



Master's degree thesis

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Investigating the demand for OOH- primary care service in nine municipalities in Møre og Romsdal

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Preface

This master thesis is our final and mandatory part of the two-year Master of Science in Logistics program, conducted at Molde University College. The study has been carried out from December 2018 until May 2019. This project has been an exciting and educational process, that resulted in knowledge within the field of health care logistics. As graduates, this experience is valuable for us in the future.

We would like to take this great opportunity to express our gratitude to our supervisor, Birgithe Eckermann Sandbæk, for her outstanding guidance and encouragement throughout this project. Her knowledge, experience and support has been of great value during the whole process. By sharing her academic expertise in the field of health care logistics, she has made this project possible. During this whole process she has made herself available at all times, in which we are extremely grateful for.

We sincerely thank key employees at Molde inter-municipality OOH- primary care service. We appreciate their willingness to cooperate with students, and for making themselves available for meetings regarding questions necessary for this study. They provided us with valuable information, data and insight in their organization of the OOH- primary care service.

We would also extend our gratitude to key personnel at the Local Emergency Medical Communication Center (LEMC), who has taken time from their busy schedule in order to provide us with data and information. We appreciate their quick feedback and collaboration during this period.

Finally, we would like to thank our friends, family and colleagues for patience and support related to this hectic and intensive period.

Molde, 24.05.2019



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Abstract

The Norwegian OOH- primary care services are currently rethinking how to optimize the organization, and how to integrate communication technologies into services to secure the quality of care, as well as reduce the strain for the scarce workforce. In times of changes, analyzing demand becomes necessary to ensure proper planning of future activities. This study aims to investigate the variations in demand for four OOH- primary care services in Møre og Romsdal. The study also examines factors that could impact the demand at the service.

The study has evaluated and answered the following research questions:

RQ I: Investigate the variations in number of inquiries per unit of time at selected OOH- primary care services in Møre og Romsdal.

RQ II: Investigate potential factors that could impact the variations in the number of inquiries at the OOH- primary care services.

The findings in this study are achieved through a quantitative approach. The primary data is received from LEMC and included the number of inquiries for four out-of-hours- primary care services, registered in a specific period of time. Various formulas within descriptive statistics are used, as well as statistical process control, to analyze the data.

The strength of this study is the existence of seasonal variations in demand at the OOH- primary care service. The demand follows, monthly, daily and hourly patterns, where the number of inquiries registered was dependent on the day of the week, and its connection to official holidays, as well as the time of the day. There were identified various factors that could impact the demand, such as demography, geography, and the coverage at the RGPs office. Based on the results and the review of the literature, there is also an expectation that the implementation of communication technology could impact the demand for OOH- primary care service in the future. The observed demand patterns and the factors affecting demand can be beneficial in the management of future activities at the OOH- primary care service.

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List of Abbreviations

A&E	Accident & Emergency
AIKL	Aukra inter-municipal OOH- primary care service
AMIS	Acute medical information system
CLT	Central limit theorem
EMCC	Emergency Medical Communication Centre
GP	General Practitioner
LEMC	Local Emergency Medical Communication Center
NSD	Norwegian Center for Research Data
MIKL	Molde inter-municipal OOH- primary care service
OOH	Out-of-hours
RGP	Regular General Practitioner
SPC	Statistical Process Control

1.0 Introduction

Nowadays, both researchers and media are emphasizing the aging population, which is leading towards fewer economically active in society (Statistics Norway 2017a). As a result, the demand for health care services is growing, and the same trend is expected in the future. Analyzing demand is an essential area in every health care organization to accommodate the increasing demand with the right capacity, and to secure proper quality in health care services. In Norway, the health care system has been an essential part of developing the Norwegian welfare. As a crucial part of the health care system, the out-of-hours (OOH)- primary care service play a critical role in securing citizens with available urgent medical assistance at all hours of the day.

The purpose of this study is to investigate the variations in the demand for OOH- primary care services in nine municipalities in the county of Møre og Romsdal. The demand is defined as the distribution of inquiries per unit of time (annual, monthly, day of the week and time periods of the day).

Today, the Norwegian OOH- primary care service is experiencing challenges managing the service. Therefore, to secure citizens with the right quality in health care services, a reorganization of the OOH- primary care services are currently underway. The improvement is based on a national pilot, where Molde and eight surrounding municipalities are participating. This has led to a desire to map the demand for the service in these municipalities. Molde University College has, therefore, been included in the project, and our study is a scientific contribution to the project. The overall goal is to investigate the existence of trends and patterns in demand for OOH- primary care services. The result of this study could benefit the service in the planning process of future activities and necessary capacity.

1.1 Background of the Study

With long distances, a scattered population, and climatic challenges, Norway is a challenging country to conduct OOH- primary care services. The rural parts of Norway are especially facing challenges with organizing these services. Reports acknowledge that the aging population is expected to be much higher in rural areas compared to the central parts of Norway (Statistics Norway 2017b). Municipalities in rural parts of Norway are also experiencing difficulties in recruiting health care personnel with the correct competence, both regular general practitioners (RGP) and nurses (KS 2017, Kalstå and Sørbø 2018). Simultaneously, a considerable share of the RGPs currently working in these areas are reaching an age that allows them exemptions from OOH- work. When new legislation in Norway also entail stricter requirements for health care professionals conducting OOH- work, additional challenges in managing and organizing the services in the districts arises.

Based on these challenges, and the fear of not being proactive to avoid subsequent consequences of upcoming challenges, the Norwegian Directorate of Health has initiated the National OOH- Primary Care Service Pilot. Since Molde and surrounding municipalities are experiencing several of the difficulties described, the municipality was one out of two selected municipalities that received funding for participating in the pilot project. The pilot has a duration of 3 years, where the goal is to test new ways of organizing the OOH- primary care service to secure sustainable and proper OOH- primary care. This includes increased accessibility, clear leadership, diversification in supply, ensuring adequate quality, and obtaining better recruitment. Central to this change is the implementation of communication technology to support diagnostics and treatment.

The pilot project will be a cooperation between Molde and eight surrounding municipalities (herby the districts). A prerequisite for the introduction of the satellites is inter-municipal cooperation, as well as a functioning communication technology solution between the districts and a central unit (casualty clinic). The intention is to replace existing OOH- work during the night (22.00-08.00) in the districts with virtual rooms (referred to as satellites) operated by nurses in nursing homes or home care services. While, the central unit will be located in Molde, operated by general practitioners and nurses. The objective is to use communication technology, such as video, to streamline a consultation from the virtual rooms in the municipalities with a general practitioner (GP) located at the casualty clinic in Molde.

Technology development has proven to be an essential resource for how health care services can be proactive and meet challenges (Nakrem and Jóhannes 2017, 25). With new solutions on the way, it becomes more critical now than ever to have effective methods for decision-making and management of operations. Without the benefit of inventory employees to safeguard against the gap between demand and supply, adequate capacity is a prerequisite to secure citizens optimal OOH- primary care. To obtain efficient planning of activities, such as allocating resources, it is necessary to analyze the demand for the services thoroughly.

1.2 Research Area

During the past decades, there has been an increase in research within the field of health care operation management. Several have reviewed literature within the area, where topics such as service operations strategies and objectives, planning- scheduling and control- of service operations and capacity planning are just a few out of many areas' researchers have studied. Most of these studies have been conducted internationally and is connected to the specialist services, such as hospitals. Within the field of OOH- primary care services, the research is relatively scarce. Norway's unique structure of the service also makes it difficult to compare and generalize the international studies to Norway.

In the years up to 2006, limited research was conducted related to the OOH- primary care service in Norway. To fill this gap, researchers started investigating various areas within the service, where most research focused on factors impacting the service. Researchers have investigated frequent attenders and how characteristics of the citizens RGPs affects the use of the service. Several researchers have also examined the correlation between the distance to the nearest casualty clinic and the use of the OOH- primary care service. Others have also studied the RGPs participation in the OOH- work. However, limited research has focused on the distribution of demand at the OOH- primary care service.

Because of local conditions that vary between counties and municipalities, Legeforening (2015) recommends that each OOH- primary care service should carry out an assessment of their activity level. Such an evaluation could contribute to an organization of the service that could be adapted to local conditions. Understanding how the situation is today might create a proper groundwork for decisions regarding capacity planning and other operational activities.

1.3 Research Problem

As mentioned, within Norwegian OOH- primary care service, research on variations in demand is practically nonexistent. Today many decisions are based on intuition rather than facts, and thus often have an ad-hoc approach (Fosse, Skarshaug, and Innerdal 2018). Based on limited research and the challenges the service faces today, this study aims to gain more knowledge about trends and patterns in demand at OOH- primary care services in nine municipalities in Møre og Romsdal. The overall research problem is:

Investigating the demand for OOH- primary care service in nine municipalities in Møre og Romsdal.

1.3.1 Research Questions

Based on the research problem, research questions have been established. These questions will be the fundamental core of the study and help with directions when analyzing the research problem. The research questions for the study are as follows:

RQ I: Investigate the variations in number of inquiries per unit of time at selected OOH- primary care services in Møre og Romsdal

RQI intend to investigate the variations in the number of inquiries at the OOH- primary care services. Through a thorough analysis of the received data sets, the researchers will be able to answer the question. Answering **RQI** would provide the basis for answering **RQII**:

RQ II: Investigate potential factors that could impact the variations in the number of inquiries at the OOH- primary care services

RQII intends to investigate how demography and other factors suggested in literature impact the number of inquiries at the selected OOH- primary care services. In addition, it intends to examine whether the implementation of satellites will impact the demand at the OOH- primary care service.

1.4 Structure of the Thesis

The thesis is structured into eight chapters, with subchapters. Section one covers the introduction and includes the purpose of the study, research area, and research problem. Section two presents the relevant theory within health care operation management and is divided into subsections consisting of demand management and process design. In overall, this chapter consists of theory and literature of relevance. The third section presents relevant research in health care and technology related to health care organizations. Section four describes the case description, with a brief presentation of the Norwegian health care system, the OOH- primary care service, and the municipalities in focus. Further, the research methodology is described in section five, where the overall approach, data collection, and data analysis are divided into subsections. Section six presents the results from the study, which is divided into four subsections; annual inquiries, as well as monthly, day of the week and hourly patterns. The discussion, based on the results, is presented in section seven. Section eight is the final part of the thesis and deals with the conclusion, limitations of the study, and suggested further research.

2.0 Health Care Operation Management

Operation management is a term that has been widely recognized through literature and practice throughout the last decades. The term has usually been linked to the manufacturing industry, yet it is equally important and applicable for service industries (Slack, Chambers, and Johnston 2010, 6). The theory reveals a consensus around the definition of health care operation management. Langabeer (2008, 6) suggest that it includes the management of business systems and processes that convert resources into services. Slack, Chambers, and Johnston (2010, 6-7) state that operation management is a critical element of health care management that concerns the activity of managing the resources that deliver services. Both definitions are consistent with how Johnston, Clark, and Shulver (2012, 12) define service operation management, which is all the activities and decisions that are fundamental when providing the specific service and securing value towards the users (i.e., managing costs and employees).

In the context of the OOH- primary care service, the value creation towards the patient may be measured on their ability to have easily accessible services available at the right time which is delivered with the right quality. According to Halbo (2010), the quality of services concerns the ability to satisfy the users of the service. He further suggests that the user's satisfaction does not only depend on the actual outcome of the service but also the users expected outcome of the service. Thus, the quality is considered as perfect if the outcome is equal to the expected outcome. According to Kros and Brown (2013), the value can be created by optimizing both the efficiency and effectiveness in the operations. Where they describe efficiency as completing an activity at the lowest cost or with the lowest possible amount of resources. While effectiveness involves doing things right to create the highest value to the organization. For some organizations, the value can be maximizing the profit, but for non-profit organizations, such as Norwegian health care services, the value could be to help as many patients as possible. Kros and Brown (2013) further state that smart operation management, by achieving both efficient and effective operations, can be a great approach to realize a high level of value. For organizations to accomplish efficiency and effectiveness in their services, it becomes essential to understand the demand and the processes within the organization. Using analytical tools and techniques can be beneficial and might result in more favorable decisions.

2.1 Demand Management

Awareness of the demand and understanding its patterns is essential for every organization to succeed with its operations and value creation. In service organizations, demand management is associated with how service organizations manage customer demand. Central to the demand management, is proper demand planning and strategies to cope with uncertainty, in which both are critical success factors for all supply chain activities (Wang et al. 2015). The ability to match supply and demand has been explained in theory as the primary goal of supply chain management (Christopher 2016, 95). In a demand-driven supply chain, such as in most health care services, analyzing customer demand is essential to coordinate planning and execution. Understanding the demand, to further match capacity and resources with the demand becomes necessary to sustain efficient operations (Langabeer 2008, 95). The operational theory describes that organizations ability to match supply with demand starts with making precise forecasts. Where forecast is defined as a prediction of future events that is useful when planning organizational operations, such as managing processes (Krajewski, Malhotra, and Ritzman 2015, 297). Forecasting is also a starting point when the organization seeks to understand variations in activity levels for a time period. In the context of health care services forecasts are used as a projection of demand that arises from three measurements; the type of health care service, the location and the time (Langabeer 2008, 95-98).

Previous literature reveals advantages that might evoke from forecasting demand in health care organizations. Langabeer (2008, 95-103) claims that demand forecasting can be beneficial as it can reduce wait-time for the patient, increase services towards the patients, and improve operational efficiencies. By using historical data on daily patient demand to predict the future has also shown to improve the balance between demand and supply, where demand forecasts led to better planning of personnel (Batal et al. 2001). Soyiri and Reidpath (2012) also claim that health forecasting can be an advantageous preparation for decision making in health care services. The theory further asserts that forecasting is the starting point when shaping the long-term capacity necessities, short-term operations, and supply chain activities (Bozarth and Handfield 2016). Rais and Viana (2010) also state that demand forecasting can provide essential information to several optimization problems.

Although demand forecasting is essential and can be beneficial, uncertainty makes it a challenging job. Patients as the key input to the production process, whether it is the physical presence or virtual presence in the production process leads to uncertainty and variations. Frei (2006) introduces five ways of variabilities initiated by customers (e.g., patients); arrival, request, capability, effort, and individual preference variability, where the variabilities can be seen sequentially in the production process. Patients arrival time varies and is not always convenient for the organization, and they have various requirements in terms of treatment. The patients' level of capability and effort also vary, where some may be able to describe their symptoms and participate in the service interactions whereas others may not. The evaluation of the process outcome will also differ according to the patient's individual preferences.

The existence of uncertainty and variations in demand makes it difficult to draw accurate forecasts. The peaks and valleys that might arise from the change in demand can be costly and result in poor service towards the patients. This reinforces the importance of making appropriate forecasts. It is essential to understand these demand patterns to lighten the cautions that might arise from demand swings. Time series are frequently used among researchers and can be explained as the pattern that presents *«repeated observations of demand in their order of occurrence.»* Time series uses historical data on demand to predict future demand and can be beneficial when the demand does not vary a lot between the years. In health care forecasts, time-series is more frequently used compared to other methods (Krajewski, Malhotra, and Ritzman 2015, 297).

One specific time series analysis that has received increased attention in the health care industry is the statistical process control (SPC), which has its origin from variation theory. In literature from Nyen (2009), it emerges that Raymond G. Carey defines it as a philosophy, strategy, and set of methods to improve systems, processes, and results. In a study conducted by Mohammed (2004), SPC has proven to be a beneficial tool for health care management and has contributed to improvements in health care processes. Further, Nyen (2009) states the importance of knowing processes and systems, as well as variations and measurements. He further describes SPC as an appropriate tool when creating a change and potentially an improvement. Mohammed, Worthington, and Woodall (2008) also describe the necessity of producing control charts when implementing SPC, where they, with the help of health care examples, present a tutorial-based approach to the choice and creation of four commonly used control charts.

There exist several methods and techniques to manage the demand to match it more effectively with the available capacity. Within the service industries, two methods are frequently used, pricing strategies and reservation strategies. The pricing strategies are used as an attempt to draw customers in periods with excess capacity and consist of discounts and premiums (McClain, Thomas, and Mazzola 1992). Airlines is a typical example of services that uses this strategy when they offer their customer less expensive tickets for travels that do not fall simultaneously with business travels. For non-profit organizations, such as the Norwegian health care service, this method would be less appropriate. However, the reservation strategy is more or less already used in Norwegian health care services today. The reservation strategy helps reducing uncertainty in demand by reserving future capacity by booking patients at a specific time or by separating the patients into sub-groups. This is typically done for operation scheduling at hospitals. Both of these strategies pursue to overcome the inability to stock the resource for the purpose of use later, by managing demand to match the capacity available (McClain, Thomas, and Mazzola 1992).

2.2 Process Design

In health care services, there exist several processes, all of which are important to create value for the organization. Processes could be defined as an activity or several activities that transform input into output (Krajewski, Malhotra, and Ritzman 2015, 23). A process that involves activities that deliver great value directly to patients, such as the production process, can be defined as a core process. In a health care production process, health care professionals transform human capital along with physical capital into health care services. While in manufacturing company's production process, raw material is converted into physical products. The health care service processes are unique and somewhat differentiated from manufacturing processes. The literature of logistics and supply chain management confirm these distinctions (Christopher 2016, 203-204, Krajewski, Malhotra, and Ritzman 2015, 23). They further describe service processes as inseparable, intangible, heterogeneous that consists of a perishable output. Compared to manufacturing processes, where production and consumption are separable, and the outputs are physical and durable. The response time is also often longer with manufacturing processes than with service processes.

Service Process Characteristics:

- Inseparable
- Intangible
- Heterogeneous
- Perishable

In most health care services, production and consumption take place at the same time, i.e., they are inseparable. This means that the interaction between health care professionals and patients is essential to deliver the service. Both the health care professional and the patient need to be present at the time of delivery. Due to variations in demand, the services are usually also heterogeneous. This becomes especially apparent at the OOH- primary care service because of variations in the type of service, time of delivery, and also which employee performing the service. Type of service delivered would, for instance, vary between patients with a fracture compared to those with strokes. Similarly, the employee performing the service could vary between these two conditions. Thus, the production process has to be flexible, enabling them to handle all kinds of consultations at any given time. In service processes, the patients are not able to see the outcome before the service is received. Since the outcome is not physical objects, it is intangible.

The OOH- primary care service is considered as labor intensive, where there is a major focus on the workforce and how they interact with the patients. Since the outcome is intangible, it results in a perishable outcome, which means that the service is expected to deliver at a particular time and cannot be stored and used later. In service organizations capacity is equivalent to inventory, as it represents the resources the service has available to meet a certain level of demand (Christopher 2016, 203-204). These resources can consist of i.e., workforce, equipment, and processes that make up activities that create value to ensure that the organization meets the demand (Hill and Hill 2011, 6). The theory explains that operation management uses resources as inputs to create outputs that satisfy requirements in the market (Slack, Chambers, and Johnston 2010, 8). In the context of the OOH- primary care service resources consist of, for example, the health care professionals (i.e., nurses, RGP, GP), medical equipment and facility. Together, these resources will ensure that the service is available at the right time, securing the patient urgent medical assistance.

In most health care processes, the production process is initiated by the patients, signifying that it has a pull system. This type of system can be explained as processes that are carried out as a response to demand (Chopra 2018, 172). In other words, the processes are demand-driven and are dependent upon some need to start the process. The characteristics of a service process indicate that there is a high degree of customer contact and customization in the production process to OOH- primary care services. Each patient will have different needs based on their condition, and the workflows have to be flexible to meet the various needs of the patients. This degree of customer contact and process divergence corresponds with what Krajewski, Malhotra, and Ritzman (2015, 73) define as a front office process. The theory also distinguishes between different process types according to its degree of volume and variety (Slack, Chambers, and Johnston 2010, 91-95). In the OOH- primary care service, the patient spends a substantial amount of time in the process, and most of the employees' time is spent with the patient. The main focus is on how the service is delivered rather than what is delivered, and it has a process focus. When there exists a process focus, theory defines the process as a professional service, where the production facility is structured to facilitate low-volume and high variety production (Slack, Brandon-Jones, and Johnston 2016, 194).

2.2.1 Planning Capacity

Planning capacity involves aligning capacity with demand. The goal is to have a level of resources that cover the current and future demand to avoid both capacity shortages and excess capacity (Langabeer and Helton 2015, 116, Krajewski, Malhotra, and Ritzman 2015, 156). Chase, Aquilano, and Jacobs (2007, 441) state that capacity planning in the service industry is affected by time and location in addition to volatile demand fluctuations in a greater extent than the manufacturing industry. Manufacturing organizations can store inventory to consume when demand peaks, while service organizations have to plan capacity to meet demand at all times. This to avoid missing essential capacity and avoid bottlenecks. A bottleneck is a point in the process where the available capacity is not able to handle the demand (Langabeer 2008, 96). During periods with low demand, a high level of capacity will result in excess capacity and a waste of resources. The capacity must be available for consumption when demand arises and located near the user. The volatility of demand is affected by the fact that services do not have a stock that can smooth the demand.

Decisions regarding capacity planning play a big role in all industries and are particularly important within the health care industry. In being health care providers, some labor is required to provide the patients with the service they need. The labor is often expensive and may also be limited (e.g., the case for districts in Norway). In addition, proper capacity management can be the difference between life and death. Therefore, it is critical that the correct labor is available at the right time, place, and in the exact capacity. To cope with the volatile demand in health care organizations, it becomes crucial to have capacity flexibility. This involves having flexible workers allowing the organization to quickly increase or decrease production levels, by moving from one task to another (Chase, Aquilano, and Jacobs 2007, 435).

Because of the variability in demand, it is essential to be aware of the peaks in demand to allocate resources accordingly and to secure quality in the services. Litvak et al. (2005) describe three different scenarios used in capacity planning that ensure quality in care when facing unpredictable demand; «(1) *Staff continuously to peak load; (2) staff to average demand and add additional health care personnel selectively from a dynamic pool of health care personnel as needed when census rises above specified levels; or (3) staff constantly to average load*». It appears that only the first scenario would ensure safety and quality, but it would not be economically feasible and would probably include a waste of resources. Others have suggested a similar approach to capacity planning where quantitative methods based on mean values as an alternative to ad-hoc approaches in operation scheduling have shown to improve list planning and lower the risk of over- or under- booking (Pandit and Tavare 2011).

The combination of variations in demand and a perishable output makes it challenging for service organizations to plan the future, especially considering managing the capacity (McClain, Thomas, and Mazzola 1992, 27). In services, such as health care, where both customer contact is high, and there exist high variabilities in demand, operation managers have to ensure adequate planning of capacity to meet day-to-day, and even hour-to-hour variations in demand (29). Proper planning, to match the consumption of resources with the patient volume and the workload, involves both capacity and demand analysis. Awareness of the trends in demand, along with available capacity, allows a change in employee scheduling to accommodate changes in demand (Langabeer 2008).

2.2.2 Redesigning Processes

When organizations have capacity shortages and are not able to match demand, improving processes may be an alternative solution. Improving processes can be the foundation to achieve better outcomes, reduce costs, and shorten the throughput time (Langabeer 2008, 75-79). Where Krajewski, Malhotra, and Ritzman (2015, 83), look at process improvements as a systematic investigation of all the flows and activities of the process in the purpose of improving it. Quantitative tools, such as forecasting methods, can be beneficial to support improvements in flows because when changing processes, it is essential that the decision relies on data and not only the manager instinctive (Langabeer 2008, 95). Analyzing the process as it is today is also beneficial to identify how the processes work today and how they can be redesigned in the future. Where the identification and definition of new opportunities for improvement start the process analysis and ends with implementation and control after the redesigning. (Krajewski, Malhotra, and Ritzman 2015, 83).

Conducting thorough process maps of the current situation, as-is, should give an overview of how the process is currently working today and is the starting step for improving a process and to identify the future process, to-be (Langabeer 2008, 75-79). Process maps illustrate each step in the process and make it possible to identify possible bottlenecks that should be eliminated from the process. In a service organization, where the consumption and production happen simultaneously, bottlenecks can result in long waiting times for the patients. Long waiting times can in health care services have a huge consequence for the patients. Therefore, there should be a high focus on removing the bottlenecks that exist. Removing bottlenecks is called de-bottlenecking, and managers have to define where the bottleneck occurs through analyzing both the demand and the capacity (96).

There is an agreement among the literature that benchmarking is a valuable source during process design (Langabeer 2008, 83, Krajewski, Malhotra, and Ritzman 2015, 96). Benchmarking is the process of identifying marked leaders to compare performance with others. Where the purpose is to find new practices that can improve the processes in the organization. The discovered success factors of market leaders need to be tailored to the organization's processes to try to improve their performance (Langabeer 2008, 83-84).

The motivation for redesigning processes often occurs because of gaps in performance, in addition to technology changes or changes in personnel. The performance of the process can be evaluated by the clinical results, the satisfaction of patient and personnel or operational aspects such as the utilization of resources (Finnell and Dixon 2016, 150). In health care organizations, redesigning processes is often done because managers seek to be more efficient and effective in the delivery of service (138). Theory state that increasing volatility of demand makes it hard for organizations to respond to the demand (Christopher 2016, 111). The theory of operation management has introduced various improvement concepts when redesigning processes in health care operations, such as the application of lean thinking, agility, and, more recently, the leagility. All these have both their advantages and disadvantages depending on where they are applied. Within logistic theory, lean may be considered as the most prevalent. However, it is mainly applicable to processes with high volume and low variability (e.g., make-to-stock processes), which means that it limits the application to all health care processes.

Many researchers have experimented with lean as an attempt to improve efficiency, clinical outcomes, and satisfaction among both employees and patients in health care organizations (D'Andreamatteo et al. 2015). Agility, on the other hand, can be described as the ability to react rapidly and flexible, thus are more applicable to processes with high variability. The theory also states that some organization may need to combine lean and agile strategies by introducing Kanban or hybrid strategies. Kanban involves short lead time and predictable demand, while the hybrid strategy is when there is unpredictable demand and long lead times. The hybrid solutions require the process to be “de-coupled”, where the process follows a lean strategy up to the decoupling point and an agile strategy after.

The combination of lean and agility is often referred to as leagility and can be applied to operations that suffer from a high level of uncertainty, such as the OOH- primary care service or other emergency services (Christopher 2016, 111-114). A study conducted by, Rahimnia and Moghadasian (2010) study leagility in professional services, a hospital. They find that patients conditions required the hospital to be extremely agile, but at the same time, they managed to benefit from lean thinking. Further, Guven-Uslu et al. (2013) describe that by using decoupling points as reference model, one can improve integration between processes, technology, and people in service operations. Decoupling points documented each subprocess and made people aware of both technology and processes in the service. They found that people had an essential role and strong impact on whether organizations can realize the change in processes.

3.0 Literature Review

Reviewing literature on OOH- primary care service in Norway show that there are various factors that can impact the demand. This chapter will give an overview of the literature that already exists within the context of the OOH- primary care service in Norway, as well as international studies within various emergency services. Finally, a review of technology in health care is presented. The literature reviewed will form the basis which will be used in the discussion.

3.1 Health Care Literature

Previous studies have laid an emphasis on the correlation between demand and distance to the nearest OOH- primary care service. Both Raknes, Hansen, and Hunskaar (2013) and Raknes, Morken, and Hunskaar (2014a) show in their study that the distance to the OOH- primary care service is a decisive factor for whether the citizens use the service or not. They find that long distances contribute to a reduced use of the OOH- primary care service. Raknes, Morken, and Hunskaar (2014b) support this in their study, where they document that if the distance increase with one kilometer it will lead to between 0.9 and 1.3 percent reduction in total contact rates at the OOH- primary care service. However, this varies between the type of contacts; physical consultation at the casualty clinic, telephone contacts and home visits. The biggest impact proved to be on the physical consultation rate, where an increase in distance reduced the contacts between 1.3 and 1.8 percent. Conversely the telephone contacts increased with 0.2 percent per kilometer increase in travel distance. While the home visits were reduced with 1.1 percent for every kilometer increase in travel distance.

Literature also suggest that the location of the municipality can have an impact on the volume of contact rates at the OOH- primary care service. Sandvik, Hunskaar, and Diaz (2012a) argue that citizens located in rural areas and peripheral municipalities have a higher tendency to use the OOH- primary care service compared to those located in more urban areas. Sandvik and Hunskaar (2018) also suggest that frequent attenders at the OOH- primary care service is more common in small municipalities. There is also an agreement in literature that frequent attenders are most prevalent among the younger and the elderly, increasing with age. In addition, the women are over-represented (Keizer et al. 2015, Buja et al. 2015, Sandvik and Hunskaar 2018).

Keizer et al. (2015), explains that the motives behind frequent attenders are the patient's perceptions, where anxieties and medical questions to GPs are the main reasons.

Literature further agrees that there exists a connection between frequent attenders and non-urgent contacts (green inquiries), which increase the pressure on the OOH- primary care service (Keizer et al. 2015, Sandvik and Hunskaar 2018). They also state that the availability of the RGP's can partially explain the high proportion of non-urgent contacts. Further, they believe that improved access to primary health care services in the daytime can reduce the use of the OOH- primary care.

There is also a consensus among literature that the OOH- primary care service often consult health care problems that are non-urgent (Keizer et al. 2015, Sandvik and Hunskaar 2018). Patients who contact the OOH- primary care service with non-urgent problems are often the youngest age group (Keizer et al. 2015). Uncertainty about the severity of diseases among children and inconvenient opening hours at the RGP's office are some of the reasons why parents prefer to use the OOH- primary care services (Lass et al. 2018). Further, literature state that frequent attenders are affected by the fact that low-income patients are exempted from health care costs, which increases the likelihood of being a frequent attender (Buja et al. 2015). Jørgensen et al. (2016) believe that unemployment, low education and existing medical problems are factors that explain frequent attenders. In order to reduce the number of frequent attenders, literature believes that education of appropriate use of the OOH- primary care service could reduce the risk of non-urgent medical problems (Keizer et al. 2015, Sandvik and Hunskaar 2018).

Whether the nearest OOH- primary care service is part of an inter-municipality cooperation or operates alone have also shown to impact the demand at the OOH- primary care service (Raknes, Morken, and Hunskår 2014b). In their study they find that inter-municipality OOH- primary care services will have a lower contact rate compared to an OOH- primary care service operating alone. They justify this by the fact that inter-municipality OOH- primary care services often are larger and more professional, and therefore to a greater extent manage to prioritize those patients who have a real need for medical assistance. In addition, GPs at OOH- primary care service that operates alone may have financial incentives to conduct consultations with patients who rather should be handled by RGP during office hours. If the inter-municipality OOH- primary care service additionally is collocated with a hospital the contact rates could be

even more reduced. Studies also show that inter-municipality OOH- primary care services that was not collocated with a hospital had a consultation rate 18 percent higher than the ones that was collocated (Raknes, Morken, and Hunskår 2014b).

Further, research suggest that the characteristics of the RGP also can have an impact on whether their patients uses the OOH- primary care service or not. Some key findings that recur among the patients visiting the OOH- primary care service, is that their RGP is either male, young or immigrant. Additionally, the patients that were connected to a RGP with a long patient list used the OOH- primary care service less than others (Sandvik, Hunskår, and Diaz 2012a). This can be seen in connection with research that show that RGP with long patient lists is more available, offering less waiting time for their patients. Where results indicate that the waiting time decreases with the RGP list length (Godager and Iversen 2010).

In a study conducted by Sandvik, Zakariassen, and Hunskår (2007) they analyzed RGP involvement in OOH-work. In their study they find that 50 year is the average age when GPs completely stops involving themselves in the OOH- primary care service. Among the respondents, 50 percent of the RGP fully participated, 15 percent only participated partially, and 35 percent did not participate. Their results indicate that elderly and women was overrepresented among the RGP that did not participate. In addition, they recognize that RGP request to exclude themselves from OOH- work.

According to Sandvik, Zakariassen, and Hunskår (2007) would factors such as increased centrality and number of citizens in the municipality decrease the RGP involvement in OOH-work. They further state that RGP connected to inter-municipality OOH- primary care services conducted less OOH-work than those without cooperation. These findings correspond with a study conducted by Sandvik and Hunskår (2007). Their results further show that the length of lists and whether the RGP have an open or closed list would impact their involvement in the OOH- primary care service. Where RGP with short lists and open lists more frequently conducted OOH- work. In 2012 there were few changes in the RGP tendency regarding OOH-work. Yet, results indicate that there are five times as likely that RGP in a peripheral municipality is involved in the OOH- primary care service, compared to a RGP in a central municipality (Sandvik, Hunskår, and Diaz 2012b). Literature also state that nurses can be a valuable resource to ease the workload for GPs during OOH- work. Both the number of patients managed, and the care provided is about the same with nurses as for GPs conducting OOH-

work (van der Biezen et al. 2016). Laurant et al. (2009) discovered in their review that nurses can substitute GPs without exposing patient care and may also improve the quality in care. They further found that role revision may also increase service capacity when demand for health care increase or when there exist capacity shortages.

There are conducted several studies internationally which analysis the demand for emergency services. Literature state that the demand have seasonal variations according to calendar variables, such as day of the week, month of the year and the connection with public holidays. Jones et al. (2008) conclude in their study that there exist seasonal and weekly patterns in the daily patient volume at the emergency department. Batal et al. (2001) conducted a study to predict future patient volume at a medical center in Denver, with help of calendar variables. Their results show that the use of calendar variables to patient volume can give a good indication on what patient volume to expect in the future. Research also claim that forecasting models, such as time-series, that include calendar variables can detect the demand patterns at emergency departments, which can be used for improving the planning of resources (Marcilio et al. 2013). Further, several studies show that Monday is the day in the week were the emergency department experience the highest degree of visitors, while in weekends the demand appear to be lowest (Batal et al. 2001, Marcilio et al. 2013).

In a study conducted by Marcikic et al. (2016) for ambulance stations in Serbia it was also found that the demand followed hourly, daily and monthly patterns. Where the demand was higher during daytime and on weekends, while it was lower during night and in weekdays. Further, reports from OOH- primary care service and accident & emergency (A&E) service in Scotland show that there was variation in demand, mainly affected by official holidays (Information Services Division 2017). They also found that children, people in their 20s and people over the age of 75 contacted the OOH- primary care service the most. It was also discovered differences between the two services, where the contacts were highest in weekdays and during winter months at the OOH- primary care service compared to weekends and summer time for the A&E service.

Similar to the report conducted for Scotland, there is conducted statistics on selected OOH- primary care service in Norway. These statistics show that the annual contact rate was 316.4 per 1000 citizen, and the daily contact rate was 0.866 per 1000 citizen in 2017. There was registered more inquiries in months related to Christmas and Easter holidays. They also found

that Wednesday was the quietest day, while Monday was the busiest day. Further, the registered activity during the day varied between weekdays and weekends, where weekdays had the most contacts in the evening, while weekends had most contacts during daytime (Eikeland et al. 2018, Sandvik, Hunskår, and Blinkenberg 2018).

3.2 Technology in Health Care

Digital technologies have been an important factor in serving patients with sufficient care, but also to keep developing to improve health care practices (Bhavnani, Narula, and Sengupta 2016). Telemedicine is a term used when referring to digital technology in health care, and Wootton et al. (2009) define it as «health care at a distance». Further they describe that others use telehealth, eHealth, online health, connected health, etc. synonymously with telemedicine.

There is a large consensus in literature that the potential is great within telemedicine. Ekeland, Bowes, and Flottorp (2010) believes that telemedicine can increase the availability of health care services, especially in rural areas. Neufeld, Case, and Serricchio (2012) describes a situation where a mental health center experienced positive results with the use of telemedicine. They could more quickly respond to new patients and the waiting time for a follow-up session where reduced. A study from the UK (Johnston 2011) show that telemedicine has yielded positive results also in palliative care, where it was possible to increase the availability for dying patients to receive treatment at home.

In a literature review from Skär and Söderberg (2018) they conclude that ethical aspect must be considered in the implementation of technology in health care services. This in order to protect patients` integrity, dignity and autonomy. Hofmann (2013) defines in another literature review several ethical challenges within welfare technology; privacy and confidentiality issues, different goals of the stakeholders and social discrimination. Finally, he state that ethical challenges arises as a result of the tradeoff between conducting health care services through human contact and technology. Clark, Capuzzi, and Harrison (2010), on the other hand, focuses on the ethical problems that can arise in the relationship between health care professionals and patients when using telemedicine. They point out the importance of changes in quantity and quality of the service, and the patients privacy and confidentiality.

Literature has also mapped out different attitudes patients and health care professionals have to the use of telemedicine. A study conducted by Polinski et al. (2016) showed that patients were highly satisfied with the use of telemedicine. Another study from Donelan et al. (2019) has examined patient and health care professional opinions on the use of video consultation in connection with follow-up care. Figures show that 62.5 percent of the patients believed that there was no difference regarding quality of care in receiving treatment over video consultation against regular consultation at the doctor's office. Video consultation was mainly preferred because it was more suitable and there was a positive change in travel time. Health care professionals stated that they experienced higher efficiency during a video consultation.

Findings from Becevic et al. (2015) indicates that both patients and health care professionals are positive towards telemedicine, however, health care professional prefer personal consultation instead of telemedicine. Clark, Capuzzi, and Harrison (2010) state that telemedicine can increase the availability to patients, as well as be beneficial for the patient's quality and provide continuity of care. However, they believe that patients often fear telemedicine because it affects patient's privacy. At the same time, unknown technology is used, and patients receive treatment distant from health care professionals. As a solution, Clark, Capuzzi, and Harrison (2010) suggest meeting the patients' fear with education and communication, which can contribute to a service that maximizes the benefits of patients, health care professionals, and the whole community. A study conducted by Johansson, Lindberg, and Söderberg (2014) has examined patients' experience with video consultation in the specialist health care service in rural areas. The results showed an overall positivity for the use of video consultation as a form of care, due to a reduced travel time. At the same time, it emerges from the study that knowledge contributes to patients being more satisfied with video consultation. They believed that this was because the patients were more confident at consultation number two.

4.0 Case Description

The study deals with nine OOH- primary care services in Norway, which operates as an important part of the Norwegian Health Care system. This chapter aims to provide an overview of the Norwegian Health Care system, the role of the OOH- primary care service and the municipalities in focus. It also asserts the production process as it is today (as-is) and how it is expected to be in the future (to-be), with satellites. The overview will establish necessary framework for the purpose of use later during the analysis and discussion of the thesis.

4.1 The Norwegian Health Care System

Throughout the last decades, there has been a successful development of the Norwegian health care system, which is now accessible for every Norwegian citizen and characterized by high quality (NOU 2015: 17, 22). The Norwegian parliament has presented core values applicable for the Norwegian health care system; equal services, improved health care services at the end of life, predictable and clear priorities, greater emphasis on the patient's codetermination and low threshold for contacting the health care services. These values underpins the health care systems overall goal which is to secure every citizen sufficient and accessible services which is professional justifiable (Helse- og omsorgsdepartementet 1999).

There exists a shared public health care responsibility between the state, the counties and the municipalities. The state has the overall responsibility for the health politics, while the parliament makes decisions regarding legislation and regulations (Norsk Helseinformatikk 2019). The Ministry of Health and Care Services shall ensure that these decisions are implemented and intend to ensure that every citizen receives equal and adequate health- and care services (Regjeringen n.d.a).

The Norwegian health care service is financed through annual budgetary allocations from the national budget (Regjeringen n.d.b). The health care service offers free health care services for children under the age of 16, while adults have to pay a certain fee. When adults have paid a certain amount in fees for the use of health care services, they are entitled to a health care exemption card, allowing them free health care services (Helsenorge 2019).

With the Ministry of Health and Care Services operating as a governing body, the Norwegian health care system is divided into three parts; regional, county and municipalities (Nylenna and Braut 2019). The Specialist health service is the state's responsibility and is operated at a regional level, where the main responsibility is to secure supply of specialized health services in the regions. Today there exists four Regional Health Authorities; West, Southeast, Mid Norway and North. These Regional Health Authorities are responsible for the operations of hospitals, as well as ambulance services, health research, education and also training of patients and their relatives (Regjeringen 2014a). Further, the counties are responsible for the public dental care service, ensuring that dental care services are available to anyone who lives or residents in the counties (Regjeringen 2014b).

For conditions requiring specialized treatment, the patients receive a referral from the Primary Health Service. The various municipalities in Norway are in charge of the Primary Health Services, where they are responsible for providing good and proper health- and social services. These services provide assurance that the citizens in the municipalities have access to necessary health care close to where they live (Regjeringen n.d.c). The RGPs, OOH- primary care service, health centers and school health services are examples of important services underlying the Primary Health Service. Nursing homes and homecare services are also underlying the municipalities responsibility for Primary Health Service. Figure 1 show an overview of the Norwegian health care system.

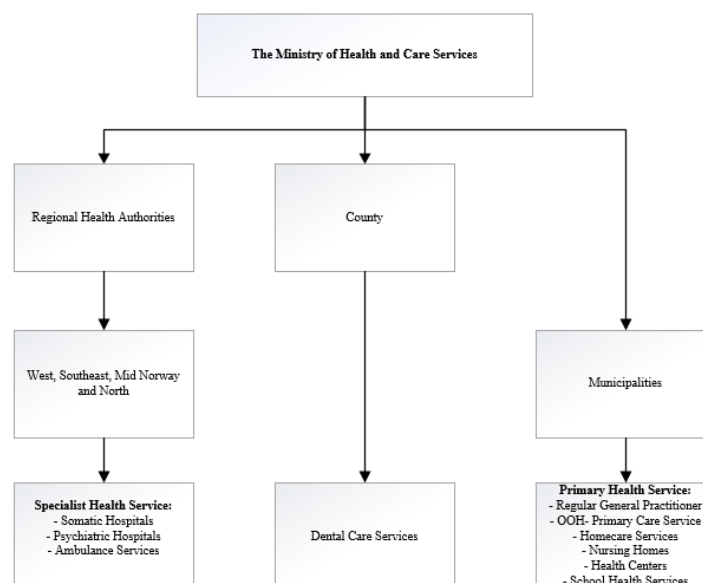


Figure 1: Schematic overview of the Norwegian health care system

Derived from Ringard et al. (2013)

4.2 The OOH- Primary Care Service

The OOH- primary care service is by the various municipalities. The purpose of the service is to ensure that all citizens receive necessary health care, independent of the time of the day and which municipality they are located in. During office hours, 08.00 – 16.00, the RGP's is responsible for immediate help to their list-patients, while OOH- primary care service shall ensure help to visitors and students without RGPs in the municipality. Outside the RGP office hours, the OOH- primary care service shall ensure that both citizens and visitors to the municipality receive necessary care (Johansen et al. 2018). In Norway the RGP offices are closed during weekends (Saturday and Sunday) and on official holidays.

The OOH- primary care service consists of one or more doctors, who either alone or together with other health care personnel conduct consultations. In addition, the scheme consists of a local emergency medical communication centers (LEMC) which receives inquiries from people who want contact with the OOH- primary care service. LEMC register all inquiries for the OOH- primary care services and distributes the patients to the nearest casualty clinic according to their location, regardless of which municipality the patient resident in (Johansen et al. 2018). When a patient contacts the LEMC, employees at LEMC will carry out an overall assessment according to the Norwegian Index for medical emergency assistances (herby triage category) (Nasjonalt kompetansesenter for prehospital akuttmedisin 2018). Inquiries that are defined as «acute» is a red response and are events that are life threatening or potentially life threatening. Yellow responses are inquiries that are defined as «urgent», and the patient requires prompt treatment to avoid worsening the condition. Green response is inquiries that are not urgent and are defined as «common», with these inquiries patients are often referred to the RGP. Even though, several inquiries classified as green might need treatment by the OOH- primary care service, e.g. cuts that need suture (Johansen et al. 2018).

4.2.1 Legal Framework

The Norwegian health care service is regulated through several laws and regulations. The framework for how to organize the OOH- primary care service and the requirements that apply to the content of the service is defined in the Health and Care Services Act and the Emergency Medicine Regulation. The Health and Care Services Act provides an overview of rules regarding the municipality's responsibility to offer people who are located in the municipality

necessary health care assistance. Meaning that the right to necessary health care is not linked to patient's residence, but where the patient is located (Helse- og omsorgstjenesteloven 2011).

The Emergency Medicine Regulation provides a more detailed description of the requirements for OOH- primary care service organization. The regulations state that the OOH- primary care service is a 24-hour arrangement, where health care personnel consider inquiries for immediate assistance, and provide necessary follow-up. The regulations also specify requirements for the emergency medical service communication system, the organizing and staffing at the LEMC. In addition to the competence of the GP and other health care personnel, medical equipment at the OOH- primary care service and collaboration between organizations that perform emergency medical services (Akuttmedisinforskriften 2015). Patients' Rights Act and the Health Personnel Act, in addition, to a number of other law and regulations, are forming the legal basis of medical practice and the obligation to provide immediate assistance.

According to legislation, Norwegian RGPs are obligated to participate in their local OOH- primary care service, besides their day to day work. Though, the legislation opens for exemptions when the RGPs request exclusion because of either health or social reasons. When the RGPs either turns 60 years old or are pregnant they are entitled to exemptions from shifts at the OOH- primary care service. Beyond this, every RGP have the right to request an exclusion from OOH-work (Forskrift om fastlegeordning i kommunene 2012).

4.2.2 Inquiries at a National Level

In 2016, there was 428 municipalities in Norway and there were 182 different OOH- primary care service registered in the country. Of the registered OOH- primary care services, 44.5 percent were OOH- primary care service that only covered one municipality. The remaining 55.5 percent were registered as inter-municipal cooperatives, meaning that more than one municipality cooperates for serving OOH- primary care services. The number of municipalities involved in inter-municipal cooperatives varied in total from two to 13 municipalities (Morken et al. 2016).

Table 1 shows the total number of inquiries at the OOH- primary care service, from 2016 until 2018. The total number of contacts includes simple contacts, consultations, home visits, interdisciplinary cooperation and administrative work.

Table 1: Number of contacts at the OOH- primary care service in Norway (2016-2018)

	2016	2017	2018
Contacts	1 052 207*	2 165 235	2 210 056

*The registration started July 1, 2016.

Derived from Helsedirektoratet (n.d.).

4.2.3 Costs

In 2017, health expenses in Norway exceeded 345 billion NOK, which accounted for 10.4 percent of the country's GDP (Statistics Norway 2019). Expenses connected directly to the Primary Health and Care services exceeded 131 billion, where approximately 6 percent were used in OOH- primary care services. Table 2 show that expenses connected to the OOH- primary care services was remarkable less than other areas underlying the Primary Health and Care services in 2017. From 2013 to 2017 there has been an increase with 286.7 percent in expenses connected to the OOH- primary care service.

Table 2: Distribution of expenses within primary health and care services pr. 1000 NOK

	2017		2016 - 2017	2013 - 2017
	Absolute numbers	%	%- change	%- change
Gross Operating Expenses	NOK 131 333 539		5,2	15,4
Prevention, Health Clinics and School Health Services	NOK 3 858 610	2,9	9,5	38,1
Other Preventive Health Care	NOK 1 452 494	1,1	8,6	25,9
Activities and Services for Seniors and Persons with Disabilities	NOK 6 335 099	4,8	6,8	25,4
Diagnosis, Treatment, Rehabilitation and Habilitation	NOK 12 518 795	9,5	5,2	26,4
Health- and Care Services in Institution	NOK 44 191 484	33,6	2,5	12,3
Homecare services	NOK 57 142 294	43,5	6,4	24,5
OOH- Primary Care Services	NOK 804 719	0,6	15,4	286,7
Institutional Facilities	NOK 5 030 044	3,8	7,0	21,3

Derived from Statistics Norway (2018).

4.3 The Municipalities in Focus

This study is based on four casualty clinics covering nine municipalities in the county of Møre og Romsdal; Molde, Eide, Fræna, Nesset, Aukra, Midsund, Sandøy, Sunndal and Rauma. The OOH- primary care services represents different sizes of OOH- districts, both single and inter-municipality cooperatives.



Figure 2: Map of the nine municipalities included in the study

Rauma and Sunndal are both single OOH- districts, while the remaining municipalities are divided into two OOH- districts. During office hours, 08.00-16.00, the OOH- primary care service is operated by the various RGP's in the OOH-districts.

Today, Molde, Fræna, Nesset and Eide are considered as one OOH-district, cooperating as a joint inter-municipal OOH-primary care service, referred to as MIKL. After office hours, 16.00-08.00, patients are referred to the casualty clinic located in Molde. In addition, Nesset operates its own casualty clinic Monday to Thursday from 16.00 to 21.00. Aukra inter-municipal OOH-primary care service, referred to as AIKL, is a cooperation between Aukra, Midsund and Sandøy, and considered as one OOH- district. The casualty clinic is located in Aukra and is operated between 15.00 and 08.00 every weekday. During weekends and official holidays, the service is operated by RGP's on call, meaning that they are not physically present at the casualty clinic but are ready whenever needed.

Sunnadal and Rauma have their own OOH- primary care service that provide immediate help to citizens located in the respective municipality. Both Sunndal and Rauma operates the service with RGPs on call in both weekdays and weekends. In the weekdays the RGPs are on call between 16.00 and 08.00, Monday to Friday, while for the weekends they are on call from 16.00 on Fridays to 08.00 on Mondays.

The planned satellites are going to be located in Midsund, Aukra, Sunndal and Rauma. These satellites will be manned by nurses working in nursing homes or homecare services. They will be operated from 22.00 until 08.00 every day.

The nine municipalities included in this study are different in the size of land area, where Sunndal is the largest with 1 713km², while Sandøy is the smallest with 21 km². The number of citizens range from 1 263 in Sandøy to 26 900 in Molde, which illustrate a substantial difference regarding population in the municipalities. The municipalities are quite similar regarding landscape, they are connected by fjords and have many mountains.

Table 3: Overview of characteristic, special conditions and centrality in the nine municipalities

Municipalities	Citizens	Areal	Km to nearest OOH (time) / Km to Molde casualty clinic (time)	Special conditions	Centrality*
Molde	26 900	363 km ²	-	College	Some degree of centrality
Eide	3 440	152 km ²	31,5km (33 min) / 31,5km (33 min)	-	Lowest centrality
Fræna	9 775	370 km ²	22km (26 min) / 22km (26 min)	-	"
Nesset	2 946	1 046 km ²	52,9km (53 min) / 52,9km (53 min)	-	"
Aukra	3 557	59 km ²	- 23,7km (50 min)	Industrial areas Ferries	"
Midsund	2 049	95 km ²	36,7km (1t 27 min) / 29,8km (58min)	Ferries	"
Sandøy	1 263	21 km ²	25,3km (1t 31 min) / 59,8km (2t 8 min)	Ferries	"
Sunnadal	7 119	1 713 km ²	- 86,8km (1t 22min)	Industrial areas	"
Rauma	7 507	1 502 km ²	- 57,9km (1t 28 min)	Tourism industry	"

*Centrality is defined as a municipality's geographical location relative to a center where there are function of high order (central function) Centrality is counted on a scale from 0 to 3, where 0 is the least central and 3 the most central municipalities Derived from Statistics Norway (1994).

As seen in table 3, the distance to the nearest casualty clinic vary between the different municipalities as several of the municipalities are cooperating in a joint OOH- primary care service. Measured from the municipality's town hall to the nearest casualty clinic, citizens in

Nesset have approximately 53 km to travel to get to the casualty clinic located in Molde. Midsund and Sandøy also have great distances to travel to the casualty clinic located in Aukra, respectively 36 km and 25 km. In addition, other special conditions may affect the travel time. Sandøy and Midsund have both ferries, resulting in longer travel time in total. Further, both Aukra and Sunndal have industrial areas (Ormen Lange and Hydro), Molde has University College, and Rauma have tourist industry, in which all may affect the use of the OOH- primary care service.

The nine municipalities have a different amount of RGPs. Table 4 provides an overview of the distribution of RGPs by age groups and gender in the various municipalities. In addition, it gives an overview of the list size (how many patients the RGPs are responsible for), and whether they have an open list where they can accept new patients or if they have a closed list with no more capacity to accept new patients. A long patient list is when the RGP have > 1100, every list length less than this is consider as a short patient list.

Table 4: Overview of the RGPs and their characteristics

	Molde	Eide	Nesset	Fræna	Aukra	Midsund	Sandøy	Sunndal	Rauma	Total
Total	27	3	3	8	2	2	1	6	8	60
Age										
< 50 years	20	1	1	4	-	2	-	3	4	35
50 - 54 years	1	-	1	2	-	-	1	1	1	7
55 - 59 years	3	-	-	-	1	-	-	2	1	7
> 59 years	3	2	1	2	1	-	-	-	2	11
Sex										
Man	17	3	2	7	2	1	1	5	2	40
Woman	10	-	1	1	-	1	-	1	6	20
List										
Open list	1	2	1	1	2	1	1	1	4	14
Closed list	26	1	2	7	-	1	-	5	4	46
List length										
< 1 100	12	2	2	4	-	2	-	2	7	31
1100 - 1400	12	1	1	3	-	-	-	4	1	22
1401 - 1700	3	-	-	1	2	-	1	-	-	7

Derived from Helsenorge (n.d.).

As shown in table 4, there is a total of 60 RGPs in the nine municipalities, where 11 of these are above 59 year, seven is between 55 and 59 years old and seven is between 50 and 54 years. According to legislation this indicates that there are 11 RGPs that legally can be exempt from OOH- work and seven which can apply for exemption. Meaning that today there exists a risk

of losing 30 percent of the RGPs from conducting OOH-work. In addition to the RGPs in the municipalities there are some substitute GPs and interns (newly qualified doctors serving compulsory practice period). Legislation have restrictions to whether the interns can perform independent OOH-work, implying that when interns are performing OOH-work an RGP need to be on call to back-up the intern. The same applies for general practitioners without the required competence. In this study RGPs and GPs conducting OOH-work is referred to as GPs.

4.3.1 As – Is Production Process

Today all the OOH- primary care services in Norway is structured with a model consisting of LEMC and the casualty clinics. LEMC involves administrative activities, while the casualty clinics involves mainly operative activities. There is also a close cooperation with the ambulance service, though the ambulance service is an external organization. The OOH-primary care service production process can be explained through four primary levels, where every level represents a certain stage in the production process. The process includes several activities, both operative and administrative. The four different levels can be referred to as; need arises, planning, evaluation of diagnosis and treatment. In the appendix 2 a fully process map is presented.

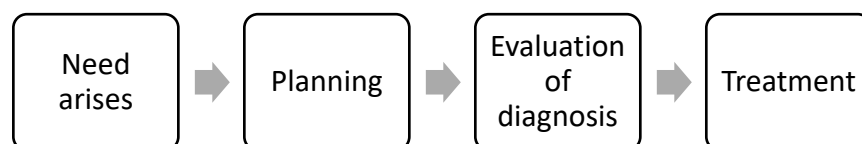


Figure 3: Different levels in the production process

The production process starts when a patient requires need for urgent medical assistance outside the RGPs office hours. When a need arises, the patients will call the LEMC or in some cases meet up directly at the casualty clinic. Patients may also call the Emergency Medical Communication Center (EMCC), depending on the degree of urgency, which is Norway's medical emergency number. When the patient meets directly at the casualty clinic they go directly to the third level in the process, this may involve waiting time for the patient if their condition is not urgent and others have to be prioritized. If the patient call LEMC, the first level triggers the second level in the production process. This level involves administrative activities conducted at the LEMC, where the upcoming activities are planned. At this stage, employees

at LEMC conducts an evaluation of the inquiry according to the triage category, as well as the contact method (i.e. ambulance, home visit or meet up at the casualty clinic). In most cases patients will receive a consultation in the near future, depending on the urgency of the inquiry. However, in some cases the ambulance might be involved to transport the patient, or the GP will conduct home visits. Some patients are also rejected or consulted over the telephone. The planning level is triggered by a high degree of variations and uncertainty, as it is hard to predict when and why the patients contact LEMC. To avoid wrong evaluations, it is important that the groundwork for decisions are accurately completed.

When the consultation is booked, the third level in the production process is triggered, the evaluation of the diagnosis. This will be conducted at the casualty clinic, or in the patient home. At this level health care professionals, such as nurses and GPs, are involved in the production process. The patient himself, or perhaps relatives, exchange information about their condition with the health care professionals, who will further conduct an assessment and give the patient a diagnosis. If the diagnosis for some reason is not set the patient will be referred to the hospital or to their RGP (if the patient's condition is not serious). If the diagnosis is set, the fourth level in the production process can start, which involves treatment of the patient. At this level there will be a high degree of customization in accordance with the individual patient needs. As far as possible, the patient will be treated at the casualty clinic or at home during home visits. Some patients might get the treatment later at their RGPs or at the hospital for a more specialized treatment. When the patient has received treatment or been referred to other parts of the health care system the production process at the OOH- primary care service is considered finished.

4.3.2 To – be Production Process

Based on the pilot project, the OOH- primary care services will in the future be structured with a model consisting of LEMC, casualty clinics, as well as satellites (virtual consultation rooms). The satellites are referred to as locations where virtual consultations with a GPs can be performed, and act as an alternative to the casualty clinic and home visit. Expanding the structure of the OOH- primary care service will also involve changing the production process, so that the satellites can be incorporated in the process. In the attachments appendix 3 a fully process map is presented.

The first level in the production process will not be impacted by the new satellites. However, the employees at the LEMC, in the second level, will have an additional alternative when distributing the patient according to contact method. The patients can now, during the night (22/23.00 - 08/09.00), be allocated to the satellites as an alternative to the casualty clinics. This will further impact the third level, the evaluation of the diagnosis. When patients are allocated to a satellite they will have a video consultation with a GP from the casualty clinic, with the help of nurses manning the satellite. If the diagnosis could be set during the video consultation the fourth level will be triggered. If the diagnosis could not be set, they will be transferred or referred to the casualty clinic or hospital for additional testing. At this point the ambulance may be involved, in order to transfer the patient, if the patients cannot get there by themselves. In situations when the diagnosis is set during the video consultation the fourth level will be triggered, the treatment. If the patient could be treated at the satellite by the nurse this will be done, if not the patient will be treated at the casualty clinic or the hospital. The production process at the OOH- primary care service is then considered finished.

4.3.2.1 Benefits of Technology

Theory state that when seeking improvement, operation management focuses greatly on the use of technology (Langabeer 2008, 21). Technology can improve productivity and improve processes by eliminating tasks or activities. Among all the various industries, the health care industry is one where technology is of utmost importance and perhaps the area it is most life changing. Within health care services, technology have showed to be a beneficial supplement to the production process. Reports show evidence that telemedicine has been implemented in various countries. In Scotland telemedicine have resulted in quicker diagnosis, reduction in the length of stay in hospitals and reduction in long travel distances (Audit Scotland 2011).). A report from Canada's Health Informatics Association (2015, 13) show similar benefits; elimination of distance barriers, improved access to services, along with a reduction in emergency rooms visits. While in Australia, telemedicine has been used as an attempt to reach out to the population located in rural areas (Bradford, Caggery, and Smith 2016).

5.0 Methodology

This section presents the methodology used in this research, how the data is collected and the data analysis. The first section presents the overall approach, followed by the data collection in section two. The last section in this chapter involves the data analysis used in the research.

5.1 Overall Approach: Case Study

The case study approach was selected as the overall approach for this research, as it allows to hold a real-world perspective and analyze the «case» in detail. A case study approach is suitable when the researchers have little or no control over the events and when the research is based on contemporary events (Yin 2018, 9). The events in this research was registered by the employees at LEMC, meaning the researchers had no control over the events. The research could also be referred to as contemporary as the events are documented in the recent past (12). Thus, the research questions used in this research meets the criterions for when a case study approach is appropriate.

The research is empirical, descriptive, quantitative and inductive. The purpose of the research was to gain new knowledge by analyzing primary data, which is the definition of empirical research. Based on the data set received from LEMC the researchers aimed to investigate patterns in number of inquiries for selected OOH- primary care services. Thus, the research is descriptive, meaning that the desire is to describe a particular situation and draw relatively safe conclusions based on comparable situations. A descriptive research design is often chosen for quantitative research which involves analyzing data based on number and sizes, such as for this research (Gripsrud, Olsson, and Silkoset 2016, 50-53). A quantitative research was beneficial since the researchers searched to explore the phenomenon carefully and with great precision and because the data set was standardized which made it easier to process (Jacobsen 2015, 134-136).

The research is also inductive, which means that the researchers did not start with any particular theory but rather with more open research questions. The researchers were open for all explanations and nothing were excluded before the investigation started (Larsen 2017, 24). In addition, there were no expectations of the results in advance. Meaning that it was necessary to collect all relevant information to analyze the data, where nothing should limit the collection of information (Jacobsen 2015, 29).

5.2 Data Collection

The data analyzed in this research originated from two different sources; primary data received from LEMCs internal systems and secondary data collected from archival records. Necessary information about the production process and organizational structure were also gathered through personal talks and e-mail correspondence with managers at LEMC and the OOH- primary care services.

5.2.1 Primary Data

The primary data was received from LEMC and based on historic records which included all inquiries to the four OOH- primary care services, registered through a specific period of time. LEMC provided 13 data sets through excel files aggregated on different levels, with the exception of daily data for number of inquiries per day at the OOH- primary care services. The aggregated data was retrieved directly from Acute medical information system (AMIS), which is the information system LEMC use to coordinate information related to emergency medical assistance. In total for all data sets, there were removed 206 inquiries (< 1% of total) due to coding errors.

The analysis of annual inquiries was based on data sets that contained a total number of inquiries per year (2016-2018). There were provided one data set for each of the nine municipalities, where the inquiries were distributed according to the triage category. The analysis of the monthly pattern was based on one data set, which showed number of inquiries in total for all nine municipalities. The total number of inquiries were distributed per month over three years (2016-2018). The analysis of the age distribution was only conducted for Molde municipality due to lack of data from the remaining municipalities. The data set contained number of inquiries per age group in a ten-year interval, for 2016-2018.

To analyze the day of the week patterns there were received one data set which contained total number of inquiries per day from November 2017 until November 2018, where the data set represented all nine municipalities. It was decided to subgroup the data set by dividing it into two separate parts in the analysis. The first subgroup consisted of data values connected to weekdays (n=248), from Monday to Friday. The remaining 117 days was represented in the second subgroup, which covered the weekends (n=104) and the official holidays (n=13).

To analyze hourly pattern, there were provided one data set at more disaggregated level. This contained a count of number of planned consultations during a two-week period, distributed among the various shifts at the OOH- primary care services. The count was based on appointments registered in System X, which is the system used to plan the time for consultations through a collaboration between the LEMC employees and the GPs at the OOH- primary care service. The received data sets contained a counted number of inquiries distributed between the time periods: 16.00-22.00, 22.00-08.00 (weekdays), 09.00-17.00, 17.00-23.00, 23.00-09.00 (weekends). Number of phone consultations was also included, which was distributed throughout the opening hours.

5.2.2 Secondary Data

The secondary data used in the research was collected from various sources. Archival records, such as «public use files», was relevant to obtain necessary information and statistics within the research context. Statistics Norway was useful for providing such public records. In addition, the public website *helsenorge* was used, which contains health care information within various topics. Here, information about the number of registered RGPs in the municipalities was extracted. The management at both LEMC and the OOH-primary care service in Molde provided information about different aspects of the OOH-primary care service, where parts of the information was used in the discussion.

5.2.3 Weakness of the Data

The OOH- primary care service experienced problems when extracting data from their systems, therefore the best alternative for this thesis was the data registered at LEMC. LEMC operates various systems, where the communication between the system appeared as imperfect. As a result, the various data sets provided was not entirely consistent with each other. There were provided data sets for three years, one year, two weeks, and some for only one municipality. Due to complex systems, there was also difficult to retrieve data at a disaggregated level, which resulted in data sets provided at extremely aggregated levels. This limited our opportunity to provide accurate results in regard to the actual variation in demand, as well as investigating other factors, such as diagnosis, gender, patient's location and contact method. As a result, we could not investigate from whom, how and why the variations emerged in the specific time periods.

5.3 Data Analysis

5.3.1 Descriptive Statistics

Descriptive statistics involves using various formulas to review, organize and present information identified in the data set and were used to simplify the information and make the data comparable. Graphs enabled the authors to visualize patterns, observations, changes between time periods and relations between variables. Histograms and boxplots were used to illustrate distribution of variables in the data set and made it possible to identify outliers. In the boxplot outliers appear as circles and represent values greater than 1,5 box length from the edge of the box, while extreme outliers are values greater than three box length from the edge of the box and appear as stars with a number attached (Pallant 2007, 76).

5.3.1.1 Central Tendency

Central tendency is different measurement methods that describe a typical and representative value from a data set. This is a numerical value located in a central location in the data set, and describe the middle information. Central tendency can be measured by using mean and median (Løvås 2013, 48-50).

The **mean** is the most common measurement for central tendency and represent the average or the «typical» object in the data set analyzed. The following formula is used to calculate the mean:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Although the mean is frequently used as a measurement to describe the data set, it can also be misleading. This is because some data sets might have outliers, that is either extremely high or low compared to the rest of the values. If this is the case, the mean would not be representable and thus another measurement of central tendency is preferable. The median can then be a more appropriate measurement.

The **median** describes the middle value in the data set analyzed, where the extreme values will not affect the central tendency. Measuring the median is done by ordering the data set from the lowest values to the highest values, in ascending order. If the data set is odd, the median represents the middlemost value. While when the data set is even the median represents the average of the two middlemost values.

5.3.1.2 Statistical Dispersion

Statistical dispersion gives an indication about the spread in the data set, and could be measured by the variance, standard deviation, minimum and maximum values and the range (Løvås 2013, 54-56).

The **variance** describes to which degree the data set tends to vary. The following formula is used to calculate the variance:

$$S^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

The **standard deviation** indicates how much the data tend to deviate from the mean value. The standard deviation is the most common measurement used in order to map the spread in a data set and is found by taking the square root of the variance. The standard deviation is calculated by the following formula:

$$S = \sqrt{S^2}$$

The **range** describe the difference between the minimum value and the maximum value in the data set. Range can be measured by the following formula:

$$\text{Range} = \text{Maximum value} - \text{Minimum Value}$$

5.3.1.3 Percentage and Inquiry Rate

Percent is used as a calculation method to compare data. In this research, percent is used to compare the distribution between the degrees of urgency, to highlight the annual percentage change between different values and to show the share value of a total value. The following formulas is used to calculate the percent:

$$\text{Percentage share} = \frac{\text{Share of the total number}}{\text{The total number}} * 100$$

$$\text{Change in percent} = \frac{\text{New value} - \text{Original value}}{\text{Original value}} * 100$$

The **inquiry rate** was used as a measure to compare the number of inquiries between the different municipalities. Since the population size varied between the municipalities in the research, the inquiry rate was a better measurement to compare the distribution of inquiries. This is because it includes the number of citizens in the calculation. The following formula was used:

$$\text{Inquiry rate} = \frac{\text{Number of inquiries}}{\text{Population size}} * 1000$$

5.3.1.4 Distribution Measures

When applying statistical tests, it was relevant to describe the distribution of the data set. Common statistical measures of distribution are skewness and kurtosis (Løvås 2013, 58).

Skewness was used to describe the asymmetry of the distribution in the data set. When the distribution is perfectly normal the skewness value would be zero, and the distribution would be formed as a bell in a histogram. A positive skewness value indicate that the mass of the distribution is centered to the left of the mean, the distribution is skewed to the left. Conversely, a negative skewness value indicate that the distribution is skewed to the right of the mean and the mass of the distribution is centered to the right. The skewness could be found by the formula:

$$\text{Skewness} = \frac{1}{n} \sum_{i=1}^n \left(\frac{x_i - \bar{x}}{s} \right)^3$$

The **kurtosis** gave an indication about how the distribution was spread between the minimum and maximum value and tell something about the «peakedness» of the distribution. A perfectly normal distribution would give a kurtosis value equal to zero. Positive kurtosis values show a rather peaked distribution in a histogram, where the data point is clustered in the center, with long thin tails. The higher the positive kurtosis value is the more peaked the distribution would look in a histogram, whereas a negative value would show a flatter line in a histogram. The kurtosis could be measures with the following formula:

$$Kurtosis = \frac{1}{n} \sum_{i=1}^n \left(\frac{x_i - \bar{x}}{s} \right)^4 - 3$$

The **Normal distribution** is a common continuous distribution used in probability theory and statistics, often referred to as the bell curve because of its bell shape. With normal distribution one can calculate the probability that values occur within certain intervals (Levine et al. 2011, 222). The empirical rule, says something about the probability that values in a normal distribution fall within one, two or three \pm standard deviation of the mean. More precisely, the empirical rule states that 68.27% of the values fall within ± 1 standard deviation of the mean. Further that, 95.44% and 99.73% of the values fall within respectively, ± 2 and ± 3 standard deviations of the mean (228-229). The normal distribution is useful because of the central limit theorem (CLT). Where the CLT express that as the size of the sample become large enough, the sampling distribution of the mean is approximately normally distributed (266).

The **Shapiro-Wilk Normality test** was used in order to test whether the data is normal distributed. The Shapiro-Wilk test assesses the normality of the distribution. A non-significant result, meaning a sigma value of more than 0.05, indicate that the data set is normal distributed. Since several statistical techniques are sensitive to outliers, it has been decided to remove several outliers in the normality test in this thesis. This is to achieve the most accurate sigma value and distribution (Pallant 2007, 62).

The **Poisson distribution** is a distribution often associated in previous practice with arrivals of emergency patients, which are commonly considered to be randomly and independently distributed in time (Alexopoulos et al. 2008). Poisson distribution can be used in probability theory and statistics to calculate the number of times a certain event occurs within a given area of opportunity, where the area of opportunity is defined by time, length, etc. The Poisson parameter is usually denoted with λ , which is the mean of the distribution. This because when λ increases, the distribution becomes more symmetric and bell-shaped, hence normally distributed, also known as the CLT (Rice 2007, 181).

5.3.2 Statistical Process Control

Statistical process control (SPC) was used to distinguish between common and special causes of variation. It visualizes the data from a process over time by the use of three sigma lines. One central line, usually the mean, and upper and lower control limits set at $\pm 3 SD$ from the mean. When the data points are located within the control limits, the process consists of common cause variations, i.e. it is in statistical control (stable). If data points fall outside the control limits, the process consists of special cause variations (Mohammed et al. 2013).

There exist several types of control charts, where the choice of chart often is determined by the type of data set. When using control chart two types of errors can occur, type I and type II. Type I error occurs when one concludes that the process is out of control, due to values outside the control limits, when in reality it is caused by pure randomness. Type II errors occur when one concludes that the process is under control and only randomness is present, but the process is actually out of statistical control (Krajewski, Malhotra, and Ritzman 2015, 127).

Based on SPC flow-chart, **C-chart** was found appropriate to use (Wheeler 2012). The underlying distribution for C-charts is the Poisson distribution. Two assumptions are present during C-chart (a) «*events occur one at a time with no multiple events occurring simultaneously or in the same location* and (b) *event are independent in that the occurrence of an event in one time period or region does not affect the probability of the occurrence of any other event*» (Mohammed, Worthington, and Woodall 2008). Since the data set used for C-chart in this research is approximately normal distributed, it is reasonable to think that there is an underlying Poisson distribution. However, when the data is experiencing more variation than one would expect with Poisson distribution, it will result in over dispersion. Something that can cause

points to seem out of control even though they aren't. Under dispersion exists in those cases where data has less variation than assumed with Poisson distribution. When there are under dispersion, the control limits are set too wide, this would increase the likelihood to assume a common cause variation, when in reality there exists special cause variation (Minitab n.d).

When using C-chart the central line is determined by calculating the overall mean for the data values with the following formula:

$$\bar{c} = \frac{\sum_{j=1}^n c_j}{n}$$

\bar{c} Indicates where in the c-chart the central line is to be located.

The upper and lower control limits (UCL and LCL) were calculated from the Poisson-based standard deviation and constructed as follows:

$$UCL = \bar{c} + 3\sqrt{\bar{c}}$$

$$LCL = \bar{c} - 3\sqrt{\bar{c}}$$

When $\bar{c} > 10$ the Poisson distribution is roughly symmetrical, meaning that the three-sigma concept works well (Mohammed, Worthington, and Woodall 2008).

When conducting C-charts in the analysis there were used a rational subgrouping, because some processes may be affected by various underlying cause-effect sub-processes. For example, one can assume that the number of inquiries at the OOH- primary care service is not equal on weekdays as on weekends. Therefore, the data was divided into two subgroups. The C- chart was only conducted for sub-group one and were used to illustrate variations in number of inquiries.

5.4 Ethical Assessments

This study is a health logistic research and not a clinical research. As no identifiable personal data was registered or traceable, the project was not subject to notification to the Norwegian Center for Research Data (NSD), according to national regulations.

6.0 Empirical Results

This section will present the results from the analysis. The first sub-chapter addresses annual inquiries and inquiry rates per OOH- primary care service and per municipality, as well as inquiry rates according to the triage category and the age distribution. The second sub-chapter present results from the analysis of monthly inquiries, followed by the analysis of the day of the week pattern in sub-chapter three. Finally, sub-chapter four addresses the pattern during the day.

6.1 Annual Inquiries

I 2018, there was registered 23 342 inquiries in total for the four OOH- primary care services. All the services had a reduction in number of inquiries during the three years period, as shown in table 5. A detailed overview of the population size, number of inquiries and inquiry rate for each of the nine municipalities is found in appendix 4.

Table 5: Population size, inquiries and inquiry rate – four OOH- primary care services.

	Population		Inquiries		Inquiry rate	
	2018	%-change 2016-2018	2018	%-change 2016-2018	2018	%-change 2016-2018
MIKL	43 061	0,4	15 798	-4,2	367	-4,6
AIKL	6 869	-0,1	2 327	-7,1	339	-7,0
Sunndal	7 119	-0,6	2 396	-9,1	337	-8,6
Rauma	7 507	0,2	2 821	-2,1	376	-2,3
Total	64 556	0,2	23 342	-4,8	362	-5,0

The highest number of inquiries were registered at MIKL, while AIKL had the lowest number of inquiries. The inquiry rate also differed between the four OOH- primary care services, ranging from 337 per 1000 citizen in Sunndal to 376 per 1000 citizen in Rauma.

The nine municipalities connected to the various OOH- primary care services had different inquiry rates. As illustrated in figure 4, Sandøy and Eide separated from the rest with the lowest inquiry rate, while Molde and Rauma had the highest inquiry rate.

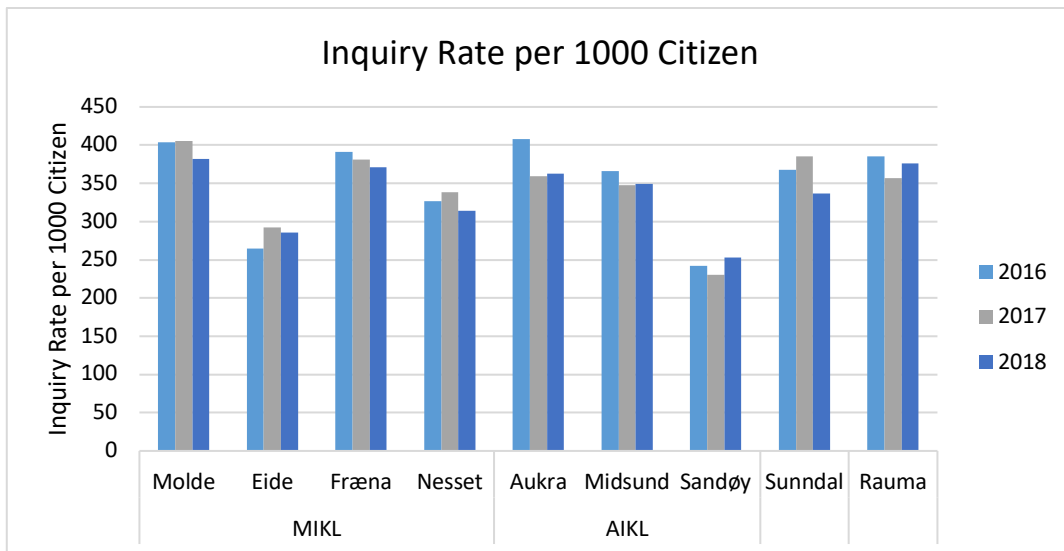


Figure 4: Distribution of inquiries per 1000 citizen.

Calculation: (number of inquiries/ population size) * 1000.

6.1.1 Inquiries per Triage Distribution

In total for all nine municipalities, the inquiries categorized as green accounted for the largest number of inquiries in all three years. Yellow and red, which is considered as more urgent, had fewer inquiries. During the three years the red and yellow inquiries increased, while the green inquiries decreased. A detailed overview of the distribution of triage category for each of the nine municipalities is found in appendix 5.

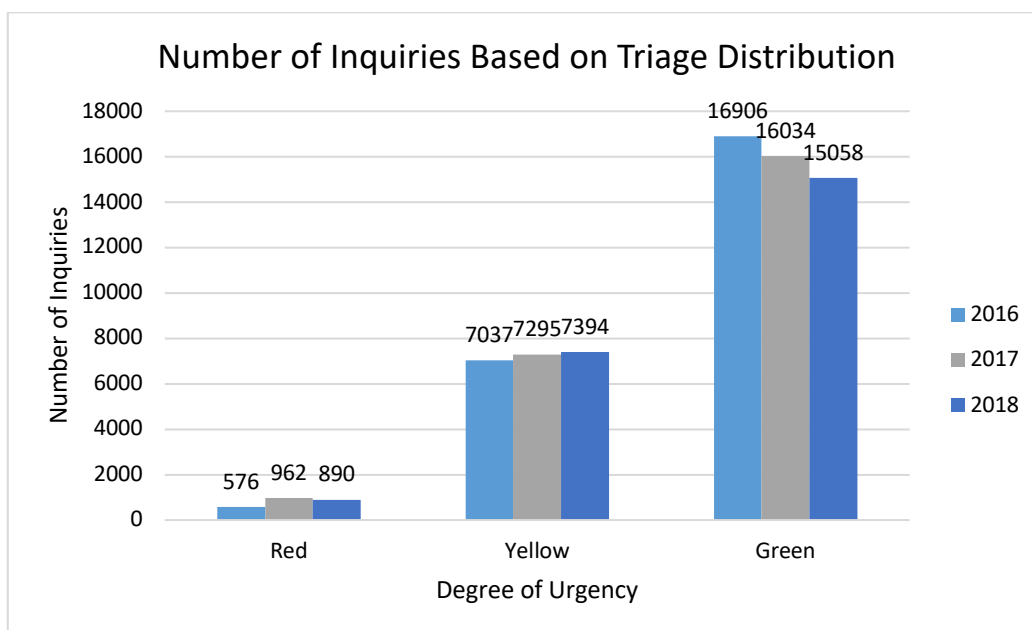


Figure 5: Distribution of inquiries according to the triage category in total.

Table 6 show the distribution of inquiries based on the triage category for the four OOH-primary care services. Based on the inquiry rate, we found that Sunndal had the highest number of red inquiries in 2018. The yellow inquiry rate was highest in Rauma, while the highest green inquiry rate was registered in Molde and Rauma.

Table 6: Population size, inquiries and inquiry rate – based on triage category.

	Population	Inquiries			Inquiry rate		
	2018	Red	Yellow	Green	Red	Yellow	Green
MIKL	43 061	569	4 840	10 389	13	112	241
AIKL	6 869	102	799	1 426	15	116	208
Sunndal	7 119	119	845	1 432	17	119	201
Rauma	7 507	100	910	1 811	13	121	241
Total	64 556	890	7 394	15 058	14	115	233

6.1.2 Age Distribution

Figure 6 illustrate the distribution of inquiries according to different age groups connected to people located in Molde municipality.

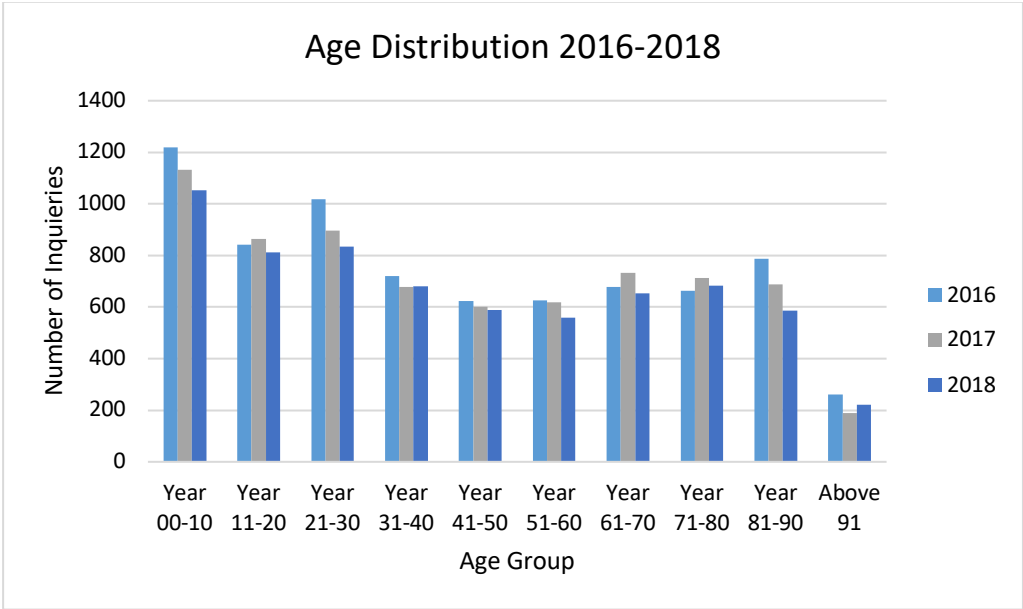


Figure 6: Number of inquiries per age group

The highest amount of inquiries in all three years were connected to patients in the younger age groups, while patients over 91 years represented the lowest amount of inquiries.

Figure 7 illustrate the inquiry rates, which consider the actual size of the population in the different age groups.

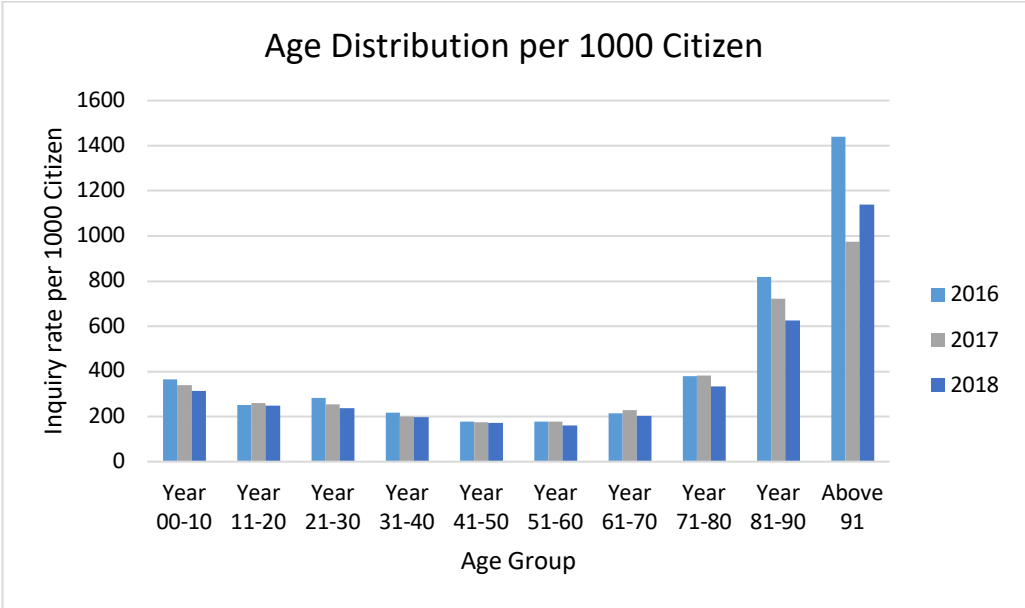


Figure 7: Inquiry rate per age group.

Calculation: (Number of inquiries per age group/population size per age group) * 1000.

The inquiry rates for the oldest age groups were highest. The 81 years and over age group contacted the OOH- primary care service more compared to the younger age groups.

6.2 Monthly Patterns

Figure 8 illustrate the distribution of inquiries, in all nine municipalities, between the different months in each of the three years, 2016-2018.

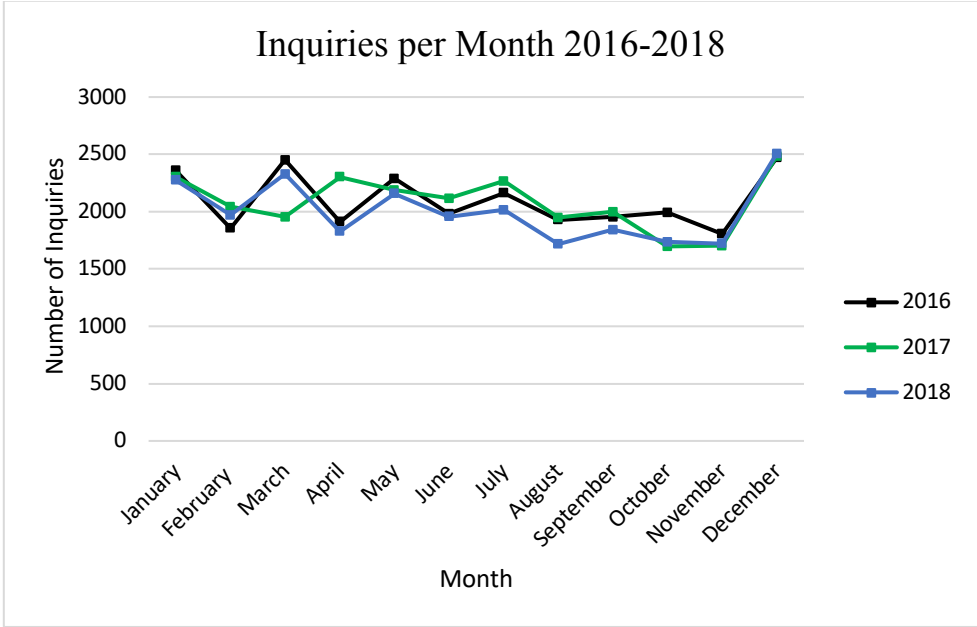


Figure 8: Number of inquiries per month (2016-2018)

Mean 2016: 2097 inquiries. Mean 2017: 2084 inquiries. Mean 2018: 2004 inquiries.

The monthly pattern was similar in all three years, where the peaks and the valleys occurred at the same time, indicating seasonal variations in the data set. December had the highest number of inquiries in all three years. In connection with the Easter month, 2016 and 2018 had a peak in March, while in 2017 there was a similar peak in April. The month with the lowest number of inquiries varied between the years. In 2018, August was the month with fewest inquiries, compared to October in 2017 and November in 2016. Equal for all years was that the month with the lowest number of inquiries was in the latter half of the year. The number of inquiries per month tended to decrease from July to November before it peaked in December.

6.3 Day of the Week Pattern

From the box plot, illustrated in figure 9, we found variations in number of inquiries between the days in the week. Weekdays were approximately equal in number of inquiries. The weekend had a higher number of inquiries, where the highest was recognized on Saturday.

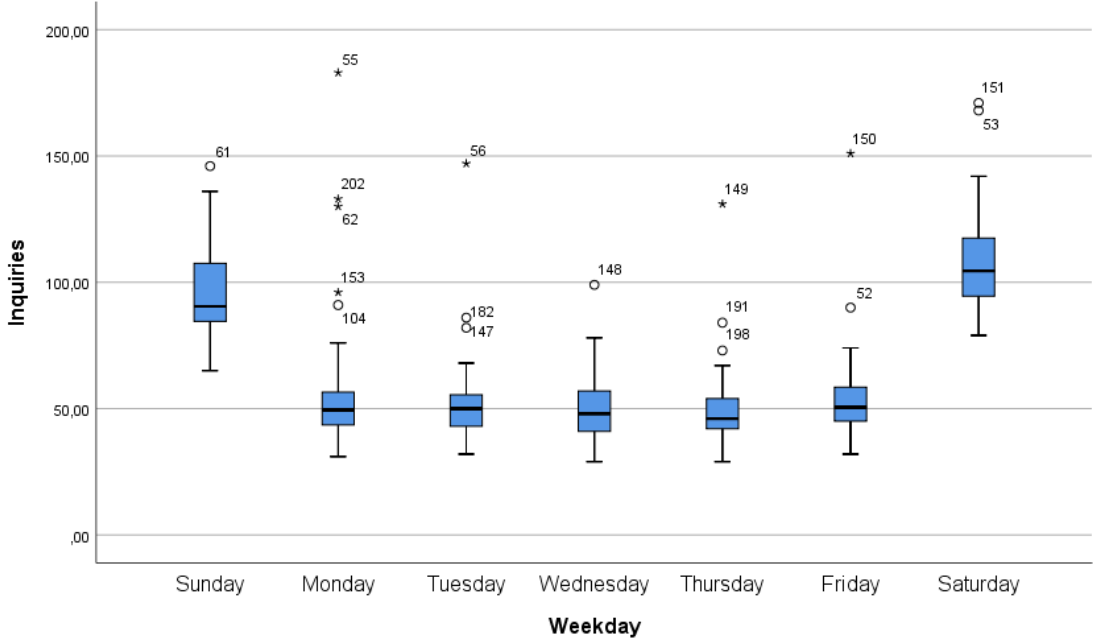


Figure 9: Box-plot distribution of inquiries per day

6.3.1 Subgroup 1 - Weekdays

The histogram, in figure 10, illustrate the daily distribution of the data values for weekdays. According to a visual assessment of the histogram we found that the data values was relatively normally distributed. This was further confirmed from the Shapiro – Wilk test, by excluding two outliers from the data set (p=0,1).

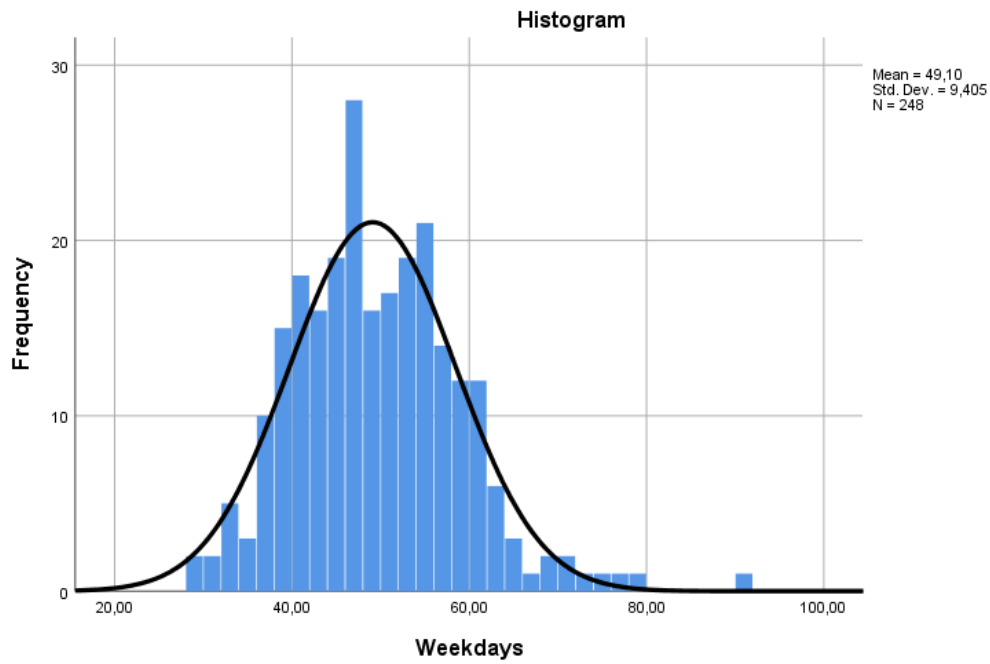


Figure 10: Distribution of inquiries - weekdays

The C-chart, in figure 11, presents the daily variations between the weekdays (n=248), where most of the data points are located within the control limits.

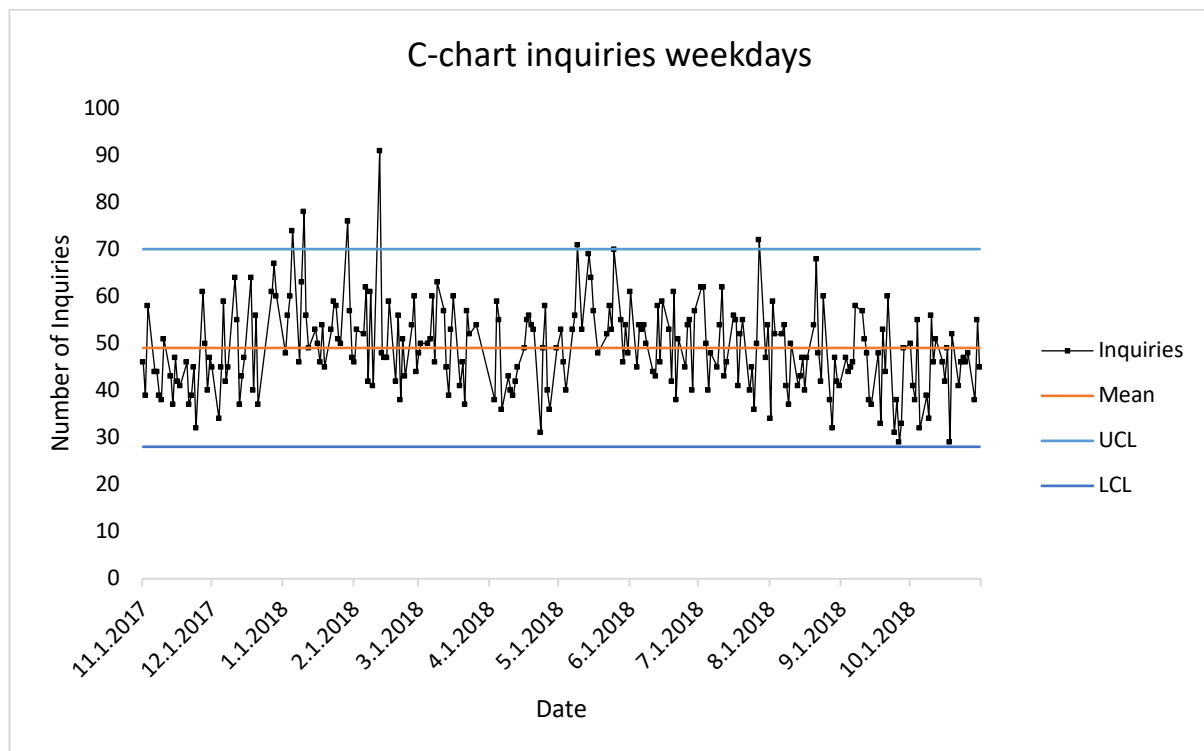


Figure 11: Variations in number of inquiries – weekdays

The pattern indicates that with few exceptions, the number of inquiries during weekdays moved randomly around the mean. None of the data points was below the lower control limit, but a few (2.8%) was above the upper control limits. This indicated that there existed special causes in the subgroup data set. Due to over dispersion points can seem out of control, even though they are not. There were not recognized any special events that could cause the increase in inquiries the days located above the upper control limit.

6.3.2 Subgroup 2 – Weekends and Official Holidays

There was a higher number of inquiries during the weekends and official holidays (n=117) compared to the weekdays. Figure 12 show variations in number of inquiries. We found clear peaks and valleys in number of inquiries between the days in the subgroup.

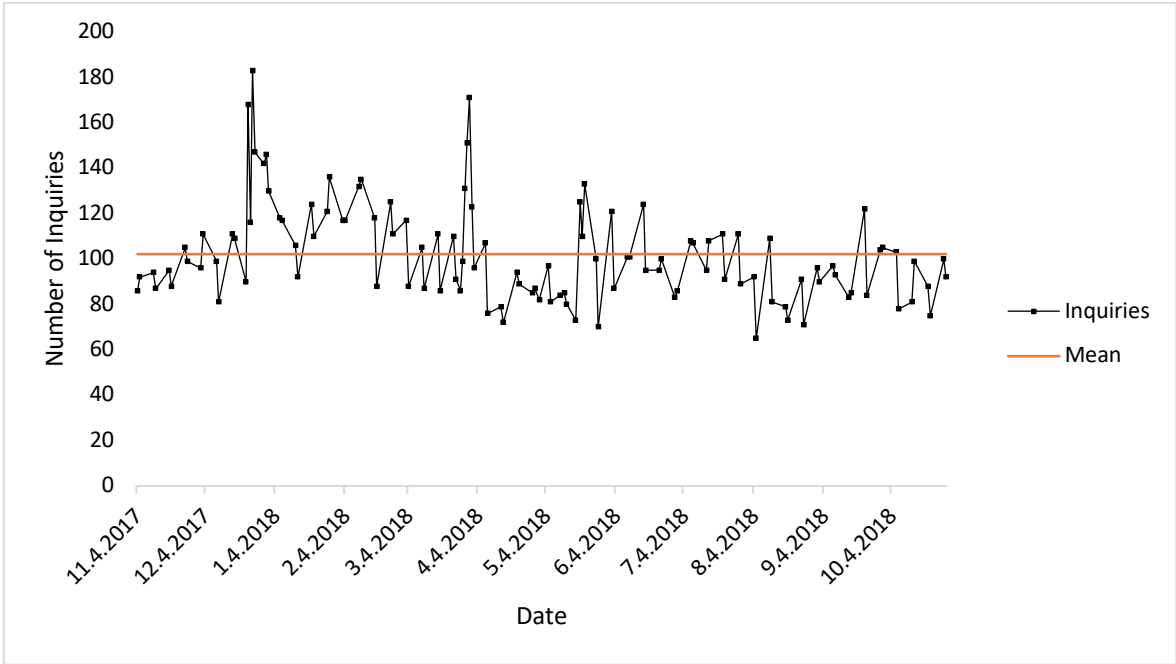


Figure 12: Variation in number of inquiries – weekends and official holidays

Most of the peaks were connected to official holidays. Especially the days connected to Christmas, New Year and Easter had a high number of inquiries. Additionally, we found a possible correlation between football games played by Molde FK and low number of inquiries at the OOH- primary care service. Several of the data points that was below the mean and was among the lowest data points in the chart was connected to dates when Molde FK played football games for the first division. However, since the data set only included one year this

was not enough evidence to conclude that a correlation existed. Thus, there was not identified any specific causes for the valleys apparent in the chart.

6.4 Hourly Patterns

6.4.1 MIKL

In total, there were registered 562 inquiries during the two-week period at MIKL, distributed between weekdays and weekends with 53 percent and 47 percent, respectively. The calculated average daily inquiry rate in weekdays was 0.7, while weekends had in average a higher inquiry rate, with 1.5 inquiries per 1000 citizen. Figure 13 illustrate the distribution of inquiry rates between the various time periods as well as phone consultations at MIKL, for both weekdays and weekends.

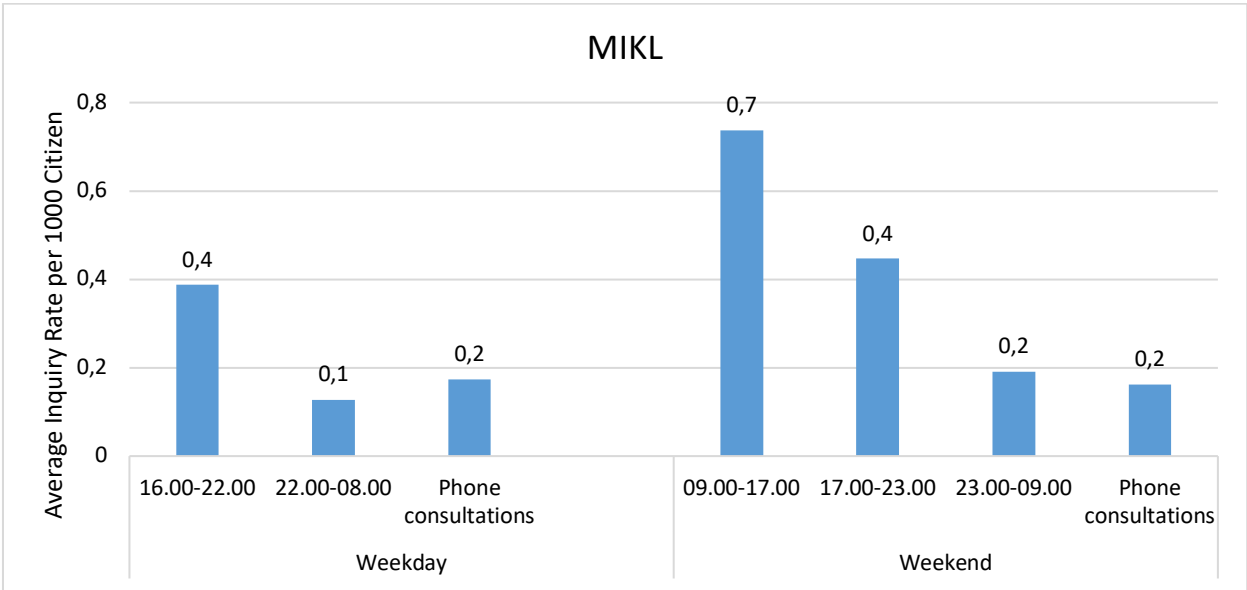


Figure 13: Average inquiry rate per 1000 citizen in weekdays and weekends – MIKL.

There were variations between the time periods in both weekdays and weekends. During weekdays, the evening, 16.00-22.00, had a considerable higher average inquiry rate compared to the night, 22.00 – 08.00. During weekend, the time period 09.00-17.00, had the highest average inquiry rate. A lower average inquiry rate was registered in the evening during the weekends. Similarly, to weekdays the night had a lower average inquiry rate compared to the other time periods. The number of phone consultations was equal for both weekdays and weekends.

6.4.2 Satellite Municipalities

In total, there were registered 209 inquiries during the two-week period for the satellite municipalities (Midsund, Aukra, Sunndal and Rauma), accounting for 45 percent in weekdays and 54 percent in weekends. The calculated average daily inquiry rate during the weekend was higher compared to the weekdays, with respectively 1.4 and 0.5. Figure 14 illustrate the average distribution of inquiry rates between the different time periods, as well as phone consultations, for both weekdays and weekends.

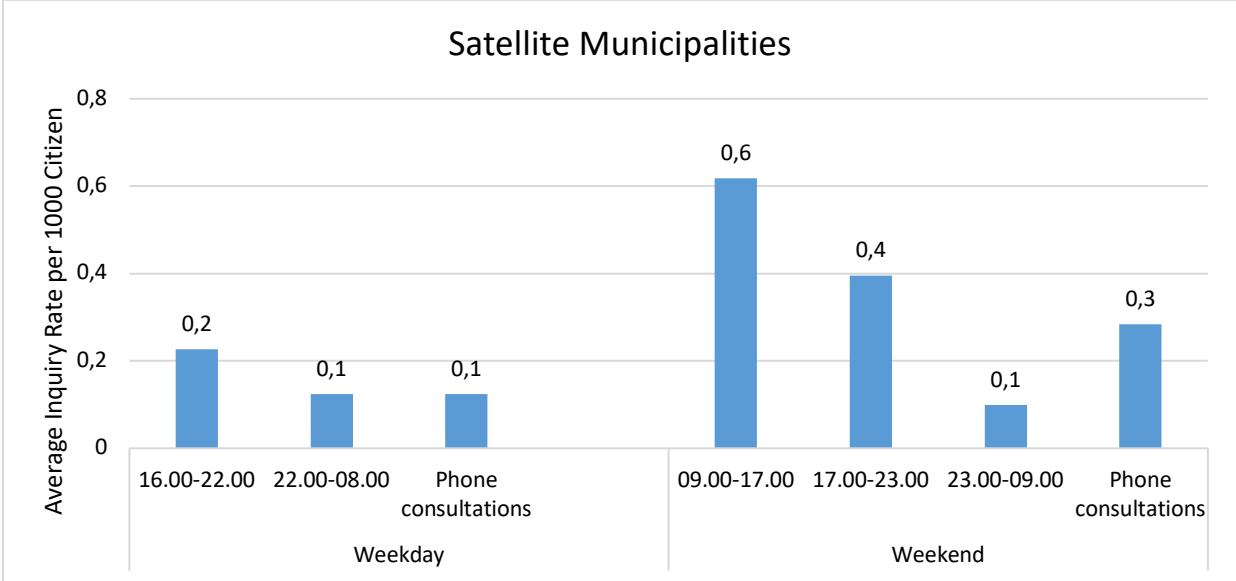


Figure 14: Average inquiry rate per 1000 citizen in weekdays and weekends – Satellite municipalities

There were variations between the different time periods, in both weekdays and weekends. In weekdays, the evening, 16.00-22.00, had the highest average inquiry rate. While during the night, 22.00-08.00, the average inquiry rate was lower. During the weekend, the average inquiry rate was highest at day time, 09.00-17.00, while a lower average inquiry rate was registered in the evening. The average inquiry rate during the night in weekends were equal to the night during weekdays. While the average inquiry rate for the phone consultations was higher in the weekends compared to the weekdays.

7.0 Discussion

This study documents variation in demand at the OOH- primary care services. Even though that there are documented an increase in OOH- primary care services expenses, as well as an expected increase in the need for health care services, our study shows a slight reduction in the number of annual inquiries through the three years. This may be a result of more proper use of the service or a more correct assessment of the received inquiries. Another explanation could be differences in the threshold for contacting the service among various areas in Norway. However, there were identified variations in demand, which is essential to acknowledge when redesigning production processes and planning capacity. The strongest impact on the number of inquiries was related to months connected to official holidays, where the peak was linked to Christmas, New Year, Easter, and Pentecost. There was also a higher number of inquiries in the winter months, compared to summer months. This indicates that there existed seasonal variation in demand for OOH- primary care services.

The number of daily inquiries was also dependent on the day of the week. The observed pattern during the week, with twice as many inquiries in the weekend compared to the weekdays, differed from other studies conducted for emergency medical services. In contrast to our peak days, emergency departments peaked on Mondays and decreased towards the weekend (Batal et al. 2001, Marcilio et al. 2013). The ambulance service, on the other hand, had a fairly similar demand pattern as our results. This indicates that demand patterns vary among different health care services and that the organization of the services (e.g., opening hours) may strongly impact the demand patterns. This is consistent with reports which show differences in demand patterns between OOH- primary care service and A&E (Information Services Division 2017).

Our findings further show that the number of inquiries per day was dependent on the day's connection to official holidays, which could explain the monthly peaks related to these days. The weekdays connected to official holidays had twice as many inquiries than those not connected. Since RGP's offices are closed both on weekends and official holidays, this indicates that the coverage at the RGP's office could influence the demand for OOH- primary care service.

Although the weekend and official holidays were considered as similar regarding the number of inquiries, there were recognized variations among these days. We found peaks mainly related to official holidays. These peaks may be explained by a higher influx of visitors in the municipalities or more activity among citizens (i.e., higher risk of injuries). When there exist variations in the demand, it may be challenging to plan the capacity to avoid shortages or unnecessary use of resources. However, by acknowledging that official holidays tend to have a higher number of inquiries than weekdays, as well as weekends, one can plan capacity accordingly (Bozarth and Handfield 2016). The OOH- primary care service can then possibly lighten the effects of demand swings and sustain efficient operations (Langabeer 2008, Krajewski, Malhotra, and Ritzman 2015).

The inquiries registered in weekdays, without official holidays, were approximately normally distributed. This differed from other reports, where the number of inquiries per day varied between the weekdays (Eikeland et al. 2018, Sandvik, Hunskaar, and Blinkenberg 2018). We found that the c-charts was a good tool to illustrate the variations in the demand. The inquiries moved randomly around the mean value ($\bar{x} = 49$), with some deviations ($> \bar{x} + 3SD$). It was not recognized any particular causes for the deviations, which signify that the demand for OOH- primary care service is volatile. However, since most of these deviations were during the winter months, it may be caused by natural causes such as temperature, wind, and weather. Although there were some deviations, the findings show a rather stable pattern for weekdays, which makes a case for appropriate capacity planning. Previous studies show various methods beneficial for capacity planning in health care when the mean demand is defined (Litvak et al. 2005, Pandit and Tavaré 2011). Due to random variations in the number of inquiries there must be conducted a trade-off between the risk of capacity shortages and excess capacity. Planning for excess capacity may result in more strain on the GPs rather than lighten it, where an outcome could probably be less satisfied GPs. It could also lead to unnecessary use of valuable resources and less efficient operations. It is therefore conceivable that optimal capacity planning could be to plan close to the mean demand and then add additional resources through GPs on call when needed, as stated in prior studies (Litvak et al. 2005).

We also found that the variations in the number of inquiries were dependent on the hour of the day, which also differed between weekdays and weekends. This indicates that there were specific time periods that patients tended to visit the OOH- primary care service more than others. The average inquiry rate for weekends was twice as high as for weekdays, for both

MIKL and the satellite municipalities. This was consistent with our prior findings, from the analysis of the days of the week. In weekdays the number of inquiries was highest during the evening. One possible explanation could be the behavior of the citizens, where they choose to seek medical assistance after work rather than visit the RGPs during opening hours. This could be because they find the service as an easy alternative and more convenient. On weekends, the highest number of inquiries were registered during day time. Which may be a result of more activity during day time, and lack of other health care alternatives. Our results also documented that the night had fewer inquiries, both during weekdays and weekends. Which could be explained by citizens thinking of the night as a less convenient time to seek medical assistance. There were few phone consultations for both MIKL and the satellite municipalities, which indicate that a small share of the inquiries also is conducted per telephone.

The number of inquiries at the OOH- primary care services also showed to differ between the various OOH- districts, as well as all the nine municipalities. This could be caused by demographic and geographic differences, such as population size, age composition, distances, and the availability of RGPs. It was found that Rauma had the highest inquiry rate among the four OOH- primary care services, and also the lowest change in inquiry rate during the three years. Since the inquiry rate did not account for either visitors in the municipality or regulars, a possible explanation could be a greater influx of visitors or more frequent attenders at this service compared to the others.

Whether the patients had access to their RGPs during day time may also have impacted the inquiry rate. Seven out of eight RGPs operating in Rauma had a short patient list, which could, according to existing literature, cause less availability and longer waiting time for patients (Godager and Iversen 2010). As a consequence, the patients may need to consult the OOH- primary care service to a greater extent for incidents that could initially have been handled by their RGPs. This could create ripple effects, where patients contact the OOH- primary care service as an alternative to their RGPs, which may result in a higher number of frequent attenders and also green inquiries. This is consistent with previous literature that suggests a connection between frequent attenders, non-urgent contacts, and low access to the RGPs (Keizer et al. 2015, Sandvik and Hunskaar 2018). These assumptions were further reinforced by the fact that the highest number of green inquiries was observed in Rauma, together with MIKL. Other studies have also suggested that OOH- primary care services that operate alone could have a higher inquiry rate than inter-municipalities. This because they fail to prioritize

patients and also based on economic incentives (Raknes, Morken, and Hunskår 2014b). However, this could not be reflected in our study, since LEMC receive the inquiries and book the consultations for all four OOH- primary care services, which means that the GPs have no impact on whether the patients are booked for a consultation or not.

When comparing all the nine municipalities regarding their number of inquiries at the OOH- primary care services, we find that Sandøy had the lowest inquiry rate in all three years. Conversely to Rauma, the low inquiry rate may be explained by the fact that Sandøy only has one RGP, with a long patient list (Godager and Iversen 2010). However, with only one RGP, it is reasonable to think that a long patient list is necessary to cover all citizens. Therefore, the low inquiry rate may not be a repercussion of a long patient list. With one RGP and a long patient list, educating the citizen regarding appropriate use of the primary health service may be vital to reducing the strain on the RGP. This, on the other hand, may explain the lower inquiry rate. Among all the municipalities Sandøy also had the fewest number of green inquiries, which also could signify more proper use of the OOH- primary care service. Further, we found that both Sandøy and Eide, with the lowest inquiry rates, had a long distance to the nearest casualty clinic, which could, according to previous literature (Raknes, Hansen, and Hunskaar 2013, Raknes, Morken, and Hunskår 2014b), explain the low inquiry rate. The longer the distance, the higher the threshold for contacting the service. These findings may correspond with the fact that Molde and Aukra, which both have a short distance to the casualty clinics, had higher inquiry rates than the cooperating municipalities in their OOH- districts.

We found that the youngest age groups represented the highest number of inquiries among citizens in Molde. This may be an effect of concerned parents who contact the service just in case, due to uncertainty in their children's health condition. The fact that children up to sixteen have free health care services could also lower the threshold for contacting the OOH- primary care service among these age groups. This is consistent with previous studies (Buja et al. 2015). Prior literature also states that green inquiries are more common among the youngest age groups (Keizer et al. 2015). Thus, the high number of green inquiries may reflect the high number of inquiries from the youngest age group. However, we found that both Molde and Rauma had a high number of green inquiries per 1000 citizen, where both have a casualty clinic within a short distance to their citizens. Therefore, unnecessary use of OOH- primary care service may also be caused by easily available casualty clinics and a lower threshold for contacting the service. Further, the results show that the number of red inquiries increased, while the green

inquiries decreased during the three years. This may, on the other hand, signify more correct use of the service during the years, where people have become more aware of the fact that the OOH- primary care service only should be used when inquiries cannot wait until RGP's office hours. Other explanations may also be stricter rules for assessment of the triage category at the LEMC, where patients are more often urged to consult their RGP's during office hours.

Based on results from previous literature (Sandvik, Hunskår, and Diaz 2012a, Sandvik and Hunskaar 2018), there was also an expectation of finding a connection between peripheral municipalities and higher use of the OOH- primary care service. All the municipalities could to some extent be considered as peripheral (ref. table 3), and the inquiry rate for six out of nine municipalities may be considered as high compared to other reports (Eikeland et al. 2018). This could indicate that the correlation mentioned in other studies also was apparent in this study. However, the high inquiry rate could also be a result of frequent attenders, which is suggested in the existing literature to be more regular in small municipalities (Sandvik and Hunskaar 2018). In Molde, the oldest age groups tended to use the service more frequently compared to the younger age groups, accounting for the age distribution in the population. This correspond with existing literature, which showed that the youngest and oldest age groups make up for most of the OOH- primary care service consultations. Frequent attenders also were more regular among these age groups, increasing with age (Buja et al. 2015, Sandvik and Hunskaar 2018). With an aging population, this could result in even more inquiries at the OOH- primary care service in the future.

Further, it may be expected that the redesign of the production process, with satellites, could impact the demand. The planned satellites will only be operated during the night, 22.00-08.00, and consequently, impact the patients contacting the service in this time period. Due to a few inquiries registered during the night, it may be argued that the satellites will have relatively little influx. However, there are other aspects of the implementations, which should be considered. It is likely that the satellites will affect the OOH- primary care service to a greater extent, by turning the demand to other time periods. It may also lower the threshold for contacting the service and possibly increase the green inquiries. However, as a start, through a testing period, the satellites may give indications on whether telemedicine could be beneficial or not for the OOH- primary care service or whether expansion to other time-periods could be advantageous. A thorough review of previous literature revealed both advantages and disadvantages that evoked from implementing telemedicine (Audit Scotland 2011, Canada's

Health Informatics Association 2015). By benchmarking against others, which have succeeded within the field, one can find valuable information which may support the selection, planning, and implementation of the satellites (Langabeer 2008, Krajewski, Malhotra, and Ritzman 2015).

Based on previous studies one can assume that both patients and health care personnel may be satisfied with the implementation of telemedicine (Becevic et al. 2015, Polinski et al. 2016, Donelan et al. 2019). Even though there are documented positive attitudes, there is also evidence that patients tend to fear telemedicine (Clark, Capuzzi, and Harrison 2010). Patients may fear the use of technology as an alternative to a physical consultation. In addition, they may be skeptical to nurses operating as a supplement to the GPs in the consultation. Thus, it is conceivable that people may be reluctant to the use of the satellite, and challenges may arise. Patients may contact the OOH- primary care service earlier in the evening to avoid using the satellites, just in case, a need arises during the night. As a consequence, green inquiries will most likely increase, and the demand will shift to other time periods, resulting in more strain on GPs conducting OOH-work during the evening. Others may also offset the visit to the next day, which could for some patients result in an aggravation of their condition, and ergo an increase in red inquiries. As a possible consequence, ripple effects may arise in other parts of the health care system, with more strain on RGPs during office hours or on the specialist service, such as hospitals. However, prior studies have also documented that patients tend to be more comfortable with telemedicine after the second consultation (Johansson, Lindberg, and Söderberg 2014), and that proper education and communication have been beneficial (Clark, Capuzzi, and Harrison 2010). It is, therefore, reasonable to think that with experience and good information, patients will eventually become positive to the satellites and avoid possible consequences of not utilizing them.

Further, the reduction of distance barriers and an increase in the availability of health care services is a documented outcome of the implementation of telemedicine (Ekeland, Bowes, and Flottorp 2010, Canada's Health Informatics Association 2015). This indicates that telemedicine could potentially secure supply in rural areas, which today is difficult to reach. In our study, the presumption is that the implementation of a satellite in Midsund will eliminate distance barriers and increase availability for patients located there. This because they no longer have to travel to the casualty clinic in Aukra for consultations during the night. Though, this will only apply for Midsund, since the other satellites will be located in municipalities which initially have a

casualty clinic. However, it is also conceivable that people from all nine municipalities may choose to meet directly at the casualty clinic in Molde instead of using the satellites, due to the possible fear of telemedicine. This would increase the distance to the nearest casualty clinic, rather than reduce it. Consequently, the number of inquiries during the night at the casualty clinic in Molde may increase and results in more strain on the GPs conducting OOH-work. Hence, capacity shortages and bottlenecks may be a consequence (Langabeer 2008). An effect of this may again be waiting time for patients, which could eventually reduce the quality of the OOH- primary care service. This reinforces the importance of proper operation management (Johnston, Clark, and Shulver 2012) before to the implementation, to secure that capacity shortage will not be an effect of the implementation of satellites.

Further, it is also realistic to think that the inquiries appearing during the night most likely are serious inquiries, which cannot be handled by the satellites. In these cases, people may need to be consulted at the casualty clinic in Molde, where they have to travel a long distance to receive the required medical assistance. A possible consequence can be more strain on the ambulance service that would need to transport the patient directly to Molde. It is also reasonable to think that there will be an increase in home visits conducted by the GPs from Molde casualty clinic, for patients that cannot be transferred from their location. Thus, the expected positive outcomes of the implementations could be converted to adverse outcomes for other levels in the health care system, and again, more strain on the GPs at the casualty clinic in Molde. On top of that, it is conceivable that consultations during the night are more time consuming due to more severe conditions for the patient, which again will increase the strain and strengthen the risk of capacity shortages.

We found that there were few inquiries during the night for both MIKL and the satellite-municipalities. It is, therefore, reasonable to think that today, there exists unnecessary use of resources, meaning that there may be too many GPs on call compared to the number of inquiries that appear during the night. It is conceivable that fewer GPs could manage the OOH- primary care service without reducing the quality in the service. Literature also state that video consultations appeared as more efficient than physical consultations (Donelan et al. 2019). If this is the reality, it will enable fewer GPs to handle more consultations during the night with the satellites than before the implementations. Therefore, the satellites could most likely result in more efficient operations. Fewer GPs conducting OOH-work during the night may also contribute to a reduction in labor costs. Nurses may even cost less to employ, than RGPs, which

again could reduce the labor costs. Additionally, according to literature, nurses could be a valuable resource to ease the workload of GPs without lowering the quality in the service (van der Biezen et al. 2016). However, to become more efficient in operations, with the use of satellites, a prerequisite will be to have enough capacity among the nurses in the district to monitor the satellites, as well as enough capacity at casualty clinic in Molde to conduct both physical consultations and video consultations during the night. With a future risk of lack of both nurses and RGPs this may be a challenge (KS 2017). Another prerequisite will be that the nurses in the district and GPs in Molde both are available at the same time, enabling them to conduct a video consultation with a patient together. The software used for the satellites also needs to be secure and have an intuitive user interface, so it is easily manageable. This to avoid ethical conflicts, as suggested in the literature (Hofmann 2013, Skär and Söderberg 2018), and also waste of time due to weak systems.

Further, one of the expected outcomes from the satellites will be to reduce the risk of shortage of GPs with the right competence. With the new competence requirement just around the corner and with an aging workforce, actions must be carried out to safeguard against capacity shortages. To do this, organizations have to improve the visibility of demand, so that they know their demand pattern. By implementing satellites as an alternative in the production process, there will be a reduction from four to two GPs operating the OOH- primary care service during the night. The satellites will ease the load during the night for the GPs in the districts, allowing them less OOH- work. However, due to relatively few inquiries during the night, the redesign will not constitute a major difference. The challenges related to enough GPs to conduct OOH-work and future recruitment of GPs with the right competence will still be a reality. However, if the satellites can be used as a backup during the day and evening shifts, it may be possible for interns to conduct «independent» OOH-work. Another alternative in the future could be to use mobile satellites, where the ambulance service and home care service could bring video consultation to the patient's location. The OOH- primary care service may then be more available for patients and also utilize the available resources. This would possibly, in the long term, contribute to less strain on the RGPs in the districts. With less strain on the RGPs it is also reasonable to think that the RGP scheme in the district will become more attractive and thereby easier to recruit new RGPs. By expanding the operation hours of the satellites or make them mobile, it is reasonable to think that the service could meet the goal of the pilot to increase the accessibility, diversification in supply, ensuring proper quality and securing better recruitment.

Finally, we found that the demand for OOH- primary care service is volatile. The daily demand, in weekdays, follows some patterns but deviates randomly from the mean value, while the weekends and official holidays have higher variations in demand. The value creation for the service is based on securing people located in each municipality with immediate medical help, at the right time with the right quality. The OOH- primary care service need to be agile so that they can be responsive and meet the demand rapidly (Christopher 2016). To quickly adapt to variations in demand, it becomes crucial to meet the demand with a flexible workforce. Molde and the surrounding municipalities are challenging areas to conduct OOH- primary care service. With the risk of potential labor shortages, innovative solutions are crucial to meet the demand in the future. The redesign of the production process is necessary, because it may be the best alternative to secure the quality of OOH- primary care service in the future. The question is whether the service manage to implement the satellites without sacrificing effectivity over efficiency, and thus reduce the value creation. By planning the capacity according to the identified demand patterns rather than on intuition, the OOH- primary care service could most likely be able to better match supply with demand (Batal et al. 2001). Therefore, to secure proper OOH- primary care today and in the future, it becomes essential to plan capacity according to the expected number of inquiries in weekdays, weekends, official holidays, as well as the different time periods of the day. This would probably reduce the strain on the RGPs, especially in peak season and time periods with higher inquiries than others.

8.0 Conclusion

This study seeks to provide Molde inter-municipality OOH- primary care service with an overview of the monthly, daily, and hourly variations in the demand.

The results from the quantitative analysis showed that the demand followed monthly, daily, and hourly patterns. There was a small variation in annual number of inquiries. However, the study documented seasonal variations. The number of inquiries per day showed to be dependent on the day of the week and also the day's connection to official holidays. Weekdays had fewer inquiries than weekends and official holidays. The hourly pattern shows that during weekdays the evening had most inquiries, while in weekends, most inquiries were registered on day time. Through the night, for both weekdays and weekends, there were fewer inquiries registered. Overall, the study shows that official holidays and the opening hours at RGP offices had a great impact on the number of inquiries registered at the OOH- primary care service.

Our findings show a large share of green inquiries, which may indicate unnecessary use of the service. The number of green inquiries was especially high in the largest municipalities, signifying that an easily accessible service could lower the threshold for contacting the service. Although, a recognized decrease in green inquiries and an increase in yellow and red inquiries may indicate that people are moving towards more appropriate use of the service, or that employees at LEMC have become more critical in the assessment of inquiries. The distance to the nearest casualty clinic and the RGPs list length could also impact the demand at the OOH- primary care service. Further, with the highest inquiry rate for the age group 81 and over, it may be expected that the demand for OOH- primary care service will increase simultaneously with the aging population.

Finally, our findings show that there were registered few inquiries during the night, indicating that the planned satellites may have little influx. However, it is conceivable that the implementation of satellites could result in ripple effects that would cause more demand during other time periods, or even in other parts of the health care system. Overall, the visibility of demand patterns could benefit the OOH- primary care service when planning future activities in a service with volatile demand.

8.1 Limitations of the Study

There were several limitations to this study. First, it was based on inquiries registered at LEMC, which were used as an estimate for the number of contacts at the OOH- primary care services. Since the data system at LEMC does not account for registered patients that do not meet up for their booked consultation, the registered inquiries do not always give a correct estimate of the inquiries handled at the OOH- primary care service. Conversely, if patients meet up directly at the casualty clinic, they will not be registered at the LEMC. Thus, we did not have a full overview of the actual number of inquiries handled at the OOH- primary care service, and the quality of the data can, therefore, be imperfect. This reduces the validity of the study. However, the data set should not deviate too much, since most of the inquiries go through LEMC, and one expects that patients want help when they initiate it themselves. Second, if the analysis had been based on larger sample sizes the results could have been considered as more accurate. A larger sample could also have made it possible to compare the results between various years. This would result in a more precise overview of variations in demand and a more accurate prediction of expected future demand. This especially applies to the data set collected for the hourly pattern, which was based on an extremely small sample. Another limitation of this study is the generalizability to other OOH- primary care services. Demographic factors tend to impact the demand for OOH- primary care services; thus, more centralized municipalities would most likely show different patterns in their demand.

8.2 Future Research

Since this study is limited to how detailed it was possible to investigate the variations in demand at the OOH- primary care services, it would lead to many opportunities for future research in the area. Due to limited research within the OOH- primary care service initially, there are also many possible pathways to conduct further research.

There could be conducted a more detailed research of the variation in inquiries per unit in time and its connection to other factors, such as diagnosis, gender, age, contact method, triage category and location of the patient. This may result in a more detailed overview of what time of the day different inquiries take place, which diagnosis and what contact method which is most common. It may also be reasonable to think that there exist specific time periods where different triage categories take place. A more detailed analysis, where the distribution of inquiries per hour is examined, may also provide the OOH- primary care service information about whether there are specific hours of the day the inquiries tend to peak (e.g., the hours right after work or right before bedtime). By acknowledging these variations, it may be easier to find the specific cause of the variation.

There could also be investigated how many of the inquiries at the LEMC that meet up at the casualty clinic for their booked consultations. Future research, can by using this study, compare data from LEMC and data from the OOH- primary care service to investigate how many of the inquiries to the LEMC that result in a consultation at the casualty clinic. Future research could also study more direct patient activities, to evaluate the throughput time at the OOH- primary care service. It is reasonable to think that this would be a more comprehensive study due to lack of registrations of the actual consultation time at the service. However, this would most likely fill a research gap and could contribute to managing future operations more accurately to align the capacity with the expected demand.

Further, it is natural to assume that the composition of resources will change when the production process changes, with the new satellites. Since this research did not involve an analysis of the capacity, future research can investigate how the need for health care professionals at the casualty clinic in Molde is expected to change when they now are going to provide immediate assistance to citizens in nine municipalities during the night. In addition, it may be beneficial to examine how the health care services (i.e., nursing homes and home care

services) in the different municipalities will be affected by the new satellites. This to avoid the possibility of capacity shortages in the districts.

To secure sustainable and proper service towards the users it could also be necessary to examine patients' attitudes towards the OOH- primary care service and their perception of the quality of the service as it is today and also after the implementation of satellites.

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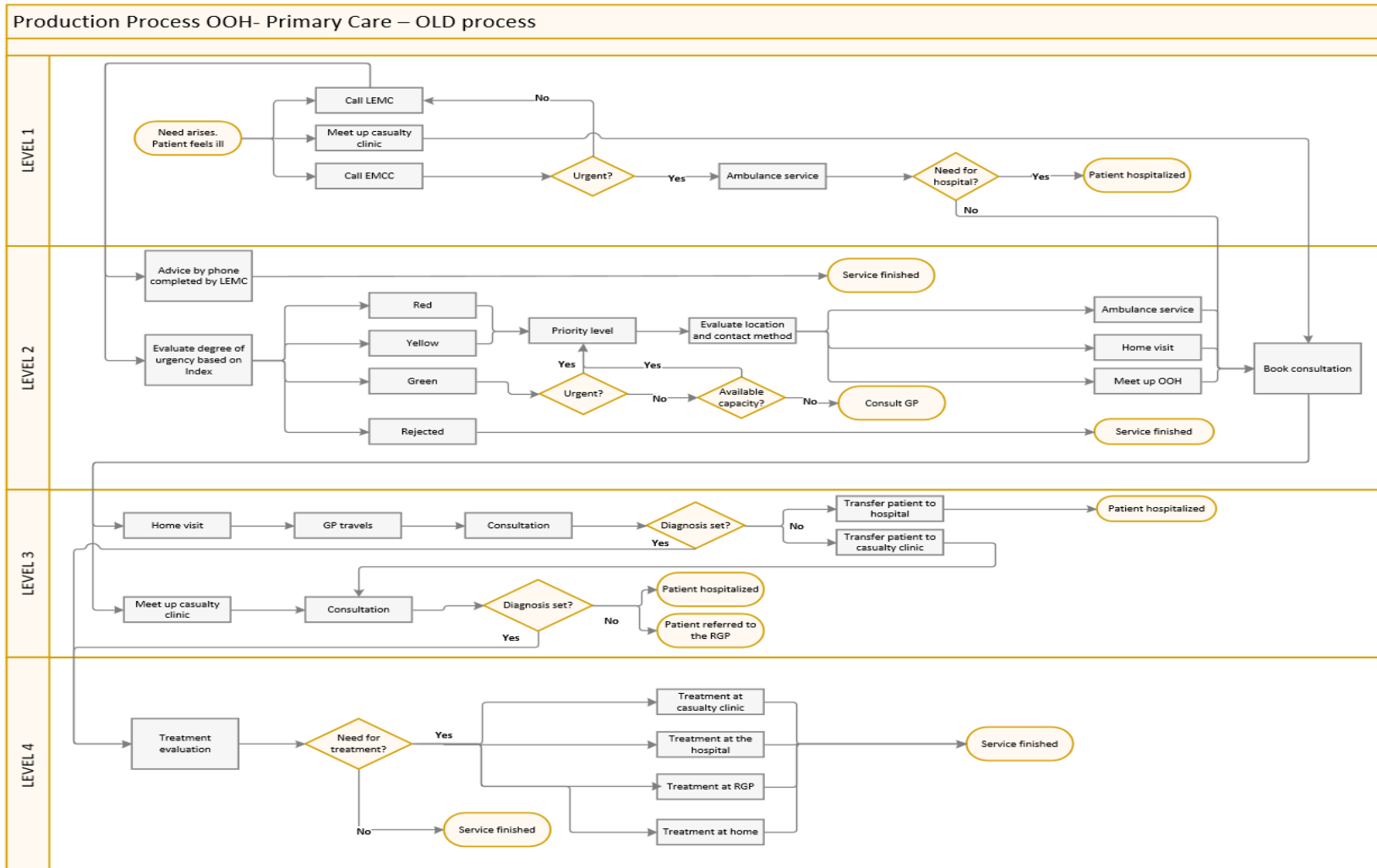
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Appendix

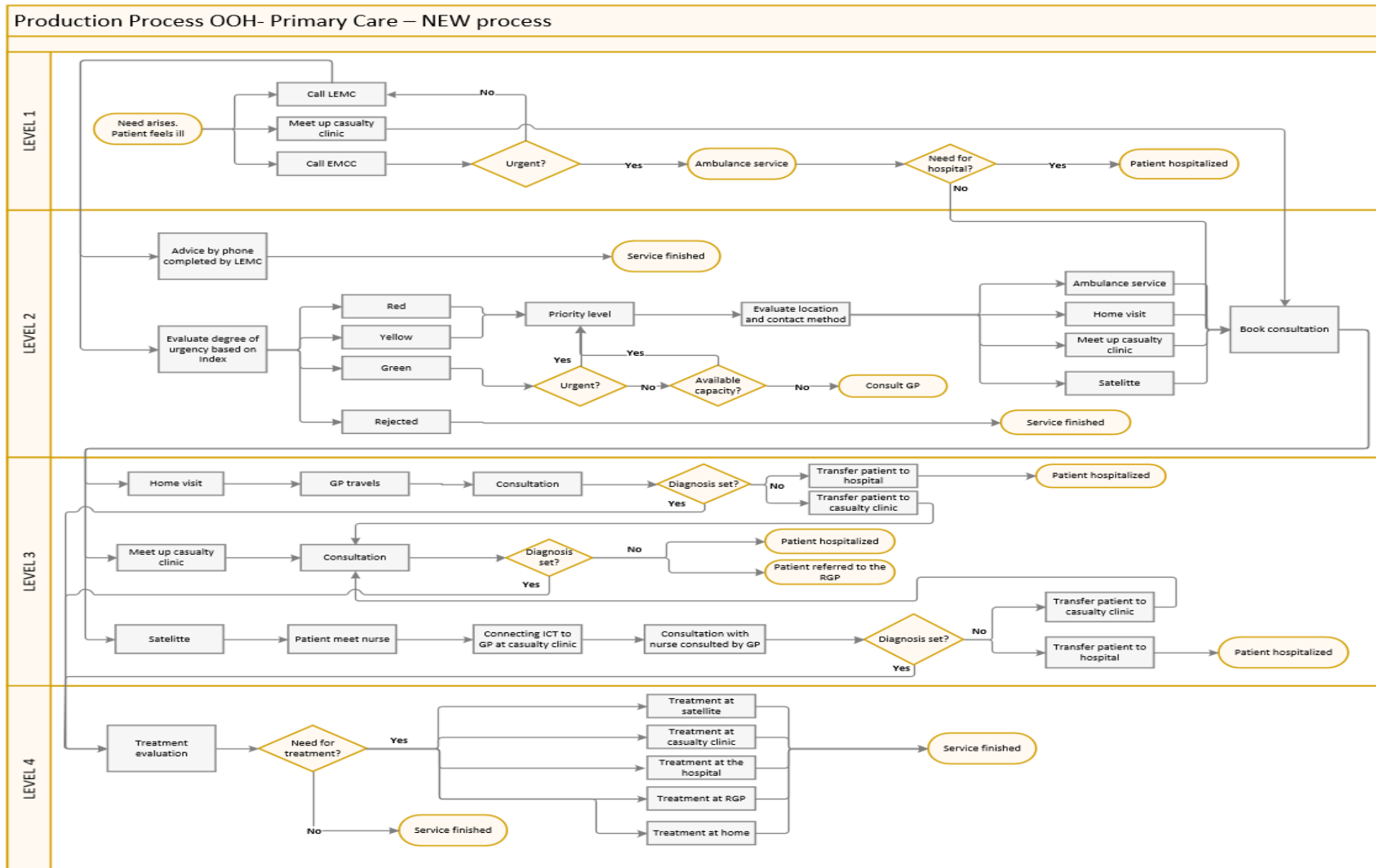
1. Number of Citizens – All Municipalities

	2016	2017	2018
1502 Molde	26 732	26 822	26 900
1539 Rauma	7 492	7 503	7 507
1543 Nesset	2 970	2 963	2 946
1545 Midsund	2 088	2 085	2 049
1546 Sandøy	1 270	1 246	1 263
1547 Aukra	3 518	3 547	3 557
1548 Fræna	9 717	9 741	9 775
1551 Eide	3 467	3 454	3 440
1563 Sunndal	7 160	7 126	7 119

2. Old Production Process



3. New Production Process



4. Population Size, Number of Inquiries, Inquiry Rate – All Municipalities

	Population			Inquiries			Inquiry rate		
	2016	2017	2018	2016	2017	2018	2016	2017	2018
Molde	26 732	26 822	26 900	10 809	10 860	10 263	404	405	382
Eide	3 467	3 454	3 440	919	1 008	983	265	292	286
Fræna	9 717	9 741	9 775	3 795	3 711	3 628	391	381	371
Nesset	2 970	2 963	2 946	972	1 001	924	327	338	314
MIKL	42 886	42 980	43 061	16 495	16 580	15 798	385	386	367
Aukra	3 518	3 547	3 557	1 435	1 273	1 291	408	359	363
Midsund	2 088	2 085	2 049	764	726	716	366	348	349
Sandøy	1 270	1 246	1 263	307	286	320	242	230	253
AIKL	6 876	6 878	6 869	2 506	2 285	2 327	364	332	339
Sunndal	7 160	7 126	7 119	2 637	2 746	2 396	368	357	337
Rauma	7 492	7 503	7 507	2 881	2 680	2 821	385	385	376
Total	64 414	64 487	64 556	24 519	24 291	23 342	381	377	362
Change in %	-	0,11 %	0,11 %	-	-0,93 %	-3,91 %	-	-1,04 %	-4,01 %

5. Triage Categories – All Municipalities

	Red		Yellow		Green	
	2018	%- change 2016-2018	2018	%- change 2016-2018	2018	%- change 2016-2018
Molde	13	63 %	113	9 %	255	-13 %
Eide	13	18 %	103	21 %	170	1 %
Fræna	15	25 %	117	8 %	239	-12 %
Nesset	11	83 %	102	2 %	201	-9 %
MIKL	13	44 %	112	9 %	241	-12 %
Aukra	12	50 %	129	2 %	222	-19 %
Midsund	22	120 %	111	-13 %	216	-5 %
Sandøy	11	267 %	89	6 %	154	0 %
AIKL	15	88 %	116	-3 %	208	-12 %
Sunndal	17	55 %	119	-5 %	201	-13 %
Rauma	13	44 %	121	2 %	241	-6 %
Total	14	56 %	115	6 %	233	-11 %

6. Descriptive Statistics

6.1 Total for the Entire Data Set (Weekdays, Weekends and Official Holidays)

Descriptive Statistics

	Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
Total	66,1	55,0	823,3	28,7	29,0	183,0	154,0	1,2	1,1

6.2 Weekdays

Descriptive Statistics

	Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
Weekdays	49,1	48,0	88,5	9,4	29,0	91,0	62,0	0,6	1,3

6.3 Weekend and Official Holidays

Descriptive Statistics

	Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
Weekend	102,2	97,0	466,2	21,6	65,0	183,0	118,0	1,2	1,9

7. Test of Normality - Weekdays

Tests of Normality			
Shapiro-Wilk			
	Statistic	df	Sig.
Weekday	0,99	246,00	0,10

8. Official Holidays

Official Holidays
22.12.2017
25.12.2017
26.12.2017
01.01.2018
27.03.2018
28.03.2018
29.03.2018
30.03.2018
02.04.2018
01.05.2018
10.05.2018
17.05.2018
21.05.2018