Realizing Interoperability within the Dutch Military Healthcare System

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Summary

The healthcare sector has tremendous potential to increase efficiency and treatment accuracy through technology, resulting in cost reduction which in turn, increases healthcare accessibility. This is particularly critical for military healthcare, as military personnel lack the freedom to choose their healthcare providers. Additionally, the health of our military directly impacts the military position of the Netherlands. The interoperability of medical patient data facilitates efficient care delivery, contributing to cost-effective and improved healthcare outcomes. Therefore, this research aims to systematically identify and analyze the key barriers preventing the Military Healthcare sector from reaching a desired state in terms of the efficient exchange of medical patient data.

The conceptual framework utilized in this research combines the gap analysis model and the European Interoperability Framework (EIF). The conceptual framework divides the research into five steps using the gap analysis model in which the EIF provides a segmented overview of the barriers. The five steps of the gap analysis are 1) assessing the current state, 2) defining the desired future state, 3) identifying the gaps and 4) barriers, and 5) providing recommendations to bridge the identified gaps and reach the desired state. In step four, the barriers are segmented according to the EIF in legal, semantic, organizational, and technical layers. A qualitative research design was employed to execute the steps of the gap analysis. Semi-structured interviews and literary research were conducted with a study population consisting of 10 relevant stakeholders involved in handling medical patient data within the Defense Organization. In addition, a semi-structured interview was held with an interoperability expert to provide recommendations. Sampling was done through snowball and purposive sampling. Data collection involved recording and transcribing interviews. The data analysis process utilized thematic coding to identify key themes and barriers.

The results showed that an interoperable Military Healthcare system is desired, either by allowing hospitals and other practicians to seamlessly interact or by providing patients with wearables. However, this research showed that the Military Healthcare sector is still far from achieving an interoperable system. The bottlenecks primarily lie in the exchange of information with operational healthcare, between first- and second-line healthcare, and between the CMH and civil hospitals. Barriers to achieving interoperability were primarily identified in the technical layer and organizational layers. In addition, some barriers in the legal and semantic layers are indicated. However, this study points out that the barriers in the technical layer can be easily overcome with the current technological innovations and legal barriers can be

overcome by the new WEGIZ law. To overcome the barriers, this study indicates further deepening of the organizational barriers by interviewing more stakeholders and involving DGO leadership and the Minister of Defense. In conclusion, the pursuit of interoperability in the healthcare sector holds immense potential. By addressing the identified barriers and fostering collaboration among stakeholders, the path can be paved for a future where seamless data exchange and interoperability become the norm. Ultimately, leading to better healthcare outcomes not only for the Dutch Defense Organization but for all.

List of abbreviations and acronyms

ADHA		Australian Digital Health Agency
AI		Artificial Intelligence
API		Application Programming Interfaces
BMB	*'Bijzondere Medische Beoordeling'*	Special Medical Assessment
CEAG	*'Coördinatiecentrum Expertise Arbeidsomstandigheden en Gezondheid'*	Coordination Center for Expertise on Working Conditions and Health
CMH		Central Military Hospital
D-HiX		Defense-HiX
DGO	*'Defensie Gezondheids Organisatie'*	Defense Health Organization
DGOT	*'Defensie Gezondheidszorg Opleidings- en Trainingscentrum'*	Defense Healthcare Education and Training Center
DTD	*'Defensie Tandheelkundige Dienst'*	Defense Dental Service
EGB	*'Eerstelijns Gezondheidszorg Bedrijf'*	First-line Healthcare Company
EHR		Electronic Health Record
EIF		European Interoperability Framework
EU		European Union
FHIR		Fast Healthcare Interoperability Resources
GP		General Practioner
H&PS		Health & Public Services
IDR	*'Instituut Samenwerking Defensie Relatieziekenhuizen'*	Institute for Collaboration with Defense Relationship Hospitals
IMG	*'Inspectie Militaire Gezondheidszorg'*	Military Healthcare Inspection
MB		Military Blood Bank
MGGZ	*'Militaire Geestelijke Gezondheidszorg'*	Military Mental Healthcare
MGLC	*'Militair Geneeskundig Logistiek Centrum'*	Military Medical Logistics Center
MRC		Military Rehabilitation Center

PGO	*'Persoonlijke Gezondheidsomgeving'*	Personal Healthcare Environment
PMR		Patient Movement Request
RFM		Recency, Frequency, Monetary
UMCU		University Medical Center Utrecht
VIPP	*'Versnellingsprogramma Informatie-Uitwisseling Patient & Professional'*	Acceleration Program Information Exchange Patient & Professional
WEGIZ	*'Wet Elektronisch Gegevensuitwisseling in de Zorg'*	Law Electronic Data Exchange in Healthcare

1. Introduction

In an era characterized by the pervasive integration of digital technology and interoperability, the healthcare industry has been noticeably slow in recognizing and capitalizing on the full potential of emerging digital innovations (Apell & Eriksson, 2021). As a result of the slow pace of digitalization in the healthcare sector, it remains an industry with enormous development potential. The need for efficient data transfer and accessibility is important for various healthcare institutions, including the Military Healthcare sector. For the purposes of this report, the term '*Military Healthcare'* encompasses all the medical care provided to military personnel in the Netherlands, including during non-operational periods and situations occurring under operational conditions outside of the Netherlands. Unlike the general population, military personnel do not have the freedom to select their healthcare providers as Dutch health incurrence companies oblige military personnel to receive care from Military Healthcare organizations. Therefore, military personnel rely on the Military Healthcare system to deliver the necessary medical services, irrespective of their location. The quality of Military Healthcare directly impacts the health and well-being of military personnel and, consequently, influences the safety and success of military operations. Therefore, ensuring the highest standards of Military Healthcare is of paramount importance. Continuous evaluation and identification of areas for improvement are essential in enhancing the quality of Military Healthcare. One such area in need of improvement is the facilitation of efficient data transfer and accessibility.

Currently, medical data is scattered throughout various medical institutions, and the data standards of different medical institutions are not uniform. This results in a low level of interoperability of medical information systems among institutions (Chen et al., 2019). Interoperability refers to the capability of different systems or software to communicate and work together seamlessly. The low level of interoperability poses a significant challenge in the Defense organization, as it contributes to technological gaps compared to our adversaries (Defensie, 2020). This issue directly impacts our national security as it impacts the enhancement of the efficiency and quality of our Military Healthcare system. By harnessing the power of data-driven work, we can improve the quality and efficiency of Military Healthcare ensuring that military personnel are highly deployable, which serves as the driving force behind a strong Defense organization. In the end, increased deployability of our military personnel will give the Dutch Defense organization a competitive advantage.

By addressing this challenge, we can enhance the effectiveness and efficiency of Military Healthcare delivery, ultimately benefiting the overall well-being of military personnel and the outcomes of military operations. The Ministry of Defense is already actively pursuing the implementation of data-driven approaches in various aspects, recognizing its potential benefits (Defensie, 2020). One of the established principles described in the Defense vision for 2035 is to *have "reliable, robust and future-proof IT that supports our information-driven and technologically advanced Defense organization and is rapidly adaptable"* (Defensie, 2020).

There are multiple reasons why an interoperable system will deliver value to the Military Healthcare sector. First, rapid access to patient data empowers healthcare practitioners to make informed decisions regarding diagnosis, treatment plans, and medication management. Particularly in critical situations such as accidents or military operations, swift access to comprehensive medical information facilitates a holistic understanding of the patient's condition and can potentially save lives.

Second, the seamless transfer of patient data among healthcare institutions fosters efficiency in healthcare delivery, resulting in time and resource savings for both patients and healthcare providers. This streamlines administrative operations, enabling medical practitioners to allocate more attention to direct patient care. By optimizing time and resources, interoperability also has the potential to reduce costs. In this way, the remaining budget can be allocated to other parts of the Dutch Defense organization to further strengthen the Dutch armed forces.

Lastly, the availability of easily accessible and interoperable patient data holds great value for medical research and public health initiatives. Aggregating and de-identifying data from multiple institutions can provide valuable insights into population health trends, disease patterns, treatment effectiveness, and potential interventions to enhance public health. By leveraging patient data, the quality of the (military) healthcare system can be significantly enhanced, contributing to improved patient outcomes and overall healthcare excellence.

Thus, an interoperable system will deliver value to the Military Healthcare sector in multiple ways. Thereby, such a system provides a foundation for further technological development. Imagine a future where military physicians put on glasses that display important medical data around the patient. In this way, a holistic patient view is available within seconds which can lead to extremely fast and well-informed medical decisions during critical situations. Before this can become a reality an efficient way of data transfer and easier accessibility of the data should be enabled between all organizations in the Military Healthcare system. The Defense Health Organization (DGO), '*Defensie Gezondheidsorganisatie*' is a complex

organization consisting of multiple subsidiary companies, which will be elaborated on in Chapter 3. Therefore, interoperability of medical patient data within the Military Healthcare sector is a challenge, despite its importance. The DGO hired Accenture, a consultancy firm, to overcome these challenges. To improve interoperability, Accenture should identify where the current bottlenecks lay, what the desired future situation is, and how the Military Healthcare sector can realize this future. However, as military information is hardly publicly available, so is information about the Military Healthcare sector. Therefore, this research aims to systematically identify and analyze the key barriers hindering the Military Healthcare sector from reaching a desired state in terms of the efficient exchange of medical patient data. By mapping these barriers and providing actionable recommendations, this study seeks to contribute to the advancement of interoperability within the military healthcare system. The main question guiding this research is as follows: *What are the most significant barriers for Military Healthcare in becoming an interoperable organization regarding medical patient data?*

To answer the main question of this research, five goals are established based on the conceptual framework that will be further explained in Chapter 5:

1. *To map the current state of interoperability of medical patient data within the Military Healthcare sector.*
2. *To map the desired state of interoperability of medical patient data within the Military Healthcare sector.*
3. *To define the gaps between the current- and the desired state of interoperability of medical patient data within the Military Healthcare sector.*
4. *To define the barriers in closing the gaps between the current- and the desired state of interoperability of medical patient data within the Military Healthcare sector.*
5. *To provide recommendations to overcome the barriers to bridge the gaps between the current- and the desired state of interoperability of medical patient data within the Military Healthcare sector.*

2. Value of Client Engagement to Accenture

This Chapter explains why Accenture is engaged to overcome the challenges addressed in Chapter 1. In addition, the value of the client engagement of the DGO to Accenture is explained. Accenture is a global professional services firm in a variety of industries and has offices in 49 countries around the globe (Hendrikman, 2023), including The Netherlands. The firm offers a diverse range of services, including digital, technology, and operations consulting, as well as outsourcing and managed services, and is known for its focus on innovation and digital transformation.

2.1 Market Analyses Consultancy Industry

The consulting market is a highly competitive and rapidly changing industry, in which consulting firms compete to provide expert advice, solutions, and services to clients across various industries. To understand the unique value proposition of Accenture compared to other companies in the consultancy market, the Dutch consultancy industry is examined by using the Porter Five Forces model. First, the threat of new entrants is relatively low because of Accenture its size and well-established client portfolio. New entrants are years away to come even close to the number of employees, number of clients and revenue of Accenture and companies that Accenture competes with. However, the threat of new entrants cannot be completely ruled out. New entrants in the Information Technology Services industry bring innovation, putting pressure on Accenture through reduced pricing strategies and providing new value propositions to the customer. Moreover, the barrier to entry into the consultancy market can be low since consultancy firms do not require considerable capital and rely more on the use of intangible. A consultancy firm primarily relies on the knowledge and expertise of its experts and may operate on a lean business model with little overhead costs. Thus, for Accenture to maintain its competitive advantage, Accenture must continuously strive to remain at the forefront of technological innovation.

Second, the bargaining power of suppliers is relatively low in the consultancy industry. The product of a consultancy firm is its employees. Thus, this force is defined by the availability of talent. Even though, the amount of highly educated people is increasing in the Netherlands (Van Der Mooren & De Vries, 2022), there is known to be a ‘war on talent’, especially in the technology industry (Salesforce, Business Insider, 2019). As Accenture focuses on technology, strategy, and implementation consultancy, the war on talent also affects Accenture. However, Accenture has positioned herself well in the labor market by being recognized as the number 5

best company to work for (Fortune Editors, 2023). Thereby, other suppliers such as software product providers, frequently want integration of their products into the portfolios of consulting firms to increase their visibility. Therefore, software product providers have low bargaining power towards consultancy firms with an enormous client portfolio.

Third, the bargaining power of buyers is high because of two reasons. First, clients always have an option of in-housing experienced professionals from the market or maintaining the status quo unless a change is inevitable. Second, clients can obtain quotations from different firms and bargain for the best rate. As a result of the wide availability in the number of consultancy firms, clients will always try to achieve the best pricing plotted against service quality and experience.

In addition, the threats of substitute services are in line with the power of buyers. As mentioned earlier, there are various substitutes for consulting services, such as in-house expertise and internal consulting teams, but also digital tools and platforms can provide solutions. As these substitutes become more prevalent and sophisticated, they may pose a greater threat to consulting firms including Accenture.

Lastly, the rivalry among existing competitors is extremely high. The consultancy industry is highly competitive, with many firms vying for market share and clients. Competitive rivalry can be intense, especially in certain segments of the market, such as strategy consulting. Firms may need to differentiate themselves through specialization, expertise, and reputation to compete effectively.

In short, the biggest internal threat in the consultancy industry is competition. Therefore, a consulting company must develop a unique value proposition that distinguishes them from their competition. Companies can either achieve this by focusing on specific areas, acquiring expertise in niche markets, and establishing a reputation for exceptional quality and customer service. In addition to the mentioned approaches, companies can also develop a unique value proposition by offering end-to-end solutions, spanning from strategic consulting to operational implementation. This comprehensive range of services enables companies to provide holistic support to clients, addressing their needs at every level of their business.

2.2 Competitive Analysis

The five biggest strategy consultancy companies in terms of size and revenue are McKinsey, Boston Consulting Group, Bain, Kearney, and Oliver Wyman (Loos, 2023), also known as the ‘big five’. Even though Accenture is a player in strategy consultancy, the big five cannot be seen as the most significant competition. The focus of Accenture lies in delivering

on the promise of technology and human ingenuity (*About Our Company,* n.d.). In other words, bringing together the benefits of technology across society, from strategy to operations. Hence, Accenture its competitive advantage stems from its ability to operate across diverse industries, leveraging robust technological capabilities that span the entire spectrum. As a result, Accenture has two groups of main competitors. First, the competitors that compete with Accenture along all service lines and are similar to Accenture as of their size, such as Deloitte, PWC (Strategy&), KPMG, and EY, also known as the 'big four'. While most of these companies are originally accounting firms, they have significantly diversified by offering consultancy services across a wide range of industries. Because the services of Accenture are primarily focused on technology implementation, which is different from the big four, there is also a group of less big consultancy companies that compete with Accenture on the same skill level regarding technology, such as Capgemini, IBM, and CGI. The main competition of Accenture is plotted in Figure 1, where the companies are placed based on the volume of assignments and the extent of technological or organizational advice.

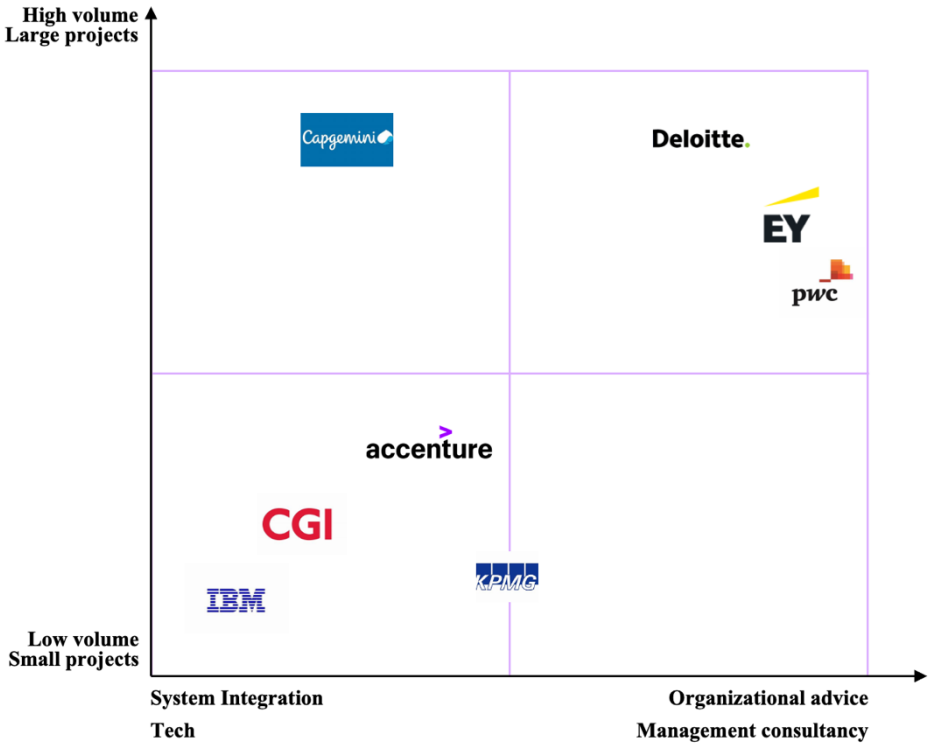

Figure 1. *Main competition landscape within the Dutch consultancy industry. Volume of assignments plotted against the nature of the assignments.*

As is shown in Figure 1, Accenture must distinguish itself from the 'big four' competitors and experienced technology consultancy companies. Companies select consultancy firms based on a variety of factors, including the firm's reputation, expertise in specific industries or functional areas, the quality and relevance of their past projects, the qualifications

and expertise of their consultants, their ability to deliver innovative solutions, pricing structure, and the overall fit with the company's values and culture. One of the key factors for Accenture is its ability to deliver innovative solutions, given its expertise in technology implementation. Therefore, the competitive advantage of Accenture is its digital transformation capabilities. Accenture has been at the forefront of digital transformation, helping organizations adapt to the rapidly evolving digital landscape. The company its expertise in areas such as cloud computing, artificial intelligence, analytics, and cybersecurity allows them to drive digital innovation and enable clients to embrace digital technologies for a competitive advantage.

2.3 Maintaining a Competitive Advantage

Accenture its competitive advantage is thus that the company is a pioneer when it comes to technological capabilities that can be applied across a wide horizon of industries. This is further exemplified by Accenture its prestigious diamond ranking in data science capabilities (*Beste Data Science Adviesbureaus Van Nederland*, 2022), solidifying its position among the foremost companies renowned for their extensive expertise in the field of data science. To ensure the continued growth of the company, it is essential to preserve its competitive advantage and thereby stay ahead of competitors in terms of digital transformation capabilities. Seeking opportunities for new clients to apply a digital transformation is hereby essential. As previously mentioned, the healthcare sector is a sector that significantly lags in terms of digital transformation. Therefore, the healthcare sector holds great opportunities for Accenture to use its capabilities and build strong client relationships. To strategically prioritize clients within the healthcare sector, the RFM model is used. The RFM model (Recency, Frequency, Monetary Value) is an analytical model used to segment customers based on their recent interactions, the frequency of their interactions, and the value they have contributed to a company. The model focuses on identifying customers who have a higher likelihood of repeat purchases and who represent higher value for the company. The Health & Public Services (H&PS) department of the Dutch Accenture office holds many clients. However, there is a lack of client engagement within the healthcare sector, and therefore the frequency of interaction with and the amount of profit from healthcare organizations is very low. Other focus sectors within the H&PS department are public safety, tax, Defense, and cities. Accenture is ranked as the top 3 best consultancy firm with expertise in the Defense sector (*Beste Defensie Adviesbureaus Van Nederland*, 2023). This points out the multitude of projects that Accenture carries out for Defense, which indicates the high frequency of interaction and the significant size of projects. Given the ranking, the Defense organization can be seen as a valuable account. As the Defense

organization has its own healthcare organization, known as the DGO, makes it the perfect opportunity for Accenture to add value to their Defense portfolio, and in the end, increase revenue.

In short, focusing on the DGO as a client for digital transformation enhances both the opportunity of the technology gap in healthcare institutions and the already well-established relationship Accenture has with the Defense organization. Therefore, this research will be of great value as it contributes to enhancing digital transformation at the DGO and will therefore strengthen the competitive advantage of Accenture.

3. Contextual Background

In this Chapter, the organization of the Defense Healthcare sector within the Ministry of Defense is explained. In addition, this chapter gives an overview of the strengths, weaknesses, threats, and opportunities of the Defense Healthcare sector in terms of digital technology.

3.1 How the Defense Health Sector is Organized

Before digital transformation can be established, it is important to understand how the DGO and relating internal and external organizations are organized. The organogram in Figure 2 shows how the Ministry of Defense is organized.

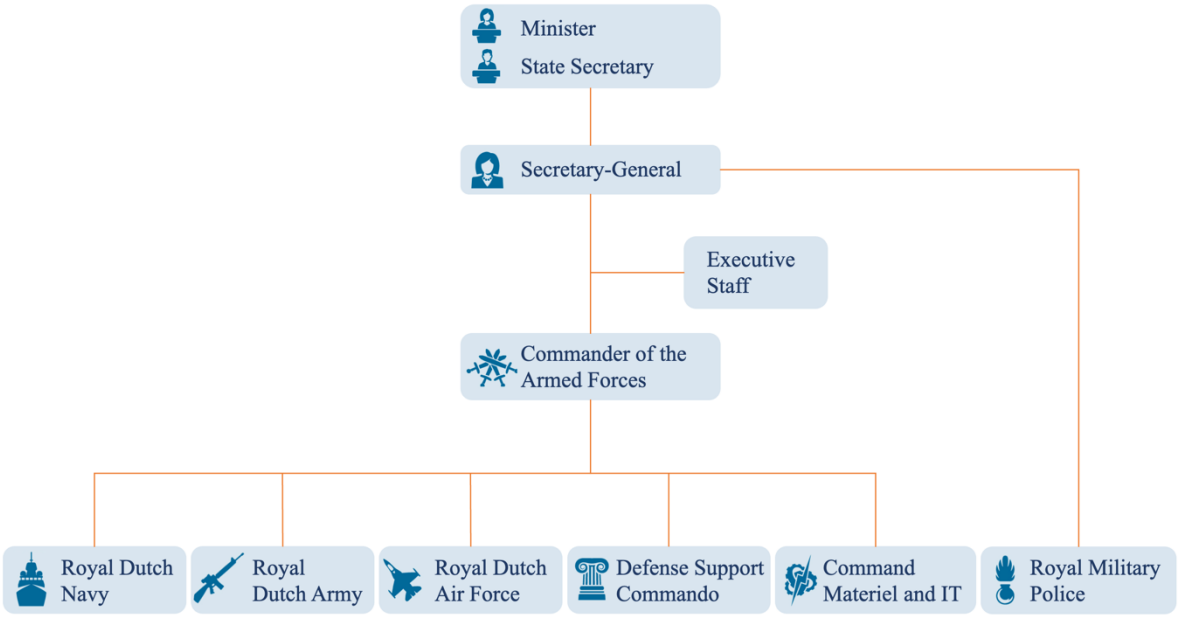

Figure 2. *Organogram of the Dutch Ministry of Defense.*

The Defense organization exists of seven Defense components. One of these Defense components is the Defense Support Commando. The DGO falls under the Defense Support Commando. However, healthcare that is provided under operational circumstances falls under the armed force that executes the mission meaning the Dutch Royal Navy, Army, or Air Force. The DGO exists of twelve sub-organizations which can be divided into 4 categories, of which an overview can be found in Figure 3. The sub-organizations that encounter medical patient data, and are thus most relevant for this study, are indicated with an asterisk. In the next paragraphs, a short explanation of each sub-organization is described.

Figure 3. *All sub-organizations within the Dutch Defense Health Organization (DGO). Suborganizations that encounter medical patient data are indicated with an asterisk (*).*

Healthcare within the military can be divided into first-line healthcare and second-line healthcare. First-line healthcare refers to the initial level of medical care that individuals receive for common health issues and preventive services and is typically received within the own Defense unit of a soldier. First, the First-line Healthcare Company (Eerstelijns Gezondheidszorg Bedrijf, EGB) is responsible for integrated care (preventive, curative, and occupational health care) for military personnel under non-operational conditions. This primary care is delivered by general practitioners, physiotherapists, occupational health experts, and pharmacists. Second, the Military Blood Bank (MB) is primarily responsible for providing blood supply during operational missions abroad. The blood bank produces deep-frozen blood products, conducts applied scientific research, and provides training to military medical personnel. Lastly, the Defense Dental Service (Defensie Tandheelkundige Dienst, DTD) is responsible for all dental care within Defense. This care is provided by military dentists, specialized dentists, dental hygienists, dental assistants, and prevention assistants.

Second-line healthcare refers to surgery or therapy for which a referral is typically required. To provide second-line healthcare, the DGO has its own hospital, the Central Military Hospital (CMH). The CMH is a public-law category hospital for military personnel and closely collaborates with UMC Utrecht. The focus of the CMH lies in ensuring military personnel their deployability by actively treating them. Other organizations that fall under second-line healthcare are the Military Rehabilitation Center (MRC) and the Military Mental Healthcare (Militaire Geestelijke Gezondheidszorg, MGGZ). The MRC helps individuals with physical disabilities rehabilitate and serves both military personnel and civilians. The MGGZ contributes

to mental health care for current and former military personnel before, during, and after deployment.

Besides first- and second-line healthcare, the DGO encompasses a range of essential support services. First, the Military Medical Logistics Center (Militair Geneeskundig Logistiek Centrum, MGLC) ensures the supply of medical facilities in operational areas, including transport and storage under specific conditions. Second, the Defense Healthcare Education and Training Center (Defensie Gezondheidszorg Opleidings- en Trainingscentrum, DGOT) delivers nearly all medical training programs for the Royal Dutch Navy, Army, Air Force, and Military Police. Its instructors train military doctors, military nurses, and other medical personnel with medical or related functions. Lastly, Institute for Collaboration with Defense Relationship Hospitals (Instituut samenwerking Defensie Relatieziekenhuizen, IDR) coordinates and supervises the collaboration between Defense and civilian hospitals. It is responsible for the education, guidance, and follow-up of medical specialist personnel going on deployments or exercises. Through a collaboration agreement, the IDR places active-duty military personnel in relationship hospitals to gain practical experience. These military personnel are available for exercises or deployments for a certain number of months each year. As a reciprocal arrangement, collaborating Hospitals provide (para)medical professionals to be trained as reservists. These reservists are available for several months each year to serve in the military, including deployments.

In addition, there are organizations that are responsible for advisory services to the DGO and its military personnel. The Coordination Center for Expertise on Working Conditions and Health (Coördinatiecentrum Expertise Arbeidsomstandigheden en Gezondheid, CEAG) possesses expertise and experience in various areas of occupational health and military healthcare. It serves as an advisory body for Defense in developing related policies. Thereby, the Special Medical Assessments (Bijzondere Medische Beoordelingen, BMB) is an expert in the fields of occupational medicine, psychological evaluation, insurance medicine, and forensic social psychiatry. It contributes to the recruitment, career progression, and reintegration process of Defense personnel. Lastly, The Military Healthcare Inspection (IMG) oversees the quality of military healthcare in the Netherlands, both within the whole DGO and during operational deployments. The IMG operates independently and reports directly to the Minister of Defense.

Thus, the DGO encompasses various organizations, each with its own management team. Naturally, each organization deals with information management. However, not every organization deals with data related to military personnel as patients as indicated in Figure 3. Medical patient data is not only exchanged within the DGO but also outside the DGO. Under

operational circumstances, the medical support does not fall under the DGO, but under the armed forces executing the mission. Therefore, this research refers to the Military Healthcare sector. Meaning, healthcare that is provided by the DGO and under operational circumstances. In addition, medical patient information is exchanged with civilian hospitals or general practitioners when needed. As a result, the operational circumstances and civilian hospitals give an extra dimension to the interoperability challenges making it even more complex.

3.2 Strengths, Weaknesses, Opportunities, and Threats for the Military Health Sector

In Figure 4, an overview of the strengths, weaknesses, threats, and opportunities of the Defense Healthcare sector in terms of digital technology is depicted.

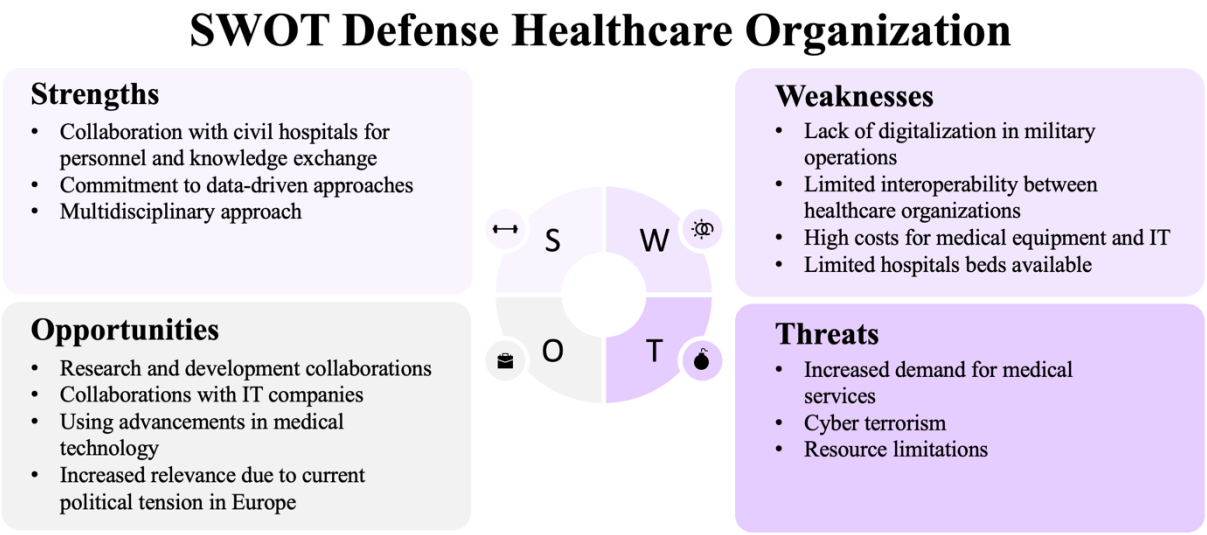

Figure 4. *SWOT analyses of the Military Healthcare sector in terms of digital technology.*

Strengths

The DGO benefits from collaborations with civil hospitals, facilitating personnel and knowledge exchange, which enhances their capabilities. This is well coordinated through the IDR. Also, the CMH benefits from the expertise and facilities of the UMCU. In this way, the CMH can offer all medical specializations for their patients instead of just the medical specialization that are available in the CMH. Secondly, the DGO demonstrates a strong commitment to data-driven approaches as shown in the Defense Vision 2035 (Defensie, 2020), allowing for more efficient and effective healthcare practices. Whilst the organization is already focused to improve in terms of interoperability, it signifies their proactive mindset and sets them on a path of growth and achievement. In addition, the Military Healthcare system exhibits a notable strength in its ability to incorporate and encompass all medical disciplines, resulting in a highly multidisciplinary approach. This comprehensive integration of diverse healthcare disciplines makes it easier to provide effective care for military patients. The system brings

together professionals from various fields, such as trauma, psychology, rehabilitation, and more, in addition to the collaborations with UMCU this allows for a holistic and well-rounded approach to healthcare.

Weaknesses

The Dutch Defense Organization faces challenges in keeping up with competitors in terms of technology adoption (Defensie, 2020). For the DGO this may hinder their ability to deliver cutting-edge healthcare services. During operations, the digitalization of healthcare services, such as robotic surgery and automatic monitoring, is very important as it contributes to maintaining a fit and healthy army. Consequently, this contributes to an advantage against components on the battlefield.

Moreover, a weakness of the Military Healthcare system is the cost factor. Providing comprehensive healthcare services within the Defense sector can be financially demanding due to the need for advanced medical equipment, extensive training, and logistical support. Budget constraints may limit funding for the Military Healthcare system, impacting its ability to invest in modern medical technologies, recruit skilled professionals, and maintain healthcare infrastructure. Currently, only a relatively small part of the Defense budget is allocated to the Defense Support Commando (*Visuals | Ministerie van Financiën - Rijksoverheid*, 2022). As the Defense Support Commando consists of multiple organizations, including the DGO, even a smaller part of the budget is allocated to the DGO specifically. Therefore, balancing cost-efficiency with high-quality care is a challenge for the system.

In addition, limited interoperability between healthcare organizations within and outside the DGO poses a barrier to seamless information exchange and collaboration. The organization also recognized the presence of technological gaps, indicating a need for investment and development to stay up to date with advancements in the industry (Defensie, 2020). There are multiple reasons that the lack of interoperability is a significant problem within the DGO. First, a lack of interoperability can result in fragmented data, redundant data entry, and delays in accessing critical patient information. Second, interoperability gaps can lead to incomplete patient records, as information may be scattered across disparate systems or not readily accessible. Third, when systems are not interoperable, the exchange of vital information, such as lab results, radiology reports, or treatment plans, becomes challenging. This can hinder effective teamwork, communication, and collaboration among healthcare professionals involved in the care of military personnel. Lastly, without interoperability, care coordination efforts become fragmented, leading to potential gaps in care, duplicated tests, or procedures, and increased administrative burden for healthcare professionals and patients.

Thereby, the number of hospital beds at the CMH is very limited (Berghege, 2019). As there are only 47 beds available at the CMH, during a crisis this will not be sufficient to treat all patients. As political tension is increasing in Europe, the limited number of hospital beds at the CMH is seen as a significant weakness.

Threats

Currently, there is a tense political situation in Europe because of the war between Ukraine and Russia. Due to these rising tensions, and thus potentially rising military operations, there is a threat of increased demand for medical services. In response to the war, the Dutch cabinet added a €2 billion investment (Ministerie van Defensie, 2022). However, Defense did not allocate additional funding to the DGO. This can potentially strain the resources and capacity of the DGO. No extra funding may limit the DGO its ability to invest in necessary infrastructure, technology, and personnel. Additionally, cyber terrorism is a growing threat that also poses a risk to the military healthcare system. As critical information is stored online, the Military Healthcare system is vulnerable to cyberattacks. These attacks can compromise patient data, disrupt healthcare operations, and jeopardize the well-being of military personnel. Robust cybersecurity measures are necessary to protect healthcare infrastructure, maintain patient privacy, and ensure uninterrupted care for military personnel.

Lastly, there is a threat of a lack of resources to build an interoperable system within the DGO. A lack of resources, such as funding, staffing, and medical supplies, poses a concrete threat to the Military Healthcare system. Insufficient funding can limit the system's ability to invest in essential equipment and infrastructure upgrades, resulting in outdated facilities and technology. Inadequate staffing levels may lead to increased workloads for healthcare professionals, compromising their ability to provide timely and quality care. Additionally, a scarcity of medical supplies and resources can result in limited treatment options, longer wait times, and reduced access to necessary medications and interventions. These resource limitations can directly impact the quality of care provided to military personnel and their families, potentially compromising their health outcomes and overall well-being.

Opportunities

An opportunity within the Military Healthcare system lies in making use of research and development institutions and software companies. Collaboration with military research institutions and universities allows for knowledge spillover which can lead to advancements in medical technologies, treatment methods, and healthcare practices. Investing in research enables the system to stay at the forefront of medical innovation, develop new treatments for military health challenges, and contribute to advancements in civilian healthcare. Knowledge

spillover of research and development institutions enhances capabilities, improves patient outcomes, and ensures state-of-the-art healthcare for military personnel (Boyde et al., 2005). In addition, advancements such as artificial intelligence (AI), telemedicine, wearable devices, and digital health platforms can revolutionize the way healthcare is delivered to (military) patients. AI algorithms can assist in the early detection of diseases, improve diagnostic accuracy, and enhance treatment planning (Kamruzzaman, 2020). Telemedicine enables remote consultations and access to healthcare, especially for personnel stationed in remote or combat areas (Penninga et al., 2020). Given that the CMH is located in Utrecht, which may not be conveniently accessible for military personnel in terms of proximity to their homes, remote consultations offer an ideal solution. In addition, wearable devices can provide real-time monitoring of vital signs and enable proactive health management (Mishra et al., 2020).

Collaborations with software companies, such as ChipSoft, allow not only for the spillover of knowledge but also for the easier implementation of the obtained technological knowledge. Chipsoft is a Dutch software company specified in software for the healthcare sector and presents a valuable opportunity for the military healthcare organization. By partnering with Chipsoft, the organization can leverage their specialized knowledge and solutions in EHR systems, potentially leading to streamlined medical processes, improved data management, and enhanced interoperability between the different military healthcare organizations.

Lastly, the current political tensions resulting from the war between Ukraine and Russia can also be seen as an opportunity for the Military Healthcare system to better prepare for a potential conflict. By acknowledging this threat and taking it seriously, the Military Healthcare system could potentially allocate more budget and resources to ensure readiness and enhance its capabilities. This could include investing in additional medical personnel, advanced medical equipment, and specialized training to handle the specific challenges associated with war-related injuries and trauma. By proactively addressing the potential impact of conflict, the Military Healthcare system can strengthen its ability to provide effective medical support and care to military personnel in times of war.

4. Theoretical Background

In the following chapter, the theoretical background is described. To get a better understanding of how to approach the research aim described in Chapter 1.4, the Gap Analysis Model and the European Interoperability Framework are explained.

4.1 Gap Analysis

A gap analysis is the means by which a company can recognize its current state and compare it with its target state. By defining and analyzing these gaps, the management team can create an action plan to move the organization forward and fill in the performance gaps (Hayes, 2022). As the current and desired situation of interoperability within and outside DGO is not yet defined in the literature, the gap analysis will work as a tool to do so. Moreover, a gap analysis will help to map the current bottlenecks of different stakeholders in terms of interoperability. Thus, this research will perform a gap analysis to meet its research aim.

A gap analysis is conducted by performing five steps. Step 1 is to identify the current state, which can be done by both quantitative and qualitative research. Step 2 is to identify the desired future state. In this step, a company or organization must make specific, measurable goals to yield long-term success. Another way of identifying the desired outcome is to analyze what other market participants are doing. In the case of the DGO, civil hospitals could be used as a possible frame of reference. When the current and future states are defined, the difference between both states, also known as the gap, can be determined in step 3. In step 4, the barriers to closing the gaps between the current and future state are determined. Lastly, in step 5, activities to overcome these barriers can be identified. Also, hereby it is important to establish explicit goals to increase the likelihood of reaching the desired state. Figure 5 gives an overview of the steps that are essential to perform a gap analysis.

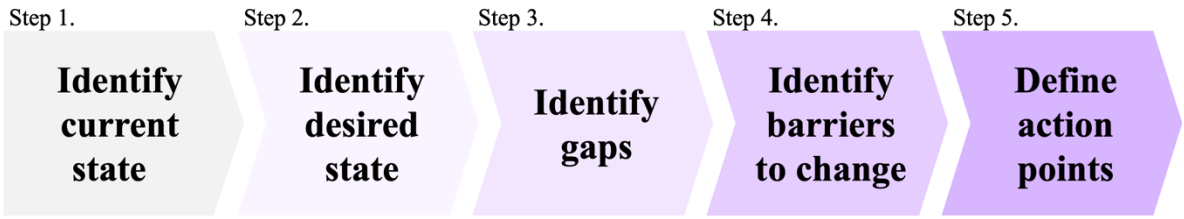

Figure 5. *Essential steps to perform a gap analyses.*

4.2 European Interoperability Framework

The European Interoperability Framework (EIF) is a strategic framework developed by the European Commission to promote interoperability among public administrations across the European Union (EU) (De Ganck, 2017). It aims to enhance collaboration, efficiency, and effectiveness in the delivery of public services by promoting the exchange of data and information in a standardized and interoperable manner.

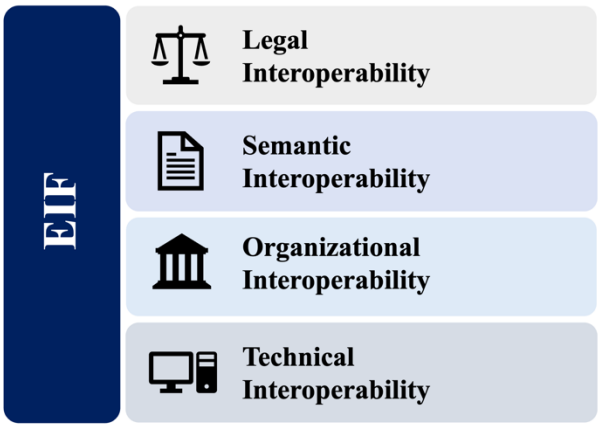

Figure 6. *The four layers of the European Interoperability Framework.*

The EIF outlines four layers of interoperability that are essential for promoting seamless collaboration and information exchange among European public administrations and are depicted in Figure 6. The first layer is **Legal Interoperability**, which focuses on aligning the legal and regulatory frameworks across different countries and organizations. It involves harmonizing laws, regulations, and policies related to data protection, privacy, security, and intellectual property rights. By establishing a common legal foundation, this layer facilitates the exchange and sharing of information across borders and jurisdictions.

The second layer is **Organizational Interoperability**, which aims to align processes, structures, and practices among various organizations or administrative units. It involves the establishment of common standards, guidelines, and procedures to enable effective cooperation and collaboration. This layer ensures that organizations can work together seamlessly by leveraging shared frameworks, methodologies, and governance structures. It also involves defining roles, responsibilities, and relationships to promote interoperability at an operational level.

Semantic Interoperability constitutes the third layer and focuses on enabling the meaningful exchange and interpretation of information between different systems or applications. It involves the use of common vocabularies, taxonomies, ontologies, and data models to ensure consistent understanding and interpretation of data. By harmonizing the

meaning and structure of data, semantic interoperability enables the exchange, integration, and reuse of data. It also facilitates automated processing, discovery, and comprehension of information across systems.

The fourth layer is **Technical Interoperability**, which deals with the technical aspects of interoperability. It encompasses the alignment of technical specifications, protocols, and interfaces to enable seamless communication and data exchange between different IT systems and applications. This layer includes aspects such as data formats, communication protocols, data exchange standards, APIs (Application Programming Interfaces), security mechanisms, and infrastructure requirements. By ensuring compatibility and interoperability at a technical level, this layer enables the smooth integration and interaction of different IT systems and applications.

5. Conceptual Framework

In the following chapter, the conceptual framework is described. The conceptual framework is a combination of the gap analysis and the EIF. Using the gap analysis model, this research can be divided into 5 steps whilst the EIF gives a segmented overview of all the barriers to closing the gaps. In this way, barriers are categorized. Categorizing the identified barriers is beneficial as it provides a structured understanding of the challenges, enables prioritization of efforts, and facilitates targeted interventions to address specific categories of barriers. This research applies the EIF to achieve this categorization, as the Military Healthcare sector can be seen as a miniature version of the European Union, comprising various diverse organizations. The EIF applies to assessing the interoperability of the military healthcare sector due to its structured approach to evaluating technical infrastructure, promoting standardization, and emphasizing collaboration among stakeholders. By leveraging the EIF, specific gaps and challenges regarding interoperability can be identified within the military healthcare sector. This framework provides a concrete methodology for mapping and addressing interoperability challenges, leading to improved healthcare outcomes for military personnel. By adopting the EIF model, this research acknowledges the significance of interoperability within the military healthcare context. In Figure 7, a schematic overview of the conceptual framework can be found.

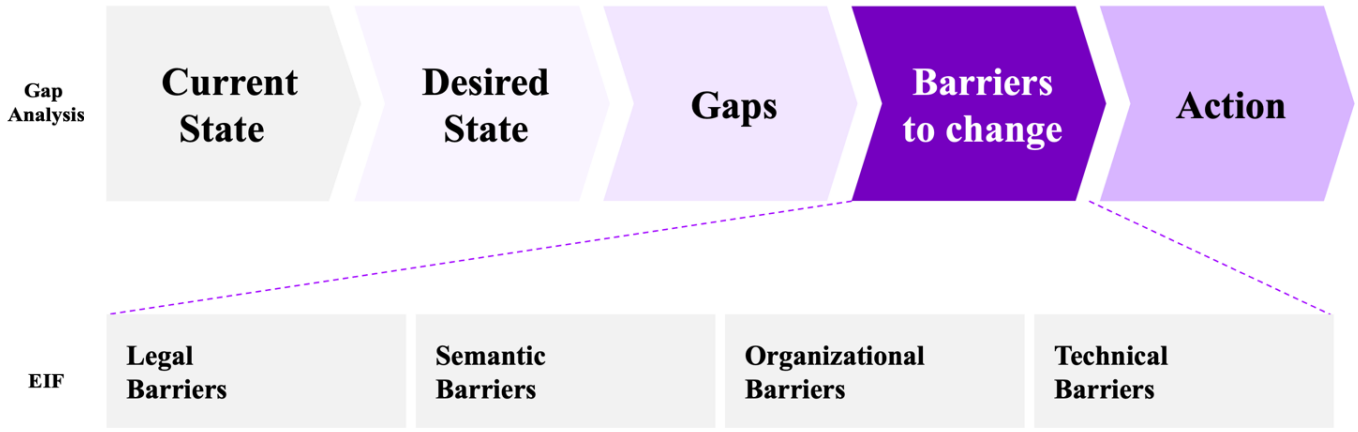

Figure 7. *The conceptual framework.*

This conceptual framework is operationalized during this research. Below, steps 1 to 5 can be found, where further details of operationalizing the conceptual framework are elaborated on. Chapter 6 will further explain how these steps are executed during this research.

Step 1

The first step of the gap analysis is defining the current state of interoperability within the Military Healthcare Sector. It is important to define the current state in a gap analysis to

understand the existing conditions, which establishes a baseline for measuring progress towards the desired state. As the current state is defined, it is important to involve many stakeholders to obtain a holistic view of the current situation.

Step 2

The second step involves gaining a comprehensive understanding of the desired state of interoperability for medical patient data. The Defense Vision (Defensie, 2020) already gives a global picture of its vision for the future. By incorporating the visions of different stakeholders into the Defense vision, a comprehensive outline of the envisioned future of interoperability can be established.

Step 3

In the third step discrepancies, shortcomings, and areas for improvement can be identified as gaps by examining the alignment between the current state and the desired state of interoperability within the Military Healthcare sector.

Step 4

In the fourth step the barriers to bridge the gaps are defined and segmented into the four layers of the EIF. This approach allows for a more comprehensive assessment, providing a clear and concise understanding of the key areas where significant challenges and bottlenecks exist within the Military Healthcare sector. It is crucial to understand the bottlenecks to determine the areas that require intervention and to progress towards the desired state of interoperability. Using the EIF when identifying the barriers leads to four different types of barriers. Firstly, legal barriers encompass all the obstacles related to laws and regulations, such as privacy and security, that impact interoperability efforts. Second, semantic barriers refer to the obstacles associated with language use and its interpretation. These barriers arise when there is a lack of common understanding, shared vocabulary, or standardized terminology within the healthcare domain. Third, organizational barriers encompass various challenges related to organizational business operations, including the lack of effective decision-making by leadership. Lastly, technical barriers refer to obstacles related to technology and the technical infrastructure. These barriers can include issues such as system compatibility, limited technical capacity, insufficient standardization of data formats, and outdated or incompatible software and hardware systems.

Step 5

In the last step, the identified gaps between the current state and the desired state are analyzed and prioritized. This involves evaluating the significance and impact of each gap on the overall interoperability goals. By prioritizing the identified gaps, organizations can focus their resources and efforts on addressing the most critical barriers first. This step helps in

developing a recommendation to implement specific strategies to bridge the identified gaps and move closer to the desired state of interoperability.

6. Methodology

In the following chapter, the research design and the study population are elaborated on. In addition, the sampling, data collection and data analysis are explained.

6.1 Research Design

A qualitative research design was used to achieve the purpose of this study, which is to map the bottlenecks of the different stakeholders regarding data interoperability within the military healthcare system and provide recommendations to overcome those challenges. Qualitative research provides insights into health-related phenomena and seeks to understand and interpret subjective experience and thus humanize health care (Cypress, 2015). Since there is limited literature on the state of interoperability within the Military Healthcare sector an exploratory approach, explained below, was seen as the most suitable research design for this case.

To gain insights into the objectives of this study, semi-structured interviews were conducted, and literature research was performed. In Table 1, an overview of the method that is used for each sub-aim is given. Semi-structured interviews prove valuable when dealing with complex issues, as they allow for the utilization of probes and spontaneous questions to delve deeper, enhance understanding, and clarify responses to inquiries (Wilson, 2014). This flexibility enables researchers to explore various dimensions of the topic and gain comprehensive insights. Therefore, this research employed the semi-structured interview approach to gather data. An interview guide is provided in Annex 1. The interview guide is written in Dutch, as the interviews were conducted in Dutch to avoid any language barriers.

Moreover, a combination of literary research has been chosen to attain a more comprehensive understanding. Currently, limited literature is available specifically addressing the DGO, apart from their official website and documents. However, fragmented information regarding the systems they employ does exist. This research serves, in part, to consolidate this information into a single report, thus contributing to a more cohesive understanding of the subject matter. Lastly, recommendations in terms of concrete actions will be provided to reach the desired state based on the results of steps 1 to 4 of the gap analysis and the insights of a data-centric expert.

Table 1. *Overview of research methods per sub-aim*

Sub-aim	Research methods
To map the current state of interoperability of medical patient data within the DGO	Literary research & Semi-structured interviews
To map the desired state of interoperability of medical patient data within the DGO	Literary research & Semi-structured interviews
To define the gaps between the current- and the desired state of interoperability of medical patient data within the DGO	Semi-structured interviews and by analyzing the differences between the current state and desired state
To define the barriers to bridging the gaps between the current- and the desired state of interoperability of medical patient data within the DGO	Semi-structured interviews
To provide recommendations to overcome the barriers to bridge the gaps between the current- and the desired state of interoperability of medical patient data within the DGO	Based on conclusions step 1-4 and by conducting an interview with an interoperability and healthcare standards expert

6.2 Study Population

For the semi-structured interviews, 10 relevant stakeholders that play a role in handling medical patient data within the DGO were interviewed. Inclusion criteria were: 1) employed or previously employed within the Defense organization, 2) encounters or encountered medical patient data. The inclusion criteria are chosen as the research focuses on the retrieval and transfer of medical patient data within the Military Healthcare Sector and the interviewees need to understand the complexity of the organization to provide insights. In Table 2, an overview of the functions of the interviewees is provided.

Table 2. *Functions of interviewees of semi-structured interviews.*

Interviewee	Function
I-1	Former Military General Practitioner at the Navy
I-2	Head of Day Treatment Department
I-3	Logistic Repatriations Coordinator & Head of Nursing Department
I-4	Nurse
I-5	Navy Soldier & Patient at CMH
I-6	Head of Military Dentistry
I-7	Surgeon at CMH
I-8	Surgeon at CMH & Medical Repatriations Coordinator
I-9	Internist and Anesthesiologist at CMH and UMCU
I-10	Employee MGGZ

6.3 Sampling

Sampling was done through snowball sampling and purposive sampling. Snowball sampling is when an interviewee is asked to name a potential new interviewee working in the same area. Purposive sampling is when the interviewees are selected based on the qualities and knowledge they possess. For the interviews, purposive sampling was performed by contacting DGO employees via LinkedIn and contacting the CMH secretary. As inclusion criterium 1 holds that the interviewee should be employed within the Defense organization, snowball sampling is very efficient. By contacting the CMH, other DGO employees were suggested for an interview. In addition, by conducting interviews in person, the opportunity for on-site referrals to additional interviewees was utilized. This allowed for the application of snowball sampling techniques, which encompassed both online and offline referrals.

6.4 Data Collection

Semi-structured interviews were conducted to investigate the current and desired state of interoperability, and the barriers to close the gaps between them. Interviews took between 20 and 40 minutes. Before the interviews, the participants were informed about how the interview would take place and what was done with the data after the interview. When the interviewee agreed the interviews were recorded. After conducting the interviews, the recordings were deleted, and the transcripts were numbered to secure the privacy of the interviewees. To conduct the semi-structured interview, an interview guide (Annex 1) was used. The topics of the interview were based on the conceptual framework provided in Chapter 5 and are presented in the interview guide. Using this interview guide ensured that the same topics were discussed during each interview to reduce bias (Dallas et al., 2005).

6.5 Data Analysis

The data analysis process involved the interpretation of the collected data from the semi-structured interviews. All interviews were transcribed verbatim to improve reliability and reduce data loss. Then, the transcripts were coded using Atlas.ti. To ensure participant anonymity, unique identification numbers (I-N) were assigned, and all personal information was removed. The analysis adopted an inductive coding approach. Inductive coding refers to a data analysis process whereby the researcher reads and interprets raw textual data to develop concepts, themes or a process model through interpretations based on data (Corbin & Strauss, 1990). As this research carries no premeditated hypothesis, inductive coding is the best approach. Inductive coding provides the flexibility to capture the unique perspectives and experiences of the participants without imposing preconceived notions or biases. By using

inductive coding, the analysis remains open to new ideas and unexpected findings, enhancing the richness and depth of the research findings (Corbin & Strauss, 1990). Within inductive coding approaches, this research applies thematic coding as it facilitates the identification of key themes within the data. Thematic coding is the preferred technique for this research as it allows for the use of the EIF while also allowing for the inclusion of new codes when necessary. In this way, the results will be divided into legal, organizational, semantic, and technical segments.

6.6 Ethical Considerations

Confidentiality was guaranteed by deleting the recordings and personal information in the transcripts. The data will be destroyed two months after the report is submitted to the University of Utrecht.

7. Results

In this chapter, the results from the literary research and semi-structured interviews are presented. The results are provided by adhering to the gap analysis model. Therefore, first, the current and desired state of medical patient data exchange is presented. Subsequently, the gaps between the current and desired state and the barriers to bridging the determined gaps are described.

7.1 Current State of Patient Data Exchange

The current state of patient data exchange is determined by researching the available literature and by conducting semi-structured interviews.

7.1.1 Literature Results

As previously mentioned, there is a large research gap when it comes to the Military Healthcare sector. For the current state of interoperability within the DGO, literature on organizations that are similar to the DGO cannot be used as a reference framework as it is important to understand the exact situation and not a similar one. However, an overview of the little literature that is available is given in this Chapter.

Currently, multiple organizations within DGO use the same Electronic Health Record (EHR) system. Since 2022, first-line healthcare, the CMH, and the MRC, all use *HiX* as EHR, all implemented by the company Chipsoft (*Militair Revalidatie Centrum Aardenburg start met EPD HiX*, 2022). Chipsoft explains the *HiX* EHR as a system that aims to streamline workflows and enhance communication among healthcare professionals. It supports seamless data exchange and interoperability with various healthcare systems, facilitating a holistic view of patient information. This enables healthcare providers to make informed decisions and deliver personalized, high-quality care (*HiX Het Meest Innovatieve ZIS EPD*, n.d.).

In addition, given that one of the pillars of the European Interoperability Framework is Legal interoperability, it is crucial to examine the current legislation within the Netherlands regarding the interoperability of data. As laws change over time it is important to consider the latest updates. Since the first of July of 2023 the law on electronic data exchange in healthcare (WEGIZ), '*Wet elektronisch gegevensuitwisseling in de zorg'*, has come into effect (*Wet Elektronische Gegevensuitwisseling in De Zorg (35.824),* n.d.). This law aims to achieve full interoperability in the electronic exchange of healthcare data by mandating electronic data exchange and providing guidelines for how data should be exchanged. It emphasizes standardized formats and protocols to facilitate data sharing independently of specific electronic

infrastructures. Importantly, the law does not impose an obligation on healthcare providers to exchange data but focuses on determining the electronic means of data exchange. It also addresses legal requirements, such as consent, privacy, and medical confidentiality, ensuring secure and standardized data sharing in compliance with existing laws.

Moreover, since 2020 every Dutch citizen must have digital access, free of charge, to their medical information ("Medisch Dossier Inzien," 2023). This can be achieved through a Personal Health Environment (persoonlijke gezondheidsomgeving, PGO), which is a website or app where individuals can gather, manage, and share their own health information. Consequently, all medical information of Dutch patients is shared and saved through digital platforms. This indicates that The Netherlands has been engaged in the digitalization of healthcare for a considerable period.

7.1.2 Interview Results

Based on the literature research and insightful interviews conducted, Figure 6 presents an overview of the communication channels utilized by diverse stakeholders, along with the specific software systems employed by each stakeholder. All grey dotted lines indicate information exchange mentioned by interviewees. Thus, when there is no dotted line between two organizations it cannot be concluded that there is no communication between these organizations. Thereby, the red 'I-N' indicates that interviewee 'N' had a critique regarding the manner of information exchange between the indicated organizations. According to the interviewees, information exchange between organizations where no red 'I-N' is indicated, is going well. Moreover, the software that is used by each organization is indicated by the oblique font. In addition, different ways of communication means are used such as using online software, faxing, calling, and e-mailing according to the interviewees. The usage of the different communication means is further elaborated on in this Chapter. However, the absence of mention regarding certain communication means does not necessarily imply that other methods are not utilized in the exchange of information.

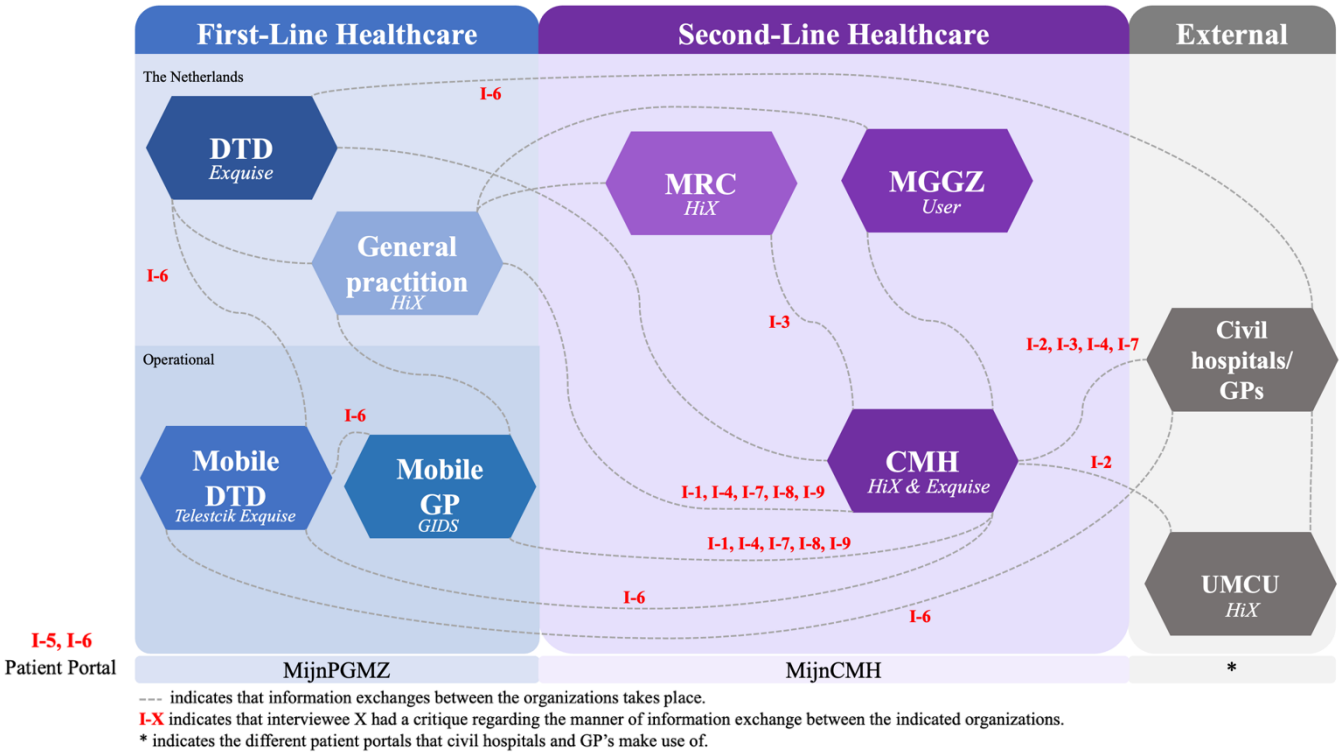

Figure 6. *Communications channels between different organizations within the Dutch Military Healthcare system.*

This visualization encapsulates the extensive web of information exchange within the studied context. In principle, military personnel are obligated by their healthcare insurance to seek medical care within the DGO. As the CMH has a strong relationship with the UMCU, treatment that is received in the UMCU also falls under Military Healthcare. However, the complexity of the communication web further expands due to the occasional admission of military patients to civilian hospitals, particularly when they require immediate medical attention following an accident close to a civilian hospital. According to the interviewees, the diversion of a military patient to a civilian hospital, except for the UMCU, is referred to as *"weglek."* Additionally, the various organizations within first- and second-line healthcare frequently seek support in the form of second opinions from specialists within the civilian healthcare system. Moreover, the interviews have revealed that operational circumstances in military healthcare often involve collaborations with military personnel and doctors from other NATO countries. Medical information exchange of the military personnel of other NATO countries is not exchanged within the Dutch Military Healthcare sector. However, doctors from other NATO countries do have to exchange medical information of the Dutch military personnel to the Dutch Military Healthcare system sometimes using their computers and software. This adds another layer of complexity to the communication web of the military healthcare system. Thus, the scope of data exchange for military patient data is enormous.

As shown in Figure 6, different software systems are used within the Military Healthcare system. As mentioned in the literature results, CMH, MRC, and GPs use *HiX*. However, the CMH uses *HiX*, and the MRC and GPs use Defense-*HiX* (D-*HiX*). In D-*HiX* the HiX software is used as a foundation but there are some alterations to the software that are specifically for the Defense organization. However, GPs under operational circumstances use *GIDS*, which is not compatible with *HiX*. In addition, the DTD makes use of a specialized software package carrying out the administration of dental practices, called *Exquise*. Oral and Maxillofacial surgeons also use *Exquise* in the CMH, ensuring that maxillofacial surgeons and dentists have access to the same patient records from their respective workstations. Dentists under operational circumstances have access to an offline version of *Exquise* using a stand-alone laptop and a Telestick. The Telestick is a form of a USB stick on which the software can be downloaded. In this way, the dental information of patients joining the operation will be loaded in *Exquise* on the Telestick. The Telestick will be plugged into the stand-alone laptop that is used during the operation. Lastly, the MGGZ uses *User* as EHR, which is also not compatible with *HiX*. Since information about the mental state of a military patient is entirely confidential, other organizations within the DGO do not need to have visibility into this file. Communication only occurs with general practitioners and/or the CMH when referrals are made. Thereby, all the MGGZ organizations in the Netherlands can access all files through *User*, if the healthcare provider has appropriate access rights.

For patients there are also different platforms to access information about their healthcare. For care that military patients receive within first-line healthcare MijnPGMZ is used. For second-line healthcare, patients use MijnCMH or MijnUMCU as some surgeries or treatments take place at the UMCU. In addition, in the case of a ‘weglek’ the patient uses the portal of the particular civil hospital.

The current communication channels hold multiple bottlenecks regarding the efficient exchange of medical patient data, as indicated by the red interviewee code in Figure 6. These bottlenecks can also be defined as the gaps that need to be bridged to get to the desired state of medical patient data exchange.

7.2 Desirable State of Patient Data Retrieval and Transfer

The desired state of patient data exchange is determined by researching examples where interoperability is realized and by conducting semi-structured interviews.

7.2.1 Literature Results

Full interoperability of medical data has yet to be achieved within the healthcare sector, including Defense health organizations. However, interoperability is a key focus worldwide and looking at other examples in similar industries might help to get a broader picture of the possibilities. Therefore, in this chapter, several examples of ongoing developments in interoperability are explored, aiming to provide a comprehensive perspective on the desired state of interoperability.

In the Netherlands, interoperability is placed to be highly important, as evident in the development of the Accelerated Information Exchange Program for Patients and Professionals (Versnellingsprogramma Informatie-uitwisseling Patient en Professional, VIPP) and the MedMij initiative. The VIPP program initiated by the Dutch government aims to accelerate the exchange of information between patients and healthcare professionals through digital means (Ministerie van Volksgezondheid, Welzijn en Sport, 2022). In addition, the MedMij inititiative is a Dutch national program that aims to establish a standardized infrastructure for the secure exchange of personal health data between individuals and healthcare providers (*Wat Is MedMij? - MedMij*, 2022). It enables individuals to gather their health information from different sources into a PGO and securely share it with authorized healthcare providers and applications.

Another interoperability innovation is Fast Healthcare Interoperability Resources (FHIR), which is an international standard that is intended to facilitate interoperability between separate systems. FHIR describes data formats for clinical and administrative healthcare data, known as resources, and is the foundation of the Dutch VIPP and MedMij initiatives. The goal of FHIR is to become a commonly used standard for use across multiple health IT platforms. By providing the standard, all healthcare providers write and read “the same language”, which increases the efficiency of data exchange (Kiourtis et al., 2019).

Estonia is a frontrunner in the field of interoperability, which they have achieved through the innovative system known as X-road. X-road is an advanced and secure information exchange infrastructure that enables seamless data sharing among various government agencies, including healthcare institutions. What makes X-road so revolutionary is that it is a decentralized system that does not rely on a central database. Instead, it functions as a secure platform on which different organizations can host and manage their own data. This enables information exchange without the need for complex data conversions or copying data between different databases (*X-Road - e-Estonia*, 2023). Thus, medical information cannot only be exchanged between medical institutions in a safe way but also with for example public insurance organizations or with police in case of an accident.

Another frontrunner in the interoperability of medical patient data is Australia. The Australian Digital Health Agency (ADHA) implemented the My Health Record system, which is a national electronic healthcare file (Hollo & Martin, 2021). My Health Record enables individuals to store and share their health information centrally with healthcare providers. The system is designed to promote interoperability and grant healthcare professionals' access to relevant medical data, regardless of their location within the country.

7.2.2 Interview Results

As the literary research holds some successful examples of healthcare interoperability all interviewees were questioned about their envisioned ideal future regarding the exchange of medical patient data. In this way, gaps between the current state and the desired state can be defined.

Figure 7 illustrates the desires of the interviewees regarding information exchange within the Military Healthcare system, along with the corresponding frequencies of these desires. The desires of the interviewees can be divided into two categories: 1) desires about information exchange between employees within the military healthcare system, and 2) desires about information management of military patients. First, the different desires for information exchange between employees of the military healthcare sector show a lot of overlap. Overall, interoperability is desired, but the degree to which certain scopes of interoperability are desired differs. Most desired is interoperability within first- and second-line healthcare and under operational circumstances. Three interviewees indicated that they desire interoperability between all Dutch hospitals. Taking it a step further, one of the interviewees expressed a vision for global interoperability. This means that when military personnel are abroad for any reason and requires emergency hospitalization in that respective country, their medical information remains accessible. Additionally, when the patient returns to The Netherlands, information regarding their treatment abroad is also available.

In this way, the location of operations will not play a role anymore in exchanging medical patient data. The quote of I-7 illustrates the desire to realize worldwide interoperability by providing wearable devices to patients which contain their medical history.

> *'An ideal world for me is that all hospitals worldwide are interoperable. I think this may not be possible, but it can be accomplished through the patients themselves: Everyone has a device containing their medical information - a 'wearable'.'* (I-7)

This quote also illustrates the desire for wearables. The term 'wearable' is used to refer to a device that individuals carry, providing real-time medical information about the individual. Two interviewees indicated that they see a future with wearables, making healthcare information exchange easier for healthcare providers and patients. One interviewee also highlighted the desire for health monitoring by a wearable. In this manner, both the patient and the care provider have access to real-time medical patient data. This shows how the interviewees believe that interoperability is interrelated to convenience for patients. The desire for I-9 to provide more flexibility for patients also shows the interconnectedness of interoperability and patient convenience.

> *'I envision a world where test results are instantly accessible from anywhere around the globe, providing our military patients with greater flexibility to undergo health tests regardless of their location.'* (I-9)

Lastly, two interviewees stated the desire for patients to have one tool or application to find all their medical information. Again, this desire is related to the desire for interoperability as such a tool or application will require interoperability between healthcare organizations.

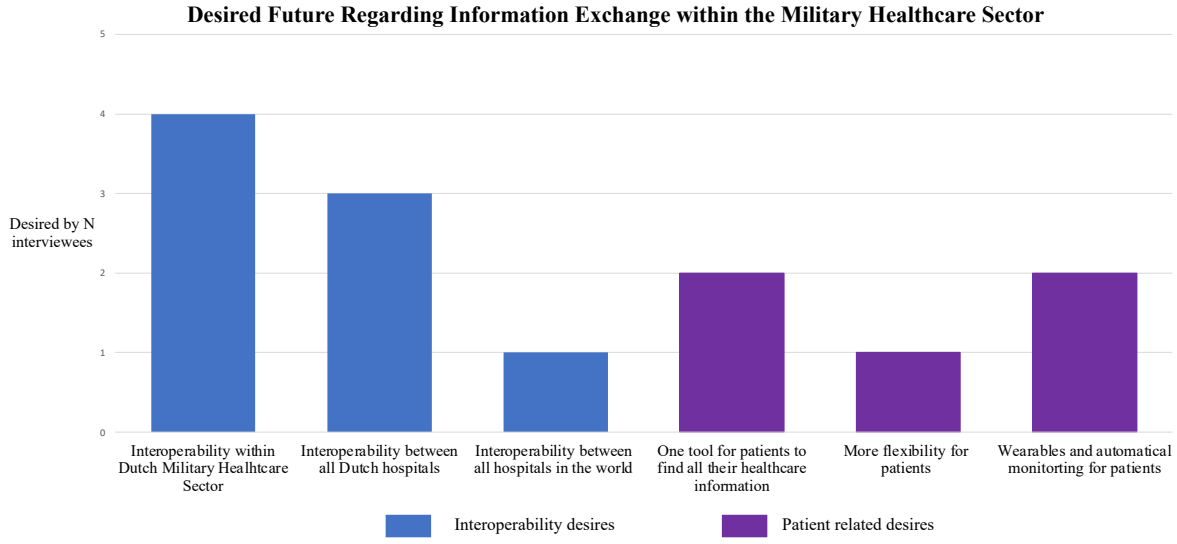

Figure 7. *Overview of the desires of the interviewees regarding information exchange within the Military Healthcare Sector and the frequency of these desires.*

7.3 Gaps Between Current and Desirable State and Barriers to Close the Gaps

Based on the semi-structured interviews the overview in Figure 6 of the current state of medical patient data exchange within the Military Healthcare sector is created. As mentioned, the current state contains many bottlenecks regarding information exchange. These bottlenecks

are gaps that need to be bridged to achieve the desired state of information exchange within the Military Healthcare sector. In this Chapter, the most significant gaps are explained and the barriers to closing the gaps according to the interviewees are elaborated on using the four layers of the EIF.

7.3.1 Information Exchange Gap between GPs and the CMH

The first gap considers the information exchange between military GPs located in the Netherlands and the CMH. The lack of efficient information exchange between both organizations is recognized by half of the interviewees. The inefficiency primarily lies in the process of referring patients from the GP to the CMH, according to the interviewees. Within the DGO, general practitioners are unable to send automatic referral letters to the CMH due to system limitations. In contrast, civilian general practitioners can effortlessly send referrals with automatically included relevant information to the receiving hospital. Even though the CMH and GPs both use *HiX* software, it is not possible to access each other's medical records. Consequently, military general practitioners are obligated to manually extract and transfer information from the medical records into a letter, which is a time-consuming process. As a result, these letters often become lengthy and require significant effort to locate relevant information, daily consuming valuable time for physicians at the CMH.

Aligning the thoughts of the interviewees by asking them why they think this gap exists with the four layers of the EIF, indicates that the barriers to bridging this gap lie in all four layers of the EIF. Legally, the establishment of efficient information exchange between GPs and CMH faces significant challenges. The interviewees highlighted that despite efforts by the Dutch government to facilitate interoperability through a referendum, the majority of the Dutch population voted against it, hindering progress in this area. However, it is unknown to which referendum the interviewee is referring to as there is no such referendum found in the archives of the Dutch Government. In the semantic layer, inefficiencies are also indicated by the interviewees. As mentioned, there is a discrepancy between the information some GPs think is necessary to send to the CMH and the information that is relevant for the CMH physicians. Moreover, one interviewee indicated the organizational barrier to bridging this gap, which can be inferred from the quote below.

> *'What I believe is that within the Defense organization, they always want a 'special sandwich', so to speak. This leads to prolonged processes because nobody truly makes a decision.*' (I-1)

In this quote, the interviewee highlights the lack of decisive action, which hampers innovation, particularly in the development of an interoperable healthcare system. According to the interviewee, this is the result of the desire for a customized solution even when a customized solution might not be necessary. Lastly, there is a technical barrier that prevents GPs and the CMH from accessing each other's patient files, despite utilizing the same software system, *HiX*. This is a result of different forms of registration in the EHR, what indicated the need for information standards.

7.3.2 Information Exchange Gap between MRC and CMH

As described in the current state, the CMH faxes relevant patient information to the MRC. Faxing information requires multiple actions and raises concerns about the intended recipient, as the fax machine is in a shared space, according to the interviewee. Additionally, this method poses significant privacy risks, as anyone with access to the fax machine can also access the patients' confidential information. Barriers to bridging this gap are both organizational and technical. The barrier is organizational in nature as it has become a habit for MRC employees to rely on faxing, finding it convenient despite the aforementioned concerns. Consequently, effecting change is challenging since the MRC itself does not perceive the need for it. Additionally, from a technical standpoint, it is not currently feasible for the MRC to access the CMH patient records and vice versa.

7.3.3 Information Exchange Gap between Operational Practitioners and the CMH

The second gap considers the lack of efficient exchange of medical patient data between the CMH and practitioners under operational circumstances. To bridge this gap, legal, organizational, and technical barriers need to be bridged. Legally, since the information exchange from operational circumstances can be from everywhere around the world meaning that the privacy and security laws of that country need to be considered. This is only the case when the facilities of the host country are used. If practitioners use the Dutch systems in other countries, the Dutch laws apply. However, this depends on the available facilities during the operation. In the organizational layer, there is a barrier to getting military patients from the operational area back to the CMH. This is performed by a Patient Movement Request (PMR) and requires extensive communication between many stakeholders, such as doctors from the receiving and sending hospitals, pilots, and logistics coordinators. Currently, this is carried out through the phone and by sending the patient record with the patient on paper. This paperwork is received by the physician that also receives the patient in the CMH. Extracting relevant information from the paper patient record is time-consuming, even when sometimes time to acy

is limited. In addition, the request is also a logistic challenge as sometimes many vehicles are required to move the patient. Thus, the organization is very inefficient without interoperability. Lastly, there is a technical barrier to bridge the gap. When military practitioners make use of the Dutch operational software system, *GIDS*, there is technically no possibility of interoperable information exchange with the *HiX* system at the CMH or GPs in the Netherlands. In addition, sometimes the Dutch Military is dependent on computers and software systems in the country where the operation takes place. These systems technically do not allow information exchange with the CMH and GPs in the Netherlands.

7.3.4 Information Exchange Gap between DTD and Operational DTD

Under operational circumstances, not only are dental photographs unable to be shared, but textual information also cannot be directly transferred to the *Exquise* software of the DTD in the Netherlands. The barrier that needs to be bridged is both organizational, as well as technical. Technical since there is simply no connection to the 'live' version of *Exquise* in the Netherlands. Organizational because the stand-alone laptop that is available under operational circumstances needs to be brought back to the Netherlands to exchange the information retrieved during the operation. This is an organizational challenge as sometimes the laptop is still in the operational area whilst the military patient is already back in the Netherlands. In that case, information retrieved during the operation cannot be synchronized with the DTD while the patient is already using the facilities of the DTD in the Netherlands. Moreover, sometimes the laptop arrives after the military patient and therefore does not contain information about the patient from the part of the operation before the laptop arrived.

7.3.5 Gap in Exchange of dental photographs

The fifth gap considers the exchange of dental photos between the DTD in the Netherlands, the mobile DTD, and civil hospitals. The practice of dentistry includes taking numerous dental photographs, which serve as the basis for many decisions. However, the exchange of these photographs is only possible between the DTD in the Netherlands and the CMH because they both utilize the same *Exquise* system. However, the exchange of these dental photographs is not possible under operational circumstances and with civil hospitals as a result of technical barriers. The offline version of *Exquise* that is used under operational circumstances is technically not able to share these photographs. Moreover, *Exquise* is not compatible with the systems that are used in civil hospitals and as a result, the dental photographs cannot be shared.

7.3.6 Information Exchange Gap between Hospitals in the Netherlands

A challenge that affects both military healthcare and civilian healthcare is the absence of seamless communication between various hospitals in the Netherlands, including the CMH. This communication barrier hinders effective collaboration and information exchange, leading to difficulties in providing comprehensive care and coordination across the healthcare system. This is a complex cap as it involves many stakeholders. Therefore, barriers to bridging this gap lie in all four layers of the EIF. Regarding the legal layer, the barrier is similar to the barrier of the first gap, as the referendum requires consent from patients to exchange information between hospitals. This legal requirement adds a layer of complexity and slows down the process of sharing patient data across healthcare institutions. Semantically, there is also a barrier since you encounter a multitude of different doctors and nurses throughout the Netherlands. An interviewee mentioned the following:

> *'It depends on the generation and specialization of how employees deal with information standards.'* (I-2)

This quote highlights that not everyone consistently adheres to the same information standards for communication. Information standards refer to established guidelines and protocols that define the format, structure, and content of health-related data to ensure consistent and interoperable communication and exchange of information among healthcare providers and systems. Thus, not adhering to the same information standards can lead to miscommunications. In addition, a notable obstacle within the organizational layer is the monopoly of ChipSoft according to one interviewee, which gives the company considerable bargaining power towards buyers. This situation hinders the willingness of ChipSoft to make the necessary adjustments for the CMH and other hospitals, preventing the implementation of a unified system across all hospitals in The Netherlands. This situation arises due to hospitals opting against implementing a unified system as it does not align with their specific requirements and needs. Lastly, this also contributes to the technical barrier, as the lack of a standardized system among hospitals in the Netherlands hinders the smooth exchange of information and impedes interoperability.

7.3.7 Central Patient Portal Gap

Lastly, there is a gap in facilitating a central patient portal where patients can find all their appointments and results. As shown in Figure 6, there are currently separate portals for first- and second-line healthcare. In addition, when 'weglek' takes place, the information about

admission in the civil hospital will not reach the portals of the first- and second-line healthcare. The fragmented healthcare information of patients can lead to confusion for the patients and is not user-friendly. According to one interviewee, the process of obtaining medicines from the CMH involves using MijnPGMZ instead of MijnCMH. The following quote highlights the resulting confusion from this situation:

> *"I find it very confusing when to use MijnPGMZ and when to use MijnCMH. I do not understand why the DGO does not provide just one portal."* (I-5)

The barriers to bridging this gap are mostly technical, there is just no platform available that centralizes the medical history and future appointments of the first- and second-line healthcare. However, according to one interviewee, the DGO is hesitant to make significant changes to patient portals to avoid adding more complexity for patients who are already familiar with the current system. However, this approach contributes to the existing challenges faced by patient portals in the military healthcare system.

To conclude, there are still numerous barriers to overcome in closing the gaps and achieving the desired state of information exchange. An overview of the gaps and the barriers linked to these gaps is provided in Figure 8. In addition, a more detailed overview is provided in Table A.1 which can be found in the Annex. Figure 8 and Table A.1 illustrate that the barriers primarily exist in the technical layer, while the semantic layer poses fewer obstacles. Additionally, several barriers in the legal and organizational layers need to be addressed and overcome.

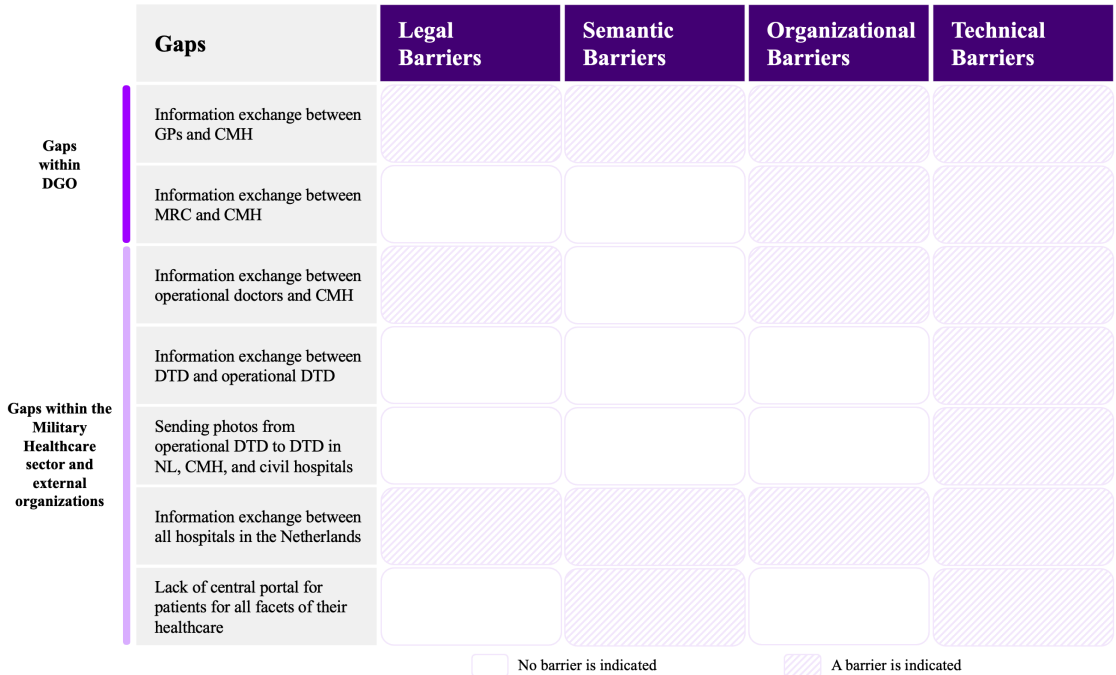

Figure 8. *An overview of the existing gaps and barriers regarding interoperability of medical patient information.*

8. Discussion

In this Chapter, the key findings of this research are stated and reflected upon. In addition, the strengths and limitations are addressed. Lastly, recommendations for the DGO and Accenture are provided.

8.1 Key Findings

This research aimed to identify and analyze the key barriers hindering the Military Healthcare sector from reaching the desired state in terms of the efficient exchange of medical patient data. The desired state of patient data exchange includes interoperability within the Military Healthcare sector, between Dutch hospitals, and potentially globally. Interviewees expressed desires for wearables, real-time data access, and a centralized tool or application to access all medical information. Based on the conducted interviews and the limited available literature, it is evident that there are still many inefficiencies in the exchange of medical patient data. Not only healthcare providers but also patients face challenges within the current system of Military Healthcare. The primary inefficiencies in the exchange of medical patient information are found in operational healthcare. Dentists, general practitioners, and the CMH face significant challenges when it comes to exchanging information with operational care. Additionally, the digital exchange of medical data between military general practitioners and the CMH is also challenging. Moreover, it can be concluded that sharing information with civilian hospitals is also highly problematic. Furthermore, there is currently no centralized portal where all patient information is stored.

Barriers to overcoming these challenges were primarily found in the technical layer of the European Interoperability Framework as an interoperable system or unified use of systems is simply not realized yet. The second most important barrier to overcome is the organizational barrier, which consists primarily of logistic inefficiencies as a result of the desire for the "special Defense sandwich" by leadership. This statement indicates that, according to the interviewee, the Defense sector consistently seeks customized solutions as they believe to encounter unique situations. Third, the monopoly of ChipSoft affects decision-making regarding systems and in turn, maintains the technological barriers. Fourth, there is a Dutch law that impedes interoperability following a referendum, creating a legal barrier. Lastly, there is a semantic barrier that relates to how different employees note and send information in terms of information standards and what they find relevant.

8.2 Reflection on Key Findings

This study revealed a strong desire for interoperability within the Military Healthcare sector, and ideally, extending to all civil hospitals and even all hospitals worldwide. Since most of the interviewees reported that they experience difficulties with information exchange under operational conditions, it is uncertain whether an interoperable system within the Dutch Military Healthcare system would be sufficient to eliminate these gaps. As mentioned, achieving an interoperable system would require the DGO to always have access to its own facilities under operational conditions, which is not the case. Therefore, to achieve total interoperability in the Military Healthcare sector, the desire for interoperability needs to be expanded to all hospitals and operational facilities in the world. In this way, the facilities and country of the operation are no longer obstacles to interoperability. However, politically speaking, this is unrealistic to achieve due to the diverse interests of different countries. Additionally, there are significant challenges posed by the vast array of laws and regulations in place. Hence, the concept of a wearable device emerges as a potentially more pragmatic solution to achieve interoperability since a wearable does not bring complex accessibility issues. In this way, the patient is always in control of whom has access to their medical data. This is way more complex in the case of healthcare providers wanting access to medical information through different platforms. For the Defense organization, the data of patients is regarded as more sensitive compared to the data of civilian patients in the civil healthcare system. This poses a huge challenge as there has to be found a balance between protecting the medical data of military personnel and establishing an efficient healthcare sector. Therefore, a wearable could facilitate this balance as all data of healthcare institutions is connected but only the patient has direct access.

In addition, the Military Healthcare sector presents an ideal group to initiate a pilot program with wearables, given its composition of young and physically fit individuals who are generally more receptive to innovations. Conducting a pilot program within military healthcare is easier to monitor and organize than a pilot program across the entire civilian health sector.

On the other hand, as mentioned in Chapter 3, a threat to the DGO is the limited budget. The DGO is completely dependent on the Dutch government in terms of budget and budget allocation. As the DGO is a governmental organization, every decision that is made must be approved by the government. Investing in interoperability would require a lot of money, especially with such a large scope. Interoperability cannot be achieved through half-hearted efforts. A fully efficient system for patient data exchange requires the participation of all organizations involved, including patients themselves. This represents a significant change.

While this study has already identified several barriers to this transformation, it is anticipated that numerous additional barriers will arise. The barriers identified in this study are primarily technical. However, as demonstrated by examples from other parts of the world, as described in Chapter 7.2.1, technically interoperability is already achievable. Thus, the numerous technical barriers indicated by the interviewees should not be confused with the actual underlying problem, which lies more in the other layers of the EIF. From an organizational and legal standpoint, it is a challenge to make these technical adaptations.

From the organizational and semantic barriers, it becomes evident that change management will be a challenge, as it involves the behavior of people to change. In many cases, people themselves can be the main obstacle within various barriers, even if it is not immediately apparent. For instance, the continued use of fax machines by the MRC is not due to a lack of alternative options but rather because individuals believe it to be more convenient. The real barrier here is the resistance to change rather than the fax machine itself. Moreover, the gap in the exchange of dental photos from the DTD to other civil hospitals is caused by a technical barrier as stated in the qualitative research. However, given the long-standing technical feasibility of transmitting photos, it raises the question of where the actual barrier lies. This question is suggested for future research.

In addition, one interviewee raised concerns about the potential difficulty some patients may face in adapting to new technologies. However, the relatively young patient population of the DGO should be seen as an opportunity to implement new technologies and thereby adhere to the desires of the interviewees to establish a centralized patient portal. Nevertheless, it is important to consider that the centralization of a patient portal is not achievable without interoperability within healthcare organizations and vice versa. In the VIPP interoperability within healthcare organizations in the Netherlands is central. However, as part of the program, start-ups are stimulated to create PGOs. This leads to different healthcare organizations within the Netherlands having different PGOs developed instead of a central PGO. Therefore, the program should manage the development of PGOs by centralized governance.

The legal barrier that was mentioned by interviewees is a law that hinders information exchange between hospitals. According to an interviewee, there was a referendum that tried to repeal this law, however, the Dutch public voted against the referendum. However, this referendum cannot be found online. In addition, given the recent development of the WEGIZ law, the previous law is also no longer applicable. As this law came into effect on the first of July 2023, it did not apply when the interviews were held since it occurred in June 2023. Therefore, since the first of July 2023, the legal barrier may no longer exist. At the same time,

this new law shows that the Dutch government is actively pursuing an interoperable healthcare system. This can be seen as an opportunity for the Military Healthcare sector as this gives an incentive to the Minister of Defense to allocate additional budget to the DGO.

Another important point raised by an interviewee is their belief that ChipSoft holds a monopoly in the Netherlands. This is seen as a barrier to change because ChipSoft holds significant bargaining power towards buyers, which reduces their incentive to invest further in the product. Therefore, the interviewee believes that systems are not adequately tailored to the needs of the DGO, as doing so would incur additional costs for ChipSoft. However, it is important to note that there is another company in the Netherlands, EPIC, which also provides EHRs. This means that decision-makers within the DGO should not underestimate their bargaining power and options in this regard. As previously mentioned, the DGO has the potential to serve as a role model and lead the way in implementing changes towards interoperability. However, the feasibility of this approach is contingent upon political considerations of the Ministry of Defense and the availability of adequate budgetary resources for implementation. On the other hand, the DGO can also use politics as a tool to push for the additional budget by showcasing the value of interoperability and the value of being ahead of competitors in terms of digital innovation.

8.3 Strengths and Limitations

This study possesses both strengths and limitations that should be acknowledged. One methodological limitation of this study is that the report was written in English while the research was conducted in Dutch. This raises the possibility of information loss during translation. To mitigate this, the researcher diligently translated the collected codes into English before compiling the report. Another limitation is the use of semi-structured interviews, where varying probe questions were posed to different interviewees. As a result, the generalizability of the findings may be compromised.

Limitations of this study include the small sample size for the semi-structured interviews. Due to the short period of this research, some groups of stakeholders are not interviewed which could lead to missing important information. In addition, from some organizations within the DGO, only one person was interviewed. This is a limitation because it may not capture the full range of opinions and experiences within the organization. It limits the ability to assess variability, nuances, and diverse perspectives that may exist within different departments or hierarchical levels. Additionally, relying on a single interviewee may introduce subjectivity or bias, potentially compromising the objectivity and robustness of the findings.

Moreover, there was only one interviewee that was a former employee at the DGO. This interviewee had a critique on the leadership decision-making culture within the DGO as a result of Defense leadership always wanting a 'special sandwich' slowing down innovation. A limitation of this research is that only one former employee is interviewed as current employees might not express a critique of their leadership, as they might be afraid to compromise their job. Therefore, it is not possible to draw a definitive conclusion regarding the existence of a barrier to change as a result of a specific mindset in leadership. Further interviews with former employees are required to make a comprehensive determination in this regard.

Even though these limitations, there are several strengths of this research. First, many different stakeholders within the DGO are interviewed for this research. This provided a comprehensive understanding of the organization and, consequently, a complete picture of the key barriers to achieving the desired state of patient information exchange.

Secondly, the semi-structured approach of the interviews allowed additional information to be obtained regarding the exchange of medical patient data. Using a systematic approach might have prevented the gathering of this information. This additional knowledge may be seen as additional relevant information to help with the development of a strategy to change the current state of interoperability.

Third, applying the European Interoperability Framework to segment the barriers strengthens this research as it allows for a detailed analysis of each barrier its characteristics and impacts, enabling targeted strategies and prioritization of efforts for effective intervention. In addition, it enhances communication and reporting by providing a structured framework for discussing findings and sharing insights with stakeholders.

Lastly, the unavailability of comparable studies in the literature is a strength of this study. Therefore, the current study fills the research gap by giving an overview of the current and desired state of interoperability, the gaps between the current and the desired state, and the barriers to closing the gaps regarding the exchange of medical patient data within the Military Healthcare sector.

8.4 Recommendations

The healthcare sector is at the dawn of a significant digital transformation, making it crucial to execute the initial steps meticulously and comprehensively. Bearing this in mind, along with the findings of this research, the following recommendations are proposed. It is advised to implement the recommendations in the following order to maximize their effectiveness.

First, to mitigate the limitations of this research it is recommended to conduct additional interviews with stakeholders. These interviews will provide a more comprehensive understanding of perspectives and insights, enriching the findings and enhancing the validity and reliability of the study. In addition, it is important to interview a larger patient population and delve into specific preferences. Understanding how patients perceive innovations such as wearables and automated health monitoring is crucial before deciding on the approach to implementing interoperability.

Second, when additional interviews are conducted the determined barriers must be validated with DGO leadership. This validation process helps ensure the accuracy and reliability of the identified barriers by seeking confirmation and input from key decision-makers and stakeholders within the organization. By involving DGO leadership, one can obtain expert perspectives and insights, align the findings with their experiences and knowledge, and establish a shared understanding of the barriers to be addressed. As the leadership must believe in the value of interoperability in military healthcare. Given the scope of the challenge only meaningful change be initiated by having the DGO leadership fully committed. Their belief and support are vital in obtaining the right resources to implement change and to overcome the obstacles that hinder effective interoperability in the Military Healthcare system.

Third, achieving the desired state of interoperability and overcoming the existing barriers in military healthcare requires substantial investment. This investment is sourced from the government budget as the DGO is a governmental organization. Consequently, it is strongly recommended that the Minister of Defense effectively demonstrate the added value of interoperability within the military healthcare sector. Emphasizing how the Military Healthcare system can serve as an exemplary model and pilot for the civil healthcare system can help garner support and justify the necessary investments. By showcasing the potential benefits, the Minister of Defense can encourage stakeholders to prioritize interoperability and allocate resources accordingly.

Fourth, it is recommended to utilize a team with the appropriate capabilities to undertake this challenge. The magnitude of this challenge is immense, so it is crucial to acquire the right capabilities to execute it successfully. Considering Accenture its expertise in interoperability and change management, and its upcoming involvement with DGO, it is recommended to collaborate with Accenture to execute this initiative successfully. As the main barriers lie in the technical layer of the EIF, it is important to add experts from the Data & AI department of Accenture. However, as discussed in Chapter 7.2, the organizational barriers should not be perceived as less significant just because there are less determined in this research. Therefore,

it is recommended to engage a significant team that focuses on the people side of change management. This team can be led by H&PS consultants, as their expertise lies in the public domain and have experienced the culture within the Defense organization.

Keeping the above in mind, concrete additional steps are recommended to create a roadmap of the different phases that the Military Healthcare sector needs to undergo to achieve interoperability. The first phase includes the above-mentioned steps. The second phase includes a pilot where two companies within the DGO use wearable devices in which the medical data of patients is stored. Performing this pilot with the CMH and GPs is recommended as these organizations are, according to this research, seen as the main bottlenecks of interoperability in The Netherlands. Therefore, improvement will be better acknowledged when achieved. Additionally, it is recommended to focus on creating a platform that enables communication between different systems without requiring full unification of the different systems that are currently used. This data will be integrated into the wearable. During an interview with an interoperability expert, the benefits of utilizing a data fabric in achieving seamless data exchange and integration across healthcare systems are emphasized. According to the interviewee, a data fabric is a platform where all the different systems come together, allowing information exchange even while using different systems. Therefore, using a data fabric is strongly recommended as it saves a tremendous amount of work to build a centralized platform instead of modifying all the EHR systems. The third phase of the road map will include expanding the pilot to other organizations within the DGO. The last phase is to expand the pilot to operational circumstances. After the execution of each pilot program, the four layers of the EIF, used in this research, should be examined by experts in each layer. The organizational, semantic, legal, and technical experts should identify strengths and weaknesses in the specific layer of data management by being present during the project full-time. Hereby, it is essential to resolve any weaknesses before moving on to the next phase. In addition, based on this research it is recommended to initiate a change management program when initiating the pilot program by informing and educating stakeholders about the upcoming change. By executing this roadmap, the Military Healthcare system becomes a frontrunner in interoperability and can serve as an example for the rest of the Netherlands.

9. Conclusion

The purpose of this study was to determine the most significant barriers to Military Healthcare becoming an interoperable organization regarding medical patient data by examining the current and desired state. It can be concluded that an interoperable Military Healthcare system is desired, either by allowing Hospitals and other practicians to seamlessly interact or by providing patients with wearables. However, this research showed that the Military Healthcare sector is still far from achieving an interoperable system. The bottlenecks primarily lie in the exchange of information with operational healthcare, between first- and second-line healthcare, and the between the CMH and civil hospitals. Barriers to achieving interoperability primarily lie in the technical layer and organizational layers. In addition, some barriers in the legal and semantic layers are indicated. However, this study points out that the barriers in the technical layer are easily overcome with the current technical innovations and legal barriers are overcome by the new WEGIZ law. Therefore, this study indicates further deepening the organizational barriers by interviewing more stakeholders and involving DGO leadership and the Minister of Defense. In conclusion, the pursuit of interoperability in the healthcare sector holds immense potential. By addressing the identified barriers and fostering collaboration among stakeholders, we can pave the way for a future where seamless data exchange and interoperability become the norm, ultimately leading to better healthcare outcomes not only for the Dutch Defense Organization but for all.

Internship reflection

For the last 5 months, I did an internship at the Health & Public Services (H&PS) department of Accenture, within the Strategy & Consultancy team. Within this department, I supported different projects, assisted with the business development of potential new projects, and organized multiple internal Accenture events. As my thesis was focused on one of H&PS client's, I have got to experience how the preliminary research is performed and how strategies are set up. Therefore, I could apply my knowledge from the different FBE courses to analyze the market, think of a suitable strategy and to wright the proper recommendations.

At the beginning of my internship, I set up some learning goals. These included gaining some practical skills such as PowerPoint and Excel and increasing my strategic skills by practicing cases, which I gained by using the tools and monitoring my progress every week. Together with my Accenture supervisor, we organized a business case afternoon with my fellow interns to increase my strategic skills in handling a business case. In addition to the practical learning goals, I also set goals to increase soft skills such as becoming more confident in what I bring to the table and learning to set boundaries, by sometimes saying no to colleagues. Increasing my soft skills was the biggest challenge during my internship as it requires getting yourself out of your comfort zone.

At the beginning of my internship, I sometimes took too much of an 'intern' role because I thought other people would know better as they already work there. During the internship, I learned to share my views and observations and let my colleagues know my perspective of the situation instead of just agreeing to theirs. Moreover, as Accenture has so much to offer it is sometimes hard to focus. At the beginning of the internship, I said yes, every time someone asked for assistance. During the internship, I learned to prioritize tasks by assessing whether the task contributed to my personal development.

What I did well during this internship was that at the beginning I already set up my learning goals, and if necessary, I updated and revised them. In this way, I could really assess if I was getting everything out of my internship. In addition, I took advantage of everything that Accenture has to offer in a proactive manner. As a result, I had the opportunity to also see other departments such as the Life Science team. What I could do better, is being less insecure from the beginning. Finding that balance of not being too bold but also not being too hesitant. I think if I would dare to fail more from the beginning my learning curve would have been even steeper.

These lessons are great to take with me when I will start my first job. I will take with me my pro-active approach as I have seen what this brought me during my internship.

Moreover, I will walk in with more confidence because of all the positive feedback from Accenture people and keeping in mind that it is not a problem to sometimes not do everything perfectly the first time.

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Annex

Interview guide (in Dutch)

1. Introductie

Bedankt voor je deelname aan dit onderzoek.
Ik zal mijzelf eerst even kort voorstellen en wat meer vertellen over mijn onderzoek. Mijn naam is Karlijn Gijsen en ik ben momentele mijn Master Science and Business Management aan de Universiteit van Utrecht (UU) aan het afronden. Als onderdeel hiervan ben ik sinds maart begonnen met mijn onderzoeksstage bij Accenture op de afdeling Health & Public Services en zo dus ook in aanraking gekomen met de defensie gezondheidsorganisatie.

Met mijn onderzoek wil ik de huidige manier van patiënten data uitwisseling in kaart brengen binnen de DGO en onder operationele omstandigheden. Door middel van deze interviews wil ik ook kijken naar het gewenste toekomstbeeld wat betreft deze informatie-uitwisseling en hoe we daar kunnen komen door barrières af te breken.

Dus tijdens dit gesprek zal ik vragen stellen die betrekking hebben op jouw ervaringen en gedachtes over de huidige manier van werken met betrekking tot patiënten data en het hebben over jouw ideale toekomstbeeld.

Ik zou graag het interview willen opnemen, is dat goed? De opname gebruik ik om een samenvatting te maken van het gesprek welke aan het einde van mijn onderzoek wordt verwijderd.

Heeft u nog vragen voor we beginnen?

2. Algemene introductie

Eerst heb ik een paar algemene vragen:
2.1 Wat is uw functie en hoe lang werkt u binnen de DGO/dit team? (Op uitzending geweest?)

3. Huidige situatie schetsen

3.1 Kunt u een achtergrond schetsen op wat voor manier u te maken heeft met medische patiënten informatie/dossiers?
3.2 Heb je hierbij ook te maken met de overdracht van deze informatie naar andere systemen/organisaties/personen?
3.3 Hoe kijkt u naar de huidige manier van informatie overdacht binnen de DGO en onder operationele omstandigheden?

4. Toekomst

4.1 Hoe zou de manier van patiënt data verkrijgen en uitwisselen met collega's en patiënt er voor jou idealiter uit komen te zien?

Zelf concluderen wat dan het gat is hiertussen en dit bij de geïnterviewde valideren.

5. Barrières

5.1 Wat zijn de redenen dat we nog niet bij dit ideale toekomstbeeld zijn?

6. Afsluitend

We hebben nu alle vragen doorlopen die ik graag wilde bespreken. Is er verder nog iets wat u kwijt wil of toe zou willen voegen?

Table A.1. *Most important gaps and barriers to closing the gaps.*

		Barriers to change			
Gaps	**Defined by**	**Legal**	**Semantic**	**Organizational**	**Technical**
Information exchange between General Practitioners and CMH	I-1, I-4, I-7, I-8, I-9	• I-2/I-9: As a result of a referendum by the Dutch government interoperability between hospitals is not possible.	• I-7/I-8: Some GPs send enormous referrals with a lot of irrelevant information, what makes the exchange inefficient.	• I-1: Defense always wants their "defensie broodje speciaal", while they also could use systems that already proved to work in regards with efficient information exchange.	• I-1/I-4: Technically not established that GP's and CMH can view each other's patient files.
Information exchange between operational doctors and the CMH	I-1, I-4, I-7, I-8, I-9	• I-7: If you want to be able to exchange information from every operational location, you will have to deal with worldwide privacy & security laws and regulations.		• I-7: You are dependent on the facilities that are available at the location of the operation. • I-8: Patient movement request done via a lot of paperwork because there is no national guidance.	• I-1/I-4: CMH uses another system than is used under operational circumstances.
Information exchange between all hospitals in the Netherlands	I-2, I-3, I-4, I-7	• I-4: As a result of privacy regulations, we cannot exchange information with civil hospitals without permission of the patient. • I-2: As a result of a referendum by the Dutch government interoperability between hospitals is not possible.	• I-2: It is generation and specialization dependent how employees handle the standards of information exchange.	• I-3: The Monopoly of ChipSoft does not allow specific adjustments to the EHR in order to establish an ideal and integral system.	• I-7/I-8: Hospitals in the Netherlands use different systems that are sometimes not compatible.
Information exchange between MRC and CMH	I-3			• I-3: People fax information because they find it more convenient compared to e-mail as the fax machine stands in a room accessible for everybody in CMH	• I-3: Technically not established that MRC and CMH can view each other's patient files.
Sending photos from operational DTD to DTD in NL, CMH, and civil hospitals	I-6				• I-6: Technically not possible to send dental pictures from operational DTD. • I-6: Also, dental pictures cannot technically be shared between DTD and civil hospitals
Information exchange between DTD and operational DTD	I-6				• I-6: As we use a stand-alone laptop under operational circumstances, we cannot exchange data with DTD in NL unless the laptop is taking to NL.
Lack of central portal for patients for all facets of their healthcare	I-2, I-5		• I-2: Afraid that some patients are not able to understand if their information is fully digital.		• I-5: Technically not central patient portal is established.