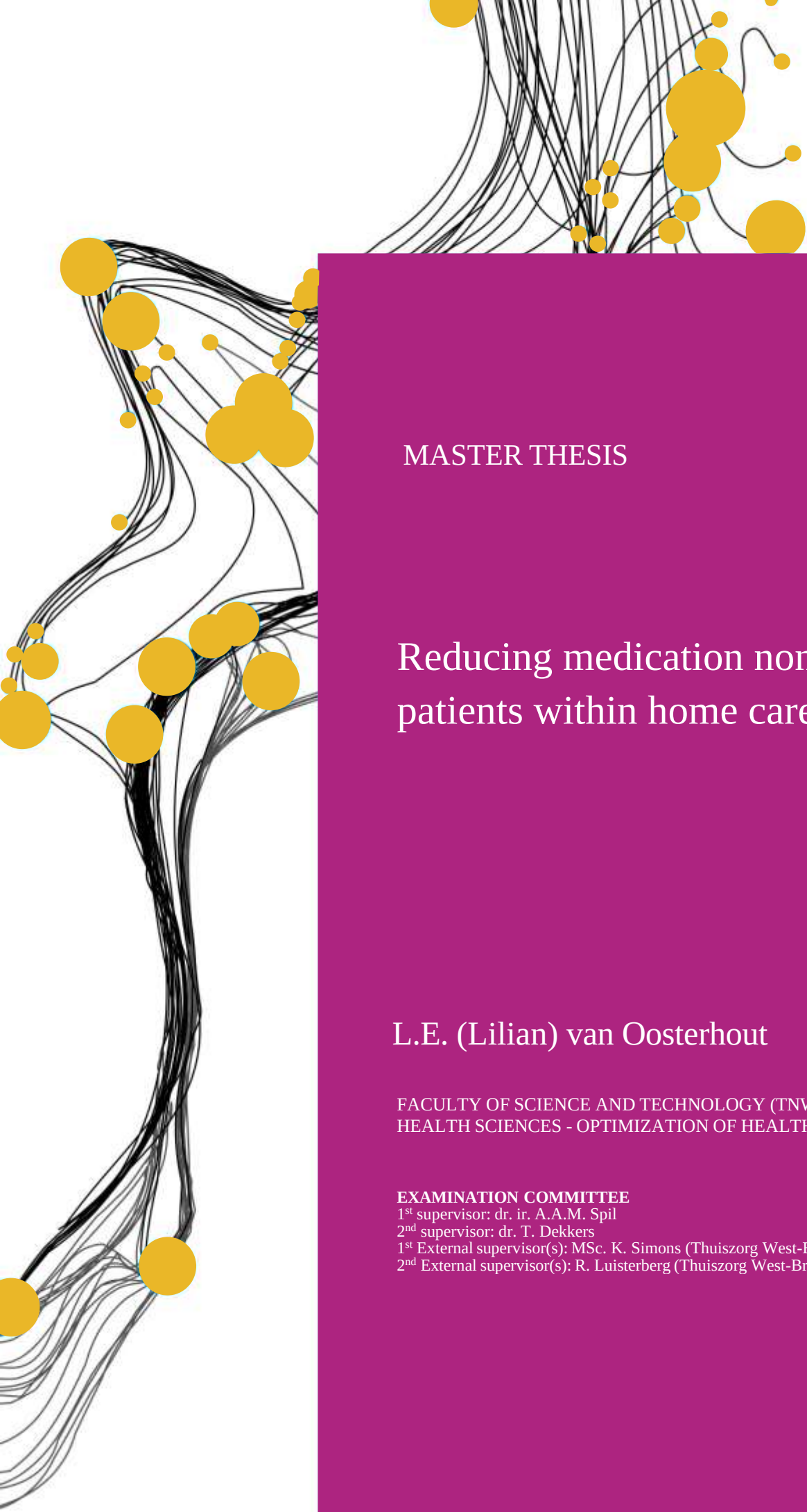

MASTER THESIS

Reducing medication non-adherence in patients within home care situation

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Table of Contents

Abstract

The Dutch population is aging, and the proportion of people aged 65 years and older is expected to increase from 16% to 26% between 2013 and 2035. The elderly population has the highest DDD per capita in combination with high medication non-adherence, which are connected to high cost. Nowadays a commonly used solution for reducing medication non-adherence is by planning medication moments where home care workers help the patient. However, this is impossible to maintain due to the increasing shortage of healthcare workers and the fact that the elderly is expected to live at home longer because of cuts within the healthcare system.

A mixed-method approach is used to investigate determinants and possible solutions for the high amount of medication non-adherence in patients within the home care situation. At first, two literature reviews are executed, the first review is focussed on reasons for medication non-adherence in the home care situation. The second literature review focuses on the effect of medication dispensers on medication adherence. Based on the outcome of the literature review, questionnaires are set out within the home care situation, Thuiszorg West-Brabant (TWB), with a total of 506 responses, consisting of 282 clients of TWB, 80 informal caregivers and 144 employees of TWB. The questionnaires are followed by five interviews conducted with two carers, two district nurses and one occupational therapist.

The findings suggest a potential positive impact of medication adherence tools for reducing medication non-adherence within the elderly population, but individual needs and reasons for non-adherence must be carefully considered for successful implementation. If cognitive impairment or a reluctance to adhere to medication is the underlying cause, medication adherence tools may not be the best solution. However, early implementation should be considered to potentially reduce the impact of cognitive impairment on the implementation process. In addition to the effect of tools, providing patients at risk with more information about their disease and medication may be part of new strategies to decrease non-adherence. With the continuous advancement of technology, there is an anticipation that tools and applications will progressively play an increasingly significant part in encouraging medication adherence and supporting independent living for the elderly population.

KEY TERMS

Medication non-adherence, Medication adherence tools, home care

1. Introduction

The Dutch population is aging, the proportion of people aged 65 years and older is expected to increase from 16% to 26% between 2013 and 2035 [1]. The population above 65 has the highest Defined Daily Dose (DDD) per capita [2]. DDD is defined by the World Health Organization (WHO) as: "The assumed average maintenance dose per day for a drug used for its main indication in adults" [3]. A high DDD is paired with high costs. Additional to the high costs of the medicines taken by the elderly, costs are made by medication non-adherence [4].

Elderly people often have a long-term therapy plan to maintain their health and quality of life. The WHO defines adherence to long-term therapy as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider" [4,5].

Medication non-adherence

Not all patients are adherent to their prescribed medication, there are two forms of medication non-adherence: intentional non-adherence, and unintentional non-adherence. Intentional non-adherence can be described as a patient willingly not taking their medication. This situation often occurs when someone does not trust the medication or has incorrect beliefs about medication intake. For example, someone believes it is necessary to take a medication break occasionally. Unintentional non-adherence occurs when a patient's intentions are to adhere to the medication regimen but cannot do so because of barriers that are not within the patient's control. For example, a patient does not understand the medication instruction. [6,7].

Current situation within the home care organizations

A common way to address medication non-adherence is by planning medication moments with home care employees These medication moments consist of an employee visiting a client's home to hand over the medication and to ensure the client takes the medication. On average, each medication session lasts approximately 15 minutes. For a client requiring three medication sessions per day, this accumulates to a total of 122 minutes per week, resulting in a substantial workload. [8]. There are several reasons that make it impossible to maintain this standard of relying on home care workers. To start off with the persistent shortage of healthcare workers which is a challenge that is anticipated to increase in the coming years. Within the healthcare sector the shortage of employees is estimated to be the highest within home care. The labour market shortage was 4.800 employees in 2022 and is expected to increase to 18.800 in 2032 [9,10]. Not only the shortage makes it impossible to continue the standard, but also the impact caused by the closure of numerous nursing homes. Around 2014, politicians decided to reduce the number of nursing homes considerably, this led to a situation where elderly must live at home longer [11].

Possible solutions for reducing medication non-adherence

Thes labour shortage and the closure of nursing homes influenced the work method within Thuiszorg West-Brabant (TWB), which is a home care organization in the south of the Netherlands. TWB is a progressive home care organization offering personalized care and support to ensure clients can live longer and safer at home. The labour shortage, elderly living at home longer and the high amount of medication non-adherence leads to a high workload for (home) care employees as can be seen in the example of medication moments above. Even more, medication non-adherence causes hospital admissions which leads to an increase in workload for the hospital's healthcare employees during the patients stay [12]. Even though, 30 to 40% of these admissions are preventable. Furthermore, home care employees get an increase in workload, after a patient gets discharged from the hospital. In 2019, more than half of the nurses indicated that they do not have enough time to dispense medication [13]. Since the workload has become unsustainable, it is crucial to find a solution.

A possible solution for unintentional non-adherence and the labour shortage can be found in assistive technology (AT) [14]. AT is "any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve functional capabilities of persons with

disabilities". Among the available AT tools for patients, there are options that increase medication adherence. These tools include reminder apps and watches, pill organizers, timers, and medication dispensers. Medication dispensers are often equipped with automatic dispenser functions, audio, and visual alarms, displays showing medication information and security locks to help prevent mistakes with medication. By using a medication dispenser, the number of medication moments can be reduced by up to 100%, resulting in a significant reduction of 122 minutes in workload for employees when a patient has three medication sessions.

Scope

This research is needed because medication non-adherence has a widespread impact on various aspects of healthcare. To create a better working environment for employees and prevent unnecessary hospital admissions a better adherence must be established. This report includes four studies, each with its own distinct objectives and scope.

The aim of the study is identifying ways to reduce medication non-adherence in patients within the home care situation. The literature review on medication non-adherence aims to show underlying factors contributing to individuals' lack of adherence to their prescribed medications. The review is targeted at adults living in Western countries in the home care situation. The literature review concerning medication dispensers aims to demonstrate the effectiveness of various tools in reducing non-adherence and to assess the impact of implementing these tools. The goal of the questionnaire and the interview is to validate the results found within the theoretical framework in a more specific target group. This group consists of clients, informal caregivers ("mantelzorgers" in Dutch), and employees of TWB.

Research questions

To examine medication non-adherence in relation to medication dispensers in the home situation, this research is conducted in a mixed method structure, where existing information from literature and new insights from questionnaires and interviews are combined. The main research question addressed in this research is:

"How can medication non-adherence be reduced in patients under the care of a home care organization?"

This main research question is divided into the following sub-questions to be able to give direction to the research set up. The sub-questions addressed in this research are:

1. *"What are the reasons for medication non-adherence in the home care situation?"*
2. *"What is the effect of implementing different medication adherence tools for reducing medication non-adherence?"*

Reading guide

The structure of this report is as follows. The four chapters which describe the literature review concerning medication non-adherence, literature review concerning medication dispensers, questionnaire, and interviews respectively. Within these chapters the methodology, results, discussion/analysis, and conclusions are described. After the four chapters a main conclusion is drawn, limitations are shown, and recommendations are given. Both reviews together from the theoretical framework, which is based on the Grounded theory Literature Review Method, which is further discussed in Appendix A.

2. Literature review medication non-adherence

2.1 Methodology

The research question addressed in this review is: *"What are the reasons for medication non-adherence in the home care situation?"*. To answer this question, the databases Web of Science, Scopus and PubMed are used. To make sure the included articles are as comparable and relevant as possible in- and exclusion criteria are formatted. These criteria can be found in Table 1. Articles are included if they focus on finding associated factors of non-adherence to medication, this should be done within the home situation. Articles are excluded when they align with one or more of the following exclusion criteria: published before 2000, study population aged younger than 18 years old or only involve non-western countries. Western countries include New-Zealand, Indonesia, Japan and countries within Europe, North America, and Oceania [4,15–17]. These criteria are chosen because, articles before 2000, are not considered up to date enough for this study, only adults are included in this study and this study focusses on a western country and thus the articles in this literature review must be comparable.

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Associated factors of non-adherence	Age category younger than 18 years old
Home situation	Article published before 2000
	Non-Western countries [4,15,16]

Table 2 presents the four main search terms used in this study: medication, home care, predictor, and non-adherence.

Table 2 Search terms

Main search terms	Sub-search terms
Medication	Medicine Medication Drug*
Home care	Home care Homecare Domiciliary care Elderly care Outpatient
Predictor	Predict* "Associated factors"
Non-adherence	Non-adher* Nonadher* Noncomplian* Non-complian*

The asterisk is used when search terms have different variations. For example, predict, predictor, and predicting can all be found with predict*. The quotation mark is used to search only for the specific order and combination of words. Figure 1 shows the initial article selection process, which involved a total of 71 articles obtained from Web of Science, 78 articles from Scopus, and 5 articles from PubMed. From the 154 articles 2 did not have a full text, 73 are duplicates and 34 are excluded based on title and abstract. From the remaining 45 articles, 16 articles are excluded after reading the full article. Since reading the full article showed no alignment with the inclusion criteria or met one or more of the exclusion criteria. A total of 26 relevant articles are eventually included within this literature review.

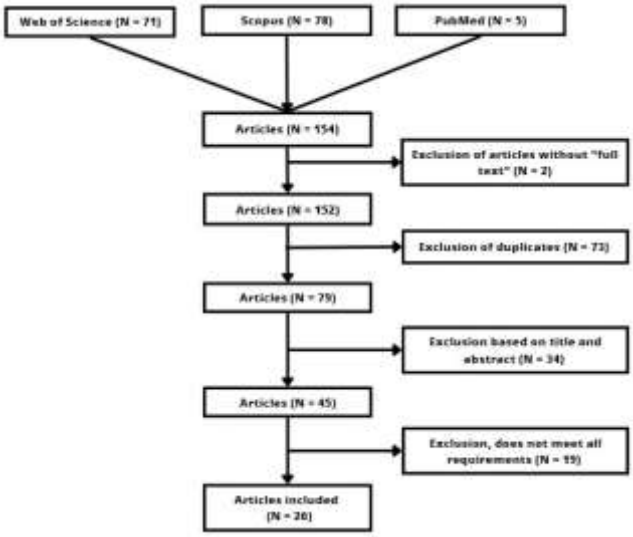

Figure 1 Article inclusion flowchart

Coding is based on highlighted information, keywords, and important phrases. Articles are coded three times: open, axial, and selective. Both deductive and inductive coding are used within the research [18]. Balkrishnan (1998) defines six predictors of medication adherence within the article: demographic variables, medical variables, medication-related variables, economic variables, and behavioural variables. [19]. The article also identifies subgroups in addition to these predictors. Both the predictors and subgroups are utilized as selective and part of the axial coding. The deductive coding is presented in Table 3. A combination of deductive and inductive coding is used for axial coding. Open coding, on the other hand, exclusively consists of inductive coding.

Table 3 Coding categories

Selective coding	Axial coding
Demographic variables	Age Gender Race Health literacy
Medical variables	Type of disease Severity of illness Duration of illness Quality of care
Medication-related variables	Use of assistive technology Type of medication Dosing regimen Adverse effects
Economic variables	Socioeconomic status Type of insurance coverage
Behavioural variables	Fragmented, short, and poor physician-patient interactions

2.2 Results

Within the included articles 142 factors are found which contribute to medication non-adherence within the home care situation. These factors are coded into 55 open coding categories, 30 axial coding categories and 5 selective coding categories. The written explanation of the codes of the factors and coding can be found in Appendices B, C, D, E, F, and G. The 5 selective coding categories and the corresponding axial coding categories are further discussed below ordered by axial category size. All numbers in Tables 4, 5, 6, 7 and 8 in columns concerning positive associations, negative associations and other are the included articles in this literature review. The numbers correspond with the first column of Table 15 in Appendix B.

Demographic variables

Demographic variables are mentioned in 19 articles with a total of 45 times. There are 7 codes within the corresponding axial coding. Associations between demographic variables and medication non-adherence found within the included articles can be seen in Table 4.

Table 4 Associations between demographic variables and medication non-adherence

Variables	Number of articles	Positive association	Negative association	Other
Age	10	1, 7, 20	9, 11, 18, 21, 24, 26	5
Gender	9	(Female) 1, 18, 20 (Male) 7, 10, 16	(Female) 11 (Male) 26	5
Low health literacy	7	1, 6, 7, 21, 23, 24, 26		
Education level	7	16, 21, 24	1, 9, 17	5
Occupation	6	3, 10, 16, 18, 21, 24		
Relationship status	5	3, 14, 21, 22, 24		
Race	5	3, 5, 11, 18, 21		

Age is mentioned in 10 articles. 3 articles show a positive association between older age and medication non-adherence. However, 6 articles found a negative association. Article 5 showed both positive and negative associations and their conclusion is indecisive.

Gender is mentioned in 9 articles. Both positive and negative associations are found between men and women and medication non-adherence. Both for men and women 4 articles show associations between gender and medication non-adherence. For both men and women 3 out of 4 articles show a positive association between gender and medication non-adherence, while 1 article for men and women indicates a negative association with medication non-adherence. Article 5 showed positive associations between both men and women and medication non-adherence, their conclusion is indecisive.

Low health literacy is mentioned in 7 articles. All articles show a positive associated between low health literacy and medication non-adherence. Low health literacy is defined differently between the articles. Low health literacy is defined as, illiterate, verbal fluency, hearing impairment, Speak language other than English, cognitive function, and inadequate functional health literacy.

Educational level is mentioned in 7 articles. Both high and low educational level are positively associated with medication non-adherence. Articles 1, 9, and 17 show a positive association between a low educational level and medication non-adherence. Whereas article 16, 21 and 24 show a positive association with high educational levels. Article 5 included articles which showed positive associations with both high and low educational levels and medication non-adherence their conclusion is indecisive.

Occupation is mentioned in 6 articles. These articles are divided into 2 categories which are jobs in general, mentioned in article 16, 21 and 24, and low-income jobs, mentioned in article 3, 10, and 18. Both categories are positively associated with medication non-adherence.

Race is mentioned in 5 articles. Articles 11, 18, and 21 show a relationship between ethnical minorities and medication non-adherence. Article 3 showed lower non-adherence in sub-Saharan Africa countries compared to North America. All 4 articles show a positive association between minorities and medication non-adherence. Article 5 includes 5 articles which mention race. 3 out of 5 show a positive association between minorities and medication non-adherence, the other 2 articles show no associations.

Relationship status is mentioned in 5 articles. These are divided into 3 categories, articles 3 and 21 mention participants having no relationship. Articles 14 and 24 mention participants living alone and article 22 mentions unmarried participants. All categories are positively associated with medication non-adherence. Article 16 also concludes that participants living alone have a higher risk of dose deviations.

Medical variables

Within the research both factors concerning illness and treatment are found which are related to medication non-adherence. Medical variables are mentioned in 18 articles with a total of 60 times. There are 9 codes within the axial coding. Associations between medical variables and medication non-adherence found within the included articles can be seen in Table 5.

Table 5 Associations between medical variables and medication non-adherence

Variables	Number of articles	Positive association	Negative association	Other
Comorbid conditions	9	1, 7, 17, 18, 21		4, 12, 22, 24
Type of disease	8	2, 4, 9, 20, 22, 26		2, 12
Health status	5	16	21, 24, 25, 26	
ADL difficulties	4	4, 19, 22		24
Frequency of use of medical services	3		17, 18, 22	
Use of medical service	2	3, 20		
Fear of disease(s) and medication	2			15, 17
Quality of care	1	1		
Severity and duration of illness	1	1		

Comorbid conditions are mentioned in 9 articles, they all define comorbid conditions in different ways. Comorbid conditions are defined as a higher Charlson Quan comorbidity score, multiple medical conditions, and comorbidities. 4 articles mention a positive association between higher rates of comorbidity and medication non-adherence. 1 article mentions a positive association between lower rates of comorbidity and medication non-adherence. 4 other articles mention that there is no association between the number of comorbidities and medication non-adherence.

Type of disease is mentioned in 8 articles. Three articles, 2, 20 and 22, focus on medication adherence in patients with dementia. Here a positive association is found in regard with medication non-adherence. This is also the case in articles 4, 9, and 26 where the focus is placed on depression. The other 2 articles focus on HIV and diabetes, and both show high medication non-adherence. However, they both did not include control groups.

Health status is mentioned in 5 articles. All articles show a positive association between health status and medication non-adherence. 3 articles mention a positive association between ADL difficulties and medication non-adherence. Within these articles ADL difficulties are defined as difficulties opening medication bottles, physically hard to handle medication and ADL impairment. 1 article shows no associations between ADL difficulties and medication non-adherence. Here ADL impairment is defined as physical function.

Frequency of use of medical services is mentioned in 3 articles. All articles show a negative association between frequency of use of medical services and medication non-adherence. ADL difficulties is mentioned in 4 articles. Use of medical service is mentioned in 2 articles. Both show a positive association between the usage of medical services and medication non-adherence. The articles describe use of medical services as receiving home care services and living in a nursing home. Fear of disease(s) and medication is mentioned in 2 articles. Both articles show no associations. However, article 15 does mention that it could be a contributing factor but there is too little information within their research.

Quality of care is mentioned in one article, the article written by El-Saifi et al (2018) shows a positive association between quality of care and medication non-adherence [20]. Lower quality of care leads to more medication non-adherence. Severity and duration of illness is mentioned in the article written by El-Saifi et al (2018) show a positive association between severity and duration of Alzheimer and medication non-adherence [20].

Medication-related variables

Within the literature multiple aspects of medication are related to medication non-adherence. This category is mentioned in 15 articles with a total of 43 times. There are 5 axial codes which are all compared below. Associations between medication-related variables and medication non-adherence found within the included articles can be seen in Table 6.

Table 6 Associations between medication-related variables and medication non-adherence

Variables	Number of articles	Positive association	Negative association	Other
Adverse effects	9	1, 2, 4, 9, 15, 19, 20		23, 26
Dosing regimen	7	3, 14, 15, 26	8	17, 23
Types of medication	5	14, 20, 24, 26	26	
Number of concurrent medications	4	1, 7, 14, 26		
Use of adherence aids	1		17	

Adverse effects are mentioned in 9 articles. All show a positive association between side effects and medication non-adherence. Articles 23 and 26 however state that there is too little data in their research to set back up this statement.

The dosing regimen is mentioned in 7 articles, 4 articles found a positive association between non-adherence and increased dose frequency. Article 8 stated a negative association between non-adherence and a regimen according to NCCN guidelines for pain-related outcomes of patients with cancer. 2 articles mentioned dosing regimens but found no association with non-adherence due to limited data.

Types of medication are mentioned in 4 articles. Bisphosphonates and symptomatic medication are compared with medication non-adherence within these articles. 3 articles show positive associations between types of medication and medication non-adherence. 1 article showed both positive and negative associations and 1 article found types of medication to be a contributing factor to medication non-adherence.

The number of concurrent medications is mentioned in 4 articles, all of these show a positive association between number of drugs and medication non-adherence.

The use of adherence aids is mentioned in 1 article and is negatively associated with medication non-adherence.

Economic variables

This literature review only addresses the financial aspect of the economic factor. The coding economic is mentioned in 11 of the included articles, with a total of 21 times. The axial coding shows 4 codes within this category. Associations between economic variables and medication non-adherence found within the included articles can be seen in Table 7.

Table 7 Associations between economic variables and medication non-adherence

Variables	Number of articles	Positive association	Negative association	Other
Cost of medication and medical care	6	11, 18		1, 3, 4, 15
Socioeconomic status	5		1, 3, 18, 26	5
Type of insurance coverage	3		3, 18, 21	
Patient income	3		3, 10, 18	

Cost of medication and medical care is mentioned in 6 articles. 2 articles show a positive association between higher costs and medication non-adherence. However, 4 articles show no, significant, association between costs and medication non-adherence. Socioeconomic status is mentioned in 5 articles whereof 4 articles show a positive association between low socioeconomic status and medication non-adherence. Article 5 included articles which showed both positive and negative effects and their conclusion is indecisive. Type of insurance coverage is mentioned in 3 articles. All articles show a negative association between type of insurance and medication non-adherence, a lower insurance coverage leads to higher medication non-adherence. Private insurance is also associated with lower medication non-adherence. Patient income is mentioned in 3 articles. All articles show a positive association between income and medication non-adherence.

Behavioural variables

Behavioural variables are mentioned in 15 of the included articles with a total of 44 times. The axial coding shows 7 codes within this category. Associations between behavioural variables and medication non-adherence found within the included articles can be seen in Table 8.

Table 8 Associations between behavioural variables and medication non-adherence

Variables	Number of articles	Positive association	Negative association
Scepticism	9	1, 2, 4, 13, 15, 17, 22, 24, 26	
Disinformation	5	13, 14, 19, 24, 26	
Medication adjustments	5	4, 19, 22, 26	3
Fragmented, short, and poor physician-patient interactions	3	16, 17, 19	
Health belief	2	18	13
Recurrence of medication non-adherence	1	2	
Patient satisfaction with healthcare provider	1		19

All 9 articles that mentioned scepticism found a positive association between scepticism and non-adherence. Important factors in this category include greater concerns than perceived benefits of medication, not seeing treatment importance and, for example, article 15 found a positive association between scepticism towards generic drugs and medication non-adherence.

5 Articles mentioned disinformation, all found a positive association between disinformation and non-adherence. Article 14, 19 and 24 specifically stated lack of knowledge and insufficient support as contributing factors to non-adherence. Article 13 stated that patients who are unaware of the chronic nature of their disease are more likely to be non-adherent. Article 26 found that patients who understand their disease and perceived need for treatment have better adherence. Medication adjustments is mentioned in 5 articles. Articles 4, 19, 22 and 26 found that patient who adjusted their medications by themselves are less likely to be adherent. Article 3 found that people who started antiretroviral medication at their own request are more likely to be adherent.

Medication adjustments is mentioned in 5 articles, 3 articles mention a positive association between medication adjustments and medication non-adherence. Article 4 found adjustment because for example cannot open the medication leads to higher non-adherence. While two other articles found a negative association.

Fragmented, short, and poor physician-patient interactions are mentioned in 3 articles. All articles show a positive association between Fragmented, short, and poor physician-patient interactions and medication non-adherence. However, there are 3 definitions of these interactions which are, more than one physician, short contact with physician and a poor relationship with the physician.

Health belief is mentioned in 2 articles, both articles look at high self-rated health. However,

1 article shows a negative association and the other a positive association between health believes and medication non-adherence. Recurrence of medication non-adherence is mentioned in the article written by El-saifi et al (2018), here a positive association is found between previous occurrence of medication non-adherence and medication non-adherence [20]. Patient satisfaction with healthcare provider is mentioned in 1 article. Here a negative association is found between patient satisfaction with healthcare provider and medication non-adherence.

2.3 Discussion

To improve generalizability only Western countries are included within the literature review because in general non-adherence is higher within non-western countries [16]. The magnitude of non-adherence in developed countries is high but in third world countries it is even higher [4,21]. This is for example due to higher use of traditional medicine, longer travel time to pharmacy, and less income. By excluding the non-western countries, the information retrieved in the review is better related to the home care situation of TWB.

Between articles there is a difference in cut-off point for significance. The cut-off point can be determined by the researchers which can lead to outcome differentiation between articles. Almost all articles worked with a significance level of $p < 0.1$, $p < 0.05$, and $p < 0.001$. The article written by Pettersen et al. (2018) did not mention a significance level which makes it hard to interpret these results [6]. Only three articles, written by Mearis et al. (2014), Stessel et al. (2018), and Bhasin et al. (2020) used a significance level of $p < 0.1$ [7,22,23]. For example, the article written by Stessel et al. (2018) shows a positive association between health status and medication non-adherence with a p value of 0.055, while other articles concluded that there is no association [7]. The article written by Bouwman et al. (2017) showed a p value of <0.20 for the univariate analysis, which makes these results less reliable [24].

One interesting aspect within the economic category is the type of insurance coverage, which presents an opportunity for improvement. Both higher-level and private insurance packages have the potential to enhance medication adherence. However, in the Netherlands, the impact of health insurance coverage on medication adherence is not expected to be significant due to the mandatory nature of healthcare insurance and the supplementary nature of private insurance. The studies that demonstrate these results are conducted in Australia and the United States, where the distinction between public and private health insurance is more pronounced. The effect of health insurance in those countries is likely to be more substantial. Nevertheless, in the Netherlands, there is potential for improvement in medication adherence if patients receive assistance in selecting the most suitable health insurance that meets their needs.

A main contributing factor to medication non-adherence is cognitive impairment, which includes (early forms of) dementia and Alzheimer’s disease. There are seven contributing factors found, which are the use of an anticholinergic drug in patients with Alzheimer's disease, number of years the patient has a lack of awareness, decrease in the Dementia Rating Scale-Memory subscale, memory complaints, dementia, forgetting to take medication and cognitive impairment. Five axial coding in different selective categories mention some factors closely related to cognitive impairment. These factors are ADL-difficulties, type of disease, severity and duration of illness, low health literacy and types of medication.

Next to cognitive impairment age is also a main contributing factor to medication non-adherence. Not only because some articles show a positive association between age and medication non-adherence. But also because of the relationships between age and many of the factors contributing to medication non-adherence such as relationship status. When looking at the variable relationship status a positive association between being single and medication non-adherence is found. This association can lead to two populations which are most likely to be medication non-adherent. Younger people are more often single due to not finding a partner yet. However, elderly people are more likely to be single due to the passing of their spouse. There is a positive association between age and number of widowed people [25]. Two other contributing factors can also be scaled within the elderly population, which are retired citizens, and permanent care in a nursing home.

Based on this research, a specific population can be identified as being at higher risk for medication non-adherence: elderly patients with cognitive impairments. Targeting this population is crucial when implementing medication adherence tools to achieve the optimal effect.

2.4 Conclusion

In total 142 contributing factors, 55 open coding, 30 axial coding and 5 selective coding are derived from the 26 included articles. Axial coding is bundled to form the 5 selective coding categories. The reasons for medication adherence in the home care situation are placed within 5 selective coding categories. From the demographic variables low health literacy, relationship status, race and occupation are positively associated with non-adherence. ADL difficulties, health status and co-morbidities are positively associated from the medical category. Frequency of medical service usage is negatively associated from this category. All variables in the medication category are positively associated with non-adherence. From the behavioural category, scepticism, disinformation, and fragmented, short, and poor physician-patient relationship are positively associated with non-adherence. Improvement of information supplied to patients at risk may be part of new strategies to decrease non-adherence. Finally, from the economic category all variables are negatively associated with non-adherence, except from cost of medication and medical care with is positively associated. The other variables, from all categories, are found to be indecisive. Cognitive impairment and older age are main contributors to medication non-adherence.

The results from this literature review will be further considered in the upcoming chapters. The associations found within this study will be further explored in the questionnaire and interviews. These associations are intertwined in the questionnaire and interview framework. The only study within this review which considers the use of adherence aids in relation to medication non-adherence is written by Okuno et al. (2001) [26]. The findings of this study indicate that using a medication adherence tool is linked to increased adherence rates. To specifically explore this potential effect of medication dispensers as an adherence tool for the target population, the next chapter discusses a literature review on this topic.

3. Literature review medication dispensers

3.1 Methodology

The research question addressed in this review is: *"What is the effect of medication dispensers on medication non-adherence?"*. To answer this question, two inclusion criteria are defined. These are: articles should focus on the non-adherence of medication and the effect of medication dispensers. Furthermore, no exclusion criteria are defined. Search terms can be found in Table 9, they are divided into two categories which are non-adherence and medication dispenser.

Table 7 Search terms

Categories	Sub-search terms
Non-adherence	Non-adher* Nonadher* Noncomplian* Non-complian*
Medication dispenser	Medication dispenser

The selection starts with 38 articles from Scopus, 2 are duplicates and 23 are excluded based on title and abstract as can be seen in Figure 2. 5 articles are excluded from the remaining 14 articles while reading the full article. These are excluded because they did not align with the inclusion criteria. A total of 9 relevant articles are found and included within this review.

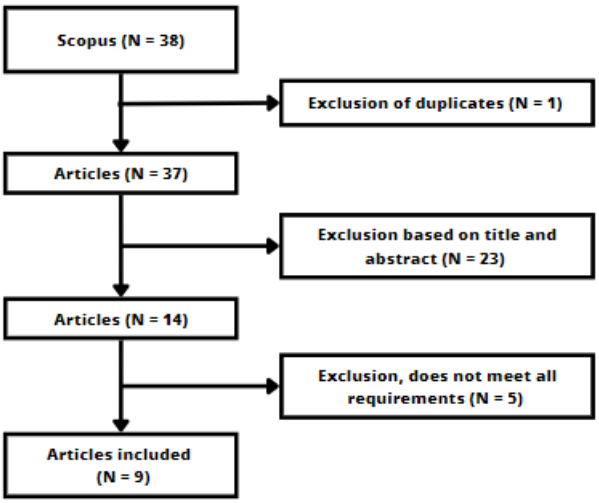

Figure 2 Article inclusion flowchart

Coding is based on highlighted information, keywords, and important phrases from all included articles. The articles are coded three times, open axial and selective coding are applied to the articles. All three coding's are only coded inductive. Full coding per article can be found in Appendix H, all coding in Appendix I and coding for each medication adherence device in Appendix J.

3.2 Results

There are multiple medication dispensers used within the 9 included articles Which can be seen in Table 10. The article written by Pinto et al. (2021) and Casciaro et al. (2020) mention multiple types of medication dispensers[27,28]. Which are medication organizers, electronic medication dispensing system (MDS) and automatic sorter and dispensers for the article written by Pinto et al. (2021). In addition, the article written by Casciaro et al. (2020) mentions all devices shown in Table 10.

Table 8 Medication adherence devices mentioned in articles

Device number	Device
1	Medication organizers
2	Smart blister packs
3	CAP-based Systems
4	Electronic medication trays
5	MDS
6	Automatic sorter and dispensers

Medication adherence devices have different designs from rather simple to quite complex designs. Medication organizers are relatively simple, they consist of multiple compartments where medication doses can be stored. Medication organizers make it possible to schedule medication and eliminate the need to sort medication every time medication is needed [27]. Smart blister packs are plastic packaging where medications are placed in pockets and are sealed to adhesive coated paper [29]. "CAP-based Systems are simple electronic devices that replace the original caps on medication vials" [27]. Electronic medication trays are comparable to medication organizers, such as pillboxes which are equipped with smart technologies such as internet or Bluetooth [29]. MDS dispense pre-packaged medications automatically on specific times and gives reminder alerts [30]. Automatic Sorter and Dispensers are an upgrade to MDS because they are capable of fetching pills individually from different medication containers. Which makes the task of sorting pill doses manually unnecessary [27].

Only one coding is used within this literature review as the first coding already gave clear outcomes. Second and third coding, as mentioned within the method, would not give any additional information and is also not necessary for clarity reasons. The first round of coding is clear enough due to the inclusion of only 9 articles and the relatively few codes for each article and medication adherence tool.

Smart blister packs, CAP-based Systems and electronic medication trays are only assigned one code. Cap-based Systems and electronic medication trays score high on useability while smart blister packs score low on usability. Medication organizers are only coded three times, they score high on usability and are best suited for individuals with high autonomy and not suited for people with any disability or disorder. Automatic sorter and dispensers are coded four times and score low on usability. However, they lead to a higher recorded adherence and save time. It is also mentioned that there is a negative association between medication dose and adherence. MDS have 22 individual codes with a total count of 31. 9 of the 22 codes are mentioned more than once, of which 8 are mentioned two times and only the code concerning a higher recorded adherence is mentioned three times. When using MDS an increase in self-reported adherence and recorded adherence is found. However, articles also mention an overestimation of self-administered adherence. Medication dispensers are mentioned to be easy to learn, have a high useability, are suited for people with low autonomy, and users are satisfied with the use of the tool. Tools have technical problems. Medication dispenser users mention an increase in health-related quality of life.

Within articles written by Arain et al. (2021) and Stip et al. (2013) an increase in self-reported medication adherence is shown [30,31]. Articles written by Schuman-Olivier et al. (2018) and Elliesen and Trummer (2016) show a contrary conclusion, an overestimation of self-administered adherence [32,33]. Articles written by Hannink et al. (2019) and Johansson et al. (2018) show an increase in recorded medication adherence [34,35]. High useability for MDS is mentioned in articles written by Casciaro et al. (2020) and Schuman-Olivier et al. (2018). Articles written by Faisal et al. (2020) and Schuman-Olivier et al. (2018) show three more codes which are mentioned multiple times, these are easy to learn, satisfied with the use of the tool and technical problems [29,32]. Articles written by Hannink et al. (2019) and Elliesen and Trummer (2016) showed an increase in health-related quality of life when using MDS [33,34].

Cap-based systems are not the best electronic devices to improve medication adherence. These devices can only be used on medication vials which are not used in every country. Furthermore, the security of the device is quite low because the caps only measure the opening of the vial and

cannot measure if the patient only opens the vial to trick the system or takes more pills than prescribed. The Cap-based systems cannot control and decrease under and overdosing. [27]

The article written by Casciaro et al. (2020) mentioned that the workload is higher for medication dispensers [28]. However, they also mention that it is reasonable to expect the workload to be low when a product scores well on usability. One of the medication dispensers within the research scores good on usability which leads to a contradiction. This can be due to low scores on usability for other medication dispensers which can lead to an average increase in workload.

3.3 Discussion

The difference in significant and non-significant outcomes in the included articles can, possibly, be explained by difference in the target population. The articles use different populations for the intervention group. However, not all groups are eligible for the use of a medication dispenser, as mentioned before, tools are suited for individuals with low autonomy but are best suited for individuals with high autonomy, and they are not suited for individuals with disability or disorders. The target populations within the articles have a broad range, from healthy individuals in good health to individuals with multiple chronic conditions, such as Parkinson's disease, opioid use disorder, and schizophrenia. Which can lead to a decrease in positive outcomes which might not be due to the medication adherence tool but due to the target population.

This however also has a flip side, medication adherence tools can for example work in a group with healthy individuals, this however does not guarantee it will work in the actual target group. As mentioned in the literature review concerning reasons of medication non-adherence the main contributing factors for medication non-adherence in the home care situation are older age and cognitive impairment. When you want to see the actual effect of implementing a medication adherence tool in the home care situation a target population is needed which at least covers both factors.

Few articles are included within this literature review. This can be the case due to multiple reasons. One of them can be the limitations within the search terms. At the start of the research only medication dispensers are searched for which limited the number of articles. Which both have advantages and disadvantages. It provides a concise group of articles, but there is a high probability that it does not encompass the complete number of articles related to medication adherence tools and their role within medication adherence. This study has provided some evidence on which tools may potentially increasing medication adherence.

Another reason of the small number of included articles is that MDS is relatively new. For example, the Medido, which is used within TWB, is on the market since 2009, the concept however is from 2005 [36]. Which makes the time researchers had for their publications limited. This does not mean the necessity of this, and other tools is limited. Since the rise of the MDS it is growing steadily and is expected to grow even more in the nearby future [37].

3.4 Conclusion

In conclusion, automatic sorters, and dispensers, have been associated with higher recorded adherence and time savings. Articles are indecisive about whether the medication adherence tools score high or low on usability. They are sure about the client's satisfaction with the use of medication dispensers. Next to this, a negative correlation between medication dose and adherence has been observed.

The use of MDS has shown an increase in both self-reported and recorded adherence, although caution is needed due to the potential overestimation of self-administered adherence. Users of medication dispensers also reported an increase in health-related quality of life. Technical problems are noted as a challenge in utilizing these tools.

However, it is worth noting that one article mentioned a higher workload associated with medication dispensers, although this may vary depending on the specific dispenser's usability. Overall, the available information suggests that medication dispensers have a positive impact on medication adherence and can contribute to reducing medication non-adherence.

4. Questionnaire

4.1 Methodology

The goal of the questionnaire is to get insight into the view, opinions, and experiences of the stakeholders within TWB about medication non-adherence, tools, and occupational therapists. Questionnaires are conducted in a structured manner which is "a document that consists of a set of standardized questions with a fixed scheme, which specifies the exact wording and order of the questions, for gathering information from respondents" [38]. This manner is chosen to obtain qualitative insights.

Questionnaire design

The questionnaire is built within Qualtrics and is written in Dutch, the full questionnaire can be found in appendix K. No existing questionnaires are found which can be used entirely or can be built upon. This is why a full new questionnaire is set up, which consists of two parts, reasons of non-adherence and tools which can possibly be used to reduce medication non-adherence. Tools include medicine boxes, medicine alert alarm clocks, alarm watches, assistance in opening packages, medicine dispensers, medicine apps, putting large letters on medicine packaging, Digicontact, and dementia clocks. Within the tools section, cooperation with the occupational therapist is also included.

The design of the questionnaire is based on the outcomes of the literature reviews. The answer options for the question regarding reasons of medication non-adherence, questions 10, 11 and 12 are based on the outcomes of the literature review concerning medication non-adherence, as can be seen in Table 11. Answer options "Does not trust the doctor" and "Does not trust the pharmacy" are based on articles written by Abel and Efird (2013) and D. Wu et al. (2022) [39,40]. Both articles show a negative association between medication non-adherence and trust in health care providers.

Table 9 Comparison between answer options and outcomes literature review non-adherence

Answer options questions 10, 11 and 12	Outcomes literature review non-adherence
Does not see importance of medication	Does not see treatment as important
Is afraid of side effects	Feared side effects
Suffers from side effects	Actual side effects
Cannot read medicine packaging	Reading impairment
Forget to take medication	Forgetting to take medication
Busy with other things	Busy with other things
Does not get medication out of package	Difficulty opening the medication bottle
Does not trust the doctor	*Based on research* [39,40]
Does not trust the pharmacy	*Based on research* [39,40]

In the first part of the questionnaire respondents are asked to state whether they have been non-adherent to medication and if so, they are asked how often and why they are non-adherent. Employees are not asked the question regarding how often respondents are non-adherent.

In the second part of the questionnaire tools are incorporated. Medication boxes and medication dispensers are tools which are included in the questionnaire based on the literature review concerning medication dispensers. A study within TWB that is carried out simultaneously with this study shows that these and all other included tools are commonly used within home care organizations. Tools are introduced to the participants by showing pictures. Participants are asked whether they know these tools, if they have worked with them, what their opinion is and if they are willing to use the tools. These questions are also asked regarding occupational therapists.

The questionnaire format is based on a Likert-scale [41]. A Likert-scale is a rating system which is often used within quantitative research and assesses attitudes, opinions, perceptions, or behaviours. When possible, questions are asked on a 5-point rating scale to measure the degree of agreement from a respondent [42]. An example of a question where the answers are based on the Likert-scale is: what is your experience with these tools? The answer set is very bad, poor, fair, good, and excellent. Answers are based on the Likert-scale when possible.

Questions 1 through 21 have answer requirements, which can be either forcing a response or

asking a response. All questions up to 12 force a response and questions 13 up to 21 ask a response. Questions 13 up to 21 ask about knowing, experience with and willingness to work with tools. They are impossible to answer with answer requirements because not all respondents know, have worked with or are willing to work with tools.

Study population

The questionnaires are sent to clients, informal caregivers, and employees within TWB. The questionnaire is exclusively filled in online. The questionnaire is sent in a newsletter via e-mail to a total of 1.607 clients and informal caregivers whereof 43 bounced as can be seen in Figure 3 below. This leads to a total of 1.564 recipients. 1.089 of which opened the e-mail and 846 clicked on the link. 282 clients and 80 informal caregivers, together 362, finished the questionnaire. Which measures up to 23% of the total recipients and 43% of the recipients who clicked on the link.

The number of employees who received the questionnaire is unsure because of the distribution of the questionnaire, which is sent through a streak of e-mails from the managers to the employees. The estimated number of employees who received the questionnaire is between 400 and 550. 144 employees filled in the questionnaire. The response rate is respectively 36% and 26%. The total number of completed questionnaires is 506.

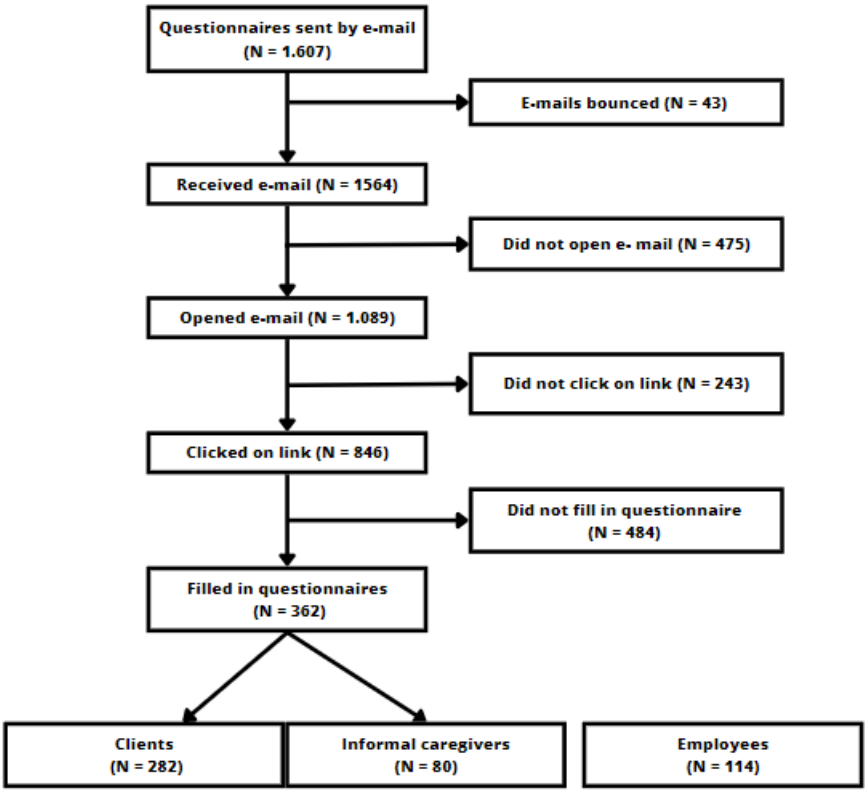

Figure 3 Questionnaire responses

Data analysis

For almost all questions results are interpreted based on median outcomes. For the questions regarding having heard of tools and reasons to, not, use tools, the results are based on the percentage of answers. Inductive coding is applied to open-ended questions. The open-ended questions are concerning reasons for whether to work with tools or occupational therapists. Coding is set up in Qualtrics. The coding can be found in Appendix M and N. Respondents answered in Dutch, this is why coding is set up in Dutch. The questionnaire is sent out between February 11th at 9:45 and March 3rd at 12:00.

Ethical approval

Ethics approval is granted on the 26th of January 2023, by the Behavioural, Management and Social Sciences Ethics Committee at the University of Twente with request number 230172. An informed consent is included in the questionnaire, which can be found in appendix L.

4.2 Results

A total of 506 questionnaires are, completely, filled in. This is a high response which leads to a high generalizability to the entire home care organization. The questionnaire is discussed based on the questionnaire format, where first the results of the clients are shown followed by the results of the informal caregivers and employees.

Medication non-adherence

32,6% of clients, 37,5% of informal caregivers and 91,7% of employees indicated that they are familiar with the term medication non-adherence before starting the questionnaire. Furthermore, 19,9% of clients and 34,6% of informal carers indicated that they or the care-dependent are non-adherent to medication. And 90% of the employees indicated that at least one of their clients is non-adherent.

Clients indicated that on average they are medication non-adherent between once a month and once every six months. Both answer options, once a month and once every six months, have 13 reactions out of 52 reactions. Informal caregivers indicated that care-dependents are on average multiple times a month medication non-adherent. The most chosen category is multiple times a month with 6 reactions out of 26 reactions.

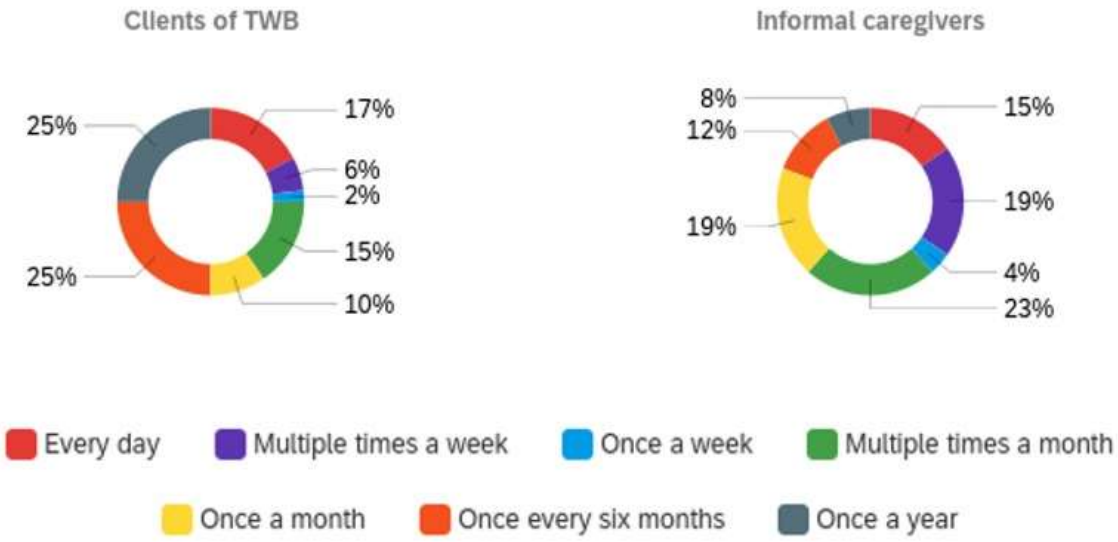

Figure 4 Average times of medication non-adherence

Reasons of medication non-adherence

Reasons of medication non-adherence can be seen in Figure 5. Clients indicate forgetting to take medication and suffering side effects as the most important reasons for medication non-adherence, with respectively 31,3% and 17,2% of 64 reactions. Informal caregivers indicate forgetting to take medication as the most important reasons of medication non-adherence with 44,4% of 36 reactions. Employees indicate forgetting to take medication and not seeing the importance of medication as the most important reasons for medication non-adherence, with respectively 25,3% and 20,9% out of 446 reactions.

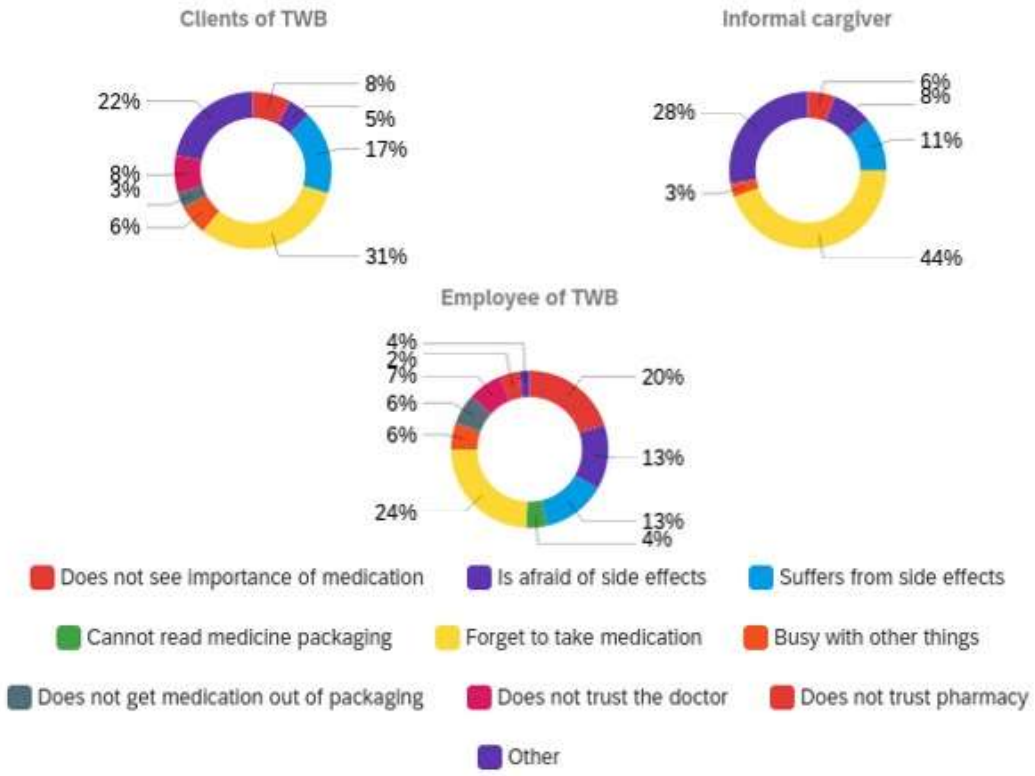

Figure 6 Reasons of medication non-adherence

Best-known tools

The best-known interventions can be seen in Figure 6, the percentages are shown relative to each other. For clients medicine boxes, medication alert alarm clocks, and alarm watches are the best known and 78,1% of the clients are familiar with occupational therapists. Among informal caregivers, medicine boxes, medication alert alarm clocks, alarm watches, and medicine dispensers are best known. A percentage of 54,9% of the informal caregivers are familiar with occupational therapists. Employees are most familiar with medicine dispensers, medicine boxes, and dementia clocks. 73,6% of the employees are familiar with occupational therapists.

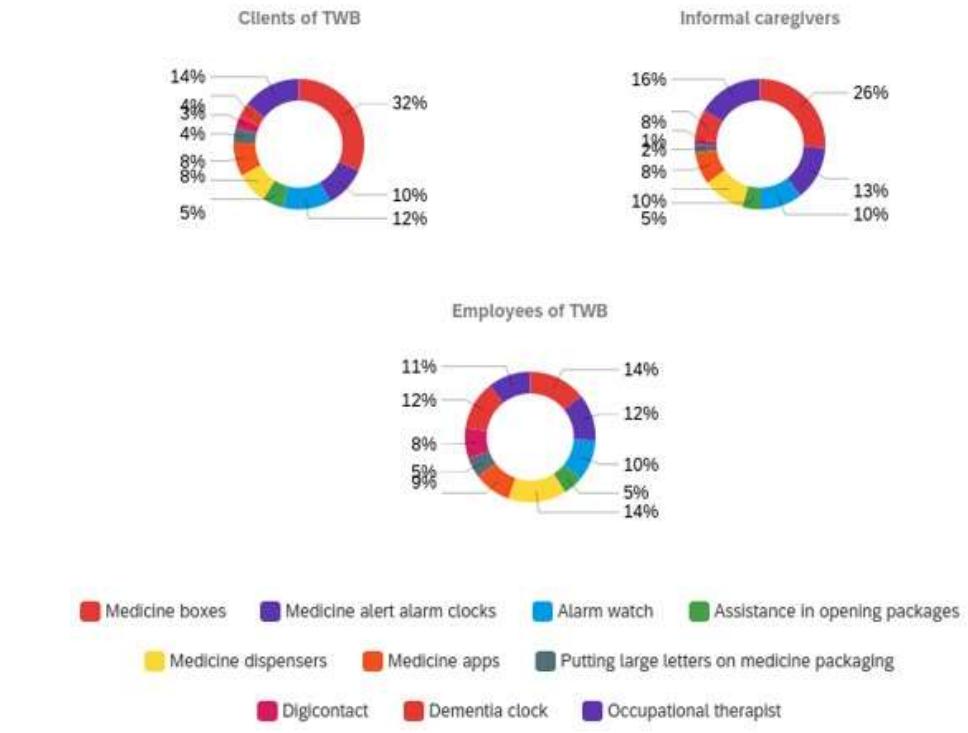

Figure 7 Best-known tools

Most-used tools

The most-used tools can be seen in Figure 7, the percentages are shown relative to each other. Clients have used medicine boxes and medicine apps the most as 27,3% of the clients have worked together with the occupational therapist. Informal caregivers have worked the most with medicine boxes, and medicine dispensers as 44.3% have worked together with the occupational therapist. Employees have worked most with medicine dispensers, medicine boxes, and dementia clocks as 41% have worked together with occupational therapists.

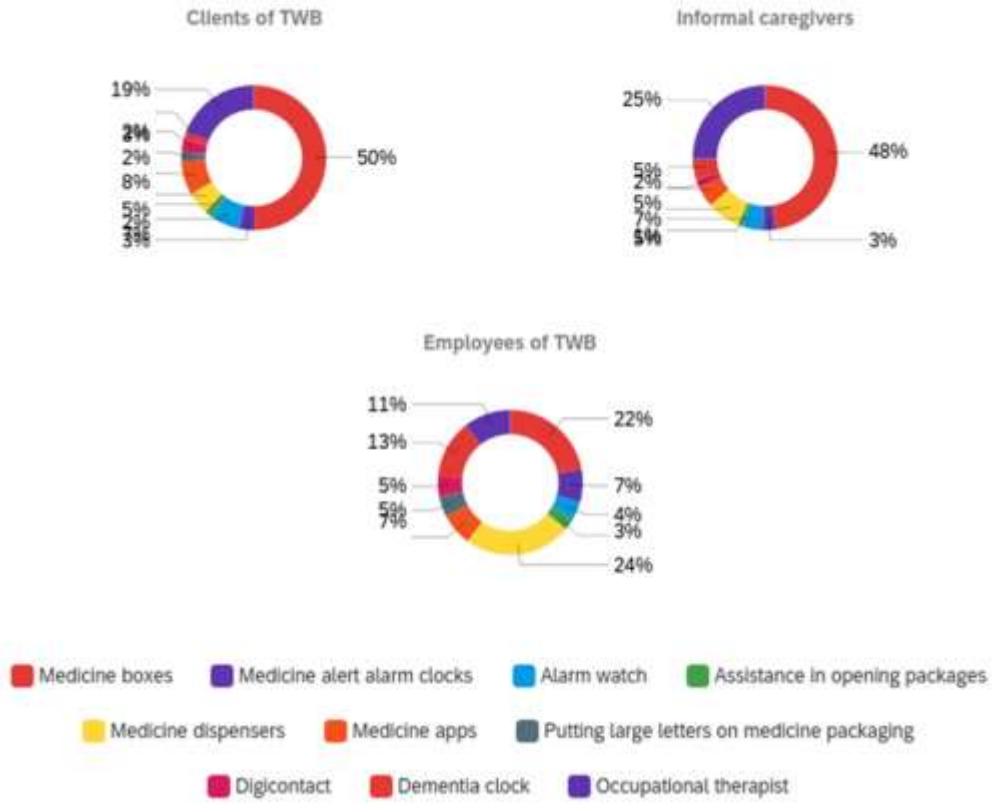

Figure 8 most-used tools

Experience with tools and occupational therapist

Clients have the best experience with medicine boxes, alarm watches, medicine dispensers, medicine apps, Digicontact, dementia clocks and occupational therapists, they all scored 4 out of 5 points on the Likert Scale. Medicine alert alarm clocks scored 3,5 out of 5 points. The lowest scoring tools for clients are, getting assistance in opening packages and putting large letters on medicine packaging which both scored 3 out of 5 points. The medicine alert alarm clocks, assistance in opening packages, Digicontact, dementia clock, and putting large letters on medicine packaging are reviewed by less than 5% of the clients which can lead to a lower accuracy.

Informal caregivers have the best experience with medicine boxes, alarm watches, assistance in opening packages, medicine dispensers, Digicontact, and the occupational therapist, they all scored 4 out of 5 points. Medicine alert alarm clocks scored 3.5 out of 5 points and the medicine app scored 3 out of 5 points. Putting large letters on medicine packaging is not mentioned by any of the informal caregivers. The medicine alert alarm clocks, assistance in opening packages, and putting large letters on medicine packaging are reviewed by less than 5% of the informal caregivers, which can lead to lower accuracy.

Employees have the best experience with assistance in opening packages, medicine dispensers, medicine apps, putting large letters on medicine packaging, Digicontact, Dementia clock, and the occupational therapist, they all scored 4 out of 5 points. Medicine boxes, medicine alert alarm clocks, and alarm watches scored a 3 out of 5. Assistance in opening packages is only reviewed by less than 5% of the employees, which can lead to lower accuracy.

Willingness to use

When clients are not familiar with tools, they are not likely to be willing to work with medicine alert alarm clocks, alarm watches, medicine dispensers, medicine apps, Digicontact, dementia clocks, and occupational therapists. Clients are neutral to working with medicine boxes, getting assistance in opening packages, and putting large letters on medicine packages. When clients are familiar with tools, they are neutral to almost all tools and the occupational therapist. Putting large letters on medicine packaging is answered between neutral and likely. The average willingness to use is made up of the willingness to use from each tool and the occupational therapist together and can be found in Figure 8. 55% of clients are not likely (at all) to work with tool when they are not familiar with the tools before starting the questionnaire. When they do know the tools this percentage decreases to 32%. 21% of clients are (very) likely to work with tool when they did not know the tools. When they do know the tools this percentage increases to 35%.

Figure 9 Client's willingness to work with tools

When informal caregivers are not familiar with tools, they are not likely to work with medicine alert alarm clocks, alarm watches, assistance in opening packages, medicine dispensers, medicine apps, Digicontact, and dementia clocks. They are between not likely and neutral towards medicine boxes. The reaction to put large letters on medicine packaging and working with occupational therapists is neutral. When informal caregivers are familiar with tools, they are not likely to work with medicine apps. Working with medicine alert alarm clocks, alarm watches, assistance in opening packages, medicine dispensers, putting large letters on medicine packaging, Digicontact, and occupational therapists is mentioned to be neutral by informal caregivers. They are likely to work with medicine boxes and dementia clocks. The average willingness to use can be found in Figure 9. 56% of informal caregivers are not likely (at all) to work with tool when they do not know the tools. When they do know the tools this percentage decreases to 29%. 22% of informal caregivers are (very) likely to work with tool when they do not know the tools. When they do know the tools this percentage increases to 41%.

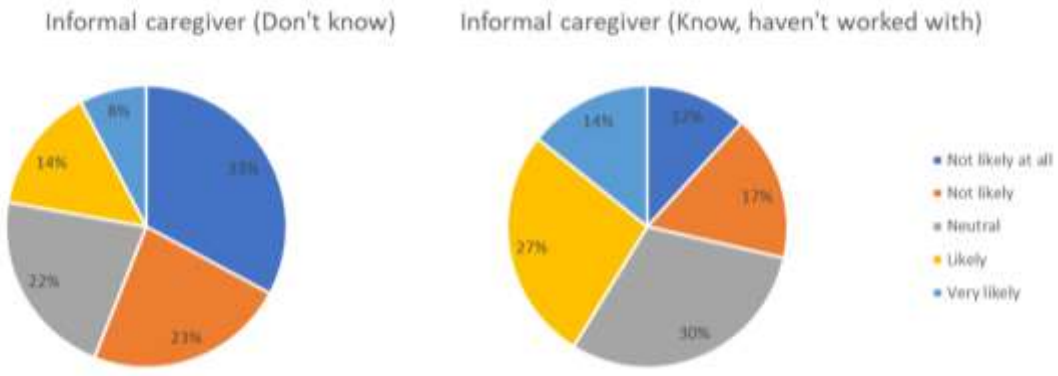

Figure 10 Informal caregivers' willingness to work with tools

When employees are not familiar with tools, they are not likely to work with medicine boxes and medicine dispensers. They mention to be neutral towards working with medicine alert alarm clocks, alarm watches, medicine apps, Digicontact and occupational therapists. Likely to get assistance in opening packages, putting large letters on medicine packaging, and using a dementia clocks. When employees are familiar with tools, they are likely to work with almost all tools and occupational therapists. The only tool they are very likely to work with is medicine dispensers. The average willingness to use can be found in Figure 10. 25% of employees are not likely (at all) to work with tool when they do not know the tools. When they do know the tools this percentage decreases to 12%. 49% of employees are (very) likely to work with tool when they do not know the tools. When they do know the tools this percentage increases to 67%.

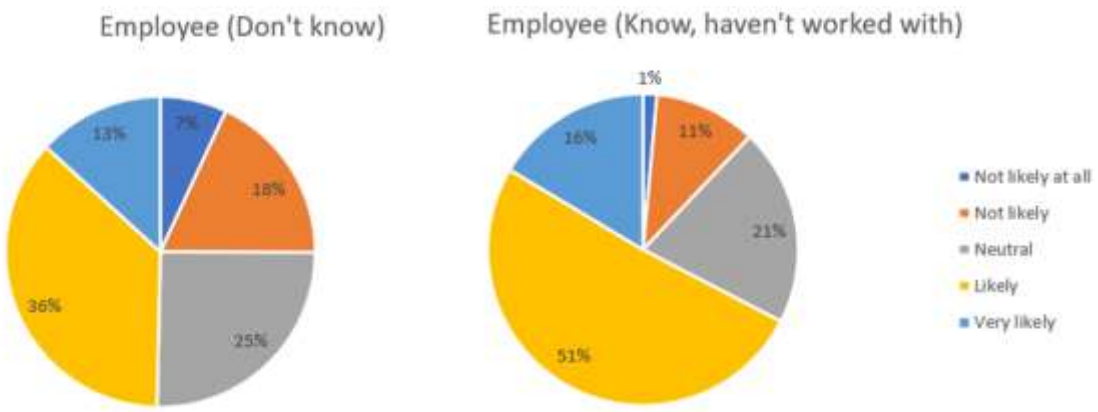

Figure 11 Employees' willingness to work with tools

Reasons for whether or not to work with tools or occupational therapists

As can be seen in the coding in Appendices M and N, the most common reasons for clients to work with tools or occupational therapists are necessity (19,7%), convenience (19,1%) and it helps to remember taking medication (11,5%). For clients the main reasons for not using tools or working with an occupational therapist are that they, think, the tools are not necessary (32,9%), or clients do not have a reason to not use a tool (19,2%), and they do not want to use a tool because they want to stay independent for as long as possible (6,6%).

The most common reasons for informal caregivers for using a tool is convenience (16,4%), it helps to remember taking medication (14,8%) and tools are easy to use (11,5%). The main reasons for not working with a tool are that informal caregivers or care-dependents think that tools are not necessary (26,8%), they cannot deal with the tool (16,1%), and tools are too digital (16,1%).

The most common reasons for employees for using tools are increasing the independence of clients (39,1%), increase adherence to therapy (9,3%) and tools are easy to use (9,3%). Main reasons for not working with tools are that clients cannot deal with the tools (22,0%), the tools are not suitable for clients (15,6%), and clients do not understand how to use the tools (8,5%).

4.3 Discussion

Clients, informal caregivers, and employees all mention different rates of self-administered medication non-adherence. Only 20% of the clients answered that they had ever been non-adherent to medication. Whereas 40% of the informal caregivers and 90% of the employees answered that the people they care for had ever been non-adherent to medication. This is also found in both literature review, here is often shown that self-registered medication non-adherence is lower than measured medication non-adherence. Two articles, written by Schuman-Olivier et al. (2018) and Elliesen and Trummer (2016), which are included in the literature review concerning medication dispensers show similar results [32,33]. However, the discrepancy can also be caused by employees seeing a lot of clients which increases the chance of one of the clients being non-adherent.

Medicine boxes are well rated by clients and informal caregivers because they stay independent and TWB is not involved with medication. As soon as TWB is involved with managing

medication medicine boxes will be replaced by the Baxterrol. A possible reason why employees do not mention having good experience working with medicine boxes is they prefer the Baxterrol because they are safer.

Most employees are (very) likely to work with the tools and occupational therapists they are familiar with but haven't worked with yet. However, the fact that most employees want to work with medication adherence tools doesn't mean that everyone is willing to work with these tools. This also holds for clients and informal caregivers, and for people working with tools they don't know yet. Therefore, it is important to not only focus on creating awareness about medication adherence tools, but also consider ways to motivate staff who are familiar with these tools but are not yet willing to work with them.

Results of the questionnaire show a positive association between respondents being familiar with tools, and their willingness to work with these tools in the future. This is also the case for the working with occupational therapists. In general people are more willing to work with products, tools, brands, and people when they are already familiar with them. According to the article written by Hekkert et al. (2013) this phenomenon is called the mere exposure effect and is well-established in different fields of science and mainly used for product branding [43].

A total of 282 clients, 80 informal caregivers and 144 employees filled in the questionnaire. For clients and informal caregivers, the response rate is 23% of the total recipients and 43% of the recipients who clicked on the link. The response rate for employees can only be estimated and is between 26% and 36%.

The response rate is expected to drop when the age of respondents is higher than 40 years old, which is the case for almost all recipients. The response rate is also likely to be lower due to a high number of digital illiterates in the research group. A higher age is related to a lower score in basic digital skills [44]. A lower number in response rate can be explained by the job distribution among employees, because not all employees of TWB are caregivers. Which can lead to a lower response rate because employees do not feel addressed. Another explanation can be found in the distribution of the questionnaires. Due to multiple delays the link to the questionnaire is sent later to the employees which gave them less responding time.

For all three stakeholder groups less than 5% of the respondents had experience working with 'assistance with opening packaging'. For several other medication adherence tools less than 5% of the respondents in at least one of the three stakeholder groups had experience working with these tools. These outcomes are not likely to be representative for the overall stakeholder population. Outliers have a big impact on the results when very little responses are obtained.

Response bias is caused by answering untruthfully or inaccurately. This can be caused by multiple reasons, to start with the tendency and individual has to provide average responses. According to a study conducted by Purnawirawan et al. (2007), individuals often prefer not to choose extreme answers. For instance, when presented with a scale ranging from one to five, many people tend to select values between 2 and 4 [45]. Another reason for response bias is the tendency of individuals to give socially desirable responses, which is described by an article written by Steenkamp et al. (2010) [46]. This is why the outcome of the questionnaire is expected to be biased towards a lower non-adherence and a higher motivation.

Due to numerous emails expressing difficulties in completing the questionnaire due to certain unanswerable questions, slight modifications have been made to the questionnaire starting from Sunday, February 12th. An additional option, Other, has been included with the question, which tools are you familiar with? Furthermore, the last question is now non-mandatory. Instead, the respondents are asked the question twice and are provided with a reminder if they have not yet answered it.

As mentioned above clients have a lower self-registered medication non-adherence than informal caregivers and employees mention. This also applies to the number of times clients are non-adherent. This can cause difficulties in improving medication adherence. If clients are unwilling to admit their non-adherence, clients are likely to not see the importance of improving medication adherence because they think their medication adherence rate is good. This can lead to resistance in adjusting medication adherence tools which can also be found in the literature reviews. This can also be connected to not seeing the importance of medication, this is mentioned by employees as an

important contributing factor of non-adherence. A combination of not seeing importance in medication and a low self-reported medication non-adherence can give many difficulties when trying to improve medication adherence.

4.4 Conclusion

This article has a high response rate, as evidenced by the article by Wu et al. (2022). The response of this article is 506, 282 clients, 80 informal caregivers, and 144 employees is high when compared to Wu's standard [47].

All three respondent groups have worked often with medicine boxes. Medicine boxes can improve non-adherence Clients have worked often with medicine apps. Informal caregivers and employees have worked often with medication dispensers and only employees have worked often with dementia clocks. Both clients and informal caregivers have good experience working with medicine boxes and alarm watches. Clients also have good experiences working with medicine apps and dementia clocks. Informal caregivers have good experience working with assistance in opening packages and employees with medicine apps, dementia clocks and putting large letters on medicine packaging.

The 3 most common reasons for medication non-adherence are forgetting to take medication, not seeing the importance of the medication, and suffering from side effects. The most important reasons to work with tools or occupational therapists, concluded from the questionnaire, are that they help the client remember to take medication and that tools are easy to use. Most important reason for not using tools is that clients cannot deal with the tools. The desire to maintain independence is mentioned as both a motivating factor for using medication adherence tools or occupational therapists, as well as a reason for not using them.

Knowledge of tools provides a higher chance that people want to work with a tool. This is why it is important to get clients, informal caregivers, and employees familiar with medication adherence tools. It is also important for them to know about the cooperation with occupational therapists regarding medication guidance. To reach an optimal effect when implementing medication adherence tools an even broader knowledge within the health care organization is needed. The information can improve the willingness to use tools. This is the case because medication does not start within home care, it is often set up by the general practitioner and the medication is dispensed by the pharmacy.

Answers from the theoretical framework and questionnaire are combined into the framework of the interview. Important points that are intertwined in the framework are: reasons for medication non-adherence, all tools and occupational therapist mentioned in the questionnaire, procedure regarding the use of tools, and considerations when using tools. Conclusions of these categories are mainly based on multiple choice questions which does not allow in-depth questions. To gather more detailed information, the findings from the three previous chapters are merged and integrated into the interview framework.

5. Interviews

5.1 Methodology

For the interviews a semi-structured approach is chosen, this is a combination of a structured and an unstructured interview. This leads to an open-ended interview that gives flexibility but ensures the outcomes are still comparable between interviewees [48]. Five interviews are physically conducted with two district nurses, two carers, and one occupational therapist.

The interview design is based on the outcomes of the literature reviews and questionnaire. The selective coding categories are derived from the theoretical framework and questionnaire. The questionnaire outcome is incorporated within the interview format by asking in depth questions on the topics included in the questionnaire. Interviews provide methodological flexibility, enabling in-depth analysis even with a relatively small sample size. They place the research focus towards the perspectives and views of the participants, adding richness, depth and qualitative information to the findings compared to the literature-based approach and questionnaire [49,50].

The dichotomy used in the questionnaire is continued in the interviews. Question 4 regarding working only with clients within TWB is a question which only aims at the occupational therapist. Some questions are in-depth questions which can only be answered when someone is familiar with the content of the first question. This is the case for questions 31, 32, 33, 34, 36 and 37, they can only be answered when the interviewee is familiar with the procedure around medication adherence tools. Question 40 can also be excluded from the interview scheme when the interviewee mentions that trainability is not looked at.

The structure of the interview can be found in appendix O. Interviews are conducted in Dutch. Before conducting the interview, an informed consent is sent to the participants. This can be found in appendix P. Before starting the interview, permission is asked to record the interview. The data can only be accessed by the researcher and is stored at an external hard drive.

To get in contact with the different stakeholders they are divided into three groups, employees, clients and informal caregivers and occupational therapists. Employees are contacted trough their district managers, an e-mail is sent with information about the project and the question to spread the information within their district. Four participants reached out which are two district nurses and two carers. Clients and informal caregivers are contacted through the monthly newsletter. Participating employees are asked to refer clients and informal caregivers to me when they are interested in participating as well. Unfortunately, no clients and informal caregivers showed interest in participating. Occupational therapists are contacted through a general information e-mail address on their website, which resulted in one participant.

The interviews are transcribed through Amber Script which is an Artificial Intelligence (AI) based transcribing program [51]. Amber Script will create a draft transcript which has an accuracy up to 85%. The draft transcript is then fully developed into an Intelligent Verbatim Transcription. Here every word will be transcribed but pauses, stutters and filler words, such as “uuh”, are left out when they add no meaning into the transcript [52]. When quotes are used from the transcript they are translated to English for clarity.

The transcribed interviews are placed in ATLAS.ti. This is an AI driven data analysis software for qualitive data which can give insights into interview data [53]. Coding of the interviews is done in three phases, AI coding, deductive coding, and inductive coding. AI coding is generated within ATLAS.ti, these codes have been read through and sorted out. The AI coding is often too precisely which leads to multiple codes for one topic. For example, four years of working experience is both coded as “Management: Work experience: 4 years” and “Technology: Work experience: 4 years”. The AI function within ATLAS.ti is not very advanced, for example “instructie”, “instructies” and “instuctie/uitleg” are not combined which leads to cluttered coding. Other forms of incorrect coding can be found widespread throughout all interviews which lead to a total of 616 individual codes within 9 code groups. The number of codes and code groups are deleted and merged and are reduced to 6 and 99 respectively.

The second coding phase is based on qualitive coding [54] . Qualitive coding will help to find themes and patterns in systematic manner by categorizing excerpts of the retrieved data. It can also help to reduce bias and increase validity and transparency. Coding used for the deductive and inductive coding is structural coding. Structural coding is based on the structure of the conversation,

within these interviews the structural coding is based on the questions asked within the interview. Deductive coding based on previous researches can be found in Appendix Q. AI, deductive and inductive coding can be found in Appendices R S and T. Results are based on both the full answers on questions and the coding.

The third coding phase is inductive coding, which is applied to parts of the interview where coding is lacking. Ethics approval is granted on the 7th of March 2023, by the Behavioural, Management and Social Sciences Ethics Committee at the University of Twente with request number 230048.

5.2 Results

All interviewees agreed to the informed consent and to be recorded. Employees from TWB worked in general between 2 and 4 years in their current job role. The occupational therapist has been working for TWB and another nursing home for 25 years. Both working intramurally and visit people at home. The target group within TWB and for the occupational therapist is mainly elderly people with limitations in daily life.

All four home care employees assist clients with taking medication, they mention that a Baxterrol is mandatory when the employees are responsible for administering medication. They are not allowed to assist with medication that is not prescribed, including loose medication. When asked if they are allowed to assist with loose medication, one of them mentioned this is not allowed and said, “Yes, we have strict district nursing sometimes” and “In principle, it is broad within TWB. But I know that it still happens in other clusters”. The occupational therapist mentioned that they are not responsible for the actual intake of medication but for assessing whether someone can still take medication independently or with assistance and considering which tool can be used. The occupational therapist mentions that it is not their responsibility. They are responsible for assessing whether someone can still take medication independently or with assistance and considering which tool can be used.

All five interviewees mention differences in responsibility in different situations. When the client is responsible for taking the medication, they are also responsible for monitoring the proper intake of medication. However, when the client can no longer do this the carer and the district nurse are responsible for the client taking the medication when they sign them, the district nurse has the final responsibility. One of the employees said, “when you administer medication yourself, you are responsible for ensuring that the client takes it and for signing it off”. One employee mentions the actions needed to be taken around medication are explicitly described in the care plan. One of the employees did mention a key focus point which is to utilize the Medido more when clients need help with taking medication.

Table 10 Medication assistance offered to clients mentioned by interviewees

Medication assistance offered to clients	Mentioned in interviews
Physical care	3, 4, 5
Baxterrol	2, 5
Medido	3, 4
Medicine boxes	1
Alarm in phone	1
Call for medication	3

Clients receive assistance with medication intake through various methods. If clients require assistance with medication, they need to switch to using either the Baxterrol or Medido systems. This ensures that the necessary help and guidance are available to them. As can be seen in Table 10, one employee mentioned that they would sometimes call for medication reminders, “however, it is not done very often because if that is the case, we try to explore the use of a Medido or the need for it to be a physical moment, as otherwise, it won't be successful”. This employee and two other employees

mention that physical care is needed sometimes because of cognitive problems or things like patches, cream, or drinks that cannot be administered using a Baxterrol or Medido.

All 5 interviewees indicate that the medication intake of clients (in the correct way) is being monitored. The occupational therapist is not responsible for that, they look at the problems someone has with taking medication independently. Two employees describe MIC notifications as a way of keeping track of medication adherence within the client group. One of them says “Well, I also know from my colleagues that some of them are very strict about it. "You know, if it's not signed off, then I make an incident report because that's the agreement". But I also have colleagues whom I talk to, and they say, "Well, I don't always make an incident report, you know, I think everyone can forget sometimes”. Mistakes were made in the past because not everyone was reporting these medication mistakes. Two other employees did not mention incident reports, they did mention reporting in the care plan and reporting back to the district nurse as protocol.

One employee and the occupational therapist indicate that information about medication intake is acted upon by looking at what happened and seeing what can be done to address these problems, for example providing more information or involving tools or planning physical moments when there are no other options.

Table 11 Reasons of medication non-adherence mentioned by interviewees

Reasons of medication non-adherence	Mentioned in interviews
Cognitive problems	1, 2, 3, 5
Client forgets to take medication	1, 2, 3
Client does not understand dosing regimen	1, 2
Motivation issues	1
Client does not see treatment as important	1
Medication does not work	1
Client does not understand why to take medication	1
Illness	3
Avoiding of care	5
Self-management	5

As can be seen in Table 11, cognitive problems are mentioned as the most important reason for medication nonadherence, followed by forgetting medication and not understanding the dosing regimen, as mentioned by 4, 3 and 2 interviewees, respectively. 7 other reasons are mentioned by one interviewee.

All interviewees mention the Medido, a medication dispenser, and medicine boxes as tools which are currently used within TWB for taking medication. However, medicine boxes are only used by clients, employees are in no way responsible for medication taken from medicine boxes. Two employees mention these tools as unsafe but do recognize that clients enjoy working with them to stay independent longer. One employee and the occupational therapist mention that they can only be used safely when clients do not have cognitive problems. All TWB employees use the Baxterrol. One district nurse and the occupational therapist also mention an alarm in a phone as a currently used tool for reducing medication non-adherence.

Two employees and the occupational therapist recommend using medication alert alarm clocks. One employee and the occupational therapist do mention that it is more likely to work when the target group is younger or in a couple of years when the elderly is more technologically literate. The employee said, “No, I think people who are of that age now, it becomes difficult, they can, fortunately, send, text, messages, but you shouldn't expect anything else from them”.

Two employees and the occupational therapist are familiar with alarm watches. While one employee and the occupational therapist believe that alarm watches can be beneficial, they have not specifically used them for medication adherence. However, both employees have experience using alarm watches in relation to fall incidents. One employee has worked with alarm watches and recommends their utilization.

Three employees mention that the Baxterrol is already pre-cut and therefore there is no need in getting assistance in opening packages. One employee and the occupational therapist have not personally worked with this tool but have heard of it. The employee did point out “that people struggle to open it properly. You should consider using a tool to assist with that”.

Two employees and the occupational therapist report that they have experience with using the medication dispenser and would recommend it. However, they do mention a condition: the client should not have cognitive problems. One employee highlights that a client can benefit from using a medication dispenser if they tend to forget medication but still possess the presence of mind to respond to the alarm. Another employee shares that they encountered technical issues with medication dispensers during their work. The occupational therapist emphasizes the significance of practice and training.

None of the employees have practical experience with medicine apps. However, two employees are familiar with the concept, and believe medicine apps can be beneficial, but they also mention that it might still be too early for widespread adaptation. They anticipate that in about ten years, as more people become technologically literate, medicine apps will likely become more popular. The occupational therapist mentioned instances where clients have used medicine apps for medication reminders.

None of the interviewees have experience working with medication packaging that features enlarged letters. Three employees state that they are not familiar with such a tool, while one employee and the occupational therapist have heard of it. These two, along with another employee, believe that this tool could assist clients in correctly taking their medication, especially when dealing with loose medication or Baxterrol. However, one employee expressed uncertainty regarding its effectiveness and mentioned alternative solutions like magnifying glasses, which can be used by clients who cannot read the test on the boxes.

Out of the five interviewees, only one employee has experience working with Digicontact. However, in that specific case, it did not prove effective due to the client's various challenges, such as difficulties with eating. Another employee is familiar with Digicontact and expressed belief in its potential to enhance medication adherence. The remaining three interviewees have no prior knowledge or experience with the tool. One interviewee believed that Digicontact could potentially improve medication adherence, while another recommended phone communication as a valuable alternative, especially for individuals without cognitive impairments.

Three of the four employees are familiar with the concept of a dementia clock. However, their usage of the clock is primarily focused on explaining the date and time to clients rather than specifically for medication purposes at present. On the other hand, the occupational therapist has hands-on experience with the tool and recommends its use. It is noted that informal caregivers can effectively utilize these clocks and assist in making medication adjustments when necessary.

All employees acknowledged the involvement of occupational therapists, with two of them expressing a positive recommendation for their role in assisting clients with medication intake. However, two other employees noted that the utilization of occupational therapists in this regard could be improved, suggesting that their current involvement may not be sufficient for effectively promoting medication adherence.

Only two employees are familiar with the specific procedure for the provision or request of medication adherence tools, they are also involved in this procedure. While the other three interviewees believe there is likely a procedure in place but are not well-acquainted with its details. The procedure addresses both the eligibility criteria for clients and the process of requesting medication adherence tools. At first clients are assessed to determine if they are capable of independently requesting the tools or if they require assistance from informal caregivers. In cases where independent request is not feasible, it becomes the responsibility of the home care employees to facilitate the process. Application forms are utilized for submitting requests for the tools which are very clear. In addition to the involvement of the client, informal caregiver, and home care employees, acute team and pharmacy can also play a role in assisting with medication intake. The acute team is responsible for responding to alarms, while the pharmacy oversees providing tools and medication.

The delivery time for medicine boxes is typically one day since clients are responsible for purchasing them, either online or in-store, this can be on the same day. However, the delivery of a medication dispenser usually takes around 2 to 3 weeks. In case of urgency, the general practitioner's

signature is required for expedited delivery. One of the employees noted that there can be delays in the delivery of medication due to the pharmacy, although the specific reason for these delays is unknown. Additionally, this employee expressed their opinion that the delivery time for medication dispensers should be faster.

The employees of TWB need to prioritize their own health by promptly using assistance tools and replacing them regularly, while also considering ergonomic practices. The delivery of medication checklists is efficient, and there is effective communication with clients and their families. However, issues with the Medido device, such as errors and alarms, have been identified. The teamwork between TWB and the pharmacy is commendable, with a belief that medication assistance tools can enhance patient independence. Non-adherence to medication is promptly recognized, and the selection of adherence tools is generally satisfactory. Nonetheless, there is room for improvement in signalling of non-adherence. Communication and teamwork are already at a satisfactory level, but further improvement is needed, particularly in the collaboration between TWB and the occupational therapist.

Both caregivers stated that they are not responsible for the selection of tools and are unaware of the process. Both district nurses and the occupational therapist emphasized the need for preliminary research to choose the appropriate medication adherence tool. Each situation should be assessed individually to determine the reasons behind the patient's non-adherence and to determine if they can manage it independently with the assistance of a tool.

The trainability of a client is being assessed by both the occupational therapist and employees of TWB. Clients undergo training, which involves the occupational therapist or TWB employees explaining the functioning of the tool and conducting practice sessions to familiarize the clients with its use.

Relieving the burden on home care is the most frequently mentioned reason for using a medication adherence tool. The second important reason is to promote client independence. Additionally, ensuring ergonomic practices and enabling clients to stay at home for as long as possible are also highlighted as important factors.

The primary reasons for not utilizing medication adherence tools are cognitive impairments and the need for additional supervision in critical situations where vital medication is involved. In such cases, relying solely on a tool may not be the most suitable solution. Additionally, if clients are unable to learn to use the tool independently, alternative approaches should be considered. Another factor to consider is when individuals lack a social support network, relying on physical healthcare interactions rather than implementing a tool may be more appropriate.

Tools should be designed to be extremely user-friendly, requiring minimal instructions for use. An example of this is the medication dispenser with just a single button. However, it is worth noting that medication dispensers can sometimes encounter errors, requiring the intervention of employees or the manufacturer to reset the device. The use of Baxterrols also presents issues, as the bags can be either too difficult or too easy to open, depending on the user. According to one of the employees "Then you have those pills flying through the air, and some people have to use scissors because they can't open them."

There are costs associated with tools, but in most situations, these are covered by the health insurance. The willingness to pay depends on the person. Some are willing to pay to keep their independence. Others just do not want to pay. The willingness to pay also depends on the communication of the employees towards the client. One employee mention working in two clusters and explains the difference. In one cluster they give information and clients say “Yeah, you know, but that's also better for you”. In the other cluster employees already decide for the client “Yes, but that is expensive and then they can't afford it, they don't have the money for that”.

All interviewees are of the opinion that medication adherence tools can have a positive impact on promoting medication adherence among the elderly. However, it is important to determine the underlying reasons for medication non-adherence to ensure that implementing tools will effectively address the issue. If the reasons are related to cognitive impairment or a lack of willingness to take medication, tools may not be the most suitable solution. Nonetheless, in general, medication adherence tools can contribute positively to enhancing clients' independence and alleviating the burden on home care. Adequate information and training are necessary for the successful implementation of these tools.

The role of tools/technology is crucial in improving medication adherence among clients in the future. As the younger generations age, technology will become increasingly important in medical care. It is anticipated that technology will have a positive impact, particularly when clients have an active social network. However, it is important to address potential issues of social isolation among the elderly. There is also a growing desire to reduce the reliance on physical medication moments. Additionally, medication intake checklists are expected to be replaced with apps, providing a more reliable way to ensure medication is not forgotten.

5.3 Discussion

The initial plan for the interview was to conduct at least two interviews for each stakeholder group. Due to different circumstances such as a hierarchical structure within the company, holidays, and long waiting time for responses this was not possible within time. Therefore, only interviews with employees and occupational therapist are included within this article. In a subsequent study it is important to also include the view of the other stakeholders. The results of the questionnaire suggest that interviewing informal carers and clients can lead to new insights on for example (reasons of) medication adherence, and willingness to work with tools. This is expected because different results can be found in the questionnaire for each of these stakeholders.

One of the employees of TWB and the occupational therapist mention the importance of practice and training when implementing a new medication adherence tool for clients. They both mention this in the context of clients experiencing cognitive problems. They state that clients need to be trained to use tools before or when early signs of forgetfulness or cognitive problems are perceived. Early implementation and practice of medication adherence tools could allow patients to develop a routine which would contribute to a patient keeping their independence for longer. Additionally, user-friendliness of adherence tools is mentioned as a factor that will contribute to a patient's independence.

There is a discrepancy between the view of clients, informal caregivers, and employees on the utilization of medication boxes. Clients and informal caregivers think that these tools are very user-friendly and leads to freedom and self-reliance. Employees acknowledge these opinions but do not agree with them, they mention safety concerns, such as over- or under-dosing, or taking wrong medication and/or at wrong times. Employees mention the Baxterrol as a possible solution to give clients freedom and at the same time enhance medication safety. This is also a way of getting patients prepared for the introduction of medication adherence tools, such as the medication dispenser where the Baxterrol is needed.

The inconsistency in the use of protocols across different clusters within the company can create challenges in implementing and enforcing new rules. One of the employees mentions that a rule is in principle valid within the whole company, however, is not always being adhered to within all clusters. This shows that protocols are not always used consistently through the whole company. This example emphasizes the need for regular training and communication to ensure that all employees understand and follow the protocols. Addressing this issue can improve compliance, reduce errors, and enhance the overall effectiveness of the organization's protocols.

5.4 Conclusion

Cognitive problems are identified as the most significant reason for medication non-adherence, followed by forgetting medication and not understanding the dosing regimen. The actions related to medication are explicitly described in the care plan, and incident reports are sometimes used to monitor non-adherence issues. The interviewees mentioned various tools used to assist clients with medication intake, such as the Medido, medicine boxes, alarm watches, and the Baxterrol. However, the use of these tools is dependent on the client's cognitive abilities and specific needs. The significance of practice and training in utilizing medication adherence tools is strongly emphasized.

The interviewees highlighted the need for further improvement in communication and collaboration between TWB and the occupational therapist, as well as the selection and provision

process for medication adherence tools. They also mentioned the potential of emerging technologies, such as medicine apps and dementia clocks, in enhancing medication adherence. However, the effectiveness and widespread adoption of these technologies may be influenced by factors such as technological literacy and cognitive abilities of the target group. In cases where an individual experiences multiple problems, it may be more beneficial to consider utilizing physical movement instead of relying solely on medication adherence tools. The interviewees emphasized the importance of providing adequate information and involving clients in the decision-making process regarding the use of tools. In addition to the importance of providing adequate information, the early implementation of tools can greatly enhance the overall impact on reducing medication non-adherence.

6 Discussion

This research consists of four parts, two literature reviews which make up the theoretical framework a questionnaire and interviews. This comprehensive approach enables a thorough exploration of the research topic from multiple perspectives, combining insights from existing literature with first-hand data collection from participants. By incorporating both quantitative and qualitative methods, the research provides a comprehensive understanding of the subject matter, enhancing the validity and depth of the findings.

Medication non-adherence is a common phenomenon, which according to respectively clients, informal caregivers and employees is the case in 19,9%, 34,6% and 90%. According to self-registered data clients are on average between once a month and once every six months medication non-adherent, while informal caregivers mention a higher frequency of multiple times a month. Medication non-adherence is associated with cognitive impairment, age, forgetfulness, suffering from side effects, avoiding care, motivational issues, and the client's perception on medication adherence. These findings are concurrent to the findings in the article written by Ownby (2006) [55].

Clients are willing to work with medicine boxes, getting assistance in opening packages, and putting large letters on medicine packages. Informal caregivers are willing to work with medicine boxes, dementia clocks, putting large letters on medicine packaging and working with occupational therapists. Employees are likely to work with, getting assistance in opening packages, putting large letters on medicine packaging, and using a dementia clocks and medicine dispensers.

Overall, medicine boxes, getting assistance in opening packages, and putting large letters on medicine packages and occupational therapist, are the medication adherence tools where all stakeholders are most willing to work with. The average willingness to use with medication adherence tools is associated with the familiarity with a tool. When stakeholders are familiar with tools, they are on average between 14% and 19% more likely to be willing to work with medication adherence tools. This is a well-established effect in different fields of science according to the article written by Hekkert et al. (2013) this phenomenon is called the mere exposure effect [43].

To achieve optimal effectiveness, it is crucial to target elderly patients with cognitive impairment when implementing medication adherence tools. Early implementation is also important, introducing clients to these tools before they experience severe cognitive problems helps familiarize them with the tools. Additionally, providing information and training plays a significant role in reducing resistance. When clients and employees are well-informed about the available tools and their benefits, it can take away a lot of resistance. According to an article by Costa et al. (2015), providing patients with more information improved their understanding of risk and reduced their resistance [56]. However, this did not always result in lower medication non-adherence. Because intentional non-adherence will always lead to some degree of medication non-adherence.

7 Conclusion

The literature review concerning reasons of medication non-adherence, the questionnaire, and the interviews all consistently identified cognitive impairment and older age as main factors contributing to medication non-adherence within the home care situation. Additionally, forgetting to take medication and not seeing the importance of medication emerged as important indicators for medication non-adherence. These findings highlight the consistent evidence across multiple research methods regarding the impact of cognitive impairment, age, forgetfulness, suffering from side effects, avoiding care, motivational issues, and the client's perception on medication adherence.

Implementing medication adherence tools has a significant effect on reducing medication non-adherence and saving time for both clients and employees. It can lead to time savings of up to 122 minutes per week for clients with multiple medication moments. However, there is a possibility of increased workload due to technical problems, although this is generally minimal compared to the time saved. Clients generally express satisfaction with the use of these tools, but the effectiveness and experience may vary depending on the individual and situation, particularly for clients with cognitive issues or lacking social support. Despite these challenges, implementing medication adherence tools has shown to improve health-related quality of life and overall, positively impact medication adherence.

The findings of this article aimed at finding ways to reduce medication non-adherence in patients under the care of a home care organisation, suggest that medication adherence tools have the potential to positively impact medication adherence among the elderly. However, careful consideration of individual needs and underlying reasons for non-adherence is crucial for successful implementation. If the underlying causes are linked to cognitive impairment or a reluctance to adhere to medication, medication adherence tools may not be the most suitable solution. However, early implementation should be considered to potentially reduce the effect of cognitive impairment on the implementation process. Next to the effect of tools, improvement of information about their disease and medication supplied to patients at risk, may be part of new strategies to decrease non-adherence. As technology continues to advance, it is expected that tools and apps will play an increasingly significant role in promoting medication adherence and supporting independent living for the aging population.

8 Strengths and limitations of the study

Multiple methods are used for gathering data on reducing medication non-adherence in the home care situation. Two theoretical framework consists of two literature reviews, a questionnaire is sent out to clients, informal caregivers and employees and interviews are conducted with employees. The different studies are intertwined, results from the theoretical framework are incorporated into the questionnaire. Both results from the theoretical framework and questionnaire are incorporated into the interview framework.

One strength of scientific research is the clear setup and design of the study, which allows for reproducibility of the results by other researchers. This means that the study can be replicated and validated by independent parties, increasing the confidence and reliability of the findings. Clear research design also allows for easier identification of potential biases or errors, making it easier to improve the quality of future research.

A noteworthy limitation of this scientific research is the fact that all four types of research are carried out by a single researcher. This could introduce potential biases and limitations associated with the researcher's perspectives, experiences, and interpretation of the data. The absence of multiple researchers or a research team may have impacted the breadth and depth of the study, as different perspectives and insights from multiple researchers could have provided a more comprehensive analysis.

A significant limitation of this scientific research is that the interviews are only conducted with one specific target group, namely the employees. This limited scope restricts the insights and perspectives obtained from other key stakeholders, such as clients, informal caregivers, or healthcare professionals.

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Appendices

Appendix A – Theoretical framework – Grounded theory Literature Review Method

Both reviews are based on the Grounded Theory Literature Review Method [57]. This method focusses on a well explicated and rigorous method of literature review. The aim is to reach a theoretically relevant and thorough analysis of the research field. The review method is set up to be as transparent as possible to increase the reproducibility of the research. Within the Grounded Theory Literature Review Method five stages are defined, these stages are further specified by sub-stages to come to a rigorous literature review. The stages are shown below in Table 14. Only step one, define, is described within the methodology. Step two up to five are described further in the article.

Table 12 Five stages of the Grounded Theory Literature Review Method [57]

Define	Define criteria for in-/exclusion Identify fields of research Determine appropriate sources Decide on specific search terms
Search	Search articles
Select	Refine the sample of articles
Analyse	Open coding Axial coding Selective coding
Present	Represent and structure the content Structure the article

The stages need to be executed in order, from top to bottom.

Three search engines are used, Scopus, Web of Science and PubMed. In PubMed the terms are searched for within the title and abstract, in Scopus and Web of Science within the title, abstract and keywords. All references retrieved from these search engines are placed in reference manager, Mendeley. Data from both reviews will be processed in the five stages of the Grounded Theory Literature Review Method.

Appendix B - Coding of included articles

Table 13 Coding of included articles

NR.	Article	Author	Contributing factors	Open coding	Axial coding	Selective coding
1	Medication Adherence in Older Patients With Dementia: A Systematic Literature Review [20]	El-Saifi N, Moyle W, Jones C, Tuffaha H.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 31	1, 2, 3, 4, 5
2	Discrepancies in Information Provided to Primary Care Physicians by Patients With and Without Dementia: The Steel Valley Seniors Survey. [58]	Ganguli M, Du Y, Rodriguez EG, Mulsant BH, McMichael KA, vander Belt J, et al.	23, 24, 25, 26, 27, 29	5, 15, 16, 17, 18	5, 14, 19, 31	1, 2, 3, 5
3	Socioeconomic factors explain suboptimal adherence to antiretroviral therapy among HIV-infected Australian adults with viral suppression [59]	Siefried KJ, Mao L, Kerr S, Cysique LA, Gates TM, McAllister J, et al.	30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42	1, 15, 19, 20, 21, 22, 23, 24, 25, 27, 28	1, 9, 14, 15, 16, 17, 18, 19, 20, 21, 22	1, 2, 3, 4, 5
4	Medication Beliefs and Self-Reported Adherence Among Community-Dwelling Older Adults [60]	Sirey JA, Weinberger MI, Greenfield A, Bruce ML.	22, 23, 43, 44, 45, 46, 47, 48	5, 11, 15, 18, 24, 26, 29	5, 9, 11, 14, 19, 23, 31	1, 2, 3, 5
5	Determinants of adherence to heart failure medication: a systematic literature review [61]	Oosterom-Calo R, van Ballegooijen, A J, Terwee, C B, te Velde, S J, Brouwer IA, Jaarsma, T, et al.	11, 12, 49, 53, 83	1, 7, 8, 14, 19	1, 7, 8, 13, 15	1, 4
6	Factors Influencing Rehospitalisation of Patients with Schizophrenia in Japan: A 1-year Longitudinal Study [62]	Shimada T, Nishi A, Yoshida T, Tanaka S, Kobayashi M.	50	30	12	4
7	Prevalence of adherence to treatment in homebound elderly people in primary health care: A descriptive, cross-sectional, multicentre study [63]	Cárdenas-Valladolid J, Martín-Madrazo C, Salinero-Fort MA, De-Santa Pau EC, Abnades-Herranz JC, de Burgos-Lunar C.	51, 52, 53, 54, 55, 56	3, 7, 8, 11, 26, 31	3, 7, 8, 11, 12	2, 3, 4
8	Does adherence to national comprehensive cancer network guidelines improve pain-related outcomes? An evaluation of inpatient cancer pain management at an academic medical center [22]	Mearis M, Shega JW, Knoebel RW.	57	32	24	2

9	Assessment of adherence and factors contributing to non-adherence among patients on anti-retroviral therapy in a tertiary care hospital: A cross sectional study [64]	Hadaye RS, Jambhale VB, Shastri S.	20, 43, 46, 58, 59, 60, 61, 62	5, 7, 11, 14, 26, 32, 33	5, 7, 11, 13, 19, 20 24	2, 3, 4
10	Primary non-adherence in Portugal: findings and implications [65]	Alves Da Costa F, Pedro AR, Teixeira I, Fátima Bragança, Aranda Da Silva J, Cabrita J.	12, 39, 40, 63	8, 27, 28	8, 21, 22	1, 4
11	Financial strain is associated with medication nonadherence and worse self-rated health among cardiovascular patients [66]	Osborn CY, Kripalani S, Goggins KM, Wallston KA.	11, 12, 56, 64, 65, 66	7, 8 , 15, 19, 26, 34	7, 8, 11, 14, 15, 24	1, 3, 4, 5
12	Drug-related problems in diabetes and transplant patients: an observational study with home visits [67]	Eichenberger PM, Haschke M, Lampert ML, Hersberger KE.	46, 67	26, 29	19, 23	3
13	Secondary prevention of coronary heart disease: Patient beliefs and health-related behaviour [68]	Byrne M, Walsh J, Murphy AW.	56, 68, 69, 70	18, 26, 35	11, 31, 32	3, 5
14	Drug therapy in the elderly: what doctors believe and patients actually do [69]	Barat I, Andreasen F, Damsgaard EMS.	29, 31, 37, 71, 72, 73, 74, 75, 76	2, 3, 11, 20, 25, 35, 36	2, 3, 16, 19, 20, 25, 32	2, 3, 4, 5
15	Challenges adhering to a medication regimen following first-time percutaneous coronary intervention: A patient perspective [6]	Pettersen TR, Fridlund B, Bendz B, Nordrehaug JE, Rotevatn S, Schjøtt J, et al.	23, 41, 44, 62, 77, 78, 79, 80, 81	5, 15, 18, 33, 37, 38	5, 14, 20, 25, 26, 31	1, 2, 5
16	Prevalence and Predictors of Patient Nonadherence to Pharmacological Acute Pain Therapy at Home After Day Surgery: A Prospective Cohort Study [7]	Stessel B, Theunissen M, Marcus MA, Kuijk V, Fiddelers SMJ, Peters AAA, et al.	82, 83, 84, 85, 86, 87	14, 28, 34	13, 22, 24	3, 4
17	Is cognitive impairment a risk factor for poor compliance among Japanese elderly in the community? [26]	Okuno J, Yanagi H, Tomura S.	20, 28, 74, 81, 88, 89, 90, 91, 92	11, 14, 18, 36, 38, 41, 42, 43, 44	11, 13, 20, 25, 26, 28, 29, 30, 31	2, 3, 4, 5
18	Predictors of Aspirin Nonadherence in Adults With Prior Myocardial Infarction [23]	Bhasin V, Mehta A, Skopicki HA, Parikh PB.	12, 39, 41, 56, 84, 93, 94, 95, 96, 97, 98	1, 8, 12, 15, 19, 26, 27, 28, 44, 45	1, 8, 11, 14, 15, 17, 21, 22, 30	1, 3, 4
19	Prescription medications: Beliefs, experiences, behavior, and adherence of sheltered housing residents [70]	George J, Munro K, McCaig DJ, Stewart DC.	24, 56, 99, 100, 102, 103	17, 24, 26, 35, 46, 47	5, 9, 11, 23, 32	2, 3, 5
20	Reasons Underlying Non-Adherence to and Discontinuation of Anticoagulation in Secondary Stroke Prevention among Patients with Atrial Fibrillation [71]	Gumbinger C, Holstein T, Stock C, Rizos T, Horstmann S, Veltkamp R.	1, 12, 23, 29, 58, 104, 105, 106	2, 5, 7, 8, 11, 17, 22, 26	2, 5, 7, 8, 18, 19	2, 3, 4
21	Factors influencing adherence in long-term use of statins [72]	Warren JR, Falster MO, Fox D, Jorm L.	11, 31, 56, 84, 107, 108, 109, 110, 111, 112, 113,	7, 19, 20, 26, 28, 30, 34,	7, 11, 12, 13, 15, 16,	1, 3, 4

			114, 115	40, 48, 49, 50	17, 22, 27	
22	The AdHOC study of Older Adults' Adherence to Medication in Eleven Countries [73]	Cooper C, Mrcpsych BM, Katona C, Schroll FM, Wagner C, Phd MA, et al	29, 31, 44, 48, 116, 117, 118, 119, 120	11, 18, 20, 24, 29, 44, 51, 52	9, 11, 16, 19, 23, 30, 31	3, 4, 5
23	Assessment of patient adherence to anti-infective treatment after returning home [74]	Faure H, Leguelinel-Blache G, Salomon L, Poujol H, Kinowski JM, Sotto A.	19, 121, 122, 123	5, 13, 25, 33	5, 12, 20	2, 4
24	Prevalence and associated factors of medication non-adherence in hematological-oncological patients in their home situation [75]	Bouwman L, Eeltink CM, Visser O , Janssen JJWM, Maaskant JM.	31, 39, 44, 48, 83, 86, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133	2, 7, 14, 18, 20, 26, 27, 29, 34, 40, 47, 53, 54	2, 7, 11, 12, 13, 16, 21, 22, 23, 27, 31, 32	1, 2, 3, 4, 5
25	Medication adherence in crisis? [76]	Sreenath S, Reddy S, Tacchi MJ, Scott J.	134, 135	40	27	3
26	Assessing medication adherence in the elderly: Which tools to use in clinical practice? [77]	MacLaughlin EJ, Raehl CL, Treadway AK, Sterling TL, Zoller DP, Bond CA.	1 11, 13, 23, 26, 44, 45, 46, 49, 53, 110, 136, 137, 138, 139, 140, 141, 142	1, 2, 3, 5, 7, 8, 9, 18, 24, 25, 26, 35, 39, 40, 55	1, 2, 3, 5, 7, 8, 9, 12, 19, 20, 27, 31, 32	1, 2, 3, 4, 5

Within this table, titles and authors are shown from all included articles. The factors and all three coding steps are shown in their column. Within these columns, different coding categories are shown. When a coding category is described multiple times within one article, it is mentioned once for better clarity. The exact number of factors or coding within a specific coding group can be found in appendices C, D, E, and F.

Appendix C - Factors contributing to non-adherence to medication

Table 14 Factors contributing to non-adherence to medication

NR.	Contributing factors	Count	NR.	Contributing factors	Count
1	Weight loss	1	72	Using CNS drugs	1
2	Taking medication rivastigmine	1	73	Using respiratory drugs	1
3	Taking cardiac medication	1	74	Higher number of Physicians	2
4	Taking cerebrovascular medication	1	75	three or more prescribed drugs	1
5	Taking gastrointestinal medication	1	76	Lack of knowledge about medication	1
6	Taking low dosage of rivastigmine compared to high dosage	1	77	Medication information from physicians and nurses was uninformative and inadequate	1
7	Taking at least 4 medications	1	78	Sceptical about generic drugs.	1
8	The use of an anticholinergic drug in patients with Alzheimer's disease	1	79	Scepticism towards generic drugs ability to work	1
9	Ineffectiveness of cholinesterase inhibitors	1	80	Healthcare professionals did not emphasise enough short- and long-term consequences of missed doses of heart medications	1
10	Side effects of cholinesterase inhibitors	1	81	Anxiety	4
11	Older age	10	82	Little pain	1
12	Female	8	83	High educational level	3
13	Ignorance about treatment importance	2	84	Employment	4
14	Number of years the patient has a lack of awareness	1	85	High baseline quality of life	1
15	Previous occurrence of medication non-adherence	1	86	Low preoperative pain	1
16	Decrease in the Dementia Rating Scale-Memory subscale	1	87	Low preoperative expectations of pain	1
17	High chronic disease score	1	88	Concerns about taking prescribed drugs	1
18	High baseline Charlson-Quan comorbidity score	1	89	Poor relationship with physicians	1
19	Illiterate	2	90	Lack of one-dose packages	1
20	Low level of education	3	91	Lack of medication calendar	1
21	Living in rural areas	1	92	Lower frequency of visiting a physician	1
22	Medicines are being considered as too expensive	3	93	Black ethnicity.	1
23	Actual side effects	6	94	Hispanic ethnicity	1
24	Feared side effects	2	95	No health insurance	1
25	Concerns about costs	1	96	low rates of multiple medical comorbidity	1
26	Patient feels the drug are not needed	2	97	No frequent medical check ups	1
27	Just does not take the medication	1	98	Absence of homeowner status	1
28	Memory complaints	2	99	Great disability in preparing and cooking a hot meal	1
29	Dementia	4	100	I make changes in the recommended management to suit my lifestyle	1
30	Being born in Australia	1	101	I do not ensure 1 have enough medicines so that I don't run out	2
31	Not in a relationship	7	102	I get confused about my medicines	1
32	Having reached the Medicare safety net threshold	1	103	Not getting help from someone to use medicines correctly	1

33	Living in subsidized housing	1	104	Permanent care in a nursing home	1
34	Receiving home care services	1	105	Hypercholesterolemia	1
35	Linkage to HIV community organizations	1	106	Anxiety toward potential side effects of OAC	1
36	Having started antiretroviral therapy at the patient's request	1	107	General Beneficiaries compared to Concession Card holders	1
37	Non-single tablet regimens	3	108	Higher education level	1
38	Greater than once daily dosing	1	109	Current smokers	1
39	Low income	4	110	Increased levels of psychological distress	2
40	Unemployed citizens	2	111	Speaking a language other than English at home (in Australia)	1
41	Financial strain	2	112	Born in Asia	1
42	Cost barriers to medication access	1	113	Born in other Oceanic countries	1
43	Forgetting to take medication	3	114	Born in America	1
44	Being careless about taking their medication	1	115	Healthy	1
45	Stop medication when patient feels better	1	116	Scored higher on the Cognitive Performance scale	1
46	Depression	8	117	Behavioural problems of resisting care	1
47	Large number of medical conditions	2	118	Behavioural problems of wandering	1
48	Greater concerns than perceived benefits of medication	1	119	Had not had their medication reviewed by a doctor in the last six months	1
49	Person is living alone	4	120	Lesser ADL impairment	1
50	No verbal fluency at discharge	1	121	Adverse event	1
51	Hearing impairment	1	122	Too many tablets to take during the day	1
52	aged <85 years	1	123	Vacation, slept in	1
53	Men	1	124	Fatigue	1
54	Nine or more drug prescriptions	1	125	Perception of receiving insufficient social support	1
55	Cognitive impairment	4	126	Use of bisphosphonates	1
56	No previous stroke	1	127	Helplessness (ICQ)	1
57	Chronic opioid-exposure	1	128	Global health	1
58	Younger age groups	8	129	Role function	1
59	Low baseline CD 4 count (<100)	1	130	Emotional function	1
60	Antiretroviral therapy over a longer period	1	131	Social function	1
61	Experience with side effects of antiretroviral therapy	1	132	Dyspnea	1
62	Busy with other things	2	133	Diarrhea	1
63	Retired citizens	1	134	Prior psychiatric history	1
64	Having more financial strain	1	135	in contact with mental health services for longer than 5 years	1
65	Better self-rated health	1	136	Low functional health literacy	1
66	Racial/ethnic minority	1	137	Decreased visual acuity	1
67	Difficulty using a pipette	1	138	Taking medication more than once a day	1
68	A weaker perception that one's illness is chronic	1	139	Taking medication daily (compared to weekly)	1
69	A weaker belief that one's medications are necessary	1	140	Disappointment with traditional prescribed medicines	1
70	More concerns about one's medication	1	141	Use of numerous medications	1
71	Using musculoskeletal drugs	1	142	Patient does not understand disease	1

Appendix D - Categories of open coding

Table 15 Categories of open coding

NR.	Coding	Count	NR.	Coding	Count
1	Living situation	5	29	Problems taking medication	4
2	Taking medication	12	30	Language barrier	2
3	Multiple medication descriptions	4	31	Hearing impairment	1
4	Effectiveness of medication	1	32	Long term medication	2
5	Side effects	8	33	Does not take time to take medication	3
6	Change in weight	1	34	Feeling good and/or healthy	8
7	Age group	10	35	Little understanding of illness or medication	4
8	Gender	9	36	High number of Physicians	2
9	Does not see treatment as important	3	37	Not enough information from physician	2
10	Recurrence of medication non-adherence	1	38	Anxiety	2
11	Memory problems	10	39	Visual impairment	1
12	Comorbidity	3	40	Mental health problems	5
13	Reading impairment	2	41	Poor relationship with physician	1
14	Education status	6	42	Lack of single doses of medication	1
15	Financial difficulties	8	43	No adherence aid	1
16	Management of medication	1	44	Few check-ups	3
17	Feared side effect	3	45	No health insurance	1
18	Scepticism towards medication	14	46	Difficulty preparing a meal	1
19	Ethnicity	8	47	Receive insufficient support	3
20	No romantic relationship	5	48	Type of insurance	1
21	Reached upper-limit insurance coverage	1	49	Higher educational level	1
22	Type of care	2	50	Addiction to substances	1
23	Linked to disease community	1	51	Problems of wandering	1
24	Start, stop, or adjust medication at own request	5	52	ADL impairment	1
25	High frequency of taking medication	7	53	Role function	1
26	Medical condition	16	54	Social status	1
27	Income	4	55	Low functional health literacy	1
28	Work	6			

Appendix E - Categories of axial coding

Table 16 Categories of axial coding

NR.	Coding	Count	NR.	Coding	Count
1	Socioeconomic status	5	17	Type of insurance coverage	3
2	Types of medication	12	18	Use of medical service	2
3	Number of concurrent medications	4	19	Type of disease	11
4	Quality of care	1	20	Dosing regimen	13
5	Adverse effects	11	21	Patient income	4
6	Severity and duration of illness	1	22	Occupation	7
7	Age	10	23	ADL difficulties	6
8	Gender	9	24	Health belief	1
9	Medication adjustments	6	25	Fragmented, short, and poor physician-patient interactions	4
10	Recurrence of medication non-adherence	1	26	Fear of disease(s) and medication	2
11	(Number of) co-morbid conditions	20	27	Health status	13
12	Low health literacy	8	28	Patient satisfaction with healthcare provider	1
13	Educational level	7	29	Use of assistive technology	1
14	Cost of medication and medical care	8	30	Frequency of use of medical services	3
15	Race	8	31	Scepticism	17
16	Relationship status	5	32	Disinformation	7

Appendix F - Categories of selective coding

Table 17 Categories of selective coding

NR.	Coding	Count
1	Economic	21
2	Medication	43
3	Medical	60
4	Demographic	45
5	Behavioural	44

Appendix G - Lines of coding

Table 18 Lines of coding

Open coding	Axial coding (Factors)	Selective coding (Category)
Living situation	Socioeconomic status	Economic
Financial difficulties	Cost of medication and medical care	Economic
Reached upper limit insurance coverage	Type of insurance coverage	Economic
Income	Patient income	Economic
No health insurance	Type of insurance coverage	Economic
Type of insurance	Type of insurance coverage	Economic
Taking medication	Types of medication	Medication
Multiple medication descriptions	Number of concurrent medications	Medication
Side effects	Adverse effects	Medication
Feared side effect	Adverse effects	Medication
High frequency of taking medication	Dosing regimen	Medication
Long term medication	Dosing regimen	Medication
Does not take time to take medication	Dosing regimen	Medication
Lack of single doses of medication	Dosing regimen	Medication
No adherence aid	Use of assistive technology	Medication
Effectiveness of medication	Quality of care	Medical
Change in weight	Severity and duration of illness	Medical
Memory problems	(Number of) co-morbid conditions	Medical
Comorbidity	(Number of) co-morbid conditions	Medical
Type of care	Use of medical service	Medical
Linked to disease community	Type of disease	Medical
Medical condition	Type of disease	Medical
Problems taking medication	ADL difficulties	Medical
Mental health problems	Health status	Medical
Few check-ups	Frequency of use of medical services	Medical
Difficulty preparing a meal	ADL difficulties	Medical
Addiction to substances	Health status	Medical
Problems of wandering	Type of disease	Medical
ADL impairment	ADL difficulties	Medical
Age group	Age	Demographic
Gender	Gender	Demographic
Reading impairment	Low health literacy	Demographic
Education status	Educational level	Demographic
Ethnicity	Race	Demographic
No romantic relationship	Relationship status	Demographic
Work	Occupation	Demographic
Language barrier	Low health literacy	Demographic
Hearing impairment	Low health literacy	Demographic
Visual impairment	Low health literacy	Demographic
Higher educational level	Educational level	Demographic
Role function	Occupation	Demographic
Social status	Low health literacy	Demographic
Low functional health literacy	Low health literacy	Demographic
Does not see treatment importance	Scepticism	Behavioural
Recurrence of medication non-	Recurrence of medication non-adherence	Behavioural

adherence		
Management of medication	Medication adjustments	Behavioural
Scepticism towards medication	Scepticism	Behavioural
Start, stop, or adjust medication at own request	Medication adjustments	Behavioural
Feeling good and/or healthy	Health belief	Behavioural
Little understanding of illness or medication	Disinformation	Behavioural
High number of Physicians	Fragmented, short, and poor physician-patient interactions	Behavioural
Not enough information from physician	Fragmented, short, and poor physician-patient interactions	Behavioural
Anxiety	Fear of disease(s) and medication	Behavioural
Poor relationship with physician	Patient satisfaction with healthcare provider	Behavioural
Receive insufficient support	Disinformation	Behavioural

Appendix H - Coding of included articles

Table 19 Coding of included articles

NR.	Article	Author	Devices	Open coding
1	Medication adherence support of an inhome electronic medication dispensing system for individuals living with chronic conditions: a pilot randomized controlled trial [30]	Mubashir Aslam Arain, Armghan Ahmad, Venus Chiu and Lorena Kembel	5	1, 2, 3, 4, 5
2	A Review of Current Pill Organizers and Dispensers [27]	João F. Pinto, João L. Vilaça and Nuno S. Dias	5	8
			1	6, 7
			6	9
3	The Usability, Acceptability, and Functionality of Smart Oral Multidose Dispensing Systems for Medication Adherence: A Scoping Review [29]	Sadaf Faisal, B Pharm, BCGP, Jessica Ivo, BSc, Catherine Lee, BSc, Caitlin Carter, MLIS, and Tejal Patel, Pharm D	5	5, 8, 10, 11, 12, 13, 14
4	A Smart Pill Dispenser to support Elderly People in Medication Adherence [28]	Simone Casciaro, Lucio Massa, Ilaria Sergi and Luigi Patrono	5	15, 16
			3	15
			1	15
			6	17
			2	17
			4	15
5	A randomized controlled efficacy study of the Medido medication dispenser in Parkinson's disease [34]	K. Hannink, L. ter Brake, N.G.M. Oonk, A.A. Wertenbroek, M. Piek, L. Vree-Egberts, M.J. Faber, J. van der Palen and L.D. Dorresteijn	5	18, 19, 20, 21
6	MySafeRx: a mobile technology platform integrating motivational coaching, adherence monitoring, and electronic pill dispensing for enhancing buprenorphine/naloxone adherence during opioid use disorder treatment: a pilot study [32]	Zev Schuman-Olivier, Jacob T. Borodovsky, Jackson Steinkamp, Qays Munir, Kyle Butler, Mary Ann Greene, Jonah Goldblatt, Hai Yi Xie1 and Lisa A. Marsch	5	11, 12, 14, 15, 22, 23, 24, 25
7	Individualization of levodopa treatment using a microtablet dispenser and ambulatory accelerometry [35]	Dongni Johansson, Anders Ericsson, Anders Johansson, Alexander Medvedev, Dag Nyholm, Fredrik Ohlsson, Marina Senek, Jack Spira, Ilias Thomas, Jerker Westin, Filip Bergquist	6	5, 26
8	Adherence to a flexible extended regimen for oral hormonal contraception provided in blister packaging compared with an adherence-supporting digital tablet dispenser: historical comparison of data from two clinical studies [33]	Jörg Elliesen, Dietmar Trummer	5	20, 22
9	A randomized controlled trial with a Canadian electronic pill dispenser used to measure and improve medication adherence in patients with schizophrenia [31]	Emmanuel Stip, Philippe D.Vincent, Juliette Sablier, Catherine Guevremont, Simon Zhornitsky and ConstantinTranulis	5	1, 5

Appendix I - Coding of included articles of literature review medication dispensers

Table 20 Coding of included articles of literature review medication dispenser

NR.	Coding	Count
1	Self-reported increase in adherence	2
2	Increase in perceived health status	1
3	Self-reported decrease in challenges with taking medication on time	1
4	Decrease in forgetfulness	1
5	Recorded adherence was higher	4
6	Best suited for individuals with high autonomy	1
7	Not suited for people with any disability or disorder	1
8	Suited for people with low autonomy	2
9	Saves time by pre-sorting medication	1
10	Use of device does not result in additional caregiver burden	1
11	Easy to learn	2
12	Satisfied with the use of the tool	2
13	Challenges with hearing the alarm	1
14	Technical problems	3
15	High useability	5
16	Higher workload	1
17	Low useability	2
18	Functional disability (ALDS) improved significant	1
19	Quality of life decreased	1
20	Health related quality of life increased	2
21	No harm or unintended effects	1
22	Overestimation of self-administered adherence	2
23	Helps become more independent	1
24	High desire to continue working with the tool	1
25	Seeing the benefit of taking my medication	1
26	Negative association between medication dose and adherence	1

Appendix J - Coding per medication adherence device

NR.	Coding	Count
Smart blister packs	17	1
CAP-based Systems	15	1
Electronic medication trays	15	1
Medication organizers	6	1
	7	1
	15	1
Automatic sorter and dispensers	5	1
	9	1
	17	1
	26	1
Electronic medication dispensing system (MDS)	1	2
	2	1
	3	1
	4	1
	5	3
	8	1
	8	2
	11	2
	12	2
	13	1
	14	2
	15	2
	16	1
	18	1
	19	1
	20	2
	21	1
	22	2
	23	1
	24	1
	25	1

Appendix K - Questionnaire

Vragenlijst medicatieontrouw

Q1

Beste deelnemer, Ik ben Lilian van Oosterhout, ik ben op dit moment bezig met mijn afstudeeropdracht voor de studie gezondheidswetenschappen aan de Universiteit Twente. Ik doe mijn afstudeeropdracht over medicatietrouw, ook wel therapietrouw genoemd, binnen Thuiszorg West Brabant.

Medicatietrouw houdt in dat een patiënt start met de medicatie, de medicatie gebruikt volgens voorschrift en de behandeling afmaakt. Bij gemiddeld een kwart van de patiënten gebeuren één of meerdere van de bovenstaande dingen niet en is er sprak van medicatieontrouw. Ook bij Thuiszorg West Brabant is er sprake van medicatieontrouw.

Binnen mijn onderzoek doe ik onderzoek naar redenen voor therapieontrouw en oplossingen hiervoor. Hierbij heb ik uw ervaring en mening nodig. Het duurt ongeveer 5 minuten om de enquête in te vullen. De enquête bestaat uit 2 delen:

- Vragen over medicatieontrouw
- Vragen over hulpmiddelen voor medicijngebruik

Mochten er nog vragen of opmerkingen zijn kunnen deze gemaild worden naar l.e.vanoosterhout@student.utwente.nl

Q2

Ga naar

Einde enquête als Nee is geselecteerd

Informatieblad & toestemmingsformulier

Ik begrijp wat in het "Informatieblad & toestemmingsformulier" staat en ga hiermee akkoord

Let op: Als u niet akkoord gaat kunt u de enquête niet verder invullen.

- Ja
- Nee

Q3

Kruis aan wat voor u van toepassing is

Ik ben een:

- ○ Cliënt bij Thuiszorg West-Brabant
- ○ Mantelzorger
- ○ Medewerker bij Thuiszorg West-Brabant

Q4

Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt volgens voorschrift of de behandeling niet afmaakt

Was u voor het invullen van de enquête bekend met de term medicatieontrouw?

- ○ Ja
- ○ Nee

Pagina-einde

Q5

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Cliënt bij Thuiszorg West-Brabant is geselecteerd

Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt volgens voorschrift of de behandeling niet afmaakt

Bent u ooit medicatieontrouw geweest?

- ○ Ja
- ○ Nee

Q6

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Mantelzorger is geselecteerd

Is de zorgbehoevende waarvoor u zorgt ooit medicatieontrouw geweest?

- ○ Ja
- ○ Nee

Q7

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Medewerker bij Thuiszorg West-Brabant is geselecteerd

Is één van uw cliënten ooit medicatieontrouw geweest?

- ○ Ja
- ○ Nee

Pagina-einde

Q8

Deze vraag weergeven

Als Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt vo... Ja is geselecteerd

Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt volgens voorschrift of de behandeling niet afmaakt

Hoe vaak bent u gemiddeld medicatieontrouw?

- ○ Elke dag
- ○ Meerdere keren per week
- ○ Één keer per week
- ○ Meerdere keren per maand
- ○ Één keer per maand
- ○ Één keer per half jaar
- ○ Één keer per jaar

Q9

Deze vraag weergeven

Als Is de zorgbehoevende waarvoor u zorgt ooit medicatieontrouw geweest? Ja is geselecteerd

Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt volgens voorschrift of de behandeling niet afmaakt

Hoe vaak is de zorgbehoevende gemiddeld medicatieontrouw?

- ○ Elke dag
- ○ Meerdere keren per week
- ○ Één keer per week
- ○ Meerdere keren per maand
- ○ Één keer per maand
- ○ Één keer per half jaar
- ○ Één keer per jaar

Q10

Deze vraag weergeven

Als Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt vo... Ja is geselecteerd

Selecteer wat van toepassing is, meerdere antwoorden mogelijk.

Waarom bent u medicatieontrouw?

- ☐ Ik zie het belang niet in van de medicatie
- ☐ Ik ben bang voor bijwerkingen
- ☐ Ik heb last van bijwerkingen
- ☐ Ik kan de verpakking niet lezen
- ☐ Ik vergeet mijn medicatie te nemen
- ☐ Ik ben druk met andere dingen
- ☐ Ik krijg de medicatie slecht uit de verpakking
- ☐ Ik heb geen vertrouwen in de arts
- ☐ Ik heb geen vertrouwen in de apotheek
- ☐ Anders - namelijk:

Q11

Deze vraag weergeven

Als Is de zorgbehoevende waarvoor u zorgt ooit medicatieontrouw geweest? Ja is geselecteerd

Selecteer wat van toepassing is, meerdere antwoorden mogelijk.

Waarom is de zorgbehoevende medicatieontrouw?

De zorgbehoevende...

- [ ] Ziet het belang niet in van de medicatie
- [ ] Is bang voor bijwerkingen
- [ ] Heeft last van bijwerkingen
- [ ] Kan de verpakking niet lezen
- [ ] Vergeet medicatie te nemen
- [ ] Is druk met andere dingen
- [ ] Krijgt de medicatie slecht uit de verpakking
- [ ] Heeft geen vertrouwen in de arts
- [ ] Heeft geen vertrouwen in de apotheek
- [ ] Anders - namelijk:

Q12

Deze vraag weergeven

Als Is één van uw cliënten ooit medicatieontrouw geweest? Ja is geselecteerd

Medicatieontrouw houdt in dat een patiënt niet start met medicatie, de medicatie niet gebruikt volgens voorschrift of de behandeling niet afmaakt

Selecteer wat van toepassing is, meerdere antwoorden mogelijk.

Waarom is de cliënt medicatieontrouw?
De cliënt...

- [ ] Ziet het belang niet in van de medicatie
- [ ] Is bang voor bijwerkingen
- [ ] Heeft last van bijwerkingen
- [ ] Kan de verpakking niet lezen
- [ ] Vergeet medicatie te nemen
- [ ] Is druk met andere dingen
- [ ] Krijgt de medicatie slecht uit de verpakking
- [ ] Heeft geen vertrouwen in de arts
- [ ] Heeft geen vertrouwen in de apotheek
- [ ] Anders - namelijk:

Q13

Selecteer wat van toepassing is, meerdere antwoorden mogelijk.

Van welk van de volgende hulpmiddelen heeft u gehoord?

- [ ] Medicijndozen

- [ ] Medicijnalarmwekkers

- [ ] Alamhorloge

- [ ] Hulp bij het openen van verpakkingen

- [ ] Medicijndispensers

- [ ] Medicijn app

- [ ] Grote letters op medicijnverpakking laten zetten

- [ ] Digicontact

- [ ] Dementieklok

- [ ] Ergotherapeut

Q14

Keuzes overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Geselecteerde opties - ingevoerde tekst

Selecteer wat van toepassing is, meerdere antwoorden mogelijk.

Met welke van de volgende hulpmiddelen heeft u gewerkt?

- [ ] Medicijndozen
- [ ] Medicijnalarmwekkers
- [ ] Alamhorloge
- [ ] Hulp bij het openen van verpakkingen
- [ ] Medicijndispensers
- [ ] Medicijn app
- [ ] Grote letters op medicijnverpakking laten zetten
- [ ] Digicontact
- [ ] Dementieklok
- [ ] Ergotherapeut

Q15

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Geselecteerde opties

Wat is uw ervaring met deze hulpmiddelen?

	Heel slecht	Slecht	Redelijk	Goed	Uitstekend
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q16

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Cliënt bij Thuiszorg West-Brabant is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen te gebruiken?

(Betreft hulpmiddelen die u niet kent)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q17

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Cliënt bij Thuiszorg West-Brabant is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen te gebruiken?

(Betreft hulpmiddelen die u kent, maar u heeft er niet mee gewerkt)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q18

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Mantelzorger is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen te gebruiken voor de zorgbehoevende?

(Betreft hulpmiddelen die u niet kent)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q19

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Mantelzorger is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen te gebruiken voor de zorgbehoevende?

(Betreft hulpmiddelen die u kent, maar u heeft er niet mee gewerkt)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q20

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Medewerker bij Thuiszorg West-Brabant is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen in te zetten bij uw cliënten?

(Betreft hulpmiddelen die u niet kent)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q21

Deze vraag weergeven

Als Kruis aan wat voor u van toepassing is Ik ben een: Medewerker bij Thuiszorg West-Brabant is geselecteerd

Stellingen overbrengen

van Selecteer wat van toepassing is, meerdere antwo... die/dat Gedeselecteerde keuzes

Zou u bereid zijn om deze hulpmiddelen in te zetten bij uw cliënten?

(Betreft hulpmiddelen die u kent, maar u heeft er niet mee gewerkt)

	Helemaal niet waarschijnlijk	Niet waarschijnlijk	Neutraal	Waarschijnlijk	Zeer waarschijnlijk
Medicijndozen	○	○	○	○	○
Medicijnalarmwekkers	○	○	○	○	○
Alamhorloge	○	○	○	○	○
Hulp bij het openen van verpakkingen	○	○	○	○	○
Medicijndispensers	○	○	○	○	○
Medicijn app	○	○	○	○	○
Grote letters op medicijnverpakking laten zetten	○	○	○	○	○
Digicontact	○	○	○	○	○
Dementieklok	○	○	○	○	○
Ergotherapeut	○	○	○	○	○

Q22

Wat zijn voor u de belangrijkste redenen om een hulpmiddel **wel** te gebruiken?

Q23

Wat zijn voor u de belangrijkste redenen om een hulpmiddel **niet** te gebruiken?

Pagina-einde

Q24

Heeft u op dit moment nog vragen of opmerkingen?

Appendix L - Informed Consent Questionnaire

Informatieblad voor onderzoek 'Hulpmiddelen om medicatieontrouw te verminderen

Doel van het onderzoek

Dit onderzoek wordt geleid door Lilian van Oosterhout, master student Health Science aan de Universiteit Twente. Het doel van dit onderzoek is om manieren te onderzoeken die therapieontrouw kunnen verminderen. De uitkomsten van de vragenlijst zullen worden gebruikt als onderdeel van het afstudeeronderzoek met als doel de therapieontrouw te verminderen

Hoe gaan we te werk?
U neemt deel aan een onderzoek waarbij we informatie zullen vergaren door:

- U een vragenlijst voor te leggen welke u online kunt invullen

Potentiële risico's en ongemakken

- Er zijn geen fysieke, juridische of economische risico's verbonden aan uw deelname aan deze studie. U hoeft geen vragen te beantwoorden die u niet wilt beantwoorden. Uw deelname is vrijwillig en u kunt uw deelname op elk gewenst moment stoppen.

Vergoeding
U ontvangt voor deelname aan dit onderzoek geen vergoeding.

Vertrouwelijkheid van gegevens
Wij doen er alles aan uw privacy zo goed mogelijk te beschermen. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u naar buiten gebracht, waardoor iemand u zal kunnen herkennen.

In een publicatie zullen anonieme gegevens of pseudoniemen worden gebruikt. De gegevens die via de vragenlijst in het kader van deze studie worden verzameld, worden opgeslagen op de beveiligde (versleutelde) gegevensdrager van de onderzoeker. De onderzoeksgegevens worden bewaard voor een periode van 10 jaar. Uiterlijk na het verstrijken van deze termijn zullen de gegevens worden verwijderd of worden geanonimiseerd
zodat ze niet meer te herleiden zijn tot een persoon. De onderzoeksgegevens worden indien nodig (bijvoorbeeld voor een controle op wetenschappelijke integriteit) en alleen in anonieme vorm ter beschikking gesteld aan personen buiten de onderzoeksgroep.

Tot slot is dit onderzoek beoordeeld en goedgekeurd door de ethische commissie van de faculteit Behavioural, Management and Social Sciences.

Vrijwilligheid
Deelname aan dit onderzoek is geheel vrijwillig. U kunt als deelnemer uw medewerking aan het onderzoek te allen tijde stoppen, of weigeren dat uw gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen. Het stopzetten van deelname heeft geen nadelige gevolgen voor u of de eventueel reeds ontvangen vergoeding.
Als u tijdens het onderzoek besluit om uw medewerking te staken, zullen de gegevens die u reeds hebt verstrekt tot het moment van intrekking van de toestemming in het onderzoek gebruikt worden.
Wilt u stoppen met het onderzoek, of heeft u vragen en/of klachten? Neem dan contact op met de onderzoeksleider.

Lilian van Oosterhout
L.e.vanoosterhout@student.utwente.nl

Voor bezwaren met betrekking tot de opzet en of uitvoering van het onderzoek kunt u zich ook wenden tot de Secretaris van de Ethische Commissie van de faculteit Behavioural, Management and Social Sciences op de Universiteit Twente via ethicscommittee-bms@utwente.nl. Dit onderzoek wordt uitgevoerd vanuit de Universiteit Twente, faculteit Behavioural, Management and Social Sciences. Indien u specifieke vragen hebt over de omgang met persoonsgegevens kun u deze ook richten aan de Functionaris Gegevensbescherming van de UT door een mail te sturen naar dpo@utwente.nl.

Tot slot heeft u het recht een verzoek tot inzage, wijziging, verwijdering of aanpassing van uw gegevens te doen bij de Onderzoeksleider.

Door dit toestemmingsformulier te ondertekenen erken ik het volgende:

1. Ik ben voldoende geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Deze vragen zijn voldoende beantwoord.
2. Ik neem vrijwillig deel aan dit onderzoek. Er is geen expliciete of impliciete dwang voor mij om aan dit onderzoek deel te nemen. Het is mij duidelijk dat ik deelname aan het onder- zoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil.
3. Ik geef toestemming om de gegevens die gedurende het onderzoek bij mij worden verzameld te verwerken zoals is opgenomen in het bijgevoegde informatieblad.
4. Ik geef toestemming om de bij mij verzamelde onderzoeksdata te bewaren en te gebruiken voor toekomstig onderzoek en voor onderwijsdoeleinden.

Appendix M – Coding question regarding reasons for using medication adherence tools

Coding	Client	Informal caregiver	Employee
Necessary	36	3	0
Convenience	35	10	10
Not forgetting	21	9	5
User-friendly	16	7	14
Description of current situation	9	2	1
Assistance with opening packages	9	0	0
Taking medication on time	8	1	7
Added value	8	2	2
No reasons	6	0	0
Effectiveness	5	5	7
Improved quality of life	5	0	0
Taking medication as prescribed	4	1	5
Other	4	1	2
Overview	4	3	0
Independence	4	4	59
Routine	3	2	0
Positive response	2	2	1
Relief of work pressure home care	2	1	4
Safety	2	1	4
Certainty	2	1	1
Aging in place	1	0	2
Positive influence on the client	1	2	4
Monitoring	0	2	0
Reliable	0	1	2
Clear	0	1	4
Efficiency	0	1	5
Enhancing medication adherence	0	0	14

Appendix N - Coding question regarding reasons for not using medication adherence tools

Coding	Client	Informal caregiver	Employee
Not necessary	55	15	2
No reasons	32	5	8
Maintain independence for as long as possible	11	1	1
Description of current medication use	9	1	1
Unable to cope	8	9	31
Hassle	5	2	0
No added value	5	0	4
Not suitable for the client	5	1	22
Does not work	5	0	9
Does not want to	5	1	3
Does not become easier	5	3	0
Use of medication blister pack	4	1	0
No effect	3	2	3
Memory problems	3	2	6
Costs	3	1	2
Lack of understanding	3	0	12
Digital	2	9	6
User-unfriendly	2	0	5
Unfamiliar with the product	1	2	1
Medical condition	1	0	2
Confusion	0	1	4
Restlessness	0	0	9
Lack of control	0	0	5
Complicated setup	0	0	3
Still need medication assistance	0	0	2

Appendix O - Interview

Interview

Introductie van mijzelf en het onderwerp.

1. Tijdens interview: vragen of interview opgenomen mag worden.

ALGEMEEN

2. Wat is uw functie?
3. Hoe lang werkt u al in deze functie?
4. (Helpt u cliënten binnen TWB? Werkt u alleen met cliënten binnen TWB of ook daarbuiten?)

MEDICATIE

5. Helpt u cliënten met het innemen van medicatie?
   Zo ja:
6. Waar bent u verantwoordelijk voor?
7. Hoe krijgen cliënten hulp bij de medicatie aangeboden?

8. Wordt het bijgehouden of cliënten hun medicatie (op de juiste manier) nemen?
   Zo ja:
9. Op welke manier wordt bijgehouden of cliënten hun medicatie (op de juiste manier) nemen?
10. Wie is verantwoordelijk voor het bijhouden van het juist nemen van de medicatie?
11. Wat ziet u vaak als de belangrijkste redenen voor het niet (op de juiste manier) nemen?
12. Wat wordt gedaan met de informatie over medicatie inname? Wordt hiernaar gehandeld?

GEBRUIK VAN HULPMIDDELEN

13. Gebruiken jullie binnen TWB momenteel hulpmiddelen voor het nemen van medicatie?
    Verschillende soorten medicatie hulpmiddelen
14. Medicijndozen
15. Medicijn alarmwekkers
16. Alarmhorloge
17. Hulp bij het openen van verpakkingen
18. Medicijndispensers
19. Medicijn app
20. Grote letters op medicijnverpakking laten zetten
21. Digicontact
22. Dementieklok
23. Ergotherapeut
24. Heeft u gehoord van de volgende hulpmiddelen?
    Zo ja:
25. Met welke hulpmiddelen heeft u gewerkt?
26. Wat is uw ervaring met deze hulpmiddelen?
27. Zou u de hulpmiddelen aanraden om mee te werken?

28. Is er een procedure rondom het aanbieden of aanvragen van hulpmiddelen?
29. Wat houdt de procedure rondom hulpmiddelen in?
30. Bent u zelf betrokken bij dit proces?
31. Wie zijn er in uw organisatie (nog meer) betrokken bij het aanbieden van hulp bij het innemen van medicatie?
32. Wat is uw mening over ieders rol bij de opname? Is deze taakverdeling voor iedereen duidelijk?
33. Staat beschreven op welke manier deze hulpmiddelen aangeleverd moeten worden (door wie/ op welke termijn)?
34. Duurt de termijn van het aanleveren van hulpmiddelen langer dan het in procedure is beschreven?

Zo ja,

35. Wat is de reden?

36. Wat gaat er in uw ervaring goed met betrekking tot het regelen van hulp bij medicatie inname? en wat zijn verbeterpunten?

37. Hoe selecteer je het juiste hulpmiddel voor een patiënt?
38. Staat beschreven welke hulpmiddelen wel niet gebruikt kunnen worden (per situatie)
39. Wordt er gekeken naar de trainbaarheid van een cliënt?
40. Hoe train je de patiënt en/of de verzorger om de hulpmiddelen te gebruiken?

41. Wat zijn voor u de belangrijkste redenen om een hulpmiddel WEL te gebruiken?
42. Wat zijn voor u de belangrijkste redenen om een hulpmiddel NIET te gebruiken?

43. Wat zijn de belangrijkste voordelen die u ziet in het gebruik van hulpmiddelen om u te helpen bij het innemen van medicatie?
44. Welke aanpassingen zouden hulpmiddelen voor u nog gebruiksvriendelijker maken?

45. Zijn er kosten verbonden aan hulpmiddelen voor medicatie?
    Zo ja:
46. Wie betalen deze kosten? Worden deze vergoed?
47. Denkt u dat cliënten bereid zijn om te betalen voor hulpmiddelen die helpen bij het innemen van medicatie?

48. Denkt u dat hulpmiddelen een positieve bijdrage kunnen leveren aan het bevorderen van de medicatietrouw bij ouderen? Waarom wel of waarom niet?
49. Hoe ziet u de rol van hulpmiddelen/technologie bij het verbeteren van medicatietrouw van cliënten in de toekomst?

OVERIG

50. Wat is nog niet aan de orde gekomen en wel belangrijk om mee te nemen?
51. Heeft u verder nog vragen of dingen die u kwijt wilt?

Appendix P - Informed Consent Interview

Informatieblad voor onderzoek 'Hulpmiddelen om medicatieontrouw te verminderen'

Doel van het onderzoek

Dit onderzoek wordt geleid door Lilian van Oosterhout, master student Health Science aan de Universiteit Twente. Het doel van dit onderzoek is om manieren te onderzoeken die therapieontrouw kunnen verminderen. De uitkomsten van de interviews zullen worden gebruikt als onderdeel van het afstudeeronderzoek met als doel manieren te vinden die therapieontrouw te verminderen

Hoe gaan we te werk?

U neemt deel aan een onderzoek waarbij we informatie zullen vergaren door:

- U te interviewen en uw antwoorden te noteren en op te nemen via een audio-opname. Er zal ook een transcript worden uitgewerkt van het interview.

Potentiële risico's en ongemakken

- Er zijn geen fysieke, juridische of economische risico's verbonden aan uw deelname aan deze studie. U hoeft geen vragen te beantwoorden die u niet wilt beantwoorden. Uw deelname is vrijwillig en u kunt uw deelname op elk gewenst moment stoppen.

Vergoeding

U ontvangt voor deelname aan dit onderzoek geen vergoeding.

Vertrouwelijkheid van gegevens

Wij doen er alles aan uw privacy zo goed mogelijk te beschermen. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u naar buiten gebracht, waardoor iemand u zal kunnen herkennen.

In een publicatie zullen anonieme gegevens of pseudoniemen worden gebruikt. De gegevens die via het interview in het kader van deze studie worden verzameld, worden opgeslagen op de beveiligde (versleutelde) gegevensdrager van de onderzoeker.

De onderzoeksgegevens worden bewaard voor een periode van 10 jaar. Uiterlijk na het verstrijken van deze termijn zullen de gegevens worden verwijderd of worden geanonimiseerd zodat ze niet meer te herleiden zijn tot een persoon.

De onderzoeksgegevens worden indien nodig (bijvoorbeeld voor een controle op wetenschappelijke integriteit) en alleen in anonieme vorm ter beschikking gesteld aan personen buiten de onderzoeksgroep.

Tot slot is dit onderzoek beoordeeld en goedgekeurd door de ethische commissie van de faculteit Behavioural, Management and Social Sciences.

Vrijwilligheid

Deelname aan dit onderzoek is geheel vrijwillig. U kunt als deelnemer uw medewerking aan het onderzoek te allen tijde stoppen, of weigeren dat uw gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen. Het stopzetten van deelname heeft geen nadelige gevolgen voor u.

Als u tijdens het onderzoek besluit om uw medewerking te staken, zullen de gegevens die u reeds hebt

verstrekt tot het moment van intrekking van de toestemming in het onderzoek gebruikt worden.

Wilt u stoppen met het onderzoek, of heeft u vragen en/of klachten? Neem dan contact op met de onderzoeksleider.

Lilian van Oosterhout
L.e.vanoosterhout@student.utwente.nl

Voor bezwaren met betrekking tot de opzet en of uitvoering van het onderzoek kunt u zich ook wenden tot de Secretaris van de Ethische Commissie van de faculteit Behavioural, Management and Social Sciences op de Universiteit Twente via ethicscommittee-bms@utwente.nl. Dit onderzoek wordt uitgevoerd vanuit de Universiteit Twente, faculteit Behavioural, Management and Social Sciences. Indien u specifieke vragen hebt over de omgang met persoonsgegevens kun u deze ook richten aan de Functionaris Gegevensbescherming van de UT door een mail te sturen naar dpo@utwente.nl.

Tot slot heeft u het recht een verzoek tot inzage, wijziging, verwijdering of aanpassing van uw gegevens te doen bij de Onderzoeksleider.

Door dit toestemmingsformulier te ondertekenen erken ik het volgende:

1. Ik ben voldoende geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Deze zijn voldoende beantwoord.
2. Ik neem vrijwillig deel aan dit onderzoek. Er is geen expliciete of impliciete dwang voor mij om aan dit onderzoek deel te nemen. Het is mij duidelijk dat ik deelname aan het onderzoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil.
3. Ik geef toestemming om de gegevens die gedurende het onderzoek bij mij worden verzameld te verwerken zoals is opgenomen in het bijgevoegde informatieblad.
4. Ik geef toestemming om de bij mij verzamelde onderzoeksdata te bewaren en te gebruiken voor toekomstig onderzoek en voor onderwijsdoeleinden.
5. Ik geef toestemming om tijdens het interview geluidopnames te maken en mijn antwoorden uit te werken in een transcript.
6. Ik geef toestemming om mijn antwoorden te gebruiken voor quotes in de onderzoekspublicaties.

Appendix Q – Deductive coding interview

Table 21 deductive coding interview

Literature review medication non-adherence	Economic	Socioeconomic status Cost of medication and medical care Type of insurance coverage Patient income
	Medication	Types of medication Number of concurrent medications Adverse effects Dosing regimen Use of assistive technology
	Medical	Quality of care Severity and duration of illness (Number of) co-morbid conditions Use of medical service Type of disease ADL difficulties Health status Frequency of use of medical services
	Demographic	Age Gender Low health literacy Educational level Race Relationship status Occupation
	Behavioural	Patients' knowledge, understanding, and beliefs about their disease(s) and medication Medication non-adherence Health belief Fragmented, short, and poor physician-patient interactions Fear of disease(s) and medication Patient satisfaction with healthcare provider
Questionnaire	Reasons of medication non-adherence	Afraid of side-effects Busy with other things Can't get medication out of the packaging Can't read packaging Forget to take medication No trust in doctor No trust in pharmacy Not seeing importance of medication Suffer from side-effects
	All tools and occupational therapist as mentioned in questionnaire	No experience Heard of tool Recommend tool Worked with tool
	Procedure concerning tools	Client responsible Employee responsible Informal caregiver responsible
	Considerations using tools	Cannot deal with tool Convenience Easy to use Necessary Not possible Not want to work with tool

		Not understand tool Remember taking medication Stay independent Too digital Tools are not necessary Trainability
Other	Job	Carer District nurse Occupational therapist

Appendix R – AI coding interview

Code AI	Subcode	Count
Limitations/problems with care and technology use	Cognitive problems	17
	Error prevention	8
	Inefficiency	1
	Difficulties in implementing intervention	4
	Motivation issues	4
	Unfamiliarity	7
	Discouragement	2
	Ignorance	3
	Opinion (negative)	2
	Reactive action	2
	Technical issues	2
	Doubt	8
	Resistance	5
	Total	**65**
Communication	Need for social contact	3
	Discussion	2
	Family relations	2
	Reminder	8
	Reminder system	4
	Taking initiative	1
	Reporting willingness	3
	Consultation	10
	Protocols	1
	Report	4
	Signalling	6
	Poor communication	2
	Social network	5
	Trust	2
	Total	**53**
Generality	Concerns about placement	2
	Control	8
	Monitoring	2
	Overview	2
	Procedures	5
	Training	2
	Total	**21**
Practical limitations and benefits of technology	Digitalisation	5
	Annoyance	1
	Convenience	5
	Costs	6
	Practical usability	3
	Technological literacy	4
	Total	**24**
Responsibility	Administrative tasks	2
	Efficiency	3
	Acknowledgement	1
	Evaluation	2
	Equality	2
	Incident response	2
	Independence	2
	Positive rating	5
	Speed of response	6
	Supervision	4
	Safety	4

	Preliminary investigation	6
	Self-reliance	31
	Total	**70**
Caretaking	ADL care	3
	Baxterrol	4
	Guidance	4
	Document management	1
	Importance of practice and training	4
	Important	1
	Client-oriented	1
	Coordination	2
	Simplicity	5
	Own control	11
	Focus on inflow and outflow	1
	Physical care	3
	Behavioural change	1
	Habit	2
	Tools	4
	Instruction	2
	Customization	5
	Medication support	11
	Administer medication	6
	Medication adjustments	3
	Medication management	3
	Medication non-compliance	3
	Medication problems	4
	Support	2
	Follow-up	4
	Organisational change	2
	Patient safety	2
	Role of GP	1
	Structure	2
	Team dynamics	2
	Tools for assessment of medicine intake	3
	Implementation of care plan	7
	Nursing home	1
	Freedom	4
	Working conditions	3
	Disease	3
	Care/reminder medication intake	5
	Care needs	1
	Caretaking	2
	Total	128

Appendix S – Deductive coding interview

Code deductive	Subcode	Count
1 Job	Carer	3
	District nurse	2
	Occupational therapist	1
	Total	**6**
2 Medication intake process	Help clients take medication	3
	Total	**6**
4 Reasons of medication non-adherence	Afraid of side effects	1
	Can't get medication out of the packaging	2
	Forget to take medication	11
	Not seeing importance of medication	2
	Suffer from side effects	1
	Total	**17**
5.1 Medicine boxes	No experience	1
	Heard of tool	2
	Recommend tool	5
	Worked with tool	4
	Total	**12**
5.2 Medicine alarms	No experience	1
	Recommend tool	2
	Total	**3**
5.3 Alarm watches	No experience	1
	Heard of tool	2
	Recommend tool	2
	Thinks it can help but not worked with	2
	Total	**7**
5.4 Help with opening packages	No effect	1
	No experience	1
	Heard of tool	2
	Recommend tool	2
	Thinks it can help but not worked with	1
	Total	**7**
5.5 Medicine dispensers	No effect	1
	Heard of tool	1
	Recommend tool	14
	Worked with tool	9
	Total	**25**
5.6 Medicine apps	No experience	1
	Heard of tool	2
	Recommend tool	3
	Thinks it can help but not worked with	1
	Worked with tool	1
	Total	**8**
5.7 Putting large letters on medicine packaging	No effect	1
	No experience	3
	Heard of tool	2
	Thinks it can help but not worked with	2

	Total	**8**
5.8 Digicontact	No experience	4
	Heard of tool	2
	Recommend tool	3
	Thinks it can help but not worked with	4
	Worked with tool	1
	Total	**14**
5.9 Dementia clock	No experience	2
	Recommend tool	3
	Worked with tool	3
	Total	**8**
5.10 Occupational therapist	No experience	1
	Recommend	2
	Thinks it can help but not worked with	1
	Worked with	4
	Total	**8**
6 Procedure concerning tools	Client responsible	21
	Employee not responsible	1
	No experience with it	2
	Informal carer responsible	2
	TWB employee responsible	16
	Total	**42**
8 Considerations using tools	Cannot deal with tool	1
	Easy to use	3
	Not possible	2
	Not wanting	2
	Not wanting to take it	2
	Not understanding tool	9
	Stay independent	1
	Too digital	1
	Tools are not necessary	1
	Trainability	7
	Total	**29**
10 Cost of tools	Health insurance	5
	High willingness to pay	3
	Low willingness to pay	5
	Total	**13**
Baxterrol	Recommend tool	6
	Worked with tool	4
	Total	**10**
Care taking		
	Collaboration client	17
Marking off		**6**
Agreement		**1**
No cognitive problems		**10**
Indicating of care		**2**
Responsibility pharmacy		
Responsibility TWB		

Appendix T – Inductive coding interview

Code inductive	Subcode	Count
10 Cost of tools	Client pays himself	4
Work experience		-
	2 years	1
	25 years	1
	3 years	2
	4 years	1
8 Considerations using tools	Utility	3
Distractions		**2**
	Hecticity	2
	Children come in	1
	Mobile phone	1
	Patient talks	2
	Too many incentives	1
Deviating from protocol		**1**
Alarm in phone		**8**
	Recommend tool	5
	Worked with tool	3
Limitations/problems with care and technology use		**60**
	Small buttons	2
Calling client for medication		**2**
Communication	Providing information	20
Clear		**3**
Implement earlier		**3**
No temporary care		**1**
No change		**1**
Reassuring		**1**
Very unsafe		**1**
Interviewee not responsible		**3**
Can always be faster		**1**
Looking at what has been tried		**1**
Working long hours with worn-out tools		**1**
Loose medication		**6**
	Not	5
	Yes	1
Giving medication		**4**
Added value tools		**1**
MIC notification		**9**
Not marked off		**3**
Not in use		**2**
Relief of work pressure home care		**15**
Insufficient		**1**
Carelessness		**1**
Eye drop glasses		**1**
Finding cause		**2**
Persuade		**2**
Finding suitable tools		**13**

Band-aids		**3**
Problem identification		**3**
Trial		**1**
Trial period		**2**
	2 weeks	2
Puffers		2
Director		**2**
Poor vision		**1**
Too many alarms		**1**
Too much interference		**5**
Technological illiteracy		**6**
Temporary medication		**3**
Temporary care		**1**
TWB		**3**
Two to three weeks		**4**
Responsibility acute team		**2**
Expectations		**1**
Next-day delivery		**2**
Restriction of freedom		**1**
Take over work		**2**
District nurse final responsibility		**5**
Changing medication		**3**
Care taking	Collaboration with TWB	7
	Culture change	3
	No physical care	7
	Younger age	3
	Elderly people	5
	Collaboration occupational therapist	3
	Collaboration informal care	10
	Collaboration with other healthcare providers	6
	Collaboration with pharmacy	4
	Collaboration with district nurse	8
	Does get physical care	14