# The link between configurations of organizational design characteristics and infectious disease control

A Qualitative Comparative Analysis of Flemish nursing homes

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# Abstract

This research addresses the different organizational structure design characteristics of nursing homes associated with infectious disease control. Sitter's seven design parameters were used to describe the organizational structure design. This research identifies structure-related configurations linked to infectious disease control. A fuzzy-set qualitative comparative analysis, using data from 219 nursing homes, is conducted to search for necessary conditions and sufficient configurations. The findings of this research confirm the link between configurations of organizational structure design characteristics and the absence or presence of Covid-19 confirmed cases, deaths due to Covid-19, and hospitalizations due to Covid-19. Also, the province in which the nursing home is located and the burden of care of residents was taken into account. This study contributes to the knowledge by establishing the link between organizational structure design and infectious disease control. Moreover, the findings could be used as handles for decision-makers of nursing homes to design or redesign the organizational structure to be prepared for pandemics or new Covid-19 waves.



**Keywords:** Organizational structure design, Sitter's design parameters, FsQCA, infectious disease control, Covid-19

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# 1. Introduction

In December 2019, a novel coronavirus, also called Covid-19, emerged and resulted in a pandemic (Zhao et al., 2020). Unfortunately, the Covid-19 pandemic also reached Belgium. The elderly are the group that is the most affected by Covid-19 (Vandael et al., 2022). Besides age, having other health issues makes people more vulnerable to Covid-19. Therefore, nursing homes are especially vulnerable to infectious diseases, such as Covid-19 (Vandael et al., 2022). In organizational structure design theory, it is argued that the organizational structure design could influence the overall firm performance, quality of work, learning and innovation capabilities. The relation between organizational structure design and infectious disease control has not been studied yet. It is argued that infectious diseases, in this case, Covid-19, transmits via human-to-human contact (Zhao et al., 2020). The organizational structure design is one of the factors that predict the contact patterns, or frequency of human-to-human contact (Potter, Smieszek & Sailer, 2015). Therefore, it is assumed that the organizational structure design could influence the infection rate in nursing homes. This research aims to determine which configurations of organizational structure characteristics of nursing homes result in the best outcome during an infection-disease pandemic. To reach this aim, the Covid-19 pandemic in Flemish nursing homes is studied. The following research question is formulated:

'Which sets of necessary and sufficient conditions, regarding organizational structure characteristics, result in the lowest number of Covid-19 confirmed cases, hospitalizations due to Covid-19 and Covid-19 related deaths in Flemish nursing homes?'

Organizational structure design theory is used during this study. An organizational structure can be defined as a framework of the relations between jobs, systems, operating processes, people, and groups (Lunenburg, 2012). Systematic thinking is used to get a deeper understanding of organizational structures (Achterbergh & Vriens, 2019). A commonly used method to describe organizational structure designs is using the organizational configurations of Mintzberg (1983). He suggests five configurations of organizations, based on three dimensions: the key part, the prime coordinating mechanism, and the type of decentralization. However, it is argued that organizational structure designs evolved into more divers and complex structures. In their book, Achterbergh and Vriens (2019) argue that describing organizational structures can be done in a more detailed way. They suggest the seven design parameters developed by Sitter.

In this study, the seven design parameters from Sitter are used to analyze the organizational structures of Flemish nursing homes. The seven parameters could be categorized into three different categories. The first one is parameters describing the production structure, which includes three parameters (Achterbergh & Vriens, 2019). The second group contains three parameters describing the control structure of an organization and the final group contains one parameter describing the relation between operational and control activities (Achterbergh & Vriens, 2019). In this study, the organizational characteristics of Flemish nursing homes are analyzed by using the parameters of Sitter. Nevertheless, not all seven parameters were equally applicable to the study due to the availability of data. Therefore, more focus will be directed to the parameters related to the production structure.

The covid-19 pandemic has illustrated how badly some nursing homes are designed for infection control and protection (Fallon, Dukelow, Kennelly & O'Neill, 2020). Potter et al. (2015) suggest that the organizational structure design influences the frequency of human-to-human contact. Working in teams or workgroups, collaborations in projects, mixing employees with different tasks, and mixing employee roles are highly predictive of contact (Potter et al., 2015). In addition, multiple employees working on the same product or service could increase the odds of contact and also the odds of longer duration contact (Potter et al., 2015). An important characteristic of Covid-19, which is an infectious disease, is that it transmits via human-to-human contact (Zhao et al., 2020). Therefore, it is assumed that organizational structure designs are a factor in predicting the number of Covid-19 confirmed cases.

The dataset that is used for this study has been collected by Teppers, Vermeerbergen, and Van Hootegem (2022). The dataset contains data from 318 different Flemish nursing homes. Teppers et al. (2022) argue that the number of cases is too small for reaching significance in statistical analysis and too large for conducting case-study. In these situations, Patty, Gerrits, and Verweij (2015) suggest a qualitative comparative analysis. The cases in the qualitative comparative analysis are selected from a variety of organizations and contexts, which makes the results generalizable. However, the analysis will also be based on in-depth, qualitative knowledge of the cases. This research contains seven conditions and 219 cases. According to Marx, Cambré, and Rihoux (2013), the number of cases is enough to make statements. Another important reason that substantiates the choice for qualitative comparative analysis is that the aim of this research is not to identify statistical relations but to examine configurations of conditions. A qualitative comparative analysis enables one to examine the configurations or sets of conditions that lead to the best outcome, which fits perfectly with the aim of the research. Therefore, a qualitative comparative analysis is conducted.

This research will contribute to the organizational structure design theory. In previous studies, a relation between the organizational structure design and quality of work (Mirkamali & Thani, 2011), overall firm performance, success of product development (Hitt, Hoskisson, Johnson & Moesel, 1996; Lei, Slocum & Pitts, 1999; Wei, Yi & Guo, 2014), and learning capabilities (Hao, Kasper & Muehlbacher, 2012) has been established. Nevertheless, the relation between the organizational structure and an infectious disease crisis has not been studied yet. The assumption that there is a relationship between the organizational design and infectious disease control is based on the fact that the spread of an infectious disease is influenced by the frequency of human-to-human contact. The organizational structure design could influence the frequency of human-to-human contact (Potter et al., 2015). Because a qualitative comparative analysis is used, the configurations or sets of conditions that result in better outcomes can be analyzed, which means that configurations of organizational structure characteristics can be researched. Therefore, this study contributes to the organizational structure design theory by examine the organizational structure characteristics that result in the best outcome during an infectious disease crisis.

Next to the theoretical contribution, this research will also have a practical contribution. Because this research outlines a holistic view on sets of conditions that will lead to a better outcome during an infectious disease, it could give nursing homes, or other long time care facilities, handles to design or redesign the organizational structure to prepare for other infectious diseases or Covid-19 waves in the future.

This paper is divided into six chapters. First, the theoretical background can be found in chapter 2 of this paper. The theoretical background will be followed with the research methodology, concluding research design, data collection, operationalization, analysis methods, and research ethics. The analysis and results will be presented in the fourth chapter. In chapter 5, a conclusion will be formulated based. Also, the theoretical and practical contributions will be discussed in chapter 5. Finally, the limitations of this research and some directions for further research will be given.

# 2. Theoretical background

In this chapter, the theoretical background of this research can be found. This chapter aims to provide theoretical background for the important concepts of this study. First, organizational structure design theory will be discussed. After a discussion of the basic concepts in organizational structure design theory, the seven design parameters developed by Sitter will be discussed. This chapter will continue with information about the practical context of this research, which is the Covid-19 crisis situation. Finally, organizational structure design theory will be applied to nursing homes, which will lead to the hypotheses of the study.

## 2.1 Organizational structure theory

The focus of this study is directed to organizational structures of Flemish nursing homes and infection-disease control. Therefore, literature about organizational structures will be discussed.

### *2.1.1 Organizational structures*

In general, the concept of structure refers to the relations between components of an organized whole (Ahmady, Mehrpour & Nikoo Ravesh, 2016). Looking at organizations, the organizational structure can be defined as a framework of the relations between jobs, systems, operating processes, people and groups (Lunenburg, 2012). Lunenburg (2012) formulated a simplified explanation of why and how organizational structures arise. Essentially, the reason that organizations exist is to achieve goals and the organizational structure gives the organization the form to fulfill its function in the environment (Lunenburg, 2012). The goals that organizations try to achieve are broken down into tasks as the basis for jobs, which are grouped into departments (Lunenburg, 2012). The departments linked together form the organizational structure (Lunenburg, 2012). In the first publications in the field of organizational structure theory, the structures were often relatively simple and based on either product or function (Oliveira & Takahashi, 2012). Other authors moved beyond the distinction based on product or function and developed the matrix organization, which crossed the two ways of organizing (Galbraith, 2009; Kuprenas, 2003).

The conceptualization of organizational structure is a manifestation of systematic thinking (Ahmady et al., 2016). Conceptualization, or systematic thinking, can be used to get a deeper understanding of organizational structures. A systematic view of organizational structures shows that the structures are composed of both hard and soft elements (Ahmady et al., 2016). The tangible elements, such as teams, groups, departments, and units represent the hard elements of an organizational structure and the relationships between these tangible elements are the soft elements (Ahmady et al., 2016). One of the authors that proposed a systematic framework to conceptualize the organizational structure is Mintzberg (1983), who suggests that organizational structures can be differentiated by three basic dimensions. The dimensions that Mintzberg (1983) suggests are the key part, the prime coordinating mechanism, and the type of decentralization. The first dimension includes five different elements or options; the strategic apex, the operative core, the middle line, support staff, and technostructure (Ahmady et al., 2016). The strategic apex represents the top management and its support staff. The operative core includes the workers who actually carry out the tasks (Lunenburg, 2012). The middle- and lower-level management is represented in the third element middle line of the key parts (Lunenburg, 2012). Mintzberg (1983) argues that the people who provide indirect services, such as maintenance, legal counsel, and clerical are part of the support staff and analysts, planners, public relations, R&D, and accountants belong to the technostructure of an organization. The second dimension suggested by Mintzberg is the prime coordinating mechanism of the organization (Lunenburg, 2012). According to Mintzberg, the prime coordinating mechanism can be direct supervision, mutual adjustment, and standardization of work processes, skills, or outputs (Lunenburg, 2012). The third dimension suggested by Mintzberg is the type of decentralization, which includes three possible types (Lunenburg, 2012). The three types of decentralization are vertical, horizontal, and selective (Lunenburg, 2012). Using the three basic dimensions of organizational structure, Mintzberg suggests five structural configurations. The five configurations are presented in Table 1. However, from the early 80s, top managers attempted to present new organization structures, such as the team structure, virtual organization, and no boundary organizations (Lunenburg, 2012). To conclude, the conceptualization of organizational structures by Mintzberg is useful to understand basic principles and concepts of organizational structure theory, but organizational structures evolved and became more diverse and complex. Achterbergh and Vriens (2019) argue that the conceptualization of organizational structures can be done in a more detailed way, which will be discussed in section 2.2.

**Table 1**

*Mintzberg's Five Organizational Structures*

| Structural Configuration | Prime Coordinating Mechanism | Key Part of Organization | Type of Decentralization |
|---|---|---|---|
| Simple structure | Direct supervision | Strategic apex | Vertical and horizontal centralization |
| Machine bureaucracy | Standardization of work processes | Technostructure | Limited horizontal decentralization |
| Professional bureaucracy | Standardization of skills | Operating core | Vertical and horizontal decentralization |
| Divisionalized form | Standardization of outputs | Middle line | Limited vertical decentralization |
| Adhocracy | Mutual adjustment | Support staff | Selective decentralization |

*Note.* From 'Organizational structure: Mintzberg's framework' by Lunenburg, F.C., 2012, International journal of scholarly, academic, intellectual diversity, 14(1), 1-8.

***2.1.2 Sitter's design parameters***

Besides the dimensions of organizational structures that Mintzberg suggested, Achterbergh and Vriens (2019) argue that describing organizational structures can be done in a much more detailed way. Several authors in the field of organizational structure theory developed and proposed so-called design parameters. The design parameters serve as guidelines for the design of organizational structures (Vriens

& Achterbergh, 2011), and can be used to describe and analyze the organizational structure. A commonly used method to describe the organizational structure in a detailed way is the use of seven parameters developed by Sitter (Achterbergh & Vriens, 2019). The seven parameters that Sitter developed can be divided into three groups (Vriens & Achterbergh, 2011). Firstly, a group of three parameters that mainly refers to operational activities in organizations or the production structure of organizations (Vriens & Achterbergh, 2011). Secondly, a group of three parameters that refers to the control structure of an organization, and the seventh parameter describes the relation between the production and control structures, which is called the degree of separation (Achterbergh & Vriens, 2019). Each parameter can have different values, dependent on these values the organizational structure has particular characteristics (Achterbergh & Vriens, 2019). Thus, the design parameters can be used to describe organizational structures in a detailed way (Achterbergh & Vriens, 2019). Moreover, the design parameters also can be used in a normative way, which can help managers to design or redesign the organizational structure to make sure that the parameters reach the value that is asked in a particular context (Achterbergh & Vriens, 2019).

When looking at Mintzberg's configurations and dimensions, and Sitter's design parameters, some overlap and some differences can be defined. An important difference is the fact that Sitter's design parameters describe the organizational structure at task-level, whereas Mintzberg's dimensions describe the organizational structure on a more general level. Nevertheless, both frameworks also show some overlap with each other. For example, Sitter's seventh parameter the degree of separation says something about the decentralization of the organization, which is also included in Mintzberg's dimensions. More concrete, an organization with a high level of decentralization is more likely to have tasks that contain both regulatory and operational activities.

**2.1.2.1 Production structure.** To get a deeper understanding of Sitter's design parameters, the parameters will be discussed. In the operational activities group, Sitter developed three parameters. Operational activities are the activities that are directly related to the organization's output (Alver, 2005). The first parameter that describes the production structure is called the degree of functional concentration and refers to the relation between operational tasks and order types (Achterbergh & Vriens, 2019). An order type is defined as a subset of all orders. An organizational structure that has a high value at functional concentration, means that all operational activities are potentially for all types of orders (Achterbergh & Vriens, 2019). Organizational structures with a high value at functional concentration typically have operational units or departments based on function (Achterbergh & Vriens, 2019). A low degree of functional concentration means that operational tasks are not coupled to all types of orders (Achterbergh & Vriens, 2019). In general, it is argued that a low degree of functional concentration is better for the overall performance, and therefore organizations try to minimize the functional concentration of the organizational structure (Achterbergh & Vriens, 2019).

The success of minimizing the functional concentration depends on the available resources, the type of product or service, and the number of orders (Achterbergh & Vriens, 2019).

The degree of differentiation of operational activities is the second parameter in the group of parameters that describes the operational activities (Achterbergh & Vriens, 2019). Sitter (1994) distinguishes three different types of operational activities: making, preparing, and supporting. The organizational structure has a high degree of differentiation of operational activities when the activities are grouped into separate production, preparation, and support units (Achterbergh & Vriens, 2019). To make it more concrete, an organizational structure that has a high value on this parameter could have separate planners, material handlers, workers, and salespeople for production activities (Achterbergh & Vriens, 2019). In organizations with an organizational structure with a lower value on this parameter, employees may have tasks with overcharging work. For example, one employee performs production activities, helps with planning and takes care of daily maintenance.

The final parameter in this group is the degree of specialization of operational tasks, which describes whether the operational tasks only contain a small part of the complete operational process (Achterbergh & Vriens, 2019). In general, this parameter is often referred to as division of labor (Mintzberg, 1983; Pugh et al., 1968). The organizational structure that scores a low value on the degree of specialization of operational activities includes operational tasks that cover the complete operational process (Achterbergh & Vriens, 2019). For example, a traditional chair maker is responsible for all the activities when making a chair. In organizations with an organizational structure that scores high on the degree of specialization of operational activities, one employee is responsible for a small part of the operational process. For example, a factory that produces in a belt-like sequential production process (Achterbergh & Vriens, 2019). According to Sitter (1994), two exemplary organizational configurations that score high at this parameter are functional organizations and line organizations.

**2.1.2.2 Control structure.** In the group with parameters related to the control structure, Sitter also developed three parameters. The first one is the degree of differentiation of regulatory activities into parts, which refers to whether the regulation activity parts are assigned to separate tasks (Achterbergh & Vriens, 2019). Regulation includes the following three sub-activities: monitoring, assessing, and acting (Sitter, 1994). Monitoring is the sub-activity that refers to gathering information with respect to indicators, such as quality or quantity guidelines (Achterbergh & Vriens, 2019). Assessing is the second sub-activity and includes a comparison of the indicator with norm values and a judgment about the differences (Achterbergh & Vriens, 2019). Finally, acting is the activity of taking action to make sure that a problematic difference between desired and actual values in the operational process (Achterbergh & Vriens, 2019). This parameter describes whether the three different sub-activities are aligned to the same task or divided over multiple different tasks.

The second parameter in this group, the degree of differentiation of regulatory activities into aspects, has to do with whether the aspects are assigned to separate tasks (Achterbergh & Vriens, 2019). Achterbergh and Vriens (2019) state that three forms of regulation activities exist. Strategic regulation is the form of regulation that refers to setting and resetting organizational goals, regulation by design is the form of regulation that refers to designing and redesigning the infrastructure, and operational regulation is the form of regulation that refers to dealing with day-to-day disturbances in the operational process (Achterbergh & Vriens, 2019). This parameter describes whether these three forms of regulation are assigned to separate tasks or are all assigned to the same tasks (Achterbergh & Vriens, 2019). Organizations that score high on this parameter have the three forms of regulation assigned to different tasks and organizations that score low on this parameter have tasks that include all three forms of regulation activities (Achterbergh & Vriens, 2019).

The third parameter in this group is the degree of specialization of regulatory activities and refers to whether regulatory activities are broken down into small sub-activities (Achterbergh & Vriens, 2019). When looking at the degree of specialization, it is the same for regulatory activities as it is for operational activities. The regulatory activities can be separated into small sub-activities (Achterbergh & Vriens, 2019). Specialization essentially means that tasks are specialized in a part of the complete process. For example, instead of assessing the complete operational process, one task is responsible for assessing one specific operational activity (Achterbergh & Vriens, 2019). An organizational structure has a high degree of specialization of regulatory activities when the regulatory scope is narrow, which means that one regulatory task is responsible for a relatively small part of the complete process (Achterbergh & Vriens, 2019). Organizational structure designs that score low on this parameter have a broader regulatory scope, which means that one regulatory task or team is responsible for a major part of the complete process (Achterbergh & Vriens, 2019).

**2.1.2.3 The degree of separation.** In the design parameters, a distinction between operational and regulatory activities is used. Nevertheless, these activities could be assigned to the same tasks. Therefore, a seventh parameter is used to describe the degree of separation of regulatory and operational activities (Achterbergh & Vriens, 2019). Organizational structures with a high value on this parameter have separated tasks related to operational activities and regulatory activities (Achterbergh & Vriens, 2019). Organizational structures with a low value on this parameter have tasks that contain both regulatory and operational activities (Achterbergh & Vriens, 2019). All three activities mentioned in regulatory activities, thus operational regulation, regulation by design, and strategic regulation have a regulatory and operational aspect. Separation means that the regulatory and operational activities are assigned to different tasks (Achterbergh & Vriens, 2019).

***2.1.3 The Covid-19 pandemic***

In the previous sections, focus is directed organizational structure design. To get more knowledge about the context of the research, the Covid-19 crisis will be discussed. Firstly, basic Covid-19 information will be given, including the ways that the virus transmits.

On March 2020, the World Health Organization (WHO) declared Covid-19 as a pandemic emergency (Zhao et al., 2020). Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was firstly reported in Wuhan, China, in December 2019 (Zhao et al., 2020). SARS-CoV-2 (from now on Covid-19) spread rapidly worldwide via human-to-human transmission, resulting in the pandemic emergency status. Fever, cough, fatigue, sputum production, dyspnea, and muscle aches are the main clinical manifestations of Covid-19 (Zhao et al., 2020). In February of 2022, Covid-19 had spread rapidly across the world with more than 406 million confirmed cases according to the Covid-19 Dashboard by the Center for Systems Science and Engineering at Johns Hopkins University (Hopkins, 2020). The Covid-19 Dashboard (Hopkins, 2020) also showed that the Covid-19 virus resulted in almost 5.8 million total deaths until February 2022, globally.

Looking at existing studies, the Covid-19 cases seem to come in waves. The first wave of Covid-19 ended at June of 2020 (Vandael et al., 2022). After the first wave, there was a relatively calm and quiet period when looking at Covid-19 until August 31 of 2020 (Vandael et al., 2022). The 31st of August also was the start of the second wave, which lasted till the end of 2020. In Belgium, the vaccination campaigns started in January 2021 (Vandael et al., 2022). The focus of this research is directed to the first Covid-19 wave, the main reason for this is the availability of data.

Since this research is about nursing homes in Belgium, some specifications of the Covid-19 confirmed cases and deaths in Belgium should be stated. The Covid-19 Dashboard (Hopkins, 2020) showed over 3.4 million confirmed cases of the Covid-19 virus in Belgium in February 2022. In February 2020, the first Covid-19 case in Belgium was confirmed and the first Covid-19-related death was confirmed in March 2020 (Vandael et al., 2022). Same as in other countries, the elderly (65 years and older) are the most affected group by the spread of the Covid-19 virus (Vandael et al., 2022). The elderly represent 94% of all Belgian Covid-19 deaths measured between March 2020 and February 2021 (Vandael et al., 2022). According to Vandael et al. (2022) during the first Covid-19 wave Belgium was ranked among the countries with the highest Covid-19 mortality. Because Covid-19 mainly impacts older people, the all-cause mortality rate exceeded the mortality rate for previous years, especially in the group of people older than 65 years (ECDC, 2020b).

The pandemic has been catastrophic for many nursing homes worldwide, and Belgian nursing homes are no exception to this (Vandael et al., 2022). Nursing home residents are vulnerable to transferable diseases like Covid-19 because of their advanced age and high prevalence of comorbidities (Vandael et al., 2022). In addition, residents of nursing homes have frequent close contact with caregivers and other residents of the nursing home (Vandael et al., 2022). Also, there are a lot of different people around in a nursing home beside the residents, like staff, visitors and caregivers, who daily interchange between the nursing home and their community, which could be an easy entry for a virus (Vandael et al., 2022).

During the entire period of the study of Vandael et al. (2022), which lasted from 11 March 2020 to 3 January 2021, 11,369 Covid-19 deaths among nursing home residents in Belgium were reported. 57% of all Covid-19 deaths reported in Belgium are represented by the 11,368 Covid-19 deaths in nursing homes (Vandael et al., 2022). The risk of Covid-19 introduction into a nursing home depends on the level of Covid-19 circulation in the community and therefore does not seem to be controllable for nursing homes (Vandael et al., 2022). This statement is substantiated by the fact that only 3% of the nursing homes never reported a possible or confirmed Covid-19 infection within the nursing home (Vandael et al., 2022).

To get a deeper understanding of the Covid-19 virus, it is important to discuss the different ways how Covid-19 could spread among the population. Zhao et al. (2020) state that Covid-19 spreads rapidly through human-to-human transmission. The primary transmission mode of Covid-19 is via large respiratory droplets (Ye et al., 2020). Also, close contact between two or more people is one of the common transmission modes of viruses (Ye et al., 2020).

Next to human-to-human transmission, Van Doremalen et al. (2020) states that the Covid-19 virus stays active or alive for three hours in air post-aerosolization, up to four hours on copper, up to 24 hours on cardboard, and up to two to three days on plastic and stainless steel. In addition, in rooms with Covid-19 patients, environmental contamination has been detected (Van Doremalen et al., 2020). Ye et al. (2020) who performed a study of environmental contamination in a Chinese hospital during the outbreak of Covid-19, showed that SARS-Cov-2 was found in the Covid-19 dedicated obstetric isolation ward and the Covid-19 dedicated isolation ward. Ye et al. (2020) also showed that SARS-Cov-2 was detected on objects such as self-service printers, desktop keyboards, and doorknobs. The most common object on which SARS-Cov-2 is detected is gloves, wherein 15.4% of the samples virus was detected (Ye et al., 2020). Despite the detection of SARS-CoV-2 on objects such as self-service printers, desktop keyboards, doorknobs, and gloves, the transmission through contact with contaminated objects has not yet been documented for Covid-19 (ECDC, 2020a).

#### *2.1.4 Organizational structures and infectious disease control*

In previous studies, the relationship between organizational structure design and several organizational competences, strengths, and weaknesses has been discussed. For example, studies have revealed the role of organizational structures in the success of development of new products and services (Hitt, Hoskisson, Johnson & Moesel, 1996; Lei, Slocum & Pitts, 1999; Wei, Yi & Guo, 2014). Also, Hao et al. (2012) argue that organizational structure design impacts organizational learning capabilities.

In addition, they argue that the organizational structure plays an important and complex role in the overall firm performance. Next to the performance, success of development, and learning capabilities, the organizational structure also influences the quality of work for the employees (Mirkamali & Thani, 2011). Thus, it can be concluded that the organizational structure design has influence on multiple factors of the organization, such as quality of work, overall firm performance, and learning and development capabilities.

However, the focus of this study is directed organizational structure design of Flemish nursing homes and a certain crisis situation, Covid-19, or more general an infectiousinfec disease. When looking at existing literature, it can be concluded that the number of studies about organizational structure designs and infectious-disease control is very limited. To substantiate this conclusion, the online search process and the search results are listed in the search tracker in Appendix 1. Nevertheless, the importance of studies about organizational structural design and infectious disease control is substantiated by the fact that the Covid-19 virus transmits via human-to-human transmission (Zhao et al., 2020). Thus, the spread of Covid-19 in nursing homes is dependent on the frequency of human-to-human contact. The human-to-human contact in nursing homes could be resident-to-resident, resident-to-staff, and staff-to-staff. Since there was a visitors ban during the period of this study, the contact between staff or residents and visitors is not taken into account. When looking at Sitter's design parameters, the organizational design characteristics could influence the frequency of human-to-human contact (Potter et al., 2015). The next section will elaborate more on the relation between the organizational design characteristics, the frequency of human-to-human contact and infectious disease control.

## 2.2 Organizational structures and infectious disease control

In this section, Sitter's design parameters are used to discuss the organizational structures of nursing homes. Also, the characteristics of organizational structures will be linked with infectious disease control. However, not all seven parameters are equally applicable to this study. One important reason for the choice to not include all seven parameters equally is the availability of data, collected by Teppers et al. (2022). Therefore, more focus is directed to the parameters that describe the production structure and less focus is directed to the other four parameters. However, the other parameters are still used to create a holistic view of the organizational structure.

### *2.2.1 The degree of functional concentration*

Since nursing homes do not have typically orders, it should be defined more specifically. An order is an individual demand for a product or service. Different orders can be identified in several ways, Mintzberg (1983) identifies different types of orders by the following three dimensions: place, client, and output. When looking at nursing homes, different order types are grouped by means of living groups. Living groups could be composed based on the care needs of residents, which could be both physical and mental care needs (Teppers et al., 2022). Because Covid-19 transmits via human-to-human contact, it is assumed that composition criteria that result in the lower frequency of human-to-human contact will lead to better outcomes during the pandemic. Living groups that are composed based on the same care needs, will be dependent on fewer different care specialists, which will lead to less human-to-human contact. In contrast, living groups that are composed based on different care needs will lead to more human-to-human contact because different care specialists will be needed to provide care to one living group. Thus, the used composition criteria could be a condition for Covid-19 confirmed cases, hospitalizations, and/or deaths to occur. The following hypothesis is formulated:

**H1**: Using different care needs as composition criteria for living groups is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

Besides looking at the degree of functional concentration from the living group perspective, it is also possible to look at it from the employee teams' point of view. The study of Nuño, Reichert, Chowell & Gumel (2008) discovered that staff is a key source of outbreaks and transmission. Staff entry and re-entry, including nurses working across multiple locations, are especially increasing the infection rate. Also, the number of staff and visitors accessing a single building and high-traffic shared areas could make nursing homes prone to infectious (Barnett & Grabowski, 2020). The introduction of the virus in the nursing homes is most likely to come from staff, which suggests that smaller, more autonomous nursing homes with fixed staff could improve infectious control (Anderson et al., 2020). Chen, Chevalier & Long (2021) argue that cross-traffic of staff between living groups and nursing homes is a potentially important transmission mode of Covid-19. Device-level geolocation data for over 501 thousand smartphones in the United States has shown that 5.1% of the individuals who spent over one hour in a nursing home also spent at least one hour in another nursing home (Chen et al., 2021). Given the fact that visitors were prohibited during the period of this study, it can be assumed that most of the individuals who spent over an hour in nursing homes were staff. Chen et al. (2021) argue that the cross-traffic of staff between living groups should be minimized during an infectious disease. Staff with overarching tasks could increase the infection rate in nursing homes. Teppers et al. (2022) distinguish six different types of teams working in nursing homes. The distinction between types is based on multiple factors, one of them is whether the teams provide care to only one living group, several living groups, or all living groups in the nursing home (Teppers et al., 2022). As stated before, the study of Chen et al. (2021) proved that teams working at multiple living groups or nursing homes could increase the infection rate. Therefore, it is expected that the types defined by Teppers et al. (2022) which provide care to several or all living groups increase the infection rate. Therefore, the following hypothesis is formulated:

**H2**: Using teams that provide care to several or all living groups is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

Next to the composition of living groups and the types of teams used in nursing homes, the size of living groups also could be a factor that affects infectious disease control. Barnett and Grabowski (2020) state that the density of residents could make nursing homes prone to infection. Anderson et al. (2020) add that small settings of living groups lower the Covid-19 infection rates within nursing homes. Based on this, small-scale, homelike nursing homes, also called ‘household’ or ‘green care’ models may be beneficial in the Covid-19 pandemic (Anderson et al., 2020). The ‘Green House’ design is an example of nursing home that is beneficial in the pandemic, ‘Green House’ models typically have 10 to 12 residents, all with private bathrooms and bedrooms, and a small number of fixed staff (Cohen et al., 2016). In the past decade, there has been an increase in interest in providing care in a small group (Dyer et al., 2020). The increasing interest in small-scale care is encouraged by scientist, because small-group care could be an approach to meet the growing demand for services and provide better infection control (Dyer et al., 2020). Vijh et al. (2022) argue that living group size influences the infection rate in nursing homes. The nursing homes with larger living group sizes have a higher infection rate (Vijh et al., 2022). Dyer et al. (2020) also state that the size of living groups appears to be related to infection rates. In addition, the number of living groups in one organization could also influence the infection rates in nursing homes (Dyer et al., 2020) The following hypothesis is formulated:

**H3:** Having (multiple) large living groups in Flemish nursing homes is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

***2.2.2 The degree of differentiation of operational activities***

When looking at nursing homes, a lot of different preparation and support tasks could be mentioned. For example, nurses and caregivers have to do so many administration tasks that this is at expense of the care for the residents (Van Dorresteijn, 2014). In addition, employees of nursing homes have to perform tasks overarching their team. Especially in small nursing homes, it is assumed that the value of this parameter is low because employees may have tasks with overarching work. The number of small-scale nursing homes has been increasing in many countries all over the world lately, and Belgium is no exception to this (De Rooij, Luijkx, Declercq & Schols, 2011). Thus, the value of nursing homes on this parameter is assumed to be low. As mentioned before, the frequency of human-to-human contact influences the spread of Covid-19. When nursing homes have professions with work that overarches the teams, it is assumed that the frequency of human-to-human contact increases since these employees have contact with staff or residents outside their team (Potter et al., 2015). Based on this, the following hypothesis is formulated:

**H4:** Having professions with overarching work is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

### *2.2.3 The degree of specialization of operational activities*

Residents of nursing homes have high medical care needs (Czwikla et al., 2022). Therefore, a lot of different specialists are involved in nursing home care (Czwikla et al., 2022). As stated before, Teppers et al. (2022) distinguish six different types of teams working in nursing homes. The distinction between types is based on whether the team is monodisciplinary or multidisciplinary, and whether the teams provide care to only one living group, several living groups, or all living groups in the nursing home (Teppers et al., 2022). When looking at monodisciplinary or multidisciplinary teams from Sitter's parameters point of view, monodisciplinary teams have a high value on this parameter and multidisciplinary teams score low on this parameter. When looking at the way that Covid-19 transmits, it is assumed that monodisciplinary teams result in more human-to-human contact. This assumption is made based on the fact that when a nursing home uses monodisciplinary teams, the resident has contact with multiple teams to receive all the needed care. Or as Potter et al. (2015) stated, having monodisciplinary teams will lead to the mixing of teams across services, which will increase the frequency of human-to-human contact. The following hypothesis is formulated:

**H5:** A high degree of specialization of operational activities in nursing homes (or: having monodisciplinary teams) is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

### *2.2.4 The control structure*

Hierarchy is the traditional mechanism that facilitates coordination and control activities. Christensen et al. (2016) argue that coordination mainly refers to how authority, patterns of accountability, and control emanate is formally arranged. The more authority is covered by hierarchical layers, the less autonomous employees are. However, Anderson et al. (2020) argue that more autonomous nursing home teams with fixed staff could improve infectious disease control. Thus, having multiple hierarchical layers could worsen the infectious disease control in nursing homes. The following hypothesis is formulated:

**H6:** A high number of hierarchical layers in Flemish nursing homes is a sufficient condition for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes.

# 3. Research Methodology

In this chapter, the methodology of this research will be discussed. First, the research design can be found, followed by the data collection methods. The operationalization of this research can be found after the data collection methods. Also, the analysis methods will be discussed in this chapter. The analysis methods will be followed by the preparation and calibration of that data. Also, the evaluation criteria will be explained and finally, the research ethics will be discussed.

## 3.1 Research design

This research aims to determine which conditions are necessary and which conditions are sufficient for Covid-19 confirmed cases and Covid-19 deaths to occur in Flemish nursing homes. As is discussed in the theoretical background, different characteristics can possibly affect the number of Covid-19 confirmed cases and deaths. Therefore, a holistic approach is appropriate. This research is based on data from nursing homes in Flanders, collected by Teppers et al. (2022) over a period from March 2020 to December 2020. Teppers et al. (2022) argue that the number of cases in the dataset is too small for statistical analysis, which will negatively affect the significance, and too large for conducting a profound case study. Patty et al. (2015) suggest a qualitative comparative analysis in these kinds of situations. The qualitative comparative analysis could solve the mismatch of both quantitative and qualitative analysis methods. In addition, qualitative comparative analysis allows for identifying conditions or configurations of conditions that are necessary or sufficient conditions for a certain outcome (Teppers et al., 2022), which fits with the aim of this research. Because cases in the qualitative comparative analysis are selected from a variety of organizations and contexts, the results will be much more generalizable than in single-case studies (Patty et al., 2015). Besides the generalizability, the analysis will still be based on the in-depth, qualitative knowledge of the cases (Patty et al., 2015). Marx et al. (2013) give an overview of how many cases a qualitative comparative analysis should include at least to be able to formulate conclusions, which can be found in Table 2. This research includes ten conditions (which are explained in section 3.3). When looking at Table 2, it can be concluded that the 318 cases in the datafile are enough to conduct a qualitative comparative analysis. The planning of this research can be found in Appendix 2. Another important argument to substantiate the choice for qualitative comparative analysis is the aim of this research, which is in fact not to find statistically significant relationships between an independent and dependent variable but to examine relationships between configurations of multiple conditions and possible outcomes.

**Table 2**

*Benchmark Table for Model Specification Assessment*

| Conditions | Threshold | | |
|---|---|---|---|
| | 10% | 5% | 1% |
| CO ≤ 2 | CA ≥ 6 | CA ≥ 8 | CA ≥ 11 |
| CO ≤ 3 | CA ≥ 9 | CA ≥ 11 | CA ≥ 14 |

| | | | |
|---|---|---|---|
| CO ≤ 4 | CA ≥ 12 | CA ≥ 15 | CA ≥ 17 |
| CO ≤ 5 | CA ≥ 17 | CA ≥ 20 | CA ≥ 25 |
| CO ≤ 6 | CA ≥ 24 | CA ≥ 29 | CA ≥ 34 |
| CO ≤ 7 | CA ≥ 33 | CA ≥ 39 | CA ≥ 47 |
| CO ≤ 8 | CA ≥ 49 | CA ≥ 55 | CA ≥ 66 |
| CO ≤ 9 | CA ≥ 69 | CA ≥ 78 | CA ≥ 92 |
| CO ≤ 10 | CA ≥ 97 | CA ≥ 112 | CA ≥ 129 |
| CO ≤ 11 | CA ≥ 139 | CA ≥ 154 | CA ≥ 181 |

*Note.* Ca, cases; CO, conditions; From 'Crisp-set qualitative comparative analysis in organizational studies. In Configurational theory and methods in organizational research' by Marx, A., Cambré, B., & Rihoux, B., 2013, Emerald Group Publishing Limited.

## 3.2 Data collection

Teppers et al. (2022) combined three different datasets in their final datafile. The three combined datasets were a web-survey among managers of nursing homes in Flanders, a dataset with the numbers of Covid-19 infections and Covid-19 deaths of 821 nursing homes in Flanders, and a dataset from the Vlaamse Sociale Bescherming about characteristics of nursing homes.

### *3.2.1 Web-survey*

The web-survey consists of three different parts. The first part of the web-survey consists of five questions about the organization of living groups in the nursing homes before the Covid-19 pandemic, thus before March 2020. The second part of the web-survey consists of questions about the structure of the staff before March 2020. The final part of the survey consists questions about changes that have been made since the start of the Covid-19 pandemic, thus the situation after March 2020. Teppers et al. (2022) appealed to the expertise of people working in nursing homes to formulate the questions in the web-survey.

The web-survey was sent to the managers of nursing homes on June 11 of 2021 and a reminder e-mail with another link to the web-survey was sent on June 21 of 2021. Several other strategies were used to increase the response. Managers of 818 nursing homes in Flanders received a link to the web-survey. After the first reminder e-mail, 228 managers were addressed via LinkedIn and 350 managers were addressed via phone and asked to consider to participate in the web-survey. Managers of 44 nursing homes (5%) indicated that they did not want to participate in this study, the main reason was a lack of time. On September 20 of 2021, a final reminder e-mail was sent and the web-survey was closed in the end of September 2021.

Managers of 410 nursing homes opened the link to the web-survey. Teppers et al. (2022) received 230 completed surveys. Also, 180 incomplete surveys were received by the researchers. Teppers et al. (2022) decided to also include the data from nursing homes which completed the survey till at least question 6, which allowed them to include another 88 nursing homes to the datafile. The total response that is included in the datafile is 318, which represents a response rate of 39% (Teppers et al., 2022). In 71% of the cases, the web-survey was answered by the director of the nursing home (Teppers et al., 2022). In 26% it was answered by the care-coordinator, head of care, someone from the board, manager or someone in charge (Teppers et al., 2022). The other 3% was answered by someone else in the organization.

#### *3.2.2 Dataset from Agentschap Zorg en Gezondheid Belgium*

The second dataset that Teppers et al. (2022) used consisted of data which is collected since 18 March 2020 and contained information about the Covid-19 situation in nursing homes. This dataset contains the number of Covid-19 deaths and confirmed Covid-19 cases of 821 different nursing homes in Flanders. The dataset with the data about the frequency of Covid-19 confirmed cases and Covid-19 deaths in nursing homes was requested from the Agentschap Zorg en Gezondheid of Belgium in February 2020 (Teppers et al., 2022). The Agentschap Zorg en Gezondheid of Belgium requested the number of Covid-19 confirmed cases and Covid-19 deaths for every week from the managers of nursing homes. This dataset contained data from week 12 of 2020 till week 35 of 2021.

#### *3.2.3 Dataset from Vlaamse Sociale Bescherming*

The third and final dataset that Teppers et al. (2022) used is from the Vlaamse Sociale Bescherming (VSB-data) and contains data about characteristics of nursing homes and its residents, the characteristics are the age of residents, the gender of residents, the burden of care, the statute of the nursing home, the size of the nursing home and the location of the nursing home.

#### *3.2.4 Final datafile*

In the first step, Teppers et al. (2022) linked the Covid-19 data with the VSB-data based on name of the nursing home. The number of confirmed Covid-19 infections, hospitalizations and deaths was divided by the average size of the nursing homes (for residents) or average number of staff (for staff), over a period from March (May for staff) till December 2020. During this process, 2 invalid data was found and labelled as missing data. In the second step of combining the datasets, Teppers et al. (2022) linked the three datasets together. The data from the web-survey was set as the base.

### 3.3 Operationalization

To examine the link between organizational structure design characteristics and infectious disease control in Flemish nursing homes, several variables were used. Because a qualitative comparative analysis is used, the independent variables are called conditions and the dependent variables are called outcomes. The outcomes will be discussed in 3.3.1 and the conditions will be discussed in 3.3.2. Also, the datafile contained several conditions which are not related to the organizational structure, which were used as control conditions, these conditions will be discussed in section 3.3.3.

### *3.3.1 Outcomes*

The final datafile contained three different outcomes: confirmed Covid-19 cases, hospitalizations due to Covid-19, and deaths due to Covid-19. As mentioned before, the final datafile contained data from week 12 of 2020 till week 35 of 2021. However, this study only used the data from week 12 of 2020 till the end of 2020 because the Belgium vaccination program started in January 2021.

### *3.3.2 Conditions*

The final datafile contained seven conditions, which will be explained in this section. The calibration of the conditions, which is part of the preparation of data for the qualitative comparative analysis, will be conducted in section 3.4.2.

The first three conditions were all related to the degree of functional concentration of living groups in nursing homes. The first condition (from now: N groups) was the number of living groups within one nursing home. The size of living groups was also a condition (from now: Group size), which was measured by a multiple-choice question whit the following possible answers: living group with less than 9 residents, living group with 9 to 16 residents, living group with 17 to 32 residents, living group with 33 to 50 residents, and living group with more than 50 residents. In addition, the criteria that determined the composition a living group was a condition (from now: Composition criteria). In the survey of Teppers et al. (2022), respondents could choose one or multiple criteria out of the following eight composition criteria:

Criteria 1) Available housing;
Criteria 2) Preferences of residents;
Criteria 3) Workload for employees;
Criteria 4) Same physical care needs;
Criteria 5) Same mental care needs;
Criteria 6) Different physical care needs;
Criteria 7) Different mental care needs;
Criteria 8) Urgency of the admission.

For the condition 'Composition criteria', the distinction between composition of living groups based on the same care needs (criteria 4 and 5), different care needs (criteria 6 and 7), and criteria that do not indicate the functional concentration (criteria 1, 2, 3 and 8) was used.

The fourth condition (from now: N provide care to) was related to the degree of functional concentration of teams. As stated in chapter 2, Teppers et al. (2022) defined six types of teams that nursing homes could use. The following 6 types of teams were identified by Teppers et al. (2022):

Type 1) Monodisciplinary teams provide care to only one community;
Type 2) Multidisciplinary teams provide care to only one community;

Type 3) Monodisciplinary teams provide care to several but not all living groups;

Type 4) Multidisciplinary teams provide care to several but not all living groups;

Type 5) Monodisciplinary teams provide care to all living groups;

Type 6) Multidisciplinary teams provide care to all living groups.

The fourth condition measures to how much living groups teams provide care to. When looking at the six types defined by Teppers et al. (2022), three categories for this condition can be distinguished: teams that provide care to only one community, teams that provide care to several living groups, and teams that provide care to all living groups.

The fifth condition (from now: Overarching work) was related to the degree of differentiation of operational activities in nursing homes. To measure this condition, nursing homes were asked whether a profession worked overarching. The total number of professions that worked overarching in a single nursing home was used for this condition.

The sixth condition (from now: Monodisciplinary teams) was related to the degree of specialization of operational activities. When looking at the six types of teams defined by Teppers et al. (2022), two categories can be distinguished: monodisciplinary teams, and multidisciplinary teams. For this condition, it was measured whether nursing homes used monodisciplinary teams, multidisciplinary teams, or both mono- and multidisciplinary teams.

The seventh condition (from now: N layers) was related to the control structure of nursing homes. This condition was the number of hierarchical layers in the organizational structure of a nursing home. Managers of nursing homes could answer how many hierarchical layers were used in the nursing home.

### *3.3.3 Control conditions*

Besides the outcome and conditions, control conditions were used as well. Control conditions are extraneous nuisance conditions which could possibly influence the outcome but are not central to the study (Schjoedt & Bird, 2014). In this study, the province in which the nursing home is located was used as a control condition. In Flanders, the possible provinces are Antwerpen, Limburg, Oost-Vlaanderen, Vlaams-Brabant, and West-Vlaanderen. Teppers et al. (2022) proved that if a nursing home is located in Limburg, the average confirmed Covid-19 cases is significantly lower than if the nursing home is located in the other provinces. This also applied to nursing homes located in Vlaams-Brabant, but with a smaller extend (Teppers et al., 2022).

Next to the location, the burden of care was used as a control condition. The measurement of the burden of care was based on the Katz Schaal. The Katz Schaal is a commonly used evaluation scale that maps the patient his dependence on care (Deckers et al., 2012). The Katz Schaal is based on the need for help on activities of daily life, such as washing, dressing, moving, continence and nutrition

(Deckers et al., 2012). Nursing homes with more than 56% of its residents depending on Katz Schaal C, Cd or D were more vulnerable to Covid-19 (Teppers et al., 2022).

### 3.4 Analysis methods

The analysis methods can be found in this section. Because a (fuzzy-set) qualitative comparative analysis is not that common, it will be explained in detail in section 3.4.1. This will be followed by the explanation of the data preparation and calibration of the fuzzy-set values. After the discussion of the calibration, the used threshold values of the evaluation criteria during the analysis of necessity, analysis of sufficient configurations, and final solution analysis will be explained.

#### *3.4.1 Fuzzy-set qualitative comparative analysis in general*

As mentioned in section one of this chapter, the most appropriate research method for realizing the purpose of this research is a qualitative comparative analysis. The use of qualitative comparative analysis increased throughout the past decade (Mello, 2012). The qualitative comparative analysis was invented by Charles Ragin, who tried to move beyond qualitative and quantitative strategies (Vancea, 2006). The first qualitative comparative analysis is based on an application of Boolean Algebra, in order to simplify complex data structures and make them logical and holistic (Vancea, 2006). A qualitative comparative analysis is an asymmetric data analysis technique based on the logic and empirical intensity of qualitative analyze technique, and combines this with quantitative methods that deal with large numbers of cases and are more generalizable than symmetric theory tools (Ragin, 1987). Thus, qualitative comparative analysis uses both case-orientation, which is a qualitative strategy, and variable-orientation which is a quantitative strategy (Vancea, 2006). Ragin (1987) considers that both qualitative and quantitative analysis strategies have their shortcomings. Case-orientated methods have a limited range of cases and variable-orientated methods uses to much simplified assumptions (Ragin, 1987). Ragin tries to overcome these shortcomings by combining the two approaches. The qualitative comparative analysis brings the two approaches together and therefore it is both holistic or interpretative because the cases are treated as whole entities, and causal-analytical because a large number of cases can be examined (Vancea, 2006).

This research used the fuzzy-set approach of the qualitative comparative analysis (fsQCA), which goes beyond the Boolean analysis (Vancea, 2006). Boolean analysis uses binary scores, for example 0 for 'out of the set' and 1 for 'in the set'. The qualitative comparative analysis based on Boolean is also called the crisp sets approach (Wagemann, 2017). A fuzzy-set approach refers to a labelling scheme that is numeric but ordinal-like (Vancea, 2006). Vancea formulates the following example of a fuzzy-set labelling scheme:

- 0 refers to completely out of the set;
- Numbers between 0 and 0.5 refers to barely in the set (more out than in);
- 0.5 refers to neither 'more in the set' or 'more out of the set';

- Numbers between 0.5 and 1 refers to almost completely in the set (more in than out);
- 1 refers to completely in the set.

Ragin argues that a fsQCA gives richer interconnections between theory and empirical evidence than other analysis methods (Vancea, 2006). The fsQCA enables quantitative researchers to abandon homogenizing assumptions about cases and causes (Vancea, 2006).

Wagemann (2017) states that qualitative comparative analysis is based on set theory. Set theory uses 'if…then' hypotheses (Wagemann, 2017). These hypotheses can be interpreted as sufficient or necessary conditions (Wagemann, 2017). Cases in a qualitative comparative analysis are not seen as combinations of variables such as in a quantitative approach, but cases are seen as a configurations of set memberships or combinations of conditions and aspects (Vancea, 2006).

Relationships between conditions and outcomes are established as necessary or sufficient conditions in a qualitative comparative analysis (Cooper & Glaesser, 2016). Necessary conditions are the conditions which the outcome cannot occur without (Braumoeller & Goertz, 2000). When using fuzzy-sets, the condition is necessary when the outcome is a subset of a condition, which means that if the condition is necessary the fuzzy scores of the condition are higher than the fuzzy-scores of the outcome (Cooper & Glaesser, 2016). In real datasets, such as the set this research uses, a condition is rarely completely necessary. The extent to which a condition is necessary can be examined with consistency and coverage (Cooper & Glaesser, 2016).

### *3.4.2 Data preparation and calibration*

Before the analyses were conducted, the data was prepared. The preparation included creating a new SPSS file which only consisted of necessary data for this study. The main reason for creating the new SPSS file was to create a clear overview. Also, all the cases including missing data were removed because a qualitative comparative analysis only works with complete data, since it uses configurations of conditions. In this process, 99 cases were removed from the data which resulted in 219 cases. When looking at Table 2, it can be concluded that 219 cases is still enough to conduct the qualitative comparative analysis. Next to the removal of cases with missing data, the data was calibrated. Calibration of data means the development of fuzzy-set values (Basurto & Speer, 2012). For the outcomes and each condition, a fuzzy-set was created. To do so, both SPSS and FsQCA were used.

Firstly, fuzzy-set values for the outcomes were developed. In SPSS, the average weekly confirmed Covid-19 cases, the average weekly hospitalizations due to Covid-19, and the average weekly deaths due to Covid-19 were requested. Basurto and Speer (2012) argue that fuzzy-set values could be based on theoretical and substantive knowledge. However, the FsQCA software also provides a function which creates the fuzzy-set values directly. For the outcomes, the calibrate function in FsQCA was used to create the fuzzy-sets. The calibrate function in FsQCA uses a logistical function to examine the fuzzy-set values (Russo & Confente, 2019). The calibrate function in FsQCA requested three threshold values for the membership in the fuzzy-set. In this study, 0.95, 0.50 and 0.05 percentiles were used as threshold values, which is a commonly used method according to Russo and Confente (2019). SPSS was used to examine the percentiles of the outcomes, which are presented in Table 3.

**Table 3**

*Percentiles (0.95, 0.50, 0.05) for outcomes 'Confirmed Covid-19 cases', 'Hospitalizations due to Covid-19', and 'Deaths due to Covid-19'*

| Outcome: | | Confirmed Covid-19 cases* | Hospitalizations due to Covid-19* | Deaths due to Covid-19* |
|---|---|---|---|---|
| N | Valid | 219 | 219 | 219 |
| | Missing | 0 | 0 | 0 |
| Percentiles | 5 | 0.05 | 0,00 | 0.00 |
| | 50 | 0.76 | 0,00 | 0.02 |
| | 95 | 4.34 | 0.06 | 0.41 |

*Note. *Weekly averages*

Next to the outcomes, fuzzy-set scores for the conditions were developed. For the conditions 'N layers', 'N groups', and 'Overarching work' fuzzy-sets values were developed by using the calibrate function in FsQCA. Again, the 0.95, 0.50 and 0.05 percentiles were used as threshold values. SPSS was requested to examine the percentiles for these conditions. The percentiles of these conditions can be found in Table 4.

**Table 4**

*Percentiles (0.95, 0.50, 0.05) for conditions 'Number of hierarchical layers', 'Number of living groups' and 'Number of professions with overarching work'*

| Condition: | | N layers | N groups | Overarching work |
|---|---|---|---|---|
| N | Valid | 219 | 219 | 219 |
| | Missing | 0 | 0 | 0 |
| Percentiles | 5 | 2.00 | 2.00 | 5.00 |
| | 50 | 3.00 | 4.00 | 13.00 |
| | 95 | 5.00 | 11.00 | 16.00 |

For the condition 'Composition criteria' the fuzzy-set values were developed based on theoretical and substantive knowledge. The eight possible composition criteria are mentioned in section 3.3.2. Firstly, composition criteria six and seven were combined because both criteria result in living groups consisting of residents with different care needs. Secondly, composition criteria four and five were combined because both criteria result in living groups consisting of residents with the same care needs. The other four criteria were combined into the third group, because these criteria do not indicate composition based on the same or different care needs. As mentioned in chapter 2, it is assumed that nursing homes which compose the living groups based on the same care needs are less vulnerable to an infectious disease compared to nursing homes that compose living groups based on different care needs. Therefore, composition based on criteria 4/5 only scores a non-membership value of 0 and based on criteria 6/7 only scores full-membership value of 1. Also, composition based on criteria 1/2/3/8 only does not indicate composition based on different care needs, therefore the fuzzy-set value is set at .40. This means that it is more out than in the membership of this condition. Finally, the fuzzy-set values of combinations of criteria were created. The fuzzy-set values of this condition are presented in Table 5.

**Table 5**

*Fuzzy-set values for the condition 'Composition criteria'*

| Condition: Composition criteria | Fuzzy-set value |
|---|---|
| Criteria 4/5 only | 0 |
| Criteria 4/5 and criteria 1/2/3/8 | .20 |
| Criteria 1/2/3/8 only | .40 |
| Criteria 4/5 and criteria 6/7 (possibly: and criteria 1/2/3/8) | .60 |
| Criteria 6/7 and criteria 1/2/3/8 | .80 |
| Criteria 6/7 only | 1 |

For the condition 'Number of living groups that one team provides care to' the fuzzy-set values were developed based on theoretical and substantive knowledge. Looking at the type of teams formulated by Teppers et al. (2022), three categories can be identified. The first category contained type of teams that provides care to only a single living group, which were team type 1 and type 2. The second category contained type of teams that provide care to several living groups, thus type 3 and type 4. The third category contained types of teams that provide care to all living groups, which were type 5 and type 6. In SPSS, the transformations of the variables were conducted with the 'Compute Variable' function. Finally, the fuzzy-set condition was created, which corresponds with the fuzzy-set values of Table 6.

**Table 6**

*Fuzzy-set values for the condition 'N provide care to'*

| N provide care to | Fuzzy-set value |
|---|---|
| Single group only | 0 |
| Single group and several groups | .20 |
| Several groups only | .40 |
| Single group and all groups (possibly: and several groups) | .60 |
| All groups and several groups | .80 |
| All groups only | 1 |

For the condition ‘Group size’ the fuzzy-set scores were developed based on theoretical and substantive knowledge. Firstly, the number of categories in this condition was decreased to three (small, medium, and large). To achieve this, the category with living groups below 9 residents and the category with living groups between 9 and 16 residents were combined into the small category (<17 residents). The second category is the medium category (17-32 residents), which corresponds with the third answer option in the survey. For category large (>32 residents), the fourth and fifth answer options of the survey were combined into one category. The transformations of the data were performed via the ‘Compute Variable’ function in SPSS. Finally, a fuzzy-set value for each possible combination of categories was determined. Thereby, the smaller the size of living groups, the lower the fuzzy-score on this condition. The fuzzy-set values of this condition can be found in Table 7.

**Table 7**

*Fuzzy-set values for the condition ‘Group size’*

| Condition: Grous size | Fuzzy-set value |
|---|---|
| Small only (<17 residents) | 0 |
| Small (<17 residents) and medium (17-32 residents) | .20 |
| Medium only (17-32 residents) | .40 |
| Small (<17 residents) and large (>32 residents) (possibly: and medium) | .60 |
| Medium (17-32 residents) and large (>32 residents) | .80 |
| Large only (>32 residents) | 1 |

For the condition ‘Monodisciplinary teams’ the fuzzy-set scores were developed based on theoretical and substantive knowledge. Again, the type of teams formulated by Teppers et al. (2022) were used. Team type 1, team type 3, and team type 5 are monodisciplinary teams. Therefore, the variables in the datafile representing these team types were combined. In addition, the other three type of teams represent multidisciplinary teams and were also. The fuzzy-set values of this condition can be found in Table 8.

**Table 8**

*Fuzzy-set values for the condition ‘Monodisciplinary teams’*

| Condition: Monodisciplinary teams | Fuzzy-set value |
|---|---|
| Multidisciplinary teams only | 0 + .001 |
| Multidisciplinary teams and monodisciplinary teams | .50 + .001 |
| Monodisciplinary teams only | 1 |

Also, for the control conditions the fuzzy-set values were developed. For the control condition ‘Province’ the fuzzy-set values were examined based on the knowledge. Teppers et al. (2022) proved that nursing homes located in Limburg had less confirmed Covid-19 cases, compared to nursing homes located in other provinces. They also proved that nursing homes located in Vlaams-Brabant performed better than West-Vlaanderen, Oost-Vlaanderen, and Antwerpen, but worse than Limburg. The fuzzy-set values for ‘Province’ can be found in Table 9. For ‘Burden of care’ the threshold value between membership and non-membership was established at 56%. This percentage is based on the study of Teppers et al. (2022), which proved that nursing homes in which more than 56% of the residents were valued as Katz Schaal C, Cd or D were more vulnerable to Covid-19. The fuzzy-set values were requested in FsQCA.

**Table 9**

*Fuzzy-set values for ‘Province’*

| Province | Fuzzy-set value |
|---|---|
| West-Vlaanderen, Oost-Vlaanderen & Antwerpen | 0 |
| Vlaams-Brabant | .55 |
| Limburg | 1 |

When conducting a fuzzy-set qualitative comparative analysis, the FsQCA software has issues with analyzing fuzzy-set values of exactly 0.5. Therefore, it is recommended to avoid the use of precise 0.5 membership score for a condition (Fiss, 2011). Fiss (2011) suggests adding a constant of .001 to the conditions below full membership scores of 1. Adding this constant will not affect the results, but assures that no cases are dropped from the analyses (Fiss, 2011). Therefore, a constant value of .001 was added to the fuzzy-scores below 1 of all conditions.

### *3.4.3 Analysis of necessary conditions*

In the first phase, focus was directed to examination of necessary conditions. The necessary conditions were evaluated with consistency and coverage. Consistency (also called inclusion) is the extent to which a condition is a necessary condition of the outcome (Ragin, 2009). A consistency value close to 1 means that the condition is close to be necessary for the outcome (Ragin, 2009). In this study, a threshold value of 0.90 for consistency for the analysis of necessity was used, which was also recommended by Malik (2022). In addition, a threshold value for coverage was examined. The coverage is used to account for the members of a condition that do not belong to a certain outcome, when the condition is a necessary condition of the outcome (Ragin, 2009). A coverage value close to 1 means that most elements of set X are included in set Y (Ragin, 2009). The coverage threshold value for necessary conditions that was used in this research is 0.75.

### *3.4.4 Analysis of sufficient configurations*

The analysis of sufficient configurations started with creating a truth table. A truth table shows all possible configurations of conditions (Pappas & Woodside, 2021). The next step of the analysis was to sort the truth table by frequency and raw consistency. The frequency threshold tells the minimum number of cases that a configuration should refer to (Pappas & Woodside, 2021). Thus, the higher the frequency threshold, the more cases are referred to by each configuration. However, a higher frequency threshold will decrease the coverage. Fiss (2011) argues a minimum frequency threshold of three in studies with more than 150 cases. Therefore, a frequency threshold value of three was used in this study. Next to the frequency threshold, also a raw consistency threshold should be examined to Schneider and Wagemann (2012). A minimum raw consistency threshold of 0.75 is recommended by Rihoux and Ragin (2008). When the minimum raw consistency threshold of 0.75 is exceeded, natural breaking points in the truth table can be used as threshold values (Pappas & Woodside, 2021).

After the examination of the threshold values, the analyses of sufficient configurations were proceeded in FsQCA. The software provides three different solutions: complex, parsimonious, and intermediate. The complex solution does not use logical remainders (Ragin, 2009). The parsimonious solution uses all logical remainders, without evaluating the plausibility. Finally, the intermediate solution uses only logical remainders that are based on the researcher's substantive and theoretical knowledge (Ragin, 2009). In this study, the number of identified configurations was large, which made interpretation of the complex solution impractical. Therefore, the parsimonious and intermediate solutions were used. Conditions that are part of both the parsimonious and intermediate solution are core conditions, while conditions that are only part of the intermediate solution are peripheral conditions (Pappas & Woodside, 2021). For the intermediate solution, all conditions were expected to be present for the presence of the outcomes and vice versa for the absence of the outcomes, based on the theoretical knowledge of chapter 2. Unlike the other conditions, the control condition 'Province' was expected to be absent for the presence of the outcomes and present for the absence of the outcomes.

For the configurations in the solution, two evaluation criteria were used. First of all, a threshold value of 0.75 was used for the consistency of each configuration of conditions. In addition, the coverage for each configuration of conditions was used to interpretate the explanatory power. For the coverage, no threshold value was set, but it was used for interpretation.

For the overall solution, two evaluation criteria were used to examine the solution fit. The first evaluation criteria that was used is the solution coverage, which describes the extent to which the outcome is explained by the configurations (Pappas & Woodside, 2021). The other criteria that was used to evaluate the solution was the solution consistency, which describes the strength of the connection between the solution and the outcome (Pappas & Woodside, 2021). For the solution consistency, a threshold value of 0.75 was used.

### 3.5 Research ethics

In this thesis, compliance with the APA Ethics Code and the Netherlands Code of Conduct for Research Integrity (2018) is ensured. The data was not manipulated or fabricated by the researcher. The data that is used in this research is from Teppers et al. (2022) and they presented their research project, the research methods and the way of linking data between the three datasets to Socio-Social Ethics Committee of the KU Leuven. The committee has approved. The final datafile is stored on the personal KU Leuven network drive of one of the researchers of the study of Teppers et al. (2022), which can only be accessed with a personal password (Teppers et al., 2022). In addition, a confidentiality statement has been signed by the researcher, which can be found in Appendix 3.

# 4. Results

A qualitative comparative analysis uses one outcome. Since multiple outcomes were used in this study, multiple qualitative comparative analyses were conducted. Firstly, the fuzzy-set qualitative comparative analysis for the confirmed Covid-19 cases in Flemish nursing homes can be found. Secondly, the fuzzy-set qualitative comparative analysis for the hospitalizations due to Covid-19 in Flemish nursing homes can be found and finally the fuzzy-set qualitative comparative analysis for deaths due to Covid-19 will be given.

## 4.1 Confirmed Covid-19 cases

Firstly, the analyses of necessary conditions can be found. The analyses of necessary conditions have been proceeded for both the presence and absence of confirmed Covid-19 cases. After the analyses of necessity, the analyses of sufficient configurations can be found. Finally, the results after adding the control conditions will be described.

### *4.1.1 Analyses of necessary conditions*

Firstly, the analyses of necessary conditions for both the presence and absence of confirmed Covid-19 cases were conducted via the FsQCA software. For the necessity analysis of the presence of confirmed Covid-19 cases, the fuzzy-set condition of the number of confirmed Covid-19 cases was set as outcome. For the necessity analysis of the absence of confirmed Covid-19 cases, the negated fuzzy-set condition of the number of confirmed Covid-19 cases was set as outcome. The fuzzy-sets of the seven causal conditions (Monodisciplinary teams, Group size, N provide care to, Composition criteria, Overarching work, N groups, N layers) were set as conditions. The negated conditions were also used. The results of the analyses of necessary conditions are presented in Table 10. Looking at the consistency, none of the conditions met the threshold value for necessary conditions (.90).

**Table 10**

*Analysis of necessary conditions for the presence and absence confirmed Covid-19 cases*

| Outcome variable: | Confirmed Covid-19 cases | | ~Confirmed Covid-19 cases | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Monodisciplinary teams | .46 | .56 | .43 | .65 |
| ~Monodisciplinary teams | .71 | .51 | .71 | .61 |
| Group size | .58 | .67 | .51 | .72 |
| ~Group size | .76 | .56 | .76 | .69 |
| N provide care to | .56 | .60 | .56 | .73 |
| ~N provide care to | .74 | .59 | .69 | .65 |
| Composition criteria | .60 | .66 | .57 | .75 |
| ~Composition criteria | .78 | .60 | .74 | .69 |
| Overarching work | .72 | .63 | .66 | .69 |
| ~Overarching work | .64 | .61 | .64 | .74 |

| | | | | |
|---|---|---|---|---|
| N groups | .75 | .69 | .60 | .66 |
| ~N groups | .63 | .56 | .72 | .77 |
| N layers | .56 | .60 | .57 | .74 |
| ~N layers | .75 | .60 | .69 | .65 |

*Note. ~, absence*

### *4.1.2 Analyses of sufficient configurations*

Next to the analyses of necessary conditions are the analyses of sufficient configurations of conditions. Firstly, the truth table for the presence of confirmed Covid-19 cases was created in FsQCA. The same causal conditions were used as in the analysis of necessary conditions. This resulted in a truth table with 128 possible configurations of conditions. As mentioned in chapter 3, configurations which presented below the threshold value of three cases, were removed from the truth table. For the raw consistency threshold, a natural breaking point of 0.85 was indicated. With the 'Standard Analyses' function in FsQCA, the parsimonious and intermediate solution were requested. The distinction between core and peripheral conditions was made based on the parsimonious and intermediate solutions. The results of the analyses of sufficient configurations are given in Table 11. Table 11 shows that the solution consistency is above the threshold value of 0.75. Table 11 also shows that the consistency for each configuration met the threshold value. In addition, the results indicate a solution coverage of 0.69. Therefore, a proportion of the outcome is covered by the eight configurations of conditions.

**Table 11**

*Analysis of sufficient configurations for the presence of confirmed Covid-19 cases, including core and peripheral conditions.*

| | Solution | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| N Groups | ● | ● | ● | ● | | | ● | |
| Group size | | ● | ● | | ● | ● | | • |
| Composition criteria | ● | | | | ● | | | ⊗ |
| Monodisciplinary teams | | | | ● | ● | ● | ● | ⊗ |
| Overarching work | | | • | | | | • | • |
| N layers | | • | | • | ● | ● | ⊗ | ⊗ |
| N provide care to | | | | ⨂ | | • | • | ⊗ |
| Raw coverage | .49 | .30 | .37 | .21 | .17 | .18 | .20 | .24 |
| Unique coverage | .12 | .01 | .01 | .02 | .01 | .01 | .01 | .02 |
| Consistency | .78 | .86 | .87 | .85 | .85 | .82 | .89 | .84 |
| Solution consistency | .76 | | | | | | | |
| Solution coverage | .69 | | | | | | | |

*Note. Black circles (●), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, 'don't care' condition.*

In addition, the analyses of sufficient configurations of conditions for the absence of confirmed Covid-19 cases was conducted. Again, a truth table was created in FsQCA software. The negated condition of confirmed Covid-19 cases was set as outcome. After removal of the configurations which represented less than 3 cases, a natural breaking point of 0.86 raw consistency was identified. Both the parsimonious and intermediate solutions were requested in FsQCA. Again, the parsimonious and intermediate solutions were combined, which resulted to the seven configurations given in Table 12. All configurations met the threshold value for consistency. Also, the results indicate a solution consistency above the threshold value and a solution coverage of 0.73, this suggests that a substantive part of the outcome is covered by the seven configurations of the solution.

**Table 12**

*Analysis of sufficient configurations for the absence of confirmed Covid-19 cases, including core and peripheral conditions.*

| | Solution | | | | | | |
|---|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| N Groups | ⨂ | ⨂ | ⨂ | | ⊗ | | |
| Group size | ⨂ | | | ⊗ | | ⨂ | ⊗ |
| Composition criteria | | | ⊗ | ⊗ | ⊗ | ⬤ | ⬤ |
| Monodisciplinary teams | | | ⨂ | | | ⨂ | ⊗ |
| Overarching work | | ⨂ | | | | ⨂ | ⨂ |
| N layers | | | ⬤ | ● | ● | ⬤ | ⨂ |
| N provide care to | | ⊗ | | ● | ● | | ⊗ |
| Raw coverage | .55 | .37 | .28 | .27 | .27 | .25 | .22 |
| Unique coverage | .13 | .02 | .01 | .02 | .02 | .01 | .02 |
| Consistency | .86 | .86 | .87 | .86 | .88 | .87 | .86 |
| Solution consistency | .82 | | | | | | |
| Solution coverage | .73 | | | | | | |

*Note. Black circles (⬤), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

### *4.1.3 Control conditions added*

As mentioned in chapter 3, the control conditions 'Burden of care' and 'Province' were added to the analyses. With the control conditions added, the analyses of necessity for both the presence and absence of the outcome did not result in conditions reaching the threshold values for necessary conditions. The outcomes of the analyses of necessary conditions for the control conditions can be found in Appendix 4, Table 4a.

For the analyses of sufficient configurations for presence and absence of confirmed Covid-19 cases adding the control variables did change the solutions. First of all, non-membership for the condition ‘Province’ was the only core condition in the solution for presence of the outcome. In addition, none of the configurations only contained (a part of) the seven the causal conditions, in every configuration a control condition could be found. Non-membership of the condition ‘Province’ was found in all configurations but one. Also interesting, the solution model with control variables added did not met the threshold value for solution consistency and the coverage was lower than the coverage of the solution model without the control conditions. The analysis of sufficiency for the presence of confirmed Covid-19 cases including the control conditions can be found in Appendix 5, Table 5. Both control variables were peripheral conditions in the analysis of sufficiency configurations for the absence of confirmed Covid-19 cases. The threshold value for the solution consistency was met. However, both the solution consistency and coverage decreased compared to the solution model without the control variables. The solution showed five configurations in total, where three configurations did not include any of the control conditions. The condition ‘N provide care to’ and the negated condition ‘Overarching work’ became core conditions. The analysis of sufficiency for the absence of confirmed Covid-19 cases including the control conditions can be found in Appendix 5, Table 5b.

## 4.2 Hospitalizations due to Covid-19

The analyses of necessity and sufficient configurations were also conducted for the outcome ‘Hospitalizations due to Covid-19’. In 4.2.1, the analyses of necessary conditions for both the presence and absence of the outcome can be found. Also, the analyses of sufficient configurations will be given. Finally, the analyses including the control conditions will be described.

### *4.2.1 Analyses of necessary conditions*

For the necessity analysis of the presence of hospitalizations due to Covid-19, the fuzzy-set condition of the number of hospitalizations due to Covid-19 was set as outcome. For the necessity analysis of the absence of hospitalizations due to Covid-19, the negated fuzzy-set condition of the number of hospitalizations due to Covid-19 was set as outcome. The same conditions were used as for the previous outcome. Table 13 shows that none of the conditions met the threshold value for consistency.

**Table 13**

*Analysis of necessary conditions for the presence and absence hospitalizations due to Covid-19*

| Outcome variable: | Hospitalizations due to Covid-19 | | ~ Hospitalizations due to Covid-19 | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Monodisciplinary teams | .46 | .76 | .49 | .53 |
| ~Monodisciplinary teams | .72 | .69 | .77 | .48 |

| | | | | |
|---|---|---|---|---|
| Group size | .54 | .84 | .64 | .64 |
| ~Group size | .77 | .77 | .84 | .54 |
| N provide care to | .56 | .81 | .65 | .60 |
| ~N provide care to | .72 | .76 | .79 | .54 |
| Composition criteria | .58 | .85 | .70 | .66 |
| ~Composition criteria | .77 | .80 | .84 | .56 |
| Overarching work | .73 | .85 | .79 | .59 |
| ~Overarching work | .65 | .83 | .79 | .66 |
| N groups | .68 | .84 | .75 | .59 |
| ~N groups | .67 | .80 | .79 | .61 |
| N layers | .59 | .85 | .67 | .62 |
| ~N layers | .74 | .78 | .84 | .57 |

*Note. ~, absence*

### *4.2.2 Analyses of sufficient configurations*

For the analysis of sufficient configurations for the presence of hospitalizations due to Covid-19, a truth table with the condition 'Hospitalizations due to Covid-19' as outcome was created. First of all, the configurations which represented less than three cases were removed from the truth table. This resulted in a natural breaking point in the raw consistency scores at 1.00, which was used. Secondly, the parsimonious and the intermediate solution were combined. The outcome is given in Table 14 Looking at the outcome, it can be seen that the threshold value for solution consistency is met. Also, each configuration met the consistency threshold value of 0.75. Nevertheless, the solution coverage is relatively low, which indicates that conditions which were not part of this study play an important role in explaining the outcome.

**Table 14**

*Analysis of sufficient configurations for the presence of hospitalizations due to Covid-19, including core and peripheral conditions.*

| | Solution | | | | | | |
|---|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| N Groups | ● | ● | ● | | | | ⨂ |
| Group size | | ⨂ | • | • | ⊗ | ⊗ | • |
| Composition criteria | ⨂ | | | ⨂ | ⊗ | ⊗ | • |
| Monodisciplinary teams | ⨂ | ● | ● | ● | ⊗ | • | ● |
| Overarching work | ● | ● | • | | • | ⊗ | ⨂ |
| N layers | ● | • | ⨂ | • | • | • | • |
| N provide care to | | | | ● | ⊗ | ⊗ | |
| Raw coverage | .23 | .16 | .14 | .14 | .20 | .14 | .11 |
| Unique coverage | .03 | .02 | .05 | .03 | .02 | .03 | .01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Consistency | 1 | 1 | 1 | .99 | 1 | 1 | 1 |
| Solution consistency | .99 | | | | | | |
| Solution coverage | .46 | | | | | | |

*Note. Black circles (●), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

In addition, the analysis of sufficient configurations for the absence of due to Covid-19 was conducted. For this analysis, a truth table with the negated condition 'Hospitalizations due to Covid-19' set as outcome was created. After the removal of configurations that represented less than three cases, a natural breaking point of 0.85 for raw consistency was identified. Again, the parsimonious and intermediate solutions were combined create the final solution. Table 15 shows the output of the analysis. Looking at the outcome in Table 15, it can be concluded that the threshold values for solution consistency and configuration consistency were met. Also, the score of 0.77 for solution coverage indicates that a substantive proportion of the outcome is explained by the conditions.

**Table 15**

*Analysis of sufficient configurations for the absence of hospitalizations due to Covid-19, including core and peripheral conditions.*

| | Solution | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| N Groups | | | ⊗ | ⊗ | | ● | ● | ⊗ |
| Group size | ⊗ | ⊗ | | | ⊗ | ● | ● | ⊗ |
| Composition criteria | | ⊗ | | ⊗ | ● | ⊗ | ⊗ | ⊗ |
| Monodisciplinary teams | | | | | ⊗ | ⨂ | | ⊗ |
| Overarching work | ⨂ | ⨂ | ⨂ | ⨂ | | | | |
| N layers | ● | ● | ● | ● | ⨂ | | ● | • |
| N provide care to | ⊗ | | ⊗ | | ⊗ | ⊗ | ⊗ | ⊗ |
| Raw coverage | .37 | .43 | .34 | .43 | .36 | .29 | .26 | .23 |
| Unique coverage | .01 | .01 | .01 | .02 | .10 | .03 | .01 | .01 |
| Consistency | .81 | .84 | .83 | .86 | .81 | .85 | .85 | .84 |
| Solution consistency | .77 | | | | | | | |
| Solution coverage | .77 | | | | | | | |

*Note. Black circles (●), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, 'don't care' condition.*

***4.2.3 Control conditions included***

After adding the control conditions, the negated condition 'Burden of care' did exceed the consistency threshold value for necessary conditions with a consistency score of 0.93 for the absence of hospitalizations due to Covid-19. Nevertheless, the condition did not reach the threshold value for coverage. This means that none of the conditions met both threshold values for necessary conditions. The outcomes of the analyses of necessary conditions for the control conditions can be found in Appendix 4, Table 4b.

For the analysis of sufficient configurations for presence of hospitalizations due to Covid-19 adding the control variables did change the solutions. First of all, for the presence of hospitalizations due to Covid-19, every but one configuration contained one of the control conditions. Especially, the control condition ‘Burden of care’ was involved in most of the configurations. Adding the control conditions did not change the solution coverage or the solution consistency mentionable. The output of the analysis of sufficient configurations for presence of hospitalizations due to Covid-19 including control conditions can be found in Appendix 5, Table 5c. The control conditions were also added to the analysis of sufficient configurations for absence of hospitalizations due to Covid-19. In contrast, the negated control condition ‘Burden of care’ was involved in four out of the five new configurations that explained a proportion of the outcome. The absence of the condition ‘Overarching work’ was the only core condition in this analysis. The output of the analysis of sufficient configurations for absence of hospitalizations due to Covid-19 including control conditions can be found in Appendix 5, Table 5d.

## 4.2 Deaths due to Covid-19

Also, for the outcome ‘Deaths due to Covid-19’ the analyses of necessary conditions have been conducted. After the analyses of necessity, the analyses of sufficient configurations will be given. In 4.2.3, the results after adding the control conditions will be described.

### *4.2.1 Analyses of necessary conditions*

For the necessity analysis of the presence of deaths due to Covid-19, the fuzzy-set condition of the number of deaths due to Covid-19 was set as outcome and vice versa for the necessity analysis of the absence of deaths due to Covid-19. Again, the same conditions were used as for the previous outcomes. Looking at Table 16, none of the conditions reached the threshold value for necessary conditions.

**Table 16**

*Analysis of necessary conditions for the presence and absence deaths due to Covid-19*

| Outcome variable: | Deaths due to Covid-19 | | ~ Deaths due to Covid-19 | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Monodisciplinary teams | .44 | .47 | .42 | .69 |
| ~Monodisciplinary teams | .71 | .43 | .68 | .66 |
| Group size | .57 | .57 | .45 | .71 |
| ~Group size | .71 | .45 | .72 | .73 |
| N provide care to | .51 | .47 | .54 | .78 |

| | | | | |
|---|---|---|---|---|
| ~N provide care to | .75 | .51 | .63 | .67 |
| Composition criteria | .58 | .55 | .52 | .77 |
| ~Composition criteria | .76 | .50 | .70 | .72 |
| Overarching work | .71 | .53 | .62 | .73 |
| ~Overarching work | .63 | .51 | .59 | .76 |
| N groups | .70 | .55 | .58 | .72 |
| ~N groups | .65 | .49 | .64 | .77 |
| N layers | .58 | .53 | .52 | .75 |
| ~N layers | .73 | .49 | .64 | .77 |

*Note. ~, absence*

### *4.2.2 Analyses of sufficient configurations*

For the analysis of the presence of the outcome, the threshold value for raw consistency of 0.75 was not met with the available data. Therefore, only the analysis of sufficient configurations for the absence of the deaths due to Covid-19 was conducted. A truth table with the negated condition 'Deaths due to Covid-19' as outcome was created. After removal of the configurations which represented less than three cases, a natural breaking point was found at 0.90 raw consistency score. Again, the parsimonious and the intermediate solution were combined. The outcome is given in Table 17, which shows that the threshold value for the solution consistency was met. Next to the solution consistency, each configuration reached the consistency threshold of 0.75. In addition, the solution coverage suggests that a proportion of the outcome is covered by the six configurations of the solution.

**Table 17**

*Analysis of sufficient configurations for the absence of deaths due to Covid-19, including core and peripheral conditions.*

| | Solution | | | | | |
|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 |
| N Groups | ⨂ | | ⊗ | | | ● |
| Group size | ⨂ | ⨂ | ⨂ | | ⊗ | ⊗ |
| Composition criteria | | ⊗ | | ⊗ | ● | ● |
| Monodisciplinary teams | | | | ● | | ⊗ |
| Overarching work | | | | | ● | |
| N layers | ● | | | ⨂ | | ⨂ |
| N provide care to | | ● | ● | ⊗ | ⊗ | ⊗ |
| Raw coverage | .32 | .37 | .34 | .19 | .28 | .22 |
| Unique coverage | .02 | .04 | .01 | .03 | .01 | .02 |
| Consistency | .90 | .88 | .90 | .83 | .88 | .89 |
| Solution consistency | .83 | | | | | |
| Solution coverage | .60 | | | | | |

*Note. Black circles (●), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

#### *4.2.3 Control conditions included*

Also, for the outcome of the presence and absence of deaths due to Covid-19, the control conditions were added to the analysis. After adding the two control conditions, the analyses of necessity did not result in any condition reaching the threshold values for necessary conditions. The outcomes of the analyses of necessary conditions for the control conditions can be found in Appendix 4, Table 4c.

The analysis for the presence of deaths due to Covid-19 including the control conditions did, in contrast to the analysis without the control conditions, met the threshold value for solution consistency. Nevertheless, the solutions coverage score was 0.14, which indicates that the proportion outcome explained by the solution is very small. Therefore, the analysis of the presence of deaths due to Covid-19 were not included in this study. The analysis for the absence of deaths due to Covid-19 including the control conditions did result to new configurations. Non-membership of the burden was represented in eight out of the nine configurations. Which indicates that the negated condition 'Burden of care' is important in explaining the outcome. Also, there was only one configuration without one of the control conditions. The analysis of sufficiency for the absence of deaths due to Covid-19 including the control conditions can be found in Appendix 5, Table 5e.

# 5. Discussion

After the results are given in chapter 4, the interpretation of the results can be found in this chapter. Also, the theoretical contribution will be given in, which will be followed up by the practical implications of this study. Finally, the limitations and suggestions for further research will be given.

## 5.1 Interpretation of the results

The qualitative comparative analyses show that none of the seven causal conditions can be valued as a necessary condition for either the absence or presence of confirmed Covid-19 cases, hospitalizations due to Covid-19, or deaths due to Covid-19. The same counts for the used control conditions. This means that none of the used conditions was represented in all the configurations of a solution.

The analysis of sufficiency for the outcome confirmed Covid-19 cases shows that different configurations of conditions could explain the outcome. This means that different configurations of organizational structure design characteristics could explain the presence of confirmed Covid-19 cases. Looking at the solutions, a few relevant observations can be made. First of all, having high number of living groups and composing living groups based on different care needs leads to confirmed Covid-19 cases to occur, regardless of the other causal conditions (solution 1). Overall, having high number of living groups is a core condition and represented in five out of the eight configurations, pointing out the importance of this condition. In addition, the raw consistency of the configurations that included having high number living groups is relatively high compared to the other configurations. Also having large living groups seems to be an important condition, especially in combination with having a high number of living groups. In contrast, having monodisciplinary teams seems to explain the presence of confirmed Covid-19 cases when it is not in combination with having a high number of living groups. Nevertheless, the configurations including monodisciplinary teams (configuration 4, 5, 6 and 7) show a lower raw coverage compared to the configurations including having high number and large living groups, which means that less of the outcome is covered by these configurations. After adding the control conditions, all configurations contained at least one of them. Especially, non-membership of the condition 'Province' was part of almost all configurations. This indicates that in most of the times, no matter which characteristics of organizational design structure a nursing home has, the fact if confirmed Covid-19 cases occur could depend on the province in which the nursing home is located.

Looking at the results regarding the analysis of sufficiency for the absence of confirmed Covid-19 cases, some interesting points can be identified. First of all, the absence of having a high number of living groups (or: presence of having low number of living groups) is represented in four out of seven configurations, which also includes the three configurations with the highest raw coverage. This indicates that the having a low number of living groups is important in explaining the absence of confirmed Covid-19 cases. Also, the absence of having large living groups (or: the presence of having small living groups) seems to be important since it is represented in four out of the seven configurations. Also, the absence of having a high number of professions with overarching work and the absence of having monodisciplinary teams (or: having multidisciplinary teams) are both represented in multiple configurations that lead to the absence of confirmed Covid-19 cases. Having a high number of hierarchical layers is represented in four configurations that lead to the absence of confirmed Covid-19 cases, which is against the expectations. Adding the control conditions had less impact on the solution compared to the analysis for the presence of confirmed Covid-19 cases. None of the control conditions can be valued as a core condition and after adding there were still configurations without control conditions remaining.

The results of the analysis of sufficiency for the presence of hospitalizations due to Covid-19 show that the solution coverage and each raw coverage are relatively low, which indicates that a small portion of the outcome is explained by the configurations. Having a high number of living groups, professions with overarching work, hierarchical layers, multidisciplinary teams and living groups composed based on the same care needs is a configuration (solution 1) that leads to the presence of hospitalizations due to Covid-19. In addition, solution 2 and 3 contain the combination of having a high number of living groups, having monodisciplinary teams, and having a high number of professions with overarching work, which is complemented with having small living groups, a high number of hierarchical layers (solution 2) or a small number of hierarchical layers, and large living groups (solution 3). Adding the control conditions resulted in four configurations, three out of the four configurations contained the condition ‘Province’. This indicates that the location of the nursing home is important in explaining the presence of hospitalizations due to Covid-19. The only configuration that did not include ‘Province’ contained having a high number of hierarchical layers, living groups, professions with overarching work, living groups composed based on the same care needs, and small living groups. Thus, nursing homes which are not located in the right province (membership of the condition ‘Province’), should strive to avoid these organizational structure characteristics.

Looking at the analysis of sufficiency for the absence of hospitalizations due to Covid-19, some interesting observations can be made. Two combinations of core conditions seem to be relevant in explaining the absence of hospitalizations due to Covid-19. The first one being the combination of having a low number of professions with overarching work and a high number of hierarchical layers. This combination of conditions complemented with peripheral conditions having small living groups and having teams that provide care to one single community (solution 1), or having small living groups and compose living groups based on the same care needs (solution 2), or having a small number of groups and teams that provide care to one single community (solution 3), or having a small number of groups and living groups composed based on the same care needs (solution 4) are all configurations that explain the absence of hospitalizations due to Covid-19.  The second combination of conditions is having a high number of living groups and having large living groups, which is against the expectations. An interesting observation is the fact that the negated condition ‘Overarching work’ was the only core condition after adding the control conditions. Another interesting finding is the fact that the control condition ‘Burden of care’ was involved in almost all configurations after including the control conditions. A possible explanation could be that other health issues makes people more vulnerable to Covid-19, which results in earlier or faster need for hospitalization. The only configuration that leads to the absence of hospitalizations, regardless of the burden of care and location of the nursing home, is having a small number of hierarchical layers, small number of professions with overarching work, teams that provide care to only one community, small living groups, living groups composed based on different care needs, and multidisciplinary teams. Thus, nursing homes with residents who have a high burden of care could strive for these organizational design characteristics.

The analysis of sufficiency for the absence of deaths due to Covid-19 shows that one conditions stands out in explaining the outcome, which is the absence of having large living groups. Also remarkable is the fact that having teams that provide care to several or all living groups is part of two out of the three configurations with the highest raw coverage. Having small living groups and having teams that provide care to several or all living groups, in combination with a low number of living groups or living groups composed based on the same care needs or both configurations (solution 2 and 3) that partially explain the absence of deaths due to Covid-19. After adding the control conditions, it can be concluded that the absence of high burden of care (or: having residents with a low burden of care) is an important condition in explaining the absence of deaths due to Covid-19. A possible explanation could be that having other health issues makes people more vulnerable to Covid-19, which was already proven in previous studies. The only configuration that leads to the absence of deaths due to Covid-19, regardless of the burden of care and location of the nursing home, is having a small number of hierarchical layers, small number of professions with overarching work, teams that provide care to only one community, small living groups, and multidisciplinary teams. Thus, nursing homes with residents who have a high burden of care could strive for these organizational design characteristics.

When looking at the hypotheses, it can be concluded that some of the hypotheses are accepted, and some are rejected based on the findings. The first hypothesis should be rejected, since no consistent evidence has been found. Looking at the findings, the hypothesis is supported in the analysis for absence of hospitalizations. However, the other analyses do not support hypothesis 1. The second hypothesis is also rejected, since it is only supported in the analysis of the absence of hospitalizations due to Covid-19. Hypothesis 3 is accepted. In general, in all analyses membership on these conditions were represented in configurations that led to presence of confirmed cases, hospitalizations and deaths due to Covid-19 and vice versa. The fourth hypothesis is (partially) accepted. Membership on this condition was represented in configurations led to presence of confirmed cases and hospitalizations due to Covid-19 and vice versa. However, the analysis of deaths due to Covid-19 does not support the hypothesis. The fifth hypothesis is also partially accepted, especially with the analyses for confirmed Covid-19 cases the hypothesis is supported. Finally, hypothesis 6 is rejected, since no consistent evidence has been found.

Coming back to the research question and Sitter's design parameters, no necessary conditions has been identified. In addition, no consistent empirical evidence has been found to substantiate the assumption that a high degree on functional concentration results in more confirmed Covid-19 cases, deaths or hospitalizations due to Covid-19. The first three hypotheses were related to this parameter, only one of the hypotheses was accepted. For the link between the degree of differentiation of operational activities and infectious disease control, empirical evidence was found. The same goes for the link between the degree of specializations of operational activities and infectious disease control. However, it must be stated that the hypotheses were only partially accepted. Finally, no empirical evidence to support the link between the control structure and infectious disease control has been found.

### 5.2 Contribution to knowledge

This study provides contributions to the organizational structure design theory. First of all, the link between organizational structure design and infectious disease control is established by this study. To specify, the link between Sitter's design parameters of nursing homes and infectious disease control was found. Also, different configurations were established based on the location of the nursing home and burden of care of the residents. Besides the link between organizational structure design theory and infectious disease control, this study provides contribution to the knowledge of the novel Covid-19 pandemic. This research includes possibly, interesting observations about the spread of the Covid-19 virus in different environments.

### 5.3 Practical implications

Before this study, organizational structures of nursing homes could be designed to facilitate high quality of work, high overall performance, learning capabilities, success of innovation, or others. However, the link between organizational structure design of nursing homes and infectious disease control had not been studied yet. The findings of this study offer guidance to decisions makers of nursing homes. First, nursing homes could prepare for other pandemics or Covid-19 waves by redesigning the organizational structure into one of the configurations that leads to the absence of confirmed Covid-19 cases, hospitalizations due to Covid-19, and deaths due to Covid-19. secondly, the decision makers could prevent to have an organizational structure design that matches one of the configurations that lead to the presence of confirmed Covid-19 cases, hospitalizations due to Covid-19, or deaths due to Covid-19. Also, decision makers could take into account the location of the nursing home (however, this only applies to Flemish nursing homes) and the burden of care of the residents. The findings could offer handles for both redesigning and designing of the organizational structure design of nursing homes. Some of the conditions can even be redesigned at the time when a pandemic occurs.

### 5.4 Limitations and directions for further research

The results of this study provide some interesting cues for further research. First of all, since this research relied on data collected by Teppers et al. (2022), some design parameters were unapplicable to this research. For future research, it would be interesting to include the other parameters as well. Including the other design parameters will complement to this study, and could complete the holistic view on the link between organizational structure design and infectious disease control. Secondly, the empirical context of this study was the first period of the Covid-19 pandemic. However, pandemics could differ a lot from each other. This is evidenced by the fact that the different Covid-19 waves show many differences. Some mutations of Covid-19, for example the Omicron and Delta variant, had severe consequences for the spread and mortality rate of the virus (Zhao et al., 2022). For future research, it could be interesting to include multiple Covid-19 variants or even multiple different pandemics into a study. Future research could examine the general organizational structure design that generally performs best in a pandemic. To conclude, some interesting cues for further research are including all seven design parameters, and including multiple Covid-19 variants or multiple pandemics.

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# Appendices

### Appendix 1: Search tracker

| Search query | Database | Results |
|---|---|---|
| ALL=(((Organi?ation* OR Business* OR Firm* OR Firm* OR Corporation* OR Enterprise*) AND (Structure* OR "Structur* design*" OR Composition* OR Layout*) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease))) | WoS | N= 29,435<br>Not about organizational structure → therefore a new query was created. |
| ALL=((“Organi?ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | WoS | N= 474<br>Contribution of organizational structure or infection-disease control in results too small |
| AB=((“Organi?ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | WoS | N= 325<br>Focus in articles mainly directed to the structure of the disease itself or on structures of hospitals and disease curing. |
| TS=((“Organi?ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | WoS | N= 396<br>Focus in results mainly directed to structure of health care |
| TI=((“Organi?ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | WoS | N= 7<br>None of the 7 articles was applicable. |
| TS=((“Organi#ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | BSC | N= 53 |
| TI=((“Organi#ation* structure”* OR “Business* structure” OR “Firm*structure” OR “Corporation* structure” OR “Enterprise* structure”) AND ("Infection-disease Control" OR “Disease control” OR Pandemic* OR Disease)) | BSC + filter= English | N= 28<br>None of the 28 articles was applicable. |

*Note.* WoS, Web of Science; BSC, Business Source Complete.

**Appendix 2: Research planning**

| Week | Tasks | Deadlines & milestones |
|---|---|---|
| **5** | First meeting with supervisor<br>Working on introduction | Start of master thesis trajectory<br>Meeting 1 – February 2 |
| **6** | Working on theoretical background | |
| **7** | Working on theoretical background | |
| **8** | Second meeting with supervisor<br>Methodology | Meeting 2 – February 22 |
| **9** | Working on methodology | Meeting 3 – March 4 |
| **10** | Finishing research proposal | |
| **11** | Finishing research proposal | Meeting 4 – March 16 |
| **12** | Finishing research proposal (introduction, theoretical framework, and methodology) | Submission of research proposal – March 25 |
| **13** | | |
| **14** | Improve and adapt proposal in response to feedback (possibly) | Assessment of research proposal – April 8 |
| **15** | Improve and adapt proposal in response to feedback (possibly) | |
| **16** | Improve and adapt proposal in response to feedback (possibly)<br>Start working on analysis | |
| **17** | Improve and adapt proposal in response to feedback (possibly)<br>Working on analysis | |
| **18** | Improve and adapt proposal in response to feedback (possibly)<br>Working on analysis | |
| **19** | Working on analysis | Second chance of research proposal – May 9 |
| **20** | Working on results | Second assessment of research proposal – May 18 |
| **21** | Working on conclusion | |
| **22** | Working on discussion and limitations | |
| **23** | Finishing master thesis | |
| **24** | Finishing master thesis | Submission of master thesis - June 13 |
| **25 - 29** | Preparing presentation | Defense master thesis - end of June and beginning of July |
| **29 – 33** | Improve and adapt thesis in response to feedback (possibly) | |
| **33** | Improve and adapt thesis in response to feedback (possibly) | Second chance of submission -August 15 |
| **33 – 35** | Preparing presentations (possibly) | Second chance of defense - second half of August |

## Appendix 3: Confidentiality statement

# Geheimhoudingsverklaring

Radboud University
*Nijmegen, the Netherlands*

**De ondergetekende:**

| | |
|---|---|
| Naam: | Koen Eemers |
| Geboortedatum: | 16-03-1998 |
| Woonplaats: | Groesbeek |
| Faculteit: | Faculteit der Managementwetenschappen |
| Studie: | Business Administration, Strategic Management |

**VERKLAART HIERBIJ HET VOLGENDE:**

1) Ondergetekende weet dat hij/zij verplicht is om alle vertrouwelijke informatie, die hem/haar in het kader van zijn/haar studie gerelateerde werkzaamheden bij of in opdracht van de Radboud Universiteit ter kennis komt uitsluitend in het kader van zijn/haar studie gerelateerde werkzaamheden bij of in opdracht van de Radboud Universiteit te gebruiken en voor het overige geheim te houden. Onder vertrouwelijke informatie wordt verstaan: alle informatie, documenten en gegevens die niet reeds openbaar is/zijn.

2) De in lid 1 genoemde verplichting geldt ook na beëindiging van de studie gerelateerde werkzaamheden bij of in opdracht van de Radboud Universiteit.

3) De in lid 1 genoemde verplichting bestaat, voor zover niet anders is overeengekomen, niet tegenover collega's of anderen die medeverantwoordelijk zijn voor een goede uitoefening van de studie gerelateerde werkzaamheden, indien en voor zover zij zelf jegens de Radboud Universiteit tot geheimhouding verplicht zijn of zich daartoe verplichten.

4) Ondergetekende neemt tijdig en adequaat alle maatregelen die redelijkerwijze nodig zijn om ervoor te zorgen dat de vertrouwelijke informatie tegen verlies en/of ongeoorloofde toegang is beschermd.

5) Alle eigendomsrechten met betrekking tot door ondergetekende ontvangen vertrouwelijke informatie en daarop gebaseerde resultaten komen toe aan en blijven berusten bij de Radboud Universiteit.

6) Het is ondergetekende verboden op welke wijze dan ook vertrouwelijke informatie, of kopieën hiervan, in bezit te hebben of te houden of te kopiëren, uitgezonderd voor zover en voor zolang dit in het kader van de studie gerelateerde werkzaamheden/opdracht is vereist, waarbij geldt dat het nimmer is toegestaan om vertrouwelijke informatie, of kopieën hiervan, ongeacht of het gaat om documenten of bestanden in welke vorm dan ook, op te slaan, te verwerken of bewerken, op een apparaat buiten, of op een netwerk anders dan, het netwerk van Radboud Universiteit.

7) Ondergetekende verplicht zich om alle in lid 1 genoemde vertrouwelijke informatie en andere op de studie gerelateerde werkzaamheden betrekking hebbende informatie, alsmede (digitale) kopieën en aantekeningen daarvan, zonder enig verzoek daartoe, bij het eindigen van zijn/haar studie gerelateerde werkzaamheden of de opdracht onmiddellijk aan de Radboud Universiteit te doen toekomen. Hieronder worden ook alle vormen van computerprogrammatuur en (digitale) gegevensdragers, tekeningen, bescheiden en/of goederen die op de werkzaamheden/opdracht betrekking hebben begrepen.

8) Ondergetekende is ermee bekend dat overtreding van enige gebods- dan wel verbodsbepaling in deze verklaring kan leiden tot beëindiging van zijn/haar studie gerelateerde werkzaamheden en/of een schadevergoedingsvordering, alsmede tot sancties door de wet daarop gesteld.

9) In geval van twijfel over de toepasselijkheid en/of uitleg van het hier bepaalde zal ondergetekende terstond en uit eigen beweging overleg met de Radboud Universiteit voeren, evenals in het geval dat hij/zij op enige wijze in een procedure wordt betrokken waarin hetgeen in deze verklaring is omschreven aan de orde (kan) komen.

10) Op deze verklaring is Nederlands recht van toepassing.

**Datum en plaats:**

**07-02-2022, Groesbeek**

**Handtekening voor akkoord:**

## Appendix 4: Output of analyses of necessity for control conditions

**Table 4a**

*Analysis of necessary conditions for the presence and absence of confirmed Covid-19 cases, for the control conditions*

| Outcome variable: | Confirmed Covid-19 cases | | ~Confirmed Covid-19 cases | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Burden of care | .71 | .71 | .65 | .79 |
| ~Burden of care | .79 | .65 | .76 | .76 |
| Province | .24 | .53 | .25 | .67 |
| ~Province | .85 | .48 | .82 | .57 |

*Note. ~, absence*

**Table 4b**

*Analysis of necessary conditions for the presence and absence of hospitalizations due to Covid-19, for the control conditions*

| Outcome variable: | Hospitalizations due to Covid-19 | | ~Hospitalizations due to Covid-19 | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Burden of care | .70 | .94 | .83 | .72 |
| ~Burden of care | .79 | .88 | .93 | .66 |
| Province | .25 | .72 | .31 | .58 |
| ~Province | .86 | .66 | .85 | .42 |

*Note. ~, absence*

**Table 4c**

*Analysis of necessary conditions for the presence and absence of deaths due to Covid-19, for the control conditions*

| Outcome variable: | Deaths due to Covid-19 | | ~ Deaths due to Covid-19 | |
|---|---|---|---|---|
| Conditions tested | Consistency | Coverage | Consistency | Coverage |
| Burden of care | .68 | .58 | .60 | .82 |
| ~Burden of care | .79 | .55 | .69 | .77 |
| Province | .27 | .49 | .22 | .64 |
| ~Province | .80 | .39 | .83 | .64 |

*Note. ~, absence*

**Appendix 5: Output of analyses of sufficiency including control conditions**

**Table 5a**

*Analysis of sufficient configurations for the presence of confirmed Covid-19 cases (control conditions)*

| | Solution | | | |
|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 |
| N Groups | ● | ● | | ● |
| Group size | | | | |
| Composition criteria | | | | ● |
| Monodisciplinary teams | | | ● | |
| Overarching work | | ● | | |
| N layers | ● | | ● | |
| N provide care to | | | | |
| Burden of care | | | | ● |
| Province | ⨂ | ⨂ | ⨂ | ⨂ |
| Raw coverage | .40 | .52 | .25 | .41 |
| Unique coverage | .02 | .09 | .05 | .02 |
| Consistency | .78 | .78 | .59 | .83 |
| Solution consistency | .71 | | | |
| Solution coverage | .66 | | | |

*Note. Black circles (●), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

**Table 5b**

*Analysis of sufficient configurations for the absence of confirmed Covid-19 cases (control conditions)*

| | Solution | | | | |
|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 |
| N Groups | | | ⊗ | | ● |
| Group size | ⊗ | | ⊗ | ⊗ | ⊗ |
| Composition criteria | ⊗ | ⊗ | ⊗ | | ⊗ |
| Monodisciplinary teams | | ⊗ | | ⊗ | ⊗ |
| Overarching work | | ⨂ | ⨂ | ⨂ | |
| N layers | | | | ⊗ | ● |
| N provide care to | ⬤ | ⨂ | | ⨂ | |
| Burden of care | | ⊗ | ⊗ | | ⊗ |
| Province | | | | | ● |
| Raw coverage | .39 | .29 | .35 | .27 | .08 |
| Unique coverage | .08 | .05 | .01 | .05 | .00 |
| Consistency | .84 | .85 | .91 | .82 | .90 |
| Solution consistency | .81 | | | | |
| Solution coverage | .59 | | | | |

*Note. Black circles (⬤), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

**Table 5c**

*Analysis of sufficient configurations for the presence of hospitalizations due to Covid-19 (control conditions)*

| | Solution | | | |
|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 |
| N Groups | | ● | ● | ● |
| Group size | ⨂ | ⨂ | ⬤ | ⬤ |
| Composition criteria | | ⨂ | | |
| Monodisciplinary teams | ⬤ | | ⨂ | ⨂ |
| Overarching work | | ⬤ | | ● |
| N layers | ● | ⬤ | ● | |
| N provide care to | | | | |
| Burden of care | | | | |
| Province | ⊗ | | ⊗ | ⊗ |
| Raw coverage | .21 | .26 | .18 | .22 |
| Unique coverage | .07 | .06 | .02 | .07 |
| Consistency | .97 | 1 | .99 | .99 |
| Solution consistency | .98 | | | |
| Solution coverage | .46 | | | |

*Note. Black circles (⬤), presence; circles with cross (⨂), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

**Table 5d**

*Analysis of sufficient configurations for the absence of hospitalizations due to Covid-19 (control conditions)*

| | Solution | | | | | |
|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 |
| N Groups | | | ⊗ | ⊗ | ● | ● |
| Group size | | ⊗ | ⊗ | ⊗ | ⊗ | ● |
| Composition criteria | ⊗ | | ⊗ | ⊗ | ⊗ | ⊗ |
| Monodisciplinary teams | ⊗ | ⊗ | | ⊗ | ⊗ | ● |
| Overarching work | ⊗ | ⊗ | ⊗ | ⊗ | | ● |
| N layers | | ⊗ | | | ● | ● |
| N provide care to | ⊗ | ⊗ | ⊗ | | ⊗ | ⊗ |
| Burden of care | ⊗ | | ⊗ | ⊗ | ⊗ | ⊗ |
| Province | | | | ● | ● | ⊗ |
| Raw coverage | .40 | .37 | .36 | .11 | .09 | .11 |
| Unique coverage | .06 | .06 | .07 | .03 | .01 | .02 |
| Consistency | .84 | .79 | .56 | .96 | .96 | .88 |
| Solution consistency | .80 | | | | | |
| Solution coverage | .61 | | | | | |

*Note. Black circles (●), presence; circles with cross (⊗), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*

**Table 5e**

*Analysis of sufficient configurations for the absence of deaths due to Covid-19 (control conditions)*

| | Solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Configuration | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| N Groups | ⊗ | | ● | ● | ⊗ | ● | ● | ● | ● |
| Group size | ⊗ | ⊗ | | | ⊗ | | ⊗ | ⊗ | ⊗ |
| Composition criteria | ⊗ | ● | ⊗ | ⊗ | ⊗ | ⊗ | | ⊗ | ⊗ |
| Monodisciplinary teams | | | ⊗ | ⊗ | ⊗ | ● | ⊗ | | ⊗ |
| Overarching work | | ⊗ | ⊗ | ● | ⊗ | ● | ● | ● | ● |
| N layers | ● | ⊗ | ● | ⊗ | ● | ● | ● | ● | ● |
| N provide care to | | | ⊗ | ⊗ | ● | ⊗ | ⊗ | ⊗ | ⊗ |
| Burden of care | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ | ⊗ | ● | ● | ⊗ |
| Province | ⊗ | ⊗ | ⊗ | ⊗ | | ⊗ | ⊗ | ⊗ | ● |
| Raw coverage | .24 | .20 | .14 | .19 | .13 | .09 | .14 | .11 | .04 |
| Unique coverage | .04 | .05 | .02 | .04 | .00 | .00 | .01 | .01 | .01 |
| Consistency | .94 | .88 | .88 | .84 | .91 | .84 | .87 | .90 | .89 |
| Solution consistency | .84 | | | | | | | | |
| Solution coverage | .47 | | | | | | | | |

*Note. Black circles (●), presence; circles with cross (⊗), absence; large circles, core condition; small circles, peripheral condition; blank space, don't care condition.*