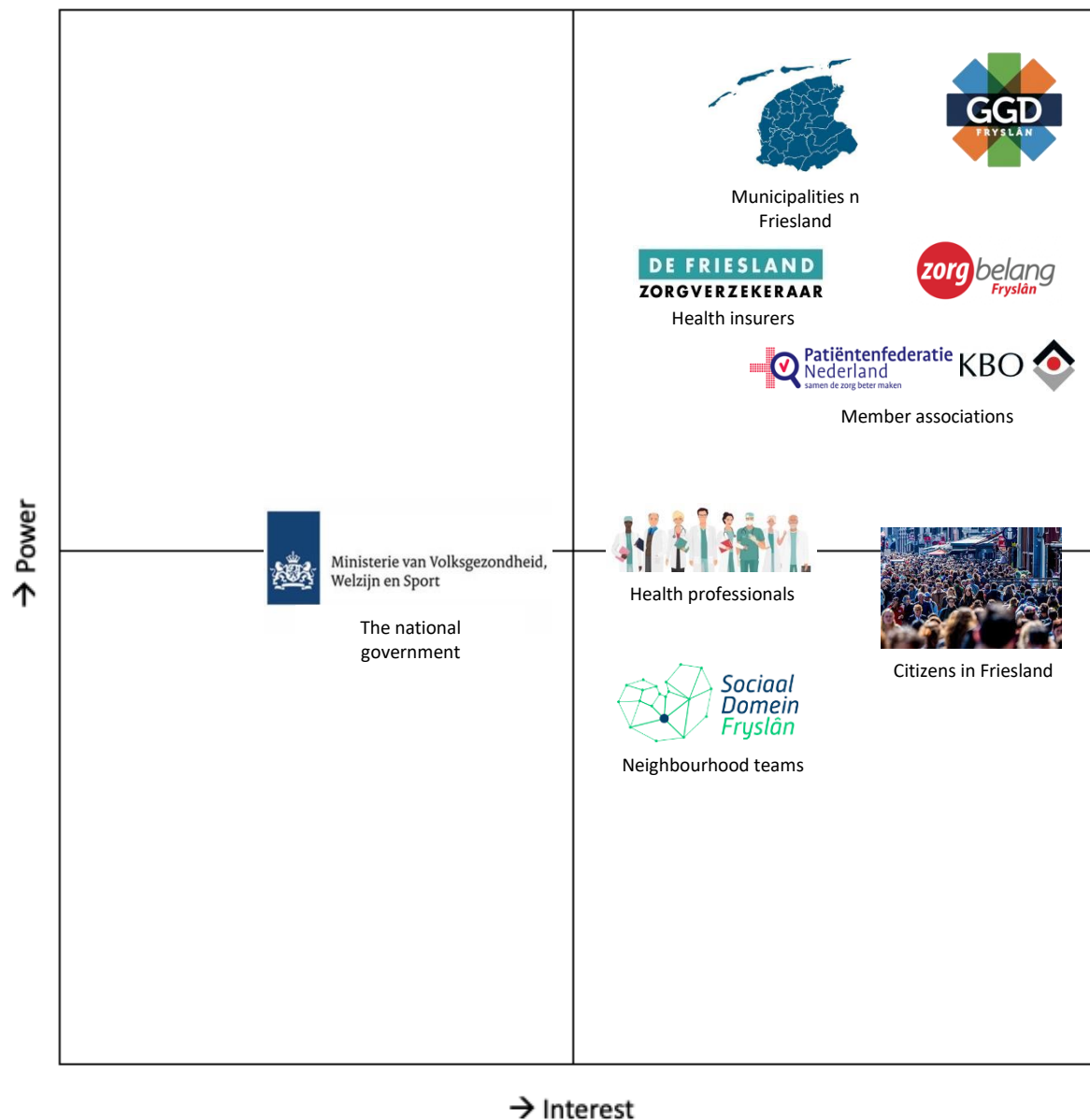


Figure 4 - Power and interest sheet for elderly with diabetes 2

4 The organization of GGD Fryslân

Improvement of independency and self-reliance of elderly with diabetes 2 is the topic of this project. GGD Fryslân is an organization that is orientated on public health. Orientation of GGD Fryslân is necessary to see if GGD Fryslân is equipped to play a leading role in the approach for elderly with diabetes 2.

4.1 Shared values

The core values of GGD Fryslân are **customer orientation**, **ownership**, **cooperation**, and **curiosity**. These core values are part of the current strategy of GGD Fryslân. It means that GGD Fryslân wants to focus on **customer orientated** care to find connection with the client or target group. These connections will help to understand the problem or situation. It also will help the customer or target group to find **ownership** in the problem and a potential start for new ideas to improve the situation. **Cooperation** is another aspect and will help to create a network of (potential) partners that are able to find each other easy as result of the founded network. By improvement of cooperation, new connections will be made. **Curiosity** is an important aspect of these core values as it will help to find ways to make new ideas possible.

Other values of GGD Fryslân are **innovation**, **involvement**, and **ambition**. GGD Fryslân is originally a bureaucratic institution and therefore, these values are real valuable to the organization as **innovation** creates new opportunities. Moreover, by finding new or improved ways that increase easiness and speed or reduces costs will help to increase quality of public healthcare for example and subsequently, will show customers the value of GGD Fryslân regarding public health. **Involvement**, especially regarding the entire chain of healthcare in Friesland. GGD Fryslân needs to be able to help and support within every aspect of healthcare and therefore, close connection with all departments is essential to help and support properly. **Ambition** is one of the factors that makes GGD Fryslân more successful with helping on other fronts than they are officially assigned to. It makes them able to perform projects and support others that also want to improve public health and healthcare.

The approach for elderly with diabetes 2 will possibly match with the shared values of GGD Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Customer orientation is related to the involvement of citizens in Friesland by GGD Fryslân. Cooperation will help to create a network that helps to improve cooperation between for example health professionals but also organizations that are related to elderly with diabetes 2. Curiosity, innovation, involvement, and ambition are also important for the design and execution of the project. GGD Fryslân however has originally a bureaucratic organization and therefore, was not focused on these aspects. Consequently, GGD Fryslân sometimes struggles with combining the bureaucratic view with the creative and innovative view. Both aspects are important and therefore, should be maintained closely. Nevertheless, the shared values of GGD Fryslân are relatively in line with the approach for elderly with diabetes 2.

4.2 Strategy

The main ambition of GGD Fryslân in 2021 is health gain. It means that they want to reduce the unhealthy years and therefore, increase the health span of citizens. Specific attention will be paid to the population group with a low social economic status (SES) as they have a relatively high percentage of unhealthy years in comparison with other population groups. To reach this goal GGD Fryslân focuses on **prevention**. In other words, they want to prevent citizens to have health problems.

The general strategy of GGD Fryslân to reach each goal is to perform their tasks as good as possible. In other words, they focus on the **quality** of their products and do not settle for less. Ways of GGD Fryslân to execute this strategy is by supporting municipalities regarding prevention programs and plans. They also want to mean more to regional partners. Other aspects they deploy on are innovation and academization. Innovation is important to improve quality of public health and healthcare and academization is important to find the right knowledge and subsequently to spread this new information.

Creating a **broad network** is one of the other parts of the strategy. To spread knowledge, a network is essential. A network creates new connections that subsequently, make it easier to communicate with others. It makes it therefore easier to spread knowledge. Moreover, partners within the network have ideas and knowledge. **Sharing knowledge** will increase opportunities in several areas, like creating new ideas and optimization of systems. A network will not only spread knowledge but will increase knowledge as well.

Besides spreading and increasing knowledge, a network has also other qualities. It improves **communication** between organizations making it easier to strengthen relationships. **Cooperation** becomes easier. It will increase the rate of problem detection in healthcare sector for example and it will also be easier to find ways to improve the situation or to solve the problem. Information is spread faster and, therefore, problems will be detected earlier or faster. It is subsequently easier to get in touch with the right organizations and persons because chances are bigger that the organization or contact persons know who to contact. Also, agreements are easier to make as chances are good that the organization or contact person already knows you and therefore, (indirectly) knows you and how you work.

The approach for elderly with diabetes 2 will possibly match with the strategy of GGD Fryslân. First, health gain is an ambition of GGD Fryslân and is also an ambition of the approach for elderly with diabetes 2. Therefore, GGD Fryslân would already be a good match with the approach. Health improvement of elderly with diabetes 2 by means of increased independency and self-reliance is a goal for the long term and therefore, requires an approach with high quality with focus on prevention. This matches with GGD Fryslân as they want to deliver products with high quality and currently focus on prevention. Another aspect of GGD Fryslân that possibility fits with the approach for elderly with diabetes 2 is their goal to work together on a regional level. This will help to integrate for example the social domain, which is one of the potential interventions mentioned in chapter 3.4 Best practices. Altogether, it means that the strategy of GGD Fryslân is in line with the approach for elderly with diabetes 2.

4.3 Structure

GGD Fryslân is a governmental organization with the task to preserve and improve the public health of all citizens in the province of Friesland. Officially, the responsibility of public health lies with municipalities, but all municipalities in the Netherlands have given this responsibility to the GGD of the concerned region. In the region of Friesland, GGD Fryslân is responsible for the public health and is part of Veiligheidsregio Fryslân (VRF). VRF operates on behalf of all municipalities in Friesland. The mayor of all municipality in Friesland forms the general board of VRF. They have the responsibility to decide upon general and financial frameworks of all departments of VRF. These departments are crisis management, fire department Fryslân, business operations and GGD Fryslân.

Within the organization of GGD Fryslân there are many employees and all of them have various and sometimes real specific responsibilities. On top of the organization is **the board committee of health** and the **management team (MT)**. The board committee of health consists of a College and a council both represented by municipalities in the province of Friesland. All aldermen in Friesland with health in their portfolio have a seat in the College of the board committee of health within GGD Fryslân. The board committee of health decide which topics will be included during their term as alderman. The MT subsequently helps to execute the plans and tasks of the board committee of health.

The MT consists of various employees from within GGD Fryslân. The head of public health within VRF is also the head of GGD Fryslân, as GGD Fryslân is responsible for the public health in the province of Friesland. Furthermore, three people of the MT are head of a region in Friesland. These **regions** are **north**, **southeast**, and **southwest**. Besides region managers, there are also other functions, which are related to departments that controlled in the centre of Friesland. Examples of departments are medical environmental sciences, and infectious disease control. There are also themes related to public health thar are controlled from within the MT. Often a MT member has more than one function or responsibility meaning that an employee can be responsible for both a region and a theme. In case there is a question related to a theme within the MT, this question will be submitted to the responsible person. In case there is a topic that is related to a region, the question will be submitted to the region manager. Within the regions, everybody has a similar position and therefore, there is no further hierarchy. Only a team coach is present, and is someone to spar with, but that person does not have more power than others.

The approach for elderly with diabetes 2 will possibly match with the structure of GGD Fryslân. The structure of GGD Fryslân will make it possible to execute the approach for elderly with diabetes 2 with relatively low occupation of employees specialized in the subject. Three employees in every region will be enough as one of them is also able to be part of the MT. In addition, is the communication with regional departments and centralized departments good, which makes it not necessary to represent an employee within each centralized department. Altogether, it means that the structure of GGD Fryslân is in line with the approach for elderly with diabetes 2.

4.4 Staff

There are many departments within GGD Fryslân with all their own teams and employees as mentioned in chapter 5.3 Structure. The centralized departments focus on a certain part of public health. All centralized departments require multiple employees with specialization on the subject. The tasks described in figure 1 are related to the specialization of the departments. In contrast to centralized departments, the regional teams exist of employees that all have their own **specialization**. Both centralized departments and regional teams work together and therefore, need to be able to have both **different views**, from local to national level. In other words, there are various positions and multiple specializations required within the organization. Interesting notion is that there are only three employees that focus on elderly and diabetes 2. Two employees write a plan to raise more awareness for elderly within GGD Fryslân. One employee focuses on a project called Tichtby Minsken, which wants to improve independency and self-reliance of patients with diabetes 2 in the region of Lemmer, Friesland. Besides the central departments and regional teams that focus on public health, there are also other teams. MT, communication, HRM, finances, and ICT are also important for the organization. These teams, excluding the MT are coordinated from with Veiligheidsregio Fryslân (VRF).

The approach for elderly with diabetes 2 will partly match with the staff of GGD Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). As employees in centralized departments and regional teams often work on different scales, it will probably be possible to broaden collaboration with other organizations and the social domain, and to focus on multiple aspects as intervention. It will however be necessary to add extra employees to be able to implement all aspects of possible interventions. For example, integration of Positive Health will require extra employees that follow schooling. Extra employees will also be necessary to represent elderly and diabetes 2 within the central departments and regional teams as every employee already has its own specialization. Altogether, it means that the staff of GGD Fryslân is relatively in line with the approach for elderly with diabetes 2 but need additional employees to be able to fulfil all multiple aspects of possible interventions mentioned in chapter 3.4 Best practices.

4.5 Style of management

Looking at the management style of GGD Fryslân, the cooperation between manager and employees is organized via both **implicit and explicit communication**. Therefore, management style is in general relatively informal. In general, decisions are made within the team by means of **consensus**. Therefore, cooperation and communication within the team is essential. Only if a decision will lead to exceeding budget, failure to comply with national guidelines, or interference with others, managers or MT members will be involved to discuss the matter and its alternatives. It means that employees are given trust to make the right decision making it a relatively effective way of management with positive outcomes. As style will not influence the success of the approach, this will not influence the approach.

4.6 Skills

Skills represented by GGD Fryslân are diversity, professionalism, accessibility, and communication. As GGD Fryslân focuses on many tasks it is key to have a team of employees with diverse expertise within different fields. As mentioned earlier, GGD Fryslân has various departments with responsibilities and therefore, **diversity** in talent, qualities, knowledge, and skills is present in the organization. In extend of knowledge, **professionalism** is also important. Professionalism regarding knowing your profession is an important aspect. It means that knowledge regarding your specialization must be up to date and should be kept up to date.

Besides having and spreading knowledge, it is also of importance to be **accessible** for others to find you or your expertise. This is applicable on organization level, colleagues should be able to find you and ask you questions, but also on outside of the organization. Clients, parents, municipalities and other persons and organizations should know what GGD Fryslân is capable of and should know that it is possible to get in touch with them. An aspect related to accessibility is **communication**. As mentioned in chapters above, communication is essential to create a network and to maintain relationships. It helps to find what are current problems, and which have priority. It helps to find the right organizations and partners to help, and it helps to find the right solution or the best way to improve the situation. It is also of importance within the organization. It helps to find the right persons within the organization and makes processes more efficiently.

The approach for elderly with diabetes 2 will possibly match with the skills of GGD Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Establishment of multiple of these interventions requires professionalism of employees as it shows the interest of GGD Fryslân in the approach for elderly with diabetes 2. Accessibility and communication are also required as it helps to establish collaborations and a network and will help to involve citizens in Friesland with the approach for elderly with diabetes 2. Altogether, it means that the skills of GGD Fryslân are in line with the approach for elderly with diabetes 2.

4.7 Finances

GGD Fryslân is founded by all municipalities in the province of Friesland and therefore, cooperate neatly with each other. Besides the close cooperation between both organizations regarding public health, **municipalities are also responsible for the finances of GGD Fryslân**. Based on provincial agreements municipalities must deliver subsidy to GGD Fryslân. The yearly subsidy of each municipality to GGD Fryslân is based on the number of citizens. The number of citizens is multiplied by a certain amount of money that originates from the provincial agreement. The eventual budget for GGD Fryslân will be used to help all citizens in the province of Friesland.

The budget will be divided over projects and other tasks of GGD Fryslân. GGD Fryslân in cooperation with municipalities will manage these projects and tasks together. In case a municipality wants to do more than what is proposed by GGD Fryslân, than that is possible. The municipality will arrange the financial support. Together with GGD Fryslân projects with municipalities can be designed and executed.

The budgets within municipalities are under relatively high pressure and therefore, it is key for GGD Fryslân to maintain the budget closely. Both under and overshoot of budget will cause financial stress within municipalities. Overshoot will mean that municipalities must compensate costs of GGD Fryslân and undershoot will mean cuts in future budgets for public health and therefore, also GGD Fryslân.

Both national government and municipalities will form guidelines that increases awareness for elderly and therefore, financial support will probably not difficult to find. Also, health insurer De Friesland is one of the partners willing to give financial support to projects focused on prevention. As interventions mentioned in chapter 3.4 Best practices will mainly focus on prevention, financial support from De Friesland health insurer will also have potential. Altogether, it means that there is potential financial support for the approach for elderly with diabetes 2. Altogether, it means that the finances of GGD Fryslân are in line with the approach for elderly with diabetes 2.

4.8 Conclusions

In general, GGD Fryslân is well equipped to fulfil tasks regarding public health regarding elderly with diabetes 2. Novel intervention found in chapter 3.4 Best practices show that several aspects are of importance for a successful approach that focuses on prevention. These interventions are focused on: integration of Positive Health, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). GGD Fryslân shows that they are in general equipped to play a lead role on these fronts.

It shows that **shared values** are in line with the ambitions of the approach for elderly with diabetes 2. Even though GGD Fryslân is a bureaucratic organization, their values enable them to help by means of cooperation, customer orientation and curiosity. The general **strategy** of GGD Fryslân is good as it specifically focuses on prevention and creating a broad network. The efficient **structure** of GGD Fryslân enables representation of elderly with diabetes 2 and Positive Health with restively low occupation of employees.

Point of improvement are that there is no specific department or team that is specialized in elderly. As aging is one of the main characteristics of current population of Friesland, this is one of the things that is still missing. In addition, does the strategy does not have any specific orientation on elderly yet. As the national government and municipalities in Friesland already focus their policies on elderly it would be a point of improvement to specify strategy party on elderly. Addition of three new employees to the **staff** would improve the situation significantly.

Furthermore, the **style** of management and the **skills** of employees also fit with the approach for elderly with diabetes 2 as it focuses on for example accessibility and communication, which help to establish the approach for elderly with diabetes 2. Altogether, GGD Fryslân is equipped to provide the right type of help for the approach with the right adjustments.

5 The organization of Zorgbelang Fryslân

Improvement of independency and self-reliance of elderly with diabetes 2 is the topic of this project. Zorgbelang Fryslân an association orientated on improvement of health for all citizens in Friesland. Orientation of Zorgbelang Fryslân is necessary to see if Zorgbelang Fryslân is equipped to play a leading role in the approach for elderly with diabetes 2.

5.1 Shared values

The goal of Zorgbelang Fryslân is to improve health in the province of Friesland for all health users. To execute this task and goal Zorgbelang Fryslân has defined core values for the association. Independency, innovation, person-orientation, and transparent change are the values that resemble the organization. **Independency** of the association is essential to help clients with their problems or complaints. It means that Zorgbelang Fryslân cannot maintain relationships that interfere with interests of clients. **Innovation** as Zorgbelang Fryslân is a relatively small association. Innovation is a way to find new effective and creative solution, which is therefore an added value to the association. As Zorgbelang Fryslân is also involved with projects regarding public health for example, innovation is also of value as contribution to these projects.

One of the services of Zorgbelang Fryslân is service regarding health-related problems or complaints. It means that employees of the association help client or patient with their problem or complaint that is often addressed to a health organization or institue. Therefore, **person-orientation** is one of the other core values. It means that Zorgbelang Fryslân looks at the person related to the problem as well as to problem in perspective. This way, the best service is given to clients because it shows them that Zorgbelang Fryslân indeed listens and helps the client as they deserve.

Transparent change is valuable to the association and its followers that Zorgbelang Fryslân represents. It means that Zorgbelang Fryslân shows activities in the province of Friesland. They illustrate their actions and consequences to show that they are available to every citizen in Friesland that requires health(care) related help.

The approach for elderly with diabetes 2 will possibly match with the shared values of Zorgbelang Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Person-orientation is important for the involvement of citizens for example. Innovation is important for the design and execution of the approach for elderly with diabetes 2. Altogether, it means that the shared values of Zorgbelang Fryslân are relatively in line with the approach for elderly with diabetes 2.

5.2 Strategy

Zorgbelang Fryslân originally is an association that represents patients and clients. They give advice, help with citizen participation and health control, and contribute to academic knowledge and output. Here, an overview is given of the strategies Zorgbelang Fryslân currently follows.

One of the probably most essential aspects of the association is **communication**. Therefore, it is an important aspect of the strategy of Zorgbelang Fryslân. A communication plan both internal and external help to give an overview of current statuses of projects and employers. It also helps to keep everybody informed as well supports employers mutually to perform optimally. An important aspect to clear communication is transparent collaboration, especially regarding results of a project or plan. The power to convert plans into actions is at last most important to realise the goals and mission of Zorgbelang Fryslân.

A deal is a deal is also one of the strategies of Zorgbelang Fryslân. It is applicable both internal and external context. Internal agreements make the team, and the employees reliable and external agreements have a similar meaning outside the association. If it is not possible to reach a deadline, it will be communicated to all involved persons. Subsequently, efforts will be made to eventually make the project or assignment successful.

Having a **broad knowledge related network** is also one of the parts of Zorgbelang Fryslân's strategy. Therefore, they are connected to the knowledge and expertise centre in Friesland. In addition, the close connection with member associations helps them to get a clear overview of what is going on in the healthcare sector. By binding both types of knowledge increase the knowledge of Zorgbelang Fryslân from health service's perspective and client's perspective.

The approach for elderly with diabetes 2 will possibly match with the strategy of Zorgbelang Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). In general, communication and keeping to your agreements is key to implement any of the above-mentioned interventions. In addition, having a broad network, especially with member associations will help to work together with other organization, to find contact with the social domain and to organize events that need involvement of citizens. Altogether, it means that the strategy of Zorgbelang Fryslân is in line with the approach for elderly with diabetes 2.

5.3 Structure

Originally, Zorgbelang Fryslân is an association supported by the province that helps to represent the voice of clients and member organizations. Currently, financial changes have changed the structure of the association that has formed three pillars. Service regarding health(care) problems and complaints, projects regarding health improvements and the association representing member associations are the three pillars that form the current form of Zorgbelang Fryslân.

Service regarding health(care) problems and complaints is the pillar that helps to negotiate and mediate on behalf of the client. The client experiences problems regarding health service of a health organizations for example and wants grandstand or acknowledgement of the situation. Zorgbelang Fryslân helps by means of letting the client speak out. They also represent the client during a trial against the organization. Within the service pillar are several departments, like Law of long-term care, independent client support, confidential counsellors, youth care and complaints.

Projects is one of the other pillars and focus mostly on health improvement. As Zorgbelang Fryslân represents many **member associations**, they have a lot of knowledge that is of great value to these projects. Besides the transfer of knowledge, Zorgbelang Fryslân has also other qualities. They often ascend functions regarding leading and/or **designing a project** and therefore, have great responsibilities within the projects.

The pillar member associations represent the members that are connected to these associations. It means for example that new projects are organized with input from the associations to make projects more connected to the target group. Furthermore, Zorgbelang Fryslân works together with associations to launch new projects that originate from these member associations.

The approach for elderly with diabetes 2 will possibly match with the structure of Zorgbelang Fryslân. The pillar that focuses on projects will be of main interest for the approach for elderly with diabetes 2 as these employees are specialized in the design and organization of projects. They will be able to provide the right knowledge for design for the approach from their experience with other projects. Furthermore, the pillar other pillar will provide information regarding problems experienced by elderly with diabetes 2 and will help to represent the voice of the members of associations connected to Zorgbelang Fryslân. Altogether, it means that the structure of Zorgbelang Fryslân is relatively in line with the approach for elderly with diabetes 2.

5.4 Staff

Zorgbelang Fryslân exists of one director and employers. Officially, only the director stands above the others. In other words, the association does have a simple and effective hierarchy. It starts with a director supported by the management assistant. Furthermore, there is a policy officer, account holder, and general employers.

General employees are divided over the pillars mentioned in chapter 6.3 Structure. Each pillar has its team with its own specializations and execute their tasks. Within the pillar of services tasks, employees have a legal specialization and therefore, little support from other teams is possible as they do not have the right experience. The teams representing the other pillars, sometimes work together more closely as they occasionally need an extra pair of hands regarding execution of projects. All have their own specialization regarding projects but that is only related to general target groups without need of extra specialization on subjects. The cooperation level is therefore relatively high within Zorgbelang Fryslân.

The approach for elderly with diabetes 2 will partly match with the staff of Zorgbelang Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). As employees within the project team already have experience with similar projects that are related to the approach for elderly with diabetes 2, they can help with the design and subsequently with interventions and projects. In addition, the organization and its teams have regular contact with member associations and therefore, can improve involvements with citizens in Friesland. Employees are however not specialized in elderly with diabetes 2. This means that they could need to put extra attention on this subject or hire an employee that is specialized. Altogether, it means that the staff of Zorgbelang Fryslân are relatively in line with the approach for elderly with diabetes 2 but possibly need additional employees to be able to fulfil all multiple aspects of possible interventions mentioned in chapter 3.4 Best practices.

5.5 style of management

The collaboration between manager and employees is organized via both **implicit and explicit communication**. Therefore, management style is in general relatively informal. In general, decisions are made within the team by means of **consensus**. Therefore, cooperation and communication within the team is essential. Only if a decision will lead to the director and concerned employees will be involved to discuss the matter and its alternatives. It means that employees are given trust to make the right decision making it a relatively effective way of management with positive outcomes. As style will not influence the success of the approach, this will not influence the approach.

5.6 Skills

Zorgbelang Fryslân is responsible for different tasks. Providing service regarding health(care) issues, question, and complaints is one of them. Therefore, it is important to have **experience in the field** and to have a legal background. Also, design and execution of projects requires experience and **knowledge** on operative level and on expertise level. In other words, it means that employers require knowledge and maintain their knowledge to be able to carry out their job.

Cooperation within in Zorgbelang Fryslân is necessary to maintain the association. Zorgbelang Fryslân is a small association and therefore, cooperation within the association is necessary to execute their tasks efficiently. Also, cooperation outside Zorgbelang Fryslân is necessary to maintain and increase the network and to obtain new knowledge, which is of value the design and execution of projects for example. **Accessibility** is also of importance to increase the network. It helps to improve connect with member associations and other organizations that are interested in the work of Zorgbelang Fryslân. This will bring more awareness to Zorgbelang Fryslân.

Communication is probably one the most important skills, as well as core value and strategy for Zorgbelang Fryslân. Communication leads to contact with people that have problems or complaints regarding health(care), to find new projects, to find member associations, to gain more knowledge and many more positive outcomes.

The approach for elderly with diabetes 2 will possibly match with the skills of Zorgbelang Fryslân. The interventions mentioned in chapter 3.4 Best practices show potential as approach for elderly with diabetes 2. Possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Establishment of multiple of these interventions requires accessibility and communication to establish collaborations and a network. It will also be help to involve citizens in Friesland with the approach for elderly with diabetes 2. Altogether, it means that the skills of Zorgbelang Fryslân are in line with the approach for elderly with diabetes 2.

5.7 Finances

Zorgbelang Fryslân originally was subsidized by the province of Friesland. This subsidy has recently been changed and therefore, new ways were investigated to find financial support. One of the ways is to execute projects for clients. Altogether, it means that there is potential financial support for the approach for elderly with diabetes 2.

5.8 Conclusions

In general, Zorgbelang Fryslân is well equipped to fulfil tasks regarding public health regarding elderly with diabetes 2. In general, Zorgbelang Fryslân is well equipped to fulfil tasks regarding public health regarding elderly with diabetes 2. Novel intervention found in chapter 3.4 Best practices show that several aspects are of importance for a successful approach that focuses on prevention. These interventions are focused on: integration of Positive Health, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Zorgbelang Fryslân shows that they are in general equipped to help on these fronts.

It shows that **shared values** are in line with the ambitions of the approach for elderly with diabetes 2. Innovation and person-orientation are positive aspects that fit with the approach regarding integration of Positive Health for example. The general **strategy** of Zorgbelang Fryslân is good as it specifically focuses on creation and maintenance of a broad network. The efficient **structure** of Zorgbelang Fryslân enables representation of elderly with diabetes 2 and Positive Health. However, there are currently not enough employees to organize new projects related to the approach for elderly with diabetes 2. Therefore, it would be favourable to hire one or two extra employees that focus on elderly with diabetes 2 and corresponding projects.

Furthermore, the **style** of management and the **skills** of employees also fit with the approach for elderly with diabetes 2 as cooperation and communication are two well represented qualities within the association. Extra knowledge or expertise on elderly with diabetes 2 would however be favourable. Therefore, hiring one or two extra employees should be focused on people with experience in these fields. Altogether, Zorgbelang Fryslân is equipped to provide the right type of help for the approach with the right adjustments.

6 Pilot study Tichtby Minsken

Tichtby Minsken is a pilot study that is currently designed by Zorgbelang Fryslân in collaboration with GGD Fryslân. It focuses on people with diabetes 2. As this project focuses on diabetes 2, GGD Fryslân has asked to give advice on the continuation of the project.

6.1 Background

Tichtby Minsken is a pilot study following up the project Seker & Sûn and Vitale Regio Fryslân. Seker & Sûn is a project that has designed four possible scenarios for future Friesland. Vitale Regio Fryslân has been active in the municipality of De Fryske Marren by means of a project that started to focus on structural use of Positive Health within general practice offices. Tichtby Minsken is a follow up study that combines the knowledge obtained from Seker & Sûn regarding the aging population and the knowledge obtained from Vitale Regio Fryslân regarding the structural use of Positive Health. Tichtby Minsken performed with cooperation between GGD Fryslân, De Friesland health insurer, and Zorgbelang Fryslân.

6.2 Design

The project is divided into two subjects. Subproject 1 focuses on health professionals like GPs, practise nurses, social workers, dieticians, and others that work in the primary healthcare sector and the social healthcare sector. The goal is to bring the medical and social domain closer to each other by means of introducing health professionals to Positive Health. As Positive Health is focused on a broad view on health and an integral approach by means of collaborations of different sectors, Positive Health has potential to bring the medical and social domain closer to each other. Details on the number of participants, the number of schooling days, the trainers for Positive Health, and recruitments of participants is under debate.

Subproject 2 is started in collaboration with general practice Arentsen & Groeneveld and focuses on approximately 20 patients with diabetes 2 in the region of Lemmer. The goal is to improve the independency and self-reliance regarding diabetes 2. The project will consist of an introduction interview executed by means the motivational conversation method of Positive Health, four to five events focusing of independency and self-reliance, and a closing interview also executed by means of the motivational conversation of Positive Health. The interviews will be conducted on individual basis and interventions will consist of approximately 10 participants. The interventions are still under debate, but ideas are related to sharing knowledge regarding diabetes 2, physical activity, and nutrition. Interventions will be held in an interactive way and will be designed in collaboration with wellbeing organization De Kear located in Lemmer. Also, the opinion of GPs, dieticians, practice nurses and participants will be used for the design of the interventions. Participants will be recruited via GPs, and dieticians, and the diabetes association in Friesland.

6.3 Goals

One of the goals of Tichtby Minsken is to bring the social and medical domain closer together. **Broadening the health professionals' network** is the first step. This means a network of health professionals from different domains that all work with the ideas related to Positive Health and other similar methods. Referral to other health professionals will become easier if cooperation is achieved. PG schooling is focused on creating a broad network and will therefore, be organized by Tichtby Minsken. The other subproject sees potential by bringing awareness of the effects of the social domain on patients and clients to health professionals. Broadening the network is not only focused on a broad network but also on frequently use of the network. This will eventually result in **broad representation of health professionals** with similar methods and is one of the intended effects of Tichtby Minsken.

The second step of broadening of the network is **integral cooperation**. The integral cooperation will provide broad representation of healthcare professionals that use Positive Health or other similar methods. This will help to create support base for the method and will eventually lead to potentially new partners. These partners will broaden the network as well. Without the broad representation, there will be no new partners and no broad network to rely on as health professionals. Another aspect of the broad network is the easiness of asking others to help, which lead to working more efficiently. Without the broad network, efficiency of work will not improve significantly and subsequently, it will not have significant influence on the intended effect of improving the health of citizens in the region of Lemmer.

Broadening the view on health and being healthy is another aspect of PG schooling. PG trainings wants to show health professionals that there is more than one health aspect related to the profession. Physical health, mental health, meaning of life, and participation in society are important aspects, of which some tend to be forgotten. By focusing on these aspects, will make it easier to retrace the conversation with the health professionals. In other words, it will be easier to find the actual purpose of the conversation and consequently, will expose the root of the problem. This is the first step of finding the right treatment or help. Finding the root or underlying problem could mean that the actual problem is not related to the profession of the health professional. It is therefore important that different social domains work together to make it able to help a client or patient efficiently and with good quality of (health)care. This will result in **working more efficiently**. It will also be easier to find the root problem and therefore, the right type of treatment or help will be easier to offer with better potential to **solve the problem or improve the situation of client or patient**.

In conclusion, broadening of network, broadening of view on health, broad representation of the novel method, working efficiently, and improving the health of citizens in the region of Lemmer are intended effects of the project Tichtby Minsken.

6.4 Analysis

In conclusion, Tichtby Minsken wants to bring the social and medical domain closer together by means of organizing Positive Health schooling for health professionals represented in both social and medical domain. The project also wants to improve independency and self-reliance of people with diabetes 2 by means of interactive interventions. Eventually, this will be the start of broadening the network of health professionals and broadening the view on health for both health professional and patient.

Based on chapter 3.4 Best practices there are already multiple interventions that have similar approaches with similar goals. These possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, regular consultations, and meetings internally, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, involve citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Comparison of these interventions with Positive Health shows that there are a lot of similarities. This means that Tichtby Minsken is on the right way to reach their goals regarding bringing closer the social and medical domain as well as improving the independency and self-reliance of people with diabetes 2. Examples of possible improvements are less referral to second line healthcare and reduction of medication prescription.

Aspects of interventions that are not used within Tichtby Minsken are the increased duration of consult/conversation, more internal consultation, and meetings, working together with other organizations, and actively starting with an integrative approach regarding organizations. These aspects are however not the main points of interest. Most important is that the root of interventions mentioned in chapter 3.4 Best practices are used to bring the social and medical domain closer together and to improve independency and self-reliance of people with diabetes 2.

6.5 Barriers

One of the barriers that has been noticed is the different views of health professionals. In specific, not every GP sees it as their job to start 'the other conversation', one of the aspects of PG to find the broader view regarding health. In other words, they see it as their task to only have a medical related conversation. In case other problems come forward, they will referral the client or patient to the health professional they see fit to help. The referral means that their task as health professionals is fulfilled and the responsibility to help is moved to the other health professional. It is difficult to enthuse people that have a whole different view than Tichtby Minsken. Broadening the network and creating support base could be one of the potential effects that also would help to find support at people with a different view.

Another barrier is the motivation of people with diabetes 2. According to conversations with practice nurses and dieticians, it is difficult to find people with diabetes 2 to motivate themselves to improve their course of disease. They do not take the seriousness of their situation and therefore, do not feel the necessity to change their habits or lifestyle. Starting with integration of Positive Health into the conversation with patients could improve the awareness of the seriousness and improve the motivation to make a change regarding habits and lifestyle. Altogether, the above-mentioned barriers are visible but there are also potential interventions to improve the situation.

6.6 Conclusions

The project Tichtby Minsken has high potential to improve health of citizens and prevent health problems. Education of health professionals in combination with bringing awareness to citizens about their own qualities and possibilities to be healthy will be a next step into the prevention strategy with potential to bring the social and medical domain closer together and to improve the independency and self-reliance of people with diabetes 2.

7 Integration of obtained knowledge

At this moment, there are multiple factors involved with the increased pressure on the healthcare system in the Netherlands. Both aging and chronic diseases like diabetes 2 seem to have a negative effect on it. Scientific research shows that both aging and diabetes 2 are related to dysfunction of complex mechanisms in the human body. It is not possible to isolate cause and consequence. Both processes are irreversible. Nevertheless, novel methods show that it is possible to reduce and maintain the process to a certain extend. These methods focus on integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, involve citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). Results show reduced referral to second line healthcare and less prescription of medication. These results are promising as it suggests that primary healthcare can solve problems by means of the novel methods like collaboration with the social domain for example. There is no scientific confirmation yet, but results are promising.

Looking at Friesland, multiple organizations are involved with elderly with diabetes 2. Especially, GGD Fryslân, municipalities in Friesland, Zorgbelang Fryslân, and De Friesland health insurer are working on novel projects concerning prevention and focus on elderly. There are also other actors like health professionals, member associations, and citizens of Friesland that are both interested and involved in elderly with diabetes 2. It is of interest for the approach to maintain the relationship with these actors closely. Therefore, more investment should be made in the relationships with health professionals like GPs, member associations, and citizens of Friesland.

Looking at GGD Fryslân and Zorgbelang Fryslân, both organizations are to a certain extend equipped to be part or have a leading part in the approach for elderly with diabetes 2. GGD Fryslân shows that they share values, strategy, and structure, as well as their style and skills are relatively in accord with the required competences to lead the approach for elderly with diabetes 2. One point of interest is the requirement of employees skilled for the themes Positive Health and elderly. Zorgbelang Fryslân shows it can be a key partner for GGD Fryslân as their shared values, strategy, style, and structure are also relatively in accord with the required competences to be a partner of the approach for elderly with diabetes 2. It is however necessary to extend the staff as they are a small association and therefore, will not have enough manpower to perform all tasks as key partner.

Tichtby Minsken shows high potential as novel projects of GGD Fryslân, De Friesland health insurer, and Zorgbelang Fryslân. Many aspects of the project are in line with novel methods mentioned in the scientific context. This means that the project has high potential to become successful with the aim of getting the medical and social domain closer together, and the aim to improve independency and self-reliance of people with diabetes 2.

7.1 Integral approach

The integral approach mentioned as potential intervention would be a good way to involve more actors with the approach for elderly with diabetes 2. Especially, member associations and citizens of Friesland are important partners that tend to be forgotten. Nevertheless, they have a valuable opinion that can influence the course of the approach as they are the target group of the approach. Zorgbelang Fryslân has close contacts with member associations, and therefore, will be of great value as communication channel. As shared values of GGD Fryslân focus on cooperation and involvement, they should be able to set up a network that will eventually form an integral approach. Besides involvement of citizens to hear their voice, it is also important to involve health professionals and other organizations involved with elderly with diabetes 2. Therefore, they will also be integrated in the network.

Establishment of the integral approach will be accomplished by integration of Positive Health. Positive Health does not only focus on the multiple aspects of health but also focuses on the integration of different domain within the care and help offering to citizens. This means that they want to help improve communication between these different domains. It is part of the broad view on health as it shows that there is more than medical related problems. Sometimes, debts and no social contacts can also be related to the health perception of client or patient for example. Focusing on only elderly with diabetes 2 however will reverse the aim of having an integral approach as it diminishes the opportunity for other elderly citizens to participate in the approach. Therefore, the approach for elderly should focus on elderly in general without special attention for diabetes 2.

7.2 Personnel

Delivery of high-quality work is one of the strategies of GGD Fryslân. Employees are important for the establishment of work with high quality. To maintain the good work of employees it is important to keep them satisfied. Work pressure and a good relationship with employees are important factors to keep them satisfied and to deliver work of good quality. The relationship with employees is good as GGD Fryslân leaves many decisions to them. This shows that GGD Fryslân trusts their employees. Work pressure is in part related to the number of employees available. The approach for elderly wants to focus on an integral approach and Positive Health and therefore, extra time and expertise is necessary to be able to focus on these aspects. This means that more employees are necessary to maintain work pressure. Therefore, it would be wise for GGD Fryslân to hire extra employees.

7.3 Projects

Currently, projects are mainly focused on prevention but do not have specific attention for elderly. The pilot study Tichtby Minsken is one of the first pilot studies that wants to raise awareness for Positive Health among health professionals. This is a good start, but it still does not focus specifically on elderly. As aging of the population and subsequently, elderly are factors that increase pressure on the healthcare system, focusing on elderly would be a good strategy of GGD Fryslân. Therefore, novel projects should focus on elderly as it will be a means to raise awareness for elderly.

In addition, focus on Positive Health is a broad view on health and to integrate into the society, medical domain, and other fields would potentially improve health of elderly. An important aspect is the themes of the projects, which should be related to health regarding more aspects than only physical health according to novel methods mentioned in the scientific context. Being interactive is also important as it improves motivation of participants.

The size of projects will determine the impact on Friesland. Small-scale projects will probably have not enough impact on the citizens and pressure on healthcare system but a too big projects could negatively influence the support and interest in Positive Health as it could be sensed as compulsory for example.

7.4 Conclusions

There are multiple aspects of importance for an approach for elderly with diabetes 2. Integral approach will improve collaboration between social and medical domain. Integral approach means involvement of multiple actors and citizens. Therefore, focus will be put on all elderly in general and not only elderly with diabetes 2. Extra personnel need to be available for the tasks regarding elderly and Positive Health. Projects should focus on prevention, with aspects like physical activity, nutrition and other interesting aspects related to health. Being interactive with citizens is an important aspect of the projects. These aspects will have an additional value for the success of the approach for elderly of GGD Fryslân.

8 Scenarios for GGD Fryslân regarding elderly with diabetes 2

Integration of all obtained information has given an overview of already available data and interventions regarding elderly with diabetes 2 and their positive effects. It also shows us how actors are involved and to what extent GGD Fryslân is currently equipped to have a role in the approach for elderly with diabetes 2. Also, the opportunities and barriers are described. This information is used to formulate different scenarios that could be followed by GGD Fryslân for the approach for elderly. No focus will be put on elderly with diabetes 2 as it reverses the aim of having an integral approach. The different scenarios are compared, and the best scenarios is determined by means of a Multi Criteria Analysis.

8.1 Scenario 1: Support interested stakeholders

GGD Fryslân will continue their current strategy. This means that they will continue to invest in **prevention** and **elderly** but without specific attention on diabetes 2. Focusing on only elderly with diabetes 2 will reverse the aim of having an integral approach. They will continue to focus on **Positive Health** but will leave taking the lead of Positive Health to Zorgbelang Fryslân. **Employees** involved with projects will promote the use of Positive Health and will ask Zorgbelang Fryslân to help them with the design of a plan to integrate Positive Health in the projects. **Projects** will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. Offering **schooling of Positive Health** to health professionals, volunteers in the social domain and other domains, and clients and patients is an example to integrate Positive Health into society and world of health professionals. Schooling will consist of courses that share the ideas of Positive Health and learn to use the conversation method. The **time** schedule is not strict as there are only current employees are present to perform the extra tasks. **Costs** will stay similar as no extra employees are hired or new projects are designed. Altogether, this strategy describes a **wait-and-see attitude** for GGD Fryslân and will eventually have good results.

8.2 Scenario 2: Gradually switching to Positive Health and elderly

GGD Fryslân will take steps towards a new direction that is focused on **Positive Health** with the broad view (on health), and **prevention** among **elderly**. This means that GGD Fryslân will invest gradually more in prevention and elderly but without specific attention for diabetes 2. Focusing on only elderly with diabetes 2 will reverse the aim of having an integral approach. They will help Zorgbelang Fryslân to take the lead of Positive Health. New **employees** will be involved with prevention, elderly, and Positive. Tasks will be helping other employees and organizations to design projects that integrate Positive Health and raise awareness for elderly. They will also design projects specifically focused on Positive Health and elderly. **Projects** will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. Offering **schooling of Positive Health** to health professionals, volunteers in social domain and other domains, clients, employees, and other interested will also be one of their tasks. Schooling will consist of courses that share the ideas of Positive Health and learn to use the conversation method and will be provided by GGD Fryslân and Zorgbelang Fryslân.

The **time** scale is not strict, but the new approach will potentially improve the pace of improving independency and self-reliance, as well as the integral approach because of the extra employees. **Costs** will rise as extra employees are hired and projects are designed. Altogether, this strategy describes an **initiating approach** that wants to improve the independency and self-reliance of elderly, and subsequently their health.

8.3 Scenario 3: Large scale implementation of Positive Health

GGD Fryslân will change their current strategy on a relatively large scale. This means that they will invest in **Positive Health** and will have an additional focus on **elderly** without specific attention on diabetes 2. Focusing on only elderly with diabetes 2 will reverse the aim of having an integral approach. GGD Fryslân will **take the lead of Positive Health** by taking over this task of Zorgbelang Fryslân. Focusing on Positive Health on a large scale will require hiring approximately six new **employees**. New employees will be involved with prevention, elderly, and Positive. Tasks will be helping other employees and organizations to design projects that integrate Positive Health and raise awareness for elderly. They will also design projects specifically focused on Positive Health and elderly. **Projects** will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. **Schooling of Positive Health** will be organized for health professionals, volunteers in social domain and other domains, clients, employees, and other interested are also on of their tasks. As GGD Fryslân has the lead of Positive Health, following these courses will be compulsory for every employee. Schooling will consist of courses that share the ideas of Positive Health and learn to use the conversation method and will be provided by GGD Fryslân and Zorgbelang Fryslân. The **time** scale is relatively short as GGD Fryslân wants to take the lead and therefore, want to implement Positive Health relatively fast. **Costs** will rise as extra employees are hired and projects are designed. Altogether, this strategy describes a scenario that will **take lead of Positive Health**.

8.4 Scenario 4: Prevention focuses on younger generations

GGD Fryslân will change their current strategy by focusing on **younger generations** only. This means that they will stop focusing on elderly and will start with **prevention** interventions that want to improve the independency and self-reliance of younger generations. They will continue with the focus on **Positive Health** but will leave taking the lead of Positive Health to Zorgbelang Fryslân. **Employees** involved with projects will promote the use of Positive Health and will ask Zorgbelang Fryslân to help them with the design of a plan to integrate Positive Health in the project focused on prevention among younger generations. **Projects** will be focused on prevention within younger generations and therefore, prioritize health education at schools, discount for gyms, and other activity that help to focus on healthy lifestyle among younger generations. Offering **schooling of Positive Health** to health professionals, volunteers in the social domain and other domains, and clients and patients is an example to integrate Positive Health into society and world of health professionals. Schooling will consist of courses that share the ideas of Positive Health and learn to use the conversation method. The **time** schedule is not strict as there are only current employees are present to perform the extra tasks. **Costs** will increase as new projects are designed for prevention among younger generations.

8.5 To assess the scenarios

Finding the best approach for GGD Fryslân regarding elderly is established by comparing the four different scenarios. These scenarios are compared by means of a multi criteria analysis. The multi criteria analysis is a tool to measure different scale levels, and to find consensus on different types of criteria. Comparing the outcomes of different scenarios helps to find the best approach for GGD Fryslân. Criteria are selected based on what is important to GGD Fryslân and criteria that can contribute to a successful approach. Each criterium is discussed individually and compared within each scenario. At the end, all criteria are added and lead to a score. The score determines the success of the scenario.

8.5.1 Integral approach

The integral approach is one of the goals for the approach for elderly. It will create support for the approach among health professionals and organizations that become involved by means of the establishment of the broad network. Using this network will be the start of collaborations between different domains. Health professionals like GPs and social workers will get in touch with each other more easily and will potentially be of help to each other. As local and regional networks are probably easier to establish as it is located relatively close to each other without creating a too big network, this would be a good result. An important aspect of the integral approach is the time that is necessary to gain each other's trust. In other words, it means that the integral approach has highest potential to be established with enough trust and support by growing it with moderate speed. Specific to this approach, it is important to create a network that also includes health professionals, organizations and more that are specialized in elderly.

Scenario 1: By focusing on Positive Health within projects related to public health and elderly, GGD Fryslân will slowly start to work on an integral approach. Within these relatively small-scaled projects schooling of Positive Health as Positive Health focuses on the establishment of an integral approach. It will eventually create broad networks within small-scale projects and therefore, local broad networks that have connections within different domains, including elderly.

Scenario 2: By focusing on Positive Health within current projects, new projects, and GGD Fryslân, it will be the start of an **integral approach** within and outside GGD Fryslân. Because multiple projects will be involved the network will establish on a moderate pace that will possibly make others curiously as well. Connection between projects is possible which will have a positive influence on the establishment of broad networks within different domains, including elderly. The networks will be established on both local and regional scale.

Scenario 3: Taking the lead of Positive Health GGD Fryslân will help to establish a broad network on provincial scale and therefore, will help create an **integral approach**. As Positive Health will be the focus of GGD Fryslân, the goal will be to integrate Positive Health in as many ways as possible. There will also be focus on elderly. This means that it will take a sprint in the establishment of the broad network and integral approach. It will also aim to establish the network and integral approach on a provincial level.

Scenario 4: By focusing on Positive Health within new projects related to prevention for younger generations will help to start an **integral approach**. Schooling of Positive Health focuses on the establishment of a broad network. Using this network will create an integral approach. It will result in connections within different domains but without any connections specific to elderly healthcare.

In conclusion, scenario 2 has highest potential to create a broad network with integral approach as it accords relatively with the important factors that aim to establish a local and/or regional network, to have a moderate pace and to include health professionals and organizations specified in elderly.

8.5.2 Personnel

Delivery of high-quality work is one of the strategies of GGD Fryslân. Employees are important for the establishment of work with high quality. To maintain the good work of employees it is important to keep them satisfied. Work pressure and a good relationship with employees are important factors to keep them satisfied and to deliver work of good quality.

Scenario 1: GGD Fryslân will use current **employees** and will not invest in new employees to invest in prevention and elderly. Several employees and other interest people will be educated to become familiar with the ideas of Positive Health or to become trainer of Positive Health to spread the knowledge. This means that pressure on employees will increase as they already have their current functions and tasks.

Scenario 2: GGD Fryslân will hire approximately three new **employees** that will be specialized in elderly and Positive Health. Tasks will be to support current employees with their tasks, with specific attention to integration of elderly and Positive Health into their projects. Other tasks will be education of Positive Health to other employees, organizations, health professionals, and interested to make them familiar with the ideas of Positive Health or to become trainer of Positive Health to spread the knowledge.

Scenario 3: GGD Fryslân will hire approximately six new **employees** that will be specialized in Positive Health and to a certain extend in elderly. Tasks will be to support current employees with their tasks, with specific attention to integration of Positive Health and elderly into their projects. Other tasks will be education of Positive Health to other employees, organizations, health professionals, and interested to make them familiar with the ideas of Positive Health or to become trainer of Positive Health to spread the knowledge. It will be compulsory for employees of GGD Fryslân to follow schooling of Positive Health.

Scenario 4: GGD Fryslân will use current **employees** and will not invest in new employees to invest in prevention and younger generations. Several employees and other interest people will be educated to become familiar with the ideas of Positive Health or to become trainer of Positive Health to spread the knowledge. This means that pressure on employees will increase as they already have their current functions and tasks.

In conclusion, scenario 2 has highest potential to create satisfied employees that deliver good work as it maintains work pressure by hiring new employees and does not impose procedures.

8.5.3 Projects

Projects will be part of raising awareness for elderly and to integrate Positive Health into the society, medical domain, and other fields. An important aspect is the themes of the projects, which should be related to health regarding more aspects than only physical health. As the approach focuses on elderly, this is also a subject of significant value. The time/employees that will be available are also related to the success of a project.

Scenario 1: Current employees will next to their regular tasks focus on designing new **projects**, by finding new innovative ways within the small-scaled projects to raise awareness for elderly, and to organize events that help to improve their independency and self-reliance. Projects will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. They also focus on integration of Positive Health in multiple domains and therefore, also focuses the integral approach.

Scenario 2: New hired employees will design new **projects** that are focused on Positive Health and elderly to raise awareness for elderly and to organize events that help to improve their independency and self-reliance. This means that projects will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. Employees are specifically focused on these projects, and therefore can be designed and implemented on local and even regional scale.

Scenario 3: New hired employees will design **projects** that are focused on Positive Health and elderly to organize events that help to improve their independency and self-reliance among citizens in Friesland. This means that projects will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. Multiple employees are specifically focused on these projects, and as GGD Fryslân has a lead role in Positive Health, multiple projects designed and implemented on provincial scale to increase awareness and support for Positive Health.

Scenario 4: Current employees will next to their regular tasks focus on designing new **projects**, by finding new innovative ways within the small-scaled projects to raise awareness for prevention, and to organize events that help to improve their independency and self-reliance of younger generations. Projects will focus on health education regarding physical activity, nutrition, and other aspects of health according to Positive Health. They also focus on integration of Positive Health in multiple domains and therefore, also focuses the integral approach.

In conclusion, scenario 3 has highest potential to establish good running projects as it accords relatively with the important factors that aim to raise awareness for elderly and to integrate Positive Health into society. The projects also focus on elderly and other aspects of health than physical health. Decisive has been the time/employees that will be available are also related to the success of a project.

8.5.4 Time

Time is a limited factor and determines for great part the effectiveness of an approach. As Positive Health is not popular among every organization, health professionals and other potential partners for GGD Fryslân, it is important to take the time to become familiar with the subject and to gain trust. Therefore, time will be seen as a factor that should have a moderate rate without become too fast. The downside of a slow rate is the effectiveness of the approach one short term as alterations are necessary for the pressure on the healthcare system.

Scenario 1: There is no precise **time** frame for this scenario, but effects of the scenario will take relatively long to become visual. As only current employees will be involved with prevention and elderly and, implementation will only be on projects on small scale, the effects will not be noticed on short term.

Scenario 2: There is no tight **time** schedule for this scenario but hiring new employees will increase the ability to design and execute new projects that focus on prevention by means of Positive Health and elderly. It will raise awareness for both themes. It will improve the pace of the aim to improve independency and self-reliance of elderly. Effects will become visible relatively fast but without being too fast.

Scenario 3: As GGD Fryslân wants to take the lead of Positive Health, there is a **time** schedule that wants to implement Positive Health relatively fast. Hiring six new employees will make it in theory possible to establish this goal.

Scenario 4: There is no precise **time** frame for this scenario, but effects of the scenario will take relatively long to become visual. As only current employees will be involved with prevention and elderly and, implementation will only be on projects on small scale, the effects will not be noticed on short term.

In theory, scenario 3 would have highest potential to become the best fitting scenario. However, as mentioned before Positive Health is not popular everywhere yet. With the goal to establish a broad platform of Positive Health on a relatively fast time scale, it is possible that employees, organizations, and/or health professionals will not be willing to participate, which could result in reversed effects with eventually reduction of support for Positive Health. Therefore, scenario 2 has highest potential to become a successful approach for elderly.

8.5.5 Costs

Costs of GGD Fryslân are depended on several aspects, like the number of employees, the number of projects the organizations want to design and execute. Costs are not a factor that significantly decrease the feasibility of a project but is a factor that should be considered as GGD Fryslân answers to the municipalities of Friesland. Another factor that is of interest is to potential of the scenario to reduce healthcare costs.

Scenario 1: The additions **costs** for GGD Fryslân of the scenario stay be relatively similar as there is no investment in extra personnel and there is no investment in extra projects. However, costs related to healthcare will possibly increase as there is no time frame and effects will take relatively slow to become visible. This means that independency and self-reliance will not improve on a short term. Consequently, the healthcare costs will keep rising at first in Friesland on provincial level.

Scenario 2: The additional **costs** for GGD Fryslân will increase in this scenario as extra personnel are hired, and extra investments are made on new projects focused on elderly and Positive Health. As this scenario focuses more actively on prevention and elderly, possible effects are less referral to second line healthcare and reduction of medication prescription. This could potentially reduce healthcare costs.

Scenario 3: The additional **costs** for GGD Fryslân will increase significantly in this scenario as extra personnel are hired, and extra investments are made on new projects focused on elderly and Positive Health. As this scenario focuses more actively on Positive Health, possible effects are less referral to second line healthcare and reduction of medication prescription. This could potentially reduce healthcare costs. However, support of employees, organizations, and health professionals is relatively essential to establish these effects. As pressure on employees, organizations, and health professionals increases to use Positive Health, it could also result in adverse effects. This could eventually lead to less reduction of healthcare costs than prognosed and reduce support for Positive Health.

Scenario 4: The additions **costs** for GGD Fryslân of the scenario stay be relatively similar as there is no investment in extra personnel and there is no investment in extra projects. However, costs related to healthcare will increase as there is no attention for elderly. This means that independency and self-reliance will not improve on a short term but only in 40 or 50 years. Consequently, the healthcare costs will keep rising.

Scenario 1 comes closest to the demands of costs regarding GGD Fryslân as it keeps costs relatively similar. Scenario 2 comes closest to the demands of costs regarding healthcare. As costs of scenario 2 eventually will result in increased independency and self-reliance of citizens in Friesland, costs for GGD Fryslân will potentially be a temporary investment making it the best scenario as it also has potential to reduce healthcare costs.

8.5.6 Suitability with GGD Fryslân

Suitability of the scenario with GGD Fryslân is probably one of the most determining factors. GGD Fryslân is a big and bureaucratic organization and therefore, is slightly cumbersome. This means that it is difficult to make sudden and big decisions. Therefore, the size of an alteration within an approach is a certain determining factor of success. GGD Fryslân is responsible for public health of all citizens in Friesland and therefore, is the target group also a determining factor as GGD Fryslân should help every citizen. At last, GGD Fryslân is closely involved with municipalities in Friesland, which will have to add elderly and prevention to their political agenda. Therefore, these factors are also of importance to the possibility of an approach to become chosen by GGD Fryslân.

Scenario 1: This is the current strategy of GGD Fryslân. It does not have any big changes, focuses on all target groups, and focuses on both elderly and prevention. Therefore, this scenario has high suitability with GGD Fryslân.

Scenario 2: This scenario wants to gradually change the perspective of GGD Fryslân towards Positive Health and elderly as municipalities of Friesland also would like to see. It is not a big change, and it includes all target groups with specific attention for elderly. Therefore, this scenario has also high suitability with GGD Fryslân.

Scenario 3: This scenario wants GGD Fryslân to be the lead of Positive Health. The target group will be broad and will focus specifically on Positive Health and on elderly. As being the lead of Positive Health will require a big change within the organization, this scenario scores nonetheless relatively low on the suitability with GGD Fryslân.

Scenario 4: This scenario wants to focus on prevention for younger generations. This means that Positive Health will be the focus of GGD Fryslân. It does however not focus on elderly and is also a relatively big change. Therefore, scores relatively low on the suitability with GGD Fryslân.

8.6 Conclusions

All taken together, scenario 2: “Gradually switching to Positive Health and elderly” will have the highest potential to improve independency and self-reliance of elderly with diabetes 2 to maintain or improve their health (tab. 1). Projects that focus on **Positive Health** and **elderly** will help to establish an **integral approach** and increase awareness for elderly. New employees will make it possible to design new projects on local and regional scale that integrate Positive Health and elderly. This will help to create a **broad network** and spread the word of Positive Health within these projects. It will also help citizens to become more independent and self-reliant by means of organizing events that focus on physical activity, nutrition, and other educative subjects regarding health.

There is no tight **time** schedule for this scenario but hiring new employees will improve the pace of the aim to improve independency and self-reliance of elderly. Effects will become visible relatively fast without being too quick and forcing any alteration. The additional **costs** for GGD Fryslân will increase in this scenario as extra personnel are hired, and extra investments are made on new projects focused on elderly and Positive Health. As this scenario focuses more actively on prevention and elderly, possible effects are less referral to second line healthcare and reduction of medication prescription. This could potentially reduce healthcare costs.

Table 1 - Multi Criteria Analysis of the four scenarios

Criteria		Scenario 1	Scenarios 2	Scenario 3	Scenario 4
<i>Integral approach</i>		+	+++	+	+
<i>Personnel</i>		PM -	PM +	PM ++	PM -
<i>Projects</i>		+	++	+++	-
<i>Time</i>		-	+	-	-
<i>Costs GGD</i>		PM 0	PM -	PM --	PM 0
<i>Healthcare costs</i>		PM -	PM ++	PM +	PM -
<i>Suitability</i>		+	+	-	-
Total benefit		0	+9	+4	-4

9 Conclusions

The challenge was to find the best suitable approach for GGD Fryslân to help elderly with diabetes type 2 to become more self-reliant in order to reduce the dependency on healthcare and health professionals. Therefore, the main question was: “What is the best approach to improve the general health of elderly with diabetes type 2 in Friesland by means of lifestyle interventions?” To answer the main question, sub questions were formulated. This chapter will provide the answers to the sub questions, which will eventually answer the main question.

9.1 Scientific context of aging and diabetes 2

Understanding what aging and diabetes 2 exactly is, is key to finding the right lifestyle interventions. Therefore, scientific literature will be used answer the following questions:

“What are the physiological aspects and consequences of aging?”

Aging is often defined as the progressive decline of the ability to maintain the physiological homeostasis of the human body and would eventually result in death. Physiological aspects related to aging are cellular senescence, mitochondrial dysfunction, sarcopenia, autophagy, chronic inflammation, neurodegeneration, and changed hormonal regulation. Altogether, above-mentioned dysfunction of mechanisms is associated with a certain decline of the human body. The type of mechanisms declining, and the rate of decline differs per individual. The interplay between dysfunction of mechanisms and rate of decline determines the process of aging. Aging is an irreversible process and therefore, age-related problems cannot be solved completely. Health conditions related to aging are obesity and the frailty syndrome. The causal relationship between aging and disease can be difficult to determine as multiple factors play a role in aging of the human body. Nevertheless, healthy lifestyle and other methods are associated to be of positive influence on the process of aging.

“What are the physiological aspects and consequences of diabetes 2?”

Diabetes 2 is a disease that is characterized by high blood sugar levels, insulin resistance and relative insulin shortage. It is the result of metabolic disbalance. This disbalance results in risk factors for other problems. Physiological aspects related to diabetes 2 are mitochondrial dysfunction, chronic inflammation, neurodegeneration, neuropathy, increased risk of trauma, and renal disorders. The dysfunction of the above-mentioned mechanisms and its rate of decline determine the course of disease. Diabetes 2 is an irreversible process and is related to other health condition like obesity, stroke, Alzheimer’s disease, and heart failure. It is therefore important to maintain diabetes 2 closely to reduce negative outcomes. Possibility to maintain diabetes 2 are among other related to lifestyle.

“How is lifestyle related to health?”

Here in this study lifestyle is interpreted as the pattern of how an individual person decides to spend their time regarding several subjects like physical activity and nutrition. Studies show that lifestyle, diet, and exposure to toxins including abuse of drugs, can affect the health span and longevity. In specific, physical activity improves mobility of elderly and therefore, improves self-reported functioning. Self-reported functioning is related to the degree of independency and therefore, improves indirectly the quality of life of elderly and people with diabetes 2. Increase muscle mass and strength also positively influences the life of elderly and the pathology of diabetes 2 as it improves mobility of elderly and reduces fat mass of people with diabetes 2. In addition, there are also other interventions related to nutrition for example that are associated with healthy aging and diabetes 2 control. It is therefore important to look at multiple aspects than physical activity alone.

“What are currently best practices regarding interventions for aging and diabetes 2?”

Best practices show that lifestyle interventions indeed have a positive influence on the human body. Both healthy bodies and chronic diseased bodies seem to have a positive influence on behaviour related to a healthy lifestyle. Not only a healthy lifestyle is important to be and feel healthy. These possible interventions are focused on: integration of Positive Health, increased duration of consult/conversation, regular consultations, and meetings internally, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, involve citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). These aspects of the interventions show potential to become aspects for the approach for elderly as well.

9.2 Actors related to elderly with diabetes 2 in Friesland

Identification of the external environment of GGD Fryslân has helped to understand what the possibilities for the new approach for elderly are.

“Which actors are involved with health of elderly with diabetes 2?”

The national government, municipalities in Friesland, GGD Fryslân, Zorgbelang Fryslân, health insurers, member associations, health professionals, neighbourhood teams, and citizens of Friesland.

“How should the (potential) relationship between actor and GGD Fryslân be maintained?”

There are multiple actors involved with the subject elderly with diabetes 2. Each relationship is different and has its own characteristics. Actors closely related to elderly (with diabetes 2) are municipalities of Friesland, GGD Fryslân, health professionals, member associations, and citizens of Friesland. Actors that are less closely related are the national government and neighbourhood teams. Municipalities of Friesland, GGD Fryslân, Zorgbelang Fryslân, and De Friesland health insurer work already together on novel projects that focus on prevention on a local scale. This collaboration seems to pay off, according to all partners. Therefore, it is important to maintain these relationships. Involvement of member associations and citizens of Friesland is present but could be improved. As GGD Fryslân want to focus on more attention for the citizens because the opinion of the participant seems to improve the success of an intervention or project, it is extra important to improve the relation between member associations and citizens of Friesland.

9.3 GGD Fryslân

It is also essential to know what is going on within GGD Fryslân. Therefore, the following question are answered.

“What is the current strategy of GGD Fryslân to improve general health of elderly in Friesland?”

GGD Fryslân focuses on many aspects. Their main shared values are customer orientation, ownership, cooperation, and curiosity. Their strategy is to focus on preventions, quality of work, having a broad network, sharing knowledge, and have a good communication system that support cooperation. These qualities fit neatly with the aims of the approach for elderly. As well as the skills of employees and the style of management as employees have their own specializations and management trusts the employees. At last, their structure will be able to be a leading role in the approach for elderly. One of the points of improvements for a future approach is extra staff that will be able to fulfil extra and new tasks regarding elderly prevention.

Tichtby Minsken is a pilot study that is not already part of the strategy of GGD Fryslân but is one of the trials under supervision of GGD Fryslân. It focuses on novel methods regarding prevention, namely Positive Health. This shows us that GGD Fryslân is already heading in the right direction as this is also one of the priorities of the approach for elderly. It also shows that GGD Fryslân potentially already is equipped to a certain extent to be an added value to the approach for elderly.

“To what extent is GGD Fryslân equipped to improve health of elderly with diabetes type 2?”

In general, GGD Fryslân is well equipped to fulfil tasks regarding public health regarding elderly with diabetes 2. Novel intervention found in chapter 3.4 Best practices show that several aspects are of importance for a successful approach that focuses on prevention. These interventions are focused on: integration of Positive Health, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). GGD Fryslân shows that they are in general equipped to play a lead role on these fronts.

9.4 Summary

Altogether, this project shows that there aging and diabetes 2 are complex processes and can involve many problems and health conditions. There are already multiple interventions that show potential to maintain or improve disease course of diabetes 2. Aging is not only a negative aspect of life but can result in problems and health conditions. Multiple interventions show that the process of aging and its negative consequences can be maintained as well. This means that there is potential to improve their health.

There are multiple actors that can help with the establishment of an approach for elderly and GGD Fryslân is also equipped to contribute to the establishment and to have a leading role in it. In addition, Zorgbelang Fryslân is equipped to be a key partner in the establishment of the approach.

10 Discussion

The project shows that GGD Fryslân will be able to form an approach for elderly with specific attention to prevention. An integral approach will be the key to success.

The support and willingness of actors is an insecurity as it is not evident what the opinion is potential partners and participants regarding Positive Health and integral approach. Therefore, evidence should be gathered to show the success of Positive Health and other similar methods to increase support.

Knowledge and information were obtained from scientific research and interviews with practice nurses, GPs, and dieticians. This is a good source of information regarding the medical view, but it does not show the experience of citizens and patients. Therefore, this gives a limitation in the project. Future projects should also focus on the aspects of citizens and patients, especially because GGD Fryslân wants to focus on the perspective of the citizens in Friesland.

Time has limited the ability to look at more interventions related to aging and diabetes 2. Current research shows that there are already many interventions that work on prevention and elderly. In other words, there are probably enough interventions that are effective and therefore, no new method or interventions should be designed from scratch. Also, in the province of Friesland there are already multiple interventions and methods in use. Future research should focus on finding these methods and interventions. Forming a map would give a good overview of what is already done per region. This will create the opportunity for others like health professionals or organizations involved with these interventions, to collaborate with others that are located near them. This is also a way to form a broad network and integral cooperation. It would also improve efficiency regarding obtaining information, designing, or innovating new projects, and with sharing of both information and projects.

Subsequently, it would be possible to design a project by means of this information. If projects with similar goals and interventions will be visualized, it has potential to form a similar project or to collaborate with other to reach the goals. As GGD Fryslân already focused on similar projects, like Vitale Regio Fryslân, this would be a good follow-up study to start something new, like De Friese preventive Aanpak (FPA).

11 Advice

Scientific research has showed us that aging and diabetes 2 are complex process in the human body and can result in health conditions that accelerate progression of deterioration of the human body. Research has also shown us that there are multiple interventions that have potential to improve or maintain health, both of healthy and diseased citizens. These interventions are focused on: integration of Positive Health, increased duration of consult/conversation, work together with other health professionals and organizations, work together with social domain, organize social and physical active events with education aspect, more involvement of citizens, and/or focus on multiple aspects as intervention (physical activity, nutrition, sleep, and recreation for example). GGD Fryslân should integrate these methods into novel projects regarding the approach for elderly.

There are many **actors** involved in elderly prevention. Some of them, like municipalities in Friesland, GGD Fryslân, Zorgbelang Fryslân, and De Friesland health insurer work already together on small-scaled projects that focus on prevention but not specifically on elderly. These relationships should be maintained and integrated into the approach for elderly. Relationships with member associations and citizens of Friesland should be intensified as they are a valuable source of information for opinions on the matter. They also determine to a great extent the success of projects in which citizens are participants.

GGD Fryslân is equipped to have a leading role in the design and execution of the approach for elderly. Their shared values, skills, and structure are of value to the approach. It will only be necessary to find extra employees that are able to perform the additional tasks for elderly and prevention. Tichtby Minsken shows also that GGD Fryslân is the right organization to have a leading role in the approach for elderly. This pilot study has already integrated many aspects of the novel interventions found in the scientific research. This means that GGD Fryslân has already part of the competences to design similar projects that focus on elderly and prevention.

Scenario “Gradually switching to Positive Health and elderly” has highest potential to be the approach for elderly as it has highest potential to improve or maintain health of elderly and it fits the values of GGD Fryslân.

An integral approach is one of the goals of the approach. It means that organizations, health professionals, and other actors are able to contact each other and work together. In other words, medical domain, social domain, and other domains will come closer together. This can be established by organizing events and designing projects that focus on cooperation and communication between different actors and domains. These events can take place in a general practice, dietician practice, welfare centre, or other places where health professionals are present. Positive Health will be used as education method. Positive Health focuses on a broad vision of health and integration of the social and medical domain. According to Positive Health, a broad vision of health will help to find underlying problems like debts or social isolation. Tackling this problem could help to solve other health-related problems.

Integration of the social and medical domain is subsequently also effective, as GPs for example will be able to refer patients with social problems to social workers or other health professionals in the social domain that can be of help. **The events** will learn that different domains can help each other and consequently, will bring different domain closer together. In case multiple organizations are present it also provides new contacts. The events will also learn to have a broad view on health, which can help to find underlying problems that can result in other problems regarding health. In addition, health professionals and others to become familiar with the ideas of Positive Health and will share this with others. It will be the start of the establishment of a broad network and integral approach. It will also help to get the medical and social domain closer together. Establishment of an integral approach will eventually have potential to decrease pressure on health professionals as they will be able to find underlying problems, which will help to find a suitable treatment. In addition, they will be able to consult their broad network in case they are not able to find the right treatment or solution. Other health professionals can assist or take over the patient and its problems, which will potentially save time. The use of Positive Health in general practices have resulted in reduction of second line healthcare referral and less prescription of medication. This effect could also be established by GGD Fryslân with the new approach for elderly.

Projects will be focus on elderly and prevention. Methods of novel interventions should be investigated and used by GGD Fryslân. As there are already many interventions that have shown positive outcomes, it is unnecessary to design new ones. Instead, method should be reused or possibly be innovated. Projects will consist out of interviews to become familiar with the participants and to connect the project to them. Also, events will be organized to make elderly aware of the broad perception of health, to help them make healthy choices regarding physical activity, nutrition, mental health and more, and to help them with social interaction. Key is to motivate them without lecturing. It should be interactive events. Positive Health will be the central point of events as it focuses on a broad perception of health, social interactions, and education. These projects will be performed on local and regional scale. Events will be given in community centres, gyms, on bowling alleys, welfare centres, and other locations where citizens can come together easily. It will help to find social interaction within a village and outside villages within the region. It will show them that social interactions can be relatively easy established. Bringing awareness of the qualities of citizens and showing them possibilities will potentially increase independency and self-reliance of elderly. It will bring trust that citizens are able to take care of themselves. It shows them possibilities to solve a problem, for which they would normally consult the GP for example. This will potentially reduce pressure on health professionals.

Extra **employees** will be necessary to execute the approach for elderly and to perform the tasks like designing and executing events and projects. If employees will have to perform these tasks besides their normal responsibilities, work pressure will increase, and performance will decrease. Therefore, GGD Fryslân will require approximately three new employees to perform the tasks for the approach for elderly. They will require experience with elderly, as well as events and projects design and execution. Education of Positive Health will be provided by GGD Fryslân. This will enable to new employees to use the ideas of Positive Health in the design and execution of new projects. It will also enable them to give schooling of Positive Health to others, which will be necessary for novel projects focused on elderly and prevention.

Partners are essential to design and execute the approach for elderly. GGD Fryslân cannot perform all tasks independently as they will require other contacts and require other expertise like that of health professionals for example. In addition, GGD Fryslân wants to establish a broad network making it necessary to involve other actors. As municipalities in Friesland, Zorgbelang Fryslân, and De Friesland health insurer already have certain expertise in designing and execution of projects related to projects within this approach, this will be excellent partners. Therefore, they will need to be asked to be help with the approach and projects. In addition, GGD Fryslân wants the approach to connect with citizens of Friesland. Therefore, member associations and citizens of Friesland in general should become more involved. Member associations are already in close contact with Zorgbelang Fryslân. This means that Zorgbelang Fryslân could be able to help with improving the relationship with GGD Fryslân. Citizens can be involved by active promotion of events and projects on local news, local papers, and more. Spreading surveys that ask questions related to elderly and prevention is also a way to involve citizens of Friesland.

Altogether, it seems that there are multiple ways for GGD Fryslân to help elderly to become more independent and self-reliant.

12 Outline of implementation

Scenario “Gradually switching to Positive Health and elderly” has highest potential to be the approach for elderly as it has highest potential to improve or maintain health of elderly and it fits the values of GGD Fryslân. The implementation consists out of multiple points of interventions. The execution of the implementation will take approximately four years. This means that it is most likely that elections of municipalities will take place in this period and therefore, there will be two periods of municipal guidelines applicable for GGD Fryslân.

12.1 Integral approach

An integral approach means that a broad team works together on a problem. Together they try to identify all aspects that are of significant value. Subsequently, they work on the problem from different perspectives to solve the problem. By looking at different aspects of the problems and working from different perspectives, close collaboration will increase the chance of solving the problem. Within this approach it means that organizations, health professionals, and other actors can contact each other and work together.

To create an integral approach, it is necessary to have a broad network. Getting in touch with current partners and enlighten them about the new approach is one of the first steps. GGD Fryslân is in close contact with municipalities, health insurer De Friesland, and Zorgbelang Fryslân. It is important to maintain these relations by keeping them involved with the operations of GGD Fryslân. Also, making new contacts and starting new collaborations with for example other health insurers and health professionals will broaden the network.

As GGD Fryslân wants to connect with citizens and to use their opinion, it would be wise to invest in other relationships as well. Member associations and citizens of Friesland are partners that could give a good representation of the opinion of citizens. GGD Fryslân should keep them involved by regularly asking their opinion by means of for example surveys.

Other interesting partners are health professionals. GGD Fryslân does not often have direct contact with for example GPs. Therefore, it would be good to get in touch with these groups as well. Another important group is within the social domain, like social workers that help to support and motivate citizens in the region. Establishment of a broad network will improve collaboration between different domains and will reveal new approaches to take up challenges that has potential to be highly effective as the problem is dealt with from different perspectives.

Another way to create a broad network is to bring the social and medical domain closer together by means of organizing events. These events will focus on cooperation and communication between different actors and domains. They can take place in general practice, dietician practice, welfare centre, or other places where health professionals are present. Schooling of Positive Health will be a good method to create an effective and good collaborating network. Positive Health is focused on a broad view and collaboration, and therefore, schooling could help to find the same focus within the network. Positive Health will help to improve health as it enables health professionals to find underlying problems, and subsequently will help to find the right treatment.

After establishment of a broad and collaborating network, meetings will be organized to keep the network warm and to point out the possibility to contact each other. Another aspect important to maintenance of the broad network is to improve the communication network, which will make it easier to find the right contact and to get in touch with each other. Eventually, closer collaboration and integral approach will be established that is able to solve problems from different perspectives to make increase the positive effect of the efforts.

12.2 Positive Health integration

One of the first steps to integrate Positive Health into GGD Fryslân and into the network of GGD Fryslân is to hire approximately three new employees. As GGD Fryslân will focus more on elderly and prevention, these employees should have experience in the field with elderly and organization of projects. They will be educated to apply the ideas of Positive Health into new projects and event. In addition, they will be schooled as trainer to spread knowledge and ideas of Positive Health. Tasks will be supporting other employees to implement Positive Health into current projects and to insert components specific for elderly, to design new regional projects focused on Positive Health and elderly, and to organize classes of Positive Health for people within and outside GGD Fryslân that are interested. This new established small team will help to implement projects on a broader scale and will help to integrate Positive Health into the network of GGD Fryslân.

Validation of the success of projects will be necessary to find support for the approach to focus on elderly and Positive Health. Therefore, it will be valuable to investigate the effects of new projects by The Academic Workplace of GGD Fryslân to find substantial proof of success.

After educating classes of Positive Health in the first years, it will be important to keep people involved with the ideas of Positive Health. Therefore, it will be important to organize follow-up courses. This will be useful to keep health professionals and others working according to the ideas of Positive Health. Eventually, Positive Health will become integrated into the network of GGD Fryslân.

12.3 Health improvement elderly

There are multiple aspects related to improving health among elderly. Part of the solution lies in independency and self-reliance of elderly. To establish improvements on these themes, new projects will be designed by new hired employees that will include Positive Health, prevention, and elderly. These projects will integrate Positive Health into the techniques of health professionals and others that are involved with citizens and specifically elderly. By introducing Positive Health, it will become easier to start a broad conversation with client or patient to find the underlying cause of a problem, to find a solution together, and most important to find the motivation of the client or patient to make a change. Another aspect of health improvement among elderly is educating citizens and elderly. Projects will consist out of interviews with citizens/participants to become familiar and to be able to connect the project to them.

Within a project, events will be organized that are focused on education of health regarding the broad perception of health, to help participants to make healthy choices regarding physical activity, nutrition, mental health, and to help them with social interaction. An important aspect of these events is to find the intrinsic motivation, which is difficult to establish. Interactive events are one of the ways to trigger the intrinsic motivation. Therefore, events will have interactive characteristics. Projects that include interviews and events will be organized on both local and regional level. Events will be organized in community centres, gyms, on bowling alleys, in welfare centres, and other locations where citizens can come together. This will be a way to show that social interaction is not impossible to establish, and it can even be relatively easy. Raising awareness of the qualities of citizens and showing them possibilities will potentially increase independency and self-reliance of elderly. It will bring trust that citizens are able to take care of themselves. It shows them possibilities to solve a problem, for which they would normally consult the GP for example. This will potentially reduce pressure on health professionals.

Altogether, as previous projects with similar methods show positive results like less referral to second line healthcare and less prescription of medication, these effects will potentially also be visible as result of new designed projects within GGD Fryslân. Eventually, these effects will potentially result within several years in decreased healthcare costs and improvement of health among citizens in the concerned region.

12.4 Prevention of reinventing the wheel

Interviews with health professionals, and organizations with similar goals as GGD Fryslân have shown that there is already a lot of information and methods available with promising results to improve pressure on the healthcare system. It can therefore be unnecessary to invent new methods. Instead, it would be more productive to find existing methods with good results and bend these over to a method that suits GGD Fryslân. The goal is to create an overview of working approaches within the province of Friesland. This overview will show us which regions are already involved with Positive Health and health improvement among elderly and will give insights on the effects of these methods. This will make it easier to design projects and to start new collaborations within a region with non-collaborating parties. It will therefore be helpful to form the integral approach.

After optimization of methods and designing of projects, implementation of new adjusted projects will start. In addition, knowledge of existing projects and its locations will be shared with others to prevent reinvention of methods and to support collaboration and an integral approach. New projects will be monitored closely to see the effects at first hand. Eventually, promising results of projects will hopefully be found and will be shared to share potential success.

12.5 Integration of the social domain

Integration of the social domain into other work fields will improve the aimed integral approach of GGD Fryslân. Social workers have close contact with clients and patients. Therefore, they are a good communication platform to their clients. Getting in touch with health professionals and other organizations involved with health preventions and Positive Health will broaden the network of the social domain. Subsequently, good use can be put in this new collaboration on both sides. Within the social domain, there is already relatively much knowledge regarding efficient approaches that can be shared with other interested parties. They can provide interventions that can have positive effects on clients and patients and therefore, health professionals could refer their clients or patients to the social domain. On the other hand, health professionals provide new potential participants on interventions within the social domain. Collaboration with GGD Fryslân and their goal to monitor the effects of new projects and interventions, will give both health professionals and the social domain the ability to test the effectiveness of their interventions. These tests will probably also give insights in the possible alterations to make them more successful. As GGD Fryslân will facilitate classes of Positive Health, it will be possible to follow them and to integrate the ideas into the organization and their approach. After setting up projects that aim to improve health of citizens and specifically elderly, it is important to maintain relationships. Eventually, it will result in close cooperation between the social domain and health professionals.

13 After care

Finished projects and interventions of GGD Fryslân can be very successful. It is however also important to maintain these positive results. To maintain positive results, it is important to know what key factors are to the success of a project or intervention. Therefore, the first step is to monitor projects and interventions closely. It will show you the successes and how they are reached. Subsequently, it gives opportunities to use this knowledge for new projects. Knowing the key factor to success and the points of improvements will make it easier to design a new project with more potential to success. Eventually, it will result in successful projects that keep maintaining optimization and innovation, and potentially improve of health among citizens and in specific elderly.

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15 Appendices

Appendix A: Outline of implementation in steps

	1-2 years	2-3 years	3-4 years
Integral approach	<ul style="list-style-type: none"> PG classes Make new contacts and cooperate Create broad network Improve communication network Periodic meetings to maintain network 	<ul style="list-style-type: none"> Maintain contact within the broad network Keep broadening the network Maintain specifically relations with municipalities, health insurers, and Zorggelang Fryslân 	<ul style="list-style-type: none"> Closer cooperation and integral approach is established
Positive Health Integration	<ul style="list-style-type: none"> Hiring new employees Design new projects focused on PG, prevention, and elderly Validate success projects PG education new employees New employees support other employees regarding PG PG classes 	<ul style="list-style-type: none"> Refreshers classes for PG Broadening of PG classes Keep working according PG 	<ul style="list-style-type: none"> Integration of Positive Health into multiple domains
Health improvement elderly	<ul style="list-style-type: none"> Projects focus on prevention, PG, and elderly Broad conversation Citizen education 	<ul style="list-style-type: none"> Less referral and medication prescription 	<ul style="list-style-type: none"> Less healthcare costs and improvement of health
Prevention of reinventing the wheel	<ul style="list-style-type: none"> Research on current working projects Create overview of working approaches 	<ul style="list-style-type: none"> Implementation new adjusted projects Share knowledge of existing projects 	<ul style="list-style-type: none"> Promising results of new projects
Integration of the social domain	<ul style="list-style-type: none"> Projects focus on involvement of social domain Improve cooperation with health professionals 	<ul style="list-style-type: none"> Maintain network Close cooperation social and professional network 	
After care	<ul style="list-style-type: none"> Guard numbers regarding healthcare costs and health improvement Make adjustments in time 	<ul style="list-style-type: none"> Evaluate projects and use input for new projects 	<ul style="list-style-type: none"> Successful projects that keep improve health of citizens