DEVELOPING DECISION SUPPORT FOR DUTCH MILITARY MEDICAL STAFF TO ALLOCATE CASUALTIES IN A COMBAT CONTEXT

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DEVELOPING DECISION SUPPORT FOR THE ALLOCATION OF DUTCH WOUNDED CASUALTIES IN A COMBAT CONTEXT

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PREFACE

Dear reader,

In front of you lies the final deliverable of my graduation project for the MSc Strategic Product Design, with the specialisation Medisign at the Delft University of Technology. By completing this report, I am closing an important period of my life. These past six years, the faculty of IDE has been my home away from home. IDE has been the place that allowed me to grow as a person, to find out who I am and what I stand for. I will cherish the values that I have learned here for the rest of my life, and it is with great pleasure that I look back at these past six years.

The last months of my student days I dived deep into a project that has been enabled by the company Offroad Apps BV in Delft. I would like to express my gratitude towards this company for providing me with the opportunity to work in such a unique context. Offroad Apps immediately made me feel welcome. A special thank goes to Vera, my company mentor, for the help and support throughout the entire project. During the project, I experienced a lot of freedom to set up and fill in my own project. I seized this freedom with both hands, knowing that I could always count on Vera for open and constructive feedback. Vera, I admire the passion you have for your company and VitalsIQ. The enthusiasm you radiate is contagious.

Besides Offroad Apps, I would like to express my gratitude to the Ministry of Defence, and in particular Frank. Frank was my inside man, the man that provided me with a huge network of people within the 400 Medical Battalion who were all enthusiastic about helping. Without Frank, I could have never dived so deep into this project this quickly. Frank, thank you for seeing the value of this project and for the guidance over the past few months.

Furthermore, I want to thank Hanneke, Jeltsje, Richard, Dick, and Mark for being extremely involved in my project, providing me with all the information I needed and much more. These people immersed me in the world of the Ministry of Defence, the medical domain and the ongoing developments. They made me fall in love with the Ministry of Defence, its complexity and versatility.

From within IDE, I was coached by Jeroen and Jasper. This duo is absolutely top notch. I loved every moment of working with them. The guidance towards the end goal, the support throughout the project, the challenge to dive deeper, it was all present. I want to thank you both for all the conversations we had and the different perspectives and methods you suggested whenever I dived right into a complex and complicated matter. I really appreciate how you always kept an eye on how I was doing during the project. You helped me to keep an overview and triggered me into getting it back whenever I lost it.

Lastly, I am grateful for my dear friends and family. Thanks for your support and constant encouragement to get the most out of my project and myself. Thanks for your understanding whenever I had no ‘mentale ruimte’ left due to the deep dives I took, or in the run up to a deadline. Thanks to both my parents for their endless support during my six years at IDE, and thanks for borrowing either one of your cars for my many trips to the Generaal Spoorkazerne in Ermelo. Thanks to Sophie, without whom I would never have known about Industrial Design Engineering, and thanks to the friends I met here that went along this journey with me from the beginning. And lastly, a special shoutout goes to the ‘Taalfreaks’. Thanks for the many discussions on complicated linguistic issues in both Dutch and English. But most of all, thanks for the endless jokes that kept me going.

Once again, thank you all! I can honestly say, you made my graduation project fun.

For now, dear reader, enjoy! I am beyond happy and proud to be able to share this report with you.

Judith

EXECUTIVE SUMMARY

The growth in the number of political frictions and terrorist attacks have made governmental institutions focus on the preparation for threatening situations. Old threats persist and all kinds of new ones are added. In order to be ready for these threats, the Royal Dutch Army is shifting its focus from main task 2 operations (peace support) to main task 1 operations (combat). As support to a tactical operation there is the military medical chain. The shift in focus has uncovered that the 400 Medical Battalion is currently not capable of supporting the Army in Combat Operations. As a result, the 400 Medical Battalion is currently in a transition process. This transition contains the reorganisation of the battalion, and the development of the Role 2 Basic Medical Treatment Facility.

By performing different research activities, such as desk research, interviews and a simulation session, an understanding of the organisational context and the context of use was developed. This resulted in an overview of the problems that arise in the Role 2 Basic.

This project continued with one of the problems: the decision-making processes. Currently, the decision-making processes within the Role 2 Basic are transferred from the context of Peace Support Operations. Resulting in the decision-making process in front of the facility being triage. Triage is done to prioritize patients, while analysis shows that the decision in a combat setting asks for a process to allocate patients. As a consequence, the currently applied process is not suitable. It does not contribute to, nor is in line with, the chain-orientation in combat. All research findings were summarized in a single patient process map, a consolidated flow model and a decision framework. With all the obtained insights in mind, this project aimed for the development of decision support for the Senior Nursing Officer, while stimulating a combat mindset. This became the focus and all further activities were contributing to developing a decision support concept.

The synthesis of this project started by a creative session with relevant actors from the focus area. The results from this session provided design opportunities and inspirational ideas and were used as a starting point for ideation. The idea generation has resulted in several ideas for the different service components. The ideas were combined and translated into design ideas, which are the predecessors of concepts. The design ideas were then evaluated before developing them into concepts. Concept development resulted in two concepts that were evaluated with and by users.

In the end, this graduation project delivered two concepts. One of the concepts is the underlying model of the decision-making process in front of the Role 2 Basic Medical Treatment Facility. It contains a new way of working, visualised and designed in the form of a protocol: the adult combat allocation protocol. The second concept is a decision support tool to pre-sort incoming patients. The pre-sorting is done based on the new way of working that has been captured in the protocol. Both concepts are the outcome of a deep dive into the Ministry of Defence, its Military Medical Chain, the shift to Combat Operations and user-centered research. The way these concepts are derived and developed makes them of great value for the Ministry of Defence, and more specifically, the 400 Medical Battalion.

LIST OF ABBREVIATIONS

#	
400GNKBAT	400 Medical Battalion
A	
AEROMEDEVAC	Evacuation of wounded by air transport
AMA	General Military Doctor
AMV	General Military Nurse
AXP	Ambulance Exchange Point
C	
C2	Command and control
CCP	Casualty Collecting Point
CMH	Central Military Hospital in the Netherlands
CD	Clinical Director
CO	Combat Operations
CP	Command Post
CSU	Casualty Staging Unit
D	
DGOTC	Healthcare Education and Training Centre of the Ministry of Defence
E	
EMC	Emergency Medical Care
F	
FMC	Field Medical Card
FOC	Fully Operational Capable
FWMEDEVAC	Forward medical evacuation: evacuation of patients from Point of Injury/Casualty Collecting Point to the first treatment facility
G	
Gnkcie	Medical Company (Geneeskundige compagnie)
Gwtcie	Wounded Transport Company (Gewondentransport compagnie)
H	
Hospcie	Hospital Company

M	
MASCAL	Mass Casualty Incident
MEDEVAC	Medical evacuation
MED OPS	Medical operation centre for patient regulation in Combat Operations
MIST AT	Medical report on the status of a patient and performed treatment in the form of: Mechanism, Injuries found, Signs, Treatment given, Age, Time of injury
N	
NATO	North Atlantic Treaty Organization
P	
PECC	Patient Evacuation Coordination Centre
PHEC	Pre-hospital Emergency Care
POI	Point of Injury
PSO	Peace Support Operation
R	
R1 MTF	Role 1 Medical Treatment Facility
R2B MTF	Role 2 Basic Medical Treatment Facility
R2E MTF	Role 2 Enhanced Medical Treatment Facility
R3 MTF	Role 3 Medical Treatment Facility, only in collaboration with NATO partners
R4 MTF	Role 4 Medical Treatment Facility, the Central Military Hospital (CMH) in the Netherlands
S	
SNO	Senior Nursing Officer
STRATEVAC	Strategic medical evacuation: evacuation of Dutch wounded to the Netherlands for specialised treatment
T	
TACEVAC	Tactical medical evacuation: evacuation of patients from one to another treatment facility within the operational area
Z	
ZAU	Ambulance

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1

INTRODUCTION

In this chapter you can find the project background. It also describes the challenge and its relevance, the scope, goal, the context of the project, and the approach. It provides an overview of the project structure and offers guidelines on how to read this report.

1.1 Background

The growth in the number of political frictions and terrorist attacks have made governmental institutions focus on the preparation for threatening situations (Licher, 2020). Old threats persist and all kinds of new ones are added (Defensievisie 2035, 2020). In order to be ready for these threats, the Royal Dutch Army is training to act on so called Article 5 situations. The NATO (North Atlantic Treaty Organisation) states the following about Article 5 situations (NATO, 2019):

"The Parties agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and consequently they agree that, if such an armed attack occurs, each of them, in exercise of the right of individual or collective self-defence recognised by Article 51 of the Charter of the United Nations, will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area."

Article 5 situations can result in wounded soldiers and even in (dealing with) Mass Casualty Incidents (MASCALs). A MASCAL is defined as *"an event that generates more patients at one time than locally available resources can manage using routine procedures. It requires exceptional emergency arrangements and additional or extraordinary assistance"* (WHO, 2007).

As support to the tactical operation there is a military medical chain. In case of wounded soldiers, the chain is triggered. Through this complex system, a large number of patients are moved in an incredibly short period of time. This is done to save as many lives as possible and increase the overall survival rate. The earlier a patient is treated, the higher the chance of survival is.

The military medical chain consists of multiple tiers (Role 0 to 4). Each tier has its own facility and medical capacity. It starts with Point of Injury (POI) and ends with military healthcare in the Netherlands. The specific context of this graduation project is the Role 2 Basic Medical Treatment Facility: the first field hospital with surgical capacities to perform damage control surgery to treat wounded soldiers coming from the frontlines.

1.2 Challenge

A couple of factors determine the scope of this graduation project.

- Shift from Peace Support Operations to Combat Operations
  During the previous formation of the 400 Medial Battalion (400GNKBAT) the focus was on static operations from compounds (Peace Support Operations), as part of the second main task of the Ministry of Defence. This resulted in a battalion that is not capable of supporting Combat Operations. In recent years, due to geopolitical influences, there has been a shift in attention to the first main task (Combat Operations). In order to be able to support operations in the first main task, a correct organisation of the medical support task is essential. Therefore, a reorientation of 400GNKBAT is taking place, with regard to the currently assigned tasks and allocated resources. The outcome of this project has to contribute to transforming 400GNKBAT into a combat-ready battalion.

- Role 2 Basic Medical Treatment Facility (under construction by 400GNKBAT)
  Part of the reorientation and reorganisation of 400GNKBAT is the redevelopment of Role 2. Within this redevelopment, the new concept Role 2 Basic Medical Treatment Facility (R2B MTF) is currently under construction. Based on the Forward Surgical Concept, the R2B MTF is a treatment facility located closer to Role 1 and the frontline than the Role 2 MTF originally was. This project will hitch on and focus on the development of the Role 2 Basic.

- Medical communication and its information flow(s)
  The shift from Peace Support Operations to Combat Operations, especially in case of an Article 5 situation, asks for communication in highly complex, chaotic and stressful situations which is prone to miscommunication and misunderstanding. This can lead to errors with fatal consequences and a decrease of the overall survival rate. Therefore, it is of importance that the communication of patient details is optimal within the given context.

The challenge is to adjust the medical communication to, and improve it for, combat operations. The focus within this challenge will lie on communication of patient details and the corresponding information flow(s): untangling the chaotic context in order to create a clear oversight and to quickly allocate patients to the appropriate treatment facilities.

1.3 Project relevance

The shift in focus has uncovered that the 400 Medical Battalion is currently not capable of supporting the Army in Combat Operations. Having the goal set to be Fully Operational Capable (FOC) to support combat operations with a Heavy Infantry Brigade by 2027, there is a lot of work to be done (400 Geneeskundig Bataljon, 2020). One of the aspects that requires adjustment and improvement is the medical communication. Currently, the medical communication is centered around Peace Support Operations, which is not in line with the shift to Combat Operations. With the expectation (and experience from combat operations decades ago) to have a much higher patient turnover in combat, the patient flow needs to increase in order to achieve a higher overall survival rate. This project contributes to getting the 400 Medical Battalion combat-ready regarding medical communication. Efficient medical communication is essential to get patients as soon as possible at the right treatment facility to receive the best care possible, given the circumstances. This contributes to increasing the overall survival rate (do the most for the most). A not-working system and unclear communication costs time. Benjamin Franklin (1748) once said *"time is money"*, in this case time is a life.

Figure 1: Soldier with VitalsIQ on home screen

1.4 Project goal

The aim of this graduation project is to create a design strategy, illustrated via a product-service concept, that supports the 400 Medical Battalion to systematically develop efficient medical communication in contribution to developing a combat-ready battalion. The design strategy should provide decision making support, and help the 400 Medical Battalion to:

- Identify concrete steps that need to be taken to develop the system in such a way that it is efficient and discharge oriented so that it supports and enhances the patient flow

- Translate these concrete steps into a plan to design a more efficient way of medical communication, within the given context, to achieve a higher overall survival rate

Worth to mention is that the current development of VitalsIQ[1] (by Offroad Apps, figure 1) and the ambition of the Ministry of Defence to digitize the Army, and make it technologically advanced, offers possibilities to hitch on and take into account (Defensievisie 2035, 2020).

[1] VitalsIQ is a mobile medical regulating tool that replaces the paper versions of the field medical card and patient health care record with a digitized solution and adds AI in order to offer decision support on triage throughout the medical chain based on the collected data.

1.5 Project approach

This project has a user-centered design approach (Delft Design Guide, 2020). A user-centered design approach ensures that the project is based on an explicit understanding of the users, their tasks and their environment. Besides, it includes the end-users in the (design) process.

This project consists of two parts: an analysis- and a synthesis part. During the research phase the information gathered is captured in models described in the book Rapid Contextual Design by Karen Holtzblatt (2004). The underlying model used for the different project-phases within these parts is the Double Diamond (Design Council, 2019). The Double Diamond is a four-phase way to structure the project. However, during the project a variant of the Double Diamond is developed, the approach of this project consists of three diamonds. It starts with the diverging phase discover in which you gain understanding of the context and unravel the problem from different user-perspectives. In this project, the discover phase also contains of a converging phase, resulting in a specific problem area. The insights gathered during this phase form the base for diverging: finding the problems within the problem area, and converging to define the specific problem. The result of the discover and define phase is the design brief. The design brief will act as starting point for the develop phase. This is the third diverging phase, from a specific brief to the search for multiple solutions/answers/ideas. In this phase idea generation and co-creation are central

pillars. In the last phase, deliver, some of the ideas will be tested with the users to reject those that will not work and improving the ones that will. However, this is not a linear process but an iterative one. The Double Diamond model is shown in figure 2.

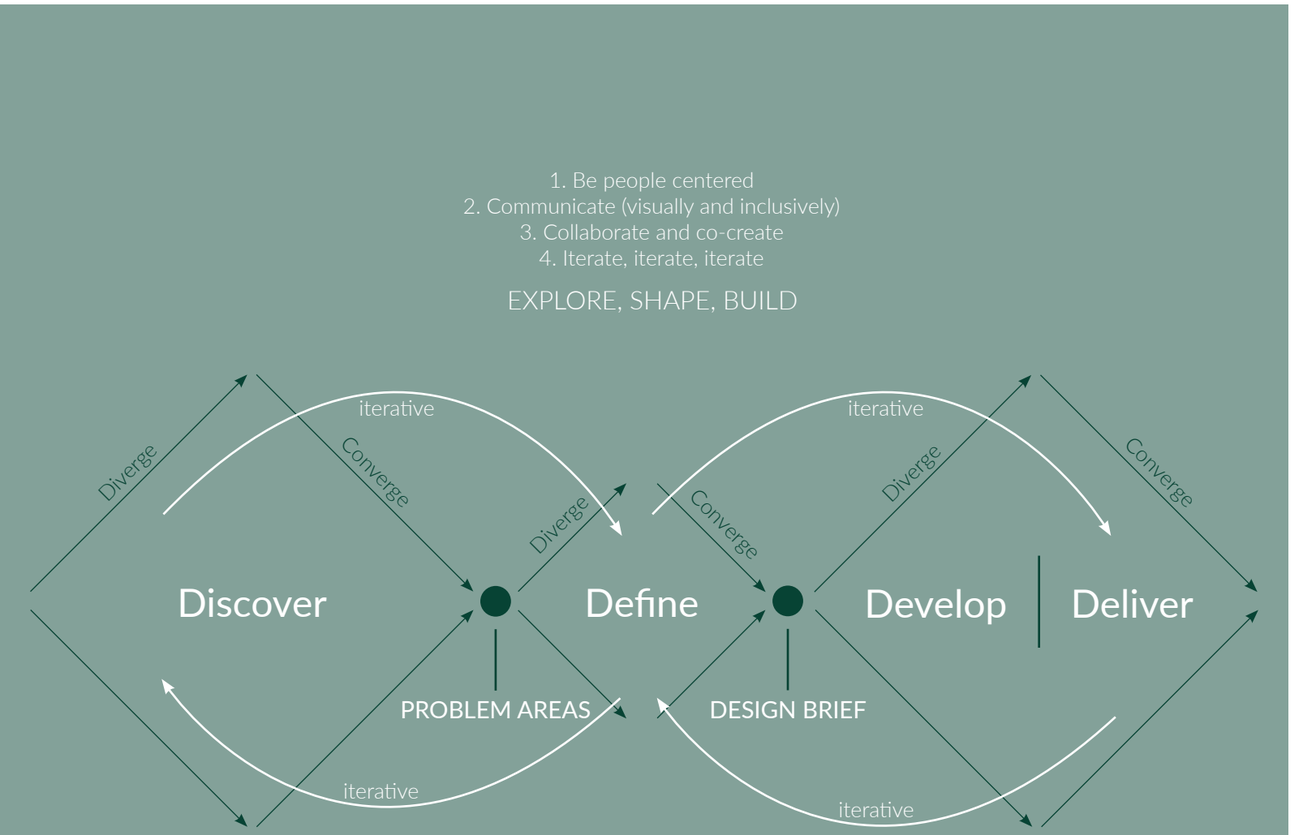


Figure 2: Double diamond with used methods throughout the project

1.6 Project context

In this project multiple parties are involved:

- Offroad Apps
  Offroad Apps is the company that provided this graduation opportunity. Offroad Apps is a company that makes applications for wearables that can be used to make faster and better decisions in dangerous situations. They are specialised in the areas of situational awareness, decision support, health monitoring, and smart triage. Their interest in this project lies in the fact that a complete analysis of the (communication) processes and (medical) information flows of the Role 2 Basic Medical Treatment Facility, with suggestions on where, when and how to improve, provides them with the opportunity to respond to and act on this. Their current main focus is the development of VitalsIQ 2.0.

- The Ministry of Defence
  Part of the Ministry of Defence is the Royal Dutch Army and the 400 Medical Battalion (400GNKBAT). The 400GNKBAT is responsible for the military medical chain from the R2B MTF on until patients are transported to the Netherlands. Their interest lies in having an outsider with a fresh look unravelling the weaknesses, opportunities, and areas for improvement within the medical chain, specifically Role 2 Basic, to point out where the complex system does not meet the requirements in case of wounded soldiers or even a MASCAL. This is necessary to be able to improve the military medical chain and increase the patient flow to deliver wounded soldiers the best medical care possible, given the circumstances, and do the most for the most.

1.7 Process + reading guide

This paragraph describes the process and the methods used during the project. It will end with a guide on how to read this report.

Each part of the project builds on the outcomes of the previous one. In the initial phase (*discover*), the analysis focusses on the current situation in Peace Support Operations, the developments towards Combat Operations, and the differences between these operations. The reason is to understand the **where we are now**, the **where we want/need to go to**, and the **gap** between those. Three methods are used to gather the information and create a deep understanding of the context and its users: desk research, literature research, and interviews. The *define* phase builds upon the results from the previous phase by structuring them in a single patient process map and a consolidated flow model from the Rapid Contextual Design method (Holtzblatt

et al., 2004). The single patient process map and flow model provide multiple relevant insights and uncover problem areas with specific needs, which form the basis for the design brief.

The design brief is the connection between *define* and *develop* (the third phase). During the idea generation within *develop*, brainstorming, and a creative session will be used to generate ideas and develop concepts. Two of the concepts will be further developed. Prototyping and testing the concept with users show what will work and what will not work. The final deliverable will illustrate how to use the concept and which steps need to be taken to continue the development.

This report is divided into 11 main chapters. Important aspects in the text are highlighted in colour. No time to read? Every chapter, except this chapter and chapter 2, ends with a conclusion in which key takeaways of the chapter are summarized.

PART I

-

ANALYSIS

Finding out the problem

To understand how medical communication in Combat Operations could be improved it is important to first create a deep understanding of the organisational context, the context of use and the human actors. This part, the analysis, is used to indicate the gap between the current situation and the desired situation. At the same time possible starting points for improvements are identified. This all results in the design brief: the problem statement, design goal and design direction.

2
ANALYSIS PROCESS

This chapter describes the process of the analysis. It starts with explaining the purpose of the research and discussing the research questions. Furthermore, the methods used to gather the information needed to answer the research questions will be explained.

2.1 Goal of the analysis and research questions

The Ministry of Defence, and specifically the Army and the 400GNKBAT, are preparing themselves for operations within the first main task. The past decades, the Army has not been deployed in combat operations and therefore the focus was fully on Peace Support Operations. This leads to a current state and a desired situation: where we are now and where we want/need to go to. The purpose of this analysis is to fully understand the organisational context (the Mistry of Defence, the Army and the 400GNKBAT) and the specific context of use (Role 2 Basic Medical Treatment Facility). Understanding these contexts will reveal the gap between the current and desired situation, and will result in a problem statement and solution direction.

The analysis focused on two main research questions:

1 **What are the differences between Peace Support Operations and Combat Operations regarding the military medical chain?**

   a What are the characteristics of Peace Support Operations?
   b What are the characteristics of Combat Operations?

2 **How can medical communication be adjusted to and improved for Combat Operations?**

   a How and to what extent can medical communication originally used in Peace Support Operations be used in Combat Operations?
   b What is the bare minimum information needed for medical personnel in the Role 2 Basic Medical Treatment Facility to do their job?

2.2 Methods used

Multiple methods are used to gather necessary information and create understanding of the context and its users. Throughout the analysis, literature has been studied on a variety of topics. However, most of the research was based on qualitative data obtained via semi-structured interviews with experts and users. Qualitative research not only provides facts, but adds meaning to those facts (Rosetto, 2014). It aims at investigating the meaning of social phenomena and the way they are experienced by people (Malterud, 2001). Through qualitative research, rich insights and understanding of the thoughts, attitudes and processes of people are gathered and new questions are developed, it empowers the researcher to accomplish a better understanding of the wants and needs of the user (Kvale, 1983). According to Miles and Huberman (1994, p.10), qualitative research can provide a "strong handle on what 'real life' is like" and "has often been advocated as the best strategy for discovery, exploring a new area, and developing hypotheses".

The focus of this project is centered around the way medical personnel communicates in the field, how they use communication to transfer patient details, and how it is experienced. Therefore, the research is conducted qualitatively. The insights obtained contribute to answering the research questions and identifying areas for improvement.

2.2.1 Desk research

Desk research was conducted in two phases. The first phase of desk research was used to gain fast and background information on the Ministry of Defence, their organisation, tasks, and the context they operate in. It provided a knowledge basis: information to hitch and elaborate on during the semi-structured interviews. It raised questions and uncovered holes of missing knowledge and understanding. Subsequently, the semi-structured interviews were conducted.

The second phase of desk research, taking place following the interviews, consisted of sifting through internal documents provided by some of the interviewees. These documents resulted in a deeper understanding of the context, the past and current developments, and the current course of events. The analysis of the existing information added depth to the interview findings.

Another part of the second phase was reading two books recommended by the deputy battalion commander of the 400 Medical Battalion. Asking for these must-read books, that best reflect the work and circumstances during a mission, was to submerge myself into the world of the Army and its medical support. By reading a book, you can travel so many miles without taking a single step. Reading these compelling stories provided the opportunity to 'feel' the context. The opportunity to 'feel' the context through books and stories is extremely important for this project since real war situations are, fortunately, rare, and there are currently no exercises held due to covid-19, so there are no exercises to attend in order to see 'reality'.

The books ***Oorlog in de operatiekamer*** by Maaike Hoogewoning and ***Medic*** by John Nichol & Tony Rennell are non-fiction, written by real experts by experience, and give a (more) holistic view on the course of events. The books provide insights into what life is like on a base, what daily activities they do, the work they do, the physical and mental environment, etc. It provided insights into what it is like to be deployed to an area with an increased threat level.

Maaike Hoogewoning is a former first lieutenant who has served two times as a surgical assistant in a military hospital in Kandahar, Afghanistan. In *Oorlog in de operatiekamer* she tells her story. Her story on their efforts to help injured colleagues or Afghan civilians with the best medical care they can provide there. Her story on how she dealt with threat and tension. Her story on all the different emotions that she felt. As she writes in her book: *"I knew I would end up in hell on earth in Afghanistan, but actually being there, seeing, hearing, smelling, feeling, is really a different story"* (Hoogewoning, 2018).

"Unfortunately, the roof is not provided with a protective layer. So, when I hear the rocket alarm, I have to get out of bed as quickly as possible and dive to the ground, lie there for two minutes, and then as fast as I can, run to the nearest bunker. In the dark, in my pyjamas, reinforced with helmet and shard vest. Now I feel it's serious, I am in a war zone with an increased threat level" - Maaike Hoogewoning, p.27

"Both his legs have been blown off far above the knee by a roadside bomb, the scorched flesh has the smell of baked tartar" - Maaike Hoogewoning, p.233

John Nichol is a former Royal Air Force (RAF) flight lieutenant, of the United Kingdom, whose Tornado Bomber was shot down on a mission over Iraq during the first Gulf War in 1991. He, together with flight lieutenant John Peters, became a prisoner of war. They were captured and tortured which brought both men close to death. Together with Tony Rennell, a writer and journalist, John Nichol tells his story in *Medic* and dedicates it to his country's exceptional military medical personnel. It's the story of the doctors, nurses and stretcher-bearers who go where the bullets are thickest, through bomb alleys and minefields, ducking mortars and rockets. Whenever someone is injured, medics run into battle to rescue wounded and to risk their own lives to save the dying.

"As a medic, you think you are bulletproof. But that night mayhem and murder were breaking out around me. At one point I was running along, and there were bullets flying all around me, and I was thinking, "What am I doing here? I could die, I really could." Oh yes, that feeling was real, very real" - p.3

"This is bad, very, very bad, he said. He lifted up his right hand and saw it was cut in two. His body armour was burning. My instinct was to get out as the Mahdi Militia tried to shoot me off" – p.263

2.2.2 Interviews

"If you want to know how people understand their world and their lives, why not talk with them?" (Kvale & Brinkman, 2009). As Weiss (1994, p. 1) says: "Through interviewing we can learn about places we have never been and could not go and about settings in which we have not lived." – Robert S. Weiss, sociologist

Interviewing provides access to the observations of others. These observations do not only consist of facts, but also of emotions and experiences from users. It includes the relationship and interdependencies between users.

In this case, the interviews were used to gain insight in the course of events, in practice, in a Role 2 (Basic) Medical Treatment Facility: the different jobs and tasks of people, their interactions with others, the (medical) communication of which they are part, their experiences and observations, frustrations and points for improvement. The interviews were semi-structured; acting as a guide to address the same topics and questions in every interview (Smith et al., 1995). The order was of less importance, which gave freedom to dodge between pre-set relevant and investigating interesting areas that arose on the go. The interview guide can be found in Appendix A.

The first interview was with the deputy battalion commander (PBC) and the battalion doctor of the 400 Medical Battalion (400GNKBAT). This interview was more of a conversation on 'what do you do, how can I help you and how can you help me with this project'. One of the things discussed was the wish to talk to experienced personnel that had been on (multiple) missions. It would be even better if they had experience within a main task 1 (combat) mission. Another criterium was the fact that they had to have experience within a Role 2 Medical Treatment Facility in Peace Support Operations and/or Role 2 Basic experience gained at the Medic Diamond 2019. Thereby, it was desired to contact personnel from all the R2B modules, since the goal of the interviews was to create an overview of the way of working and communicating in a R2B MTF. The PBC and the battalion doctor provided me with names, ranks and functions of personnel, alongside their email addresses, to seek contact.

Before the start of the interviews, it was made clear in the mail exchange that the interviews were a search for honest stories. Thus, not the stories that mask the gaps or the stories in which things are excused or dismissed as 'yes, there is no other way'. Honest stories in which people talk about the ins and outs within a Role 2 (Basic), where things going well, where things going wrong, what could be improved and what they would like/need.

All interviews started with a short introduction on ourselves, the project, and user-centered design. This short introduction mainly served to take people along in the process and to make them understand what I do. This allows them to tell in a more targeted way, which yields more relevant information without omitting or disregarding the context.

The other topics that were addressed during the interviews were:

- The job
  What do they do, what are their tasks? What are their responsibilities and with whom do they work closely?

- The environment
  The environment and its influence. The physical environment consists of the space, the (medical) equipment, etc. The mental environment is about sound, stress, and emotions.

- Communication and information
  The goal was to map the current communication together with the associated information flows. Soon noticed was the fact that people spoke from the experience in main task 2 missions, so the layer ‘what in main task 1’ was added, which triggered the interviewees to think about communication of the bare minimum/most necessary information.

- Frustrations
  Honest stories. What causes the most frustration(s)? What really needs to be improved?

- Needs and values
  Needs and values are about what is seen as ‘essential’ and what people value as a person. To illustrate, clarity can be one of those core values, of which good communication might be a need that contributes to that core value.

The order in which people were interviewed (figure 3) contributed to first getting the big picture and then zoom in to the specific context of use. Therefore, the human actors within the R2B were interviewed last. From the group of human actors, a selection with relevant ones (the specific area for improvement) was made for a creative session.

1x Project manager *‘Studie Doorontwikkeling 400’*
- Combat experience

1x Innovation manager of JIVC (Joint Informatievoorziening Commando) and KIXS (Kennis Innovatie eXperimenten Simulatie) who developed the current Capability model
- Staff employee

2x General Military Nurse with C2 experience and participation in the Medic Diamond of 2019, the first large scale test of the development of the Role 2 Basic and its Medical Treatment Facility
- No combat experience

1x General Military Nurse who participated in the Medic Diamond of 2019 in the role of Senior Nursing Officer (SNO)
- No combat experience

1x Role 2 General Military Nurse who participated in the Medic Diamond of 2019 and was located in the ‘holding area’
- No combat experience

1x Role 2 Emergency Doctor who participated in the Medic Diamond 2019
- No combat experience

1x Role 2 ER nurse, originally from the Royal Air Force, who participated in the Medic Diamond of 2019 and can take on the role of SNO
- No combat experience

1x Surgeon who participated in the Medic Diamond of 2019 and acted as Clinical Director as well
- No combat experience

1x Head of quality management and care development who started as an ICU and ER nurse
- Combat experience

3x Doctrine & analysis

2.2.3 Creative session

‘Creativity is the process that leads to novel and useful solutions to given problems’ (Amabile, 1996).

In recent years, there has been an increase in awareness of the importance of creativity to long term success of businesses, government, and non-profit organisations. It is vital for their growth and performance (Mumford et al., 2012). However, creativity is a complex and complicated phenomenon (Runco et al., 1999). Nevertheless, everyone has the ability to solve problems effectively and use creative and critical thinking (Treffinger et al., 2005). Unfortunately, not everyone is using their mental power to do so. By teaching people simple, easy-to-use tools and guiding them in a systematic way, anyone can be more creatively productive.

The goal of the creative session was to trigger the relevant human actors into thinking in a different way than they are used to. Simulating different scenarios in the session mostly contributed to answering the research question on the bare minimum information need for medical personnel to do their job.

3

ORGANISATIONAL CONTEXT

Minstry of Defence and its military medical chain

The Dutch Military Medical Chain is embedded in the complex organisational context of the Ministry of Defence. In order to understand the gap (and its importance) between the current (where we are now) and desired situation (where we want/need to go to), an understanding of the organisation, and what they do, must be created first. This chapter describes the need-to-know basis of the Ministry of Defence as an organisation and its Military Medical Chain. It dives into the organisational structure, the three main tasks of the Army and the developments over the past years and their influence on the present and future.

3.1 The Ministry of Defence

The Ministry of Defence protects us (Ministerie van Defensie, 2021a). It protects our nation, our freedom, and our safety. As an organisation it is one of the largest employers of the Netherlands.

The Ministry of Defence consists of multiple departments and is headed by the Minister of Defence. Part of the Ministry of Defence is the Armed Forces which is under the leadership of the Commander of the Armed Forces. The Commander of the Armed Forces heads the Royal Dutch Navy, the Royal Dutch Air Force and the Royal Dutch Army. The Army is under the command of the Army Commander and consists of three brigades (11 Airmobile Brigade, 13 Light Brigade and 43 Mechanised Brigade) and an Operational Support Command Land (see figure 4). The Land Operational Support Command is the largest unit within the Army and supports operations and exercises with people and equipment. To clarify, the 400 Medical Battalion (400GNKBAT) is part of this unit and is responsible for providing operational hospitals and medical care during all types of missions for the entire armed forces since 2017. This project focuses on medical support for Army operations.

3.3.1 The Royal Dutch Army

The Armed Forces have three main tasks (Ministerie van Defensie, 2021a):

1 The protection of own territory (physically and digitally) and that of NATO allies
2 The contribution to and encouragement of international legal order and stability
3 The provision of assistance during disasters and crises

Every deployment contributes to either one of the main tasks of the Armed Forces. Current deployments of the Army are in the Dutch civilian healthcare setting due to COVID-19, abroad as contribution the UN Minusma police mission in Mali, in Burkina Faso to train an African battalion for participation in the Minusma mission in Mali, Peace Support Operations in the Middle East, and in Lithuania the Army contributes to the reinforced NATO military presence (enhanced Forward Presence, eFP) (Ministerie van Defensie, 2021b). The eFP is a multinational battlegroup under German leadership and is focused on military exercises in international context. All the current deployments contribute to main task 2 and/or 3.

3.3.2 Developments over the past and coming years that influence the Army

In the past years there have been multiple factors and developments involving the Ministry of Defence that have been of influence on the Army and its supporting units. The relevant ones are highlighted, as well as the effects and future developments as a

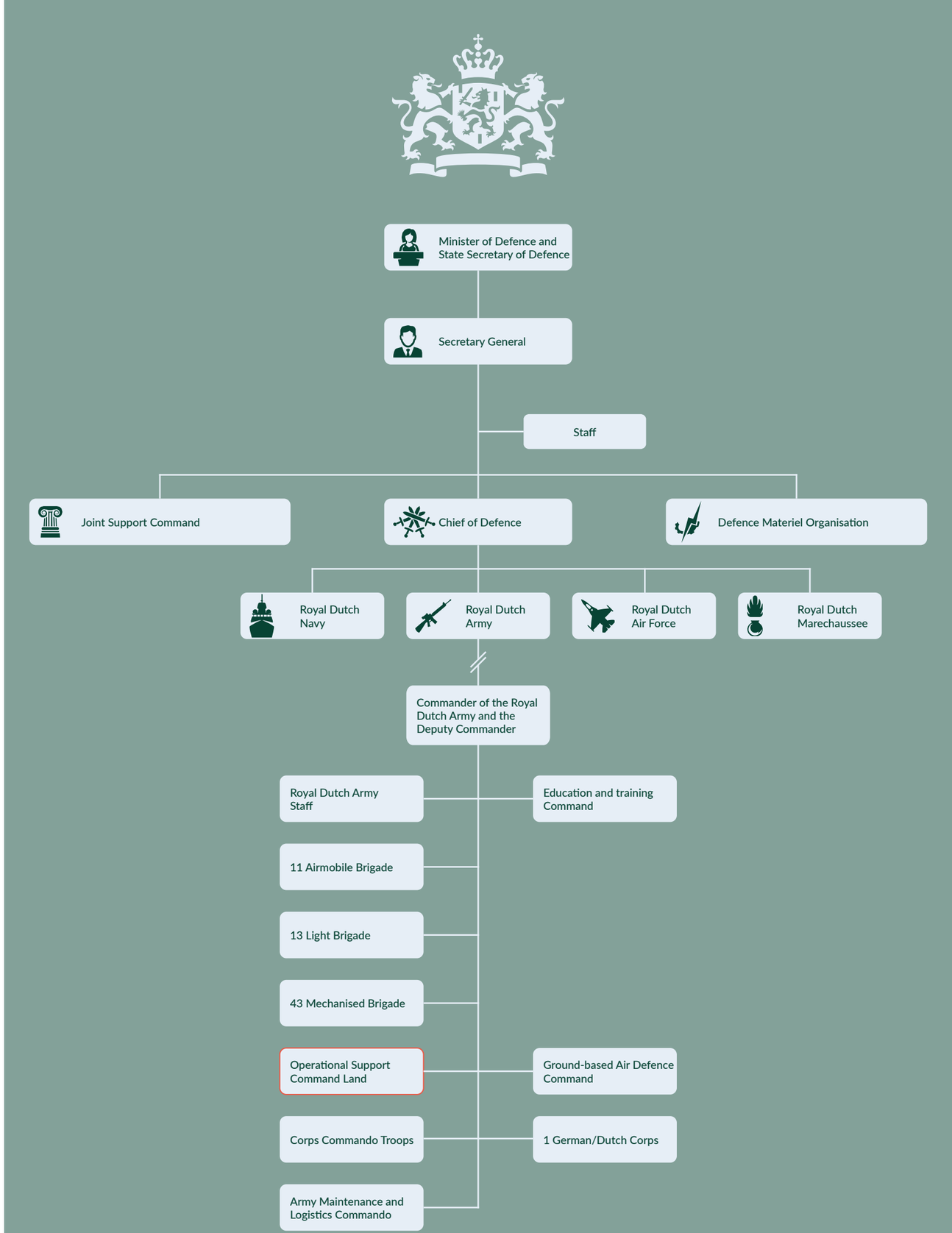


Figure 4: Organisational overview of the Dutch Ministry of Defence and its Army

reaction to these effects.

Budget cuts
The past decades have been dominated by cutbacks within the Ministry of Defence. One of the preconditions was the retention of quality of (medical) care and at the same time a mandated reduction in personnel (400 Geneeskundig Bataljon, 2020). Due to budget cuts and the threat level at that time, the focus of the (re)formation of the 400 Medical Battalion was on Peace Support Operations (second main task) and therefore static operations from compounds. This had and still has significant consequences for the combat-readiness of 400GNKBAT.

Shift to the first main task
In recent years, there has been a growth in the number of political frictions and terrorist attacks. Old threats persist and all kinds of new ones are added (Defensievisie 2035, 2020). Due to these threats and geopolitical influences, there has been a shift in focus to the first main task.

Negative effects of past developments
With the current shift to Combat Operations, the negative effects of decades of budget cuts become visible. The current structure and state of the organisation are not sufficient and not properly equipped for the changing threats. The consequences within the medical support are that, with the battalion's current personnel and equipment, it is not possible to independently move, deploy, and maintain a Role 2 Basic and/or a Role 2 Enhanced.

The future
This worrying observation resulted in a new vision. Defence needs more adaptability, speed and combat power. By 2035, the Ministry of Defence wants to be a smart, high-tech organisation. This requires the Ministry of Defence and the Army to be a strong innovation and high-quality workforce, with great interest and power in information technology. Being flexible is one of the core characteristics of the future Army.

Despite significant investments, there is still a major shortage of support and supplies for these future scenarios. 400GNKBAT is one of those supporting units and needs to reform and innovate to meet future demands.

3.2 Mass Casualty Incidents

It is no secret that when the Army goes on missions, there is a possibility of getting injured. Deployment of the Army to dangerous areas such as Iraq, with the presence and threat of ISIS, and the possible Article 5 situations in the future, can even result in Mass Casualty Incidents (MASCALs). A MASCAL is defined as "an event that generates more patients at one time than locally available resources can manage using routine procedures. It requires exceptional emergency arrangements and additional or extraordinary assistance" (WHO, 2007). In other words, a MASCAL can be any event that results in such a number of victims that it disrupts the normal emergency and health care services (PAHO/WHO, 2001).

In case of (a) wounded soldier(s) and/or a MASCAL, the Military Medical Chain is triggered. However, we as a nation, have not participated in and focused on missions containing such events, with numbers of patients that high, for decades. Therefore, the Military Medical Chain and its current personnel is not ready for such an event to occur.

"The very real prospect that some will not return in one piece and some not at all ..."

From the book *Medic*, by John Nichol and Tony Rennell, 2009

3.3 The Military Medical Chain

The founding of the International Red Cross in 1864 has led to an agreement about improving the fate and life prospect of the wounded soldiers in the field and in times of war (Regiment Geneeskundige Troepen, 2019). This resulted in the founding of the Regiment Medical Troops (Regiment Geneeskundige Troepen) in 1869. Their motto is *"Eripiendo Victoriae Prosum"* which means by helping, I serve the victory. In other words, they support the tactical operation.

Military healthcare promotes health in relation to the ability to deploy Defence personnel (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015). The focus is on effective treatment of traumatized soldiers, with a curative purpose. Over the years, the way of providing medical care has been developed, which has led to the Military Medical Chain as we know it now.

3.3.1 The roles of the Military Medical Chain

The Military Medical Chain consists of multiple tiers (KL Doctrine, 2014). The functions and capabilities required to maintain the pre-defined levels of care per tier are described in roles: Role 0 up to and including Role 4. Every role corresponds to a different care level: the level of (specialised) care that can be delivered, and for which the capacities are available. The levels of care are intrinsic to the level of care of a higher role. For a simplified overview of the Military Medical Chain see figure 5.

Within the Dutch Army Role 1 is the responsibility of the 11, 13, and 43 Medical Companies (Geneeskundige compagnie, Gnkcie) of the 11 Airmobile, 13 Light, and 43 Mechanised Brigade (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015; Ministerie van Defensie, 2021c). Role 2 (and the possible contribution to a Role 3) is the responsibility of the 400 Medical Battalion (400GNKBAT).

3.3.2 The chain as support to the tactical operation

When on a mission, the Army composes a tactical plan. Part of this tactical plan is to calculate the expected losses during a certain period of time (48 hours). Based on this loss expectation, a medical plan is put together by the Medical Company (Gnkcie) of the relevant brigade. The medical plan consists of the amount of different treatment facilities and how they are positioned relative to each other. Thus, which Roles 1 transport patients to which Role 2 Basic and which R2B's transport patients to which R2E. The Gnkcie of the brigade aligns their plan with the 400GNKBAT to put together a full plan that can be rolled out during the operation. Another part of the medical plan is the deployment of ZAUs (ambulances). Within the medical plan, based on the loss expectation, it is calculated how many ZAUs should be stand by at which facility. See figure 6 for a simplified overview of a battleground with a medical plan to roll out.

3.3.3 Differences between Peace Support Operations and Combat Operations

With only roles there is no chain. This paragraph zooms in on the factors medical evacuation (MEDEVAC), patient regulation, communication, and the difference between those factors in Peace Support Operations and Combat Operations. All the differences arise from the different main goals of the chains. The Military Medical Chain in Peace Support Operations is a treatment-oriented chain (doing the most for every single patient), while in combat the turnover is much higher and therefore it is a discharge- and transport-oriented chain (doing the most for the most).

MEDEVAC

There are three different forms of medical evacuation: forward medical evacuation, tactical evacuation and strategic evacuation.

- Forward medical evacuation (FWMEDEVAC)
  The evacuation from wounded soldiers from the Point of Injury/Casualty Collection Point (POI/CCP) to the first medical treatment facility.

- Tactical medical evacuation (TACEVAC)
  The evacuation of patients from one treatment facility to another one in the operational area.

- Strategic medical evacuation (STRATEVAC)
  The evacuation of patients from the operational area to a treatment facility outside the area, most of the times this is a Role 4 treatment facility.

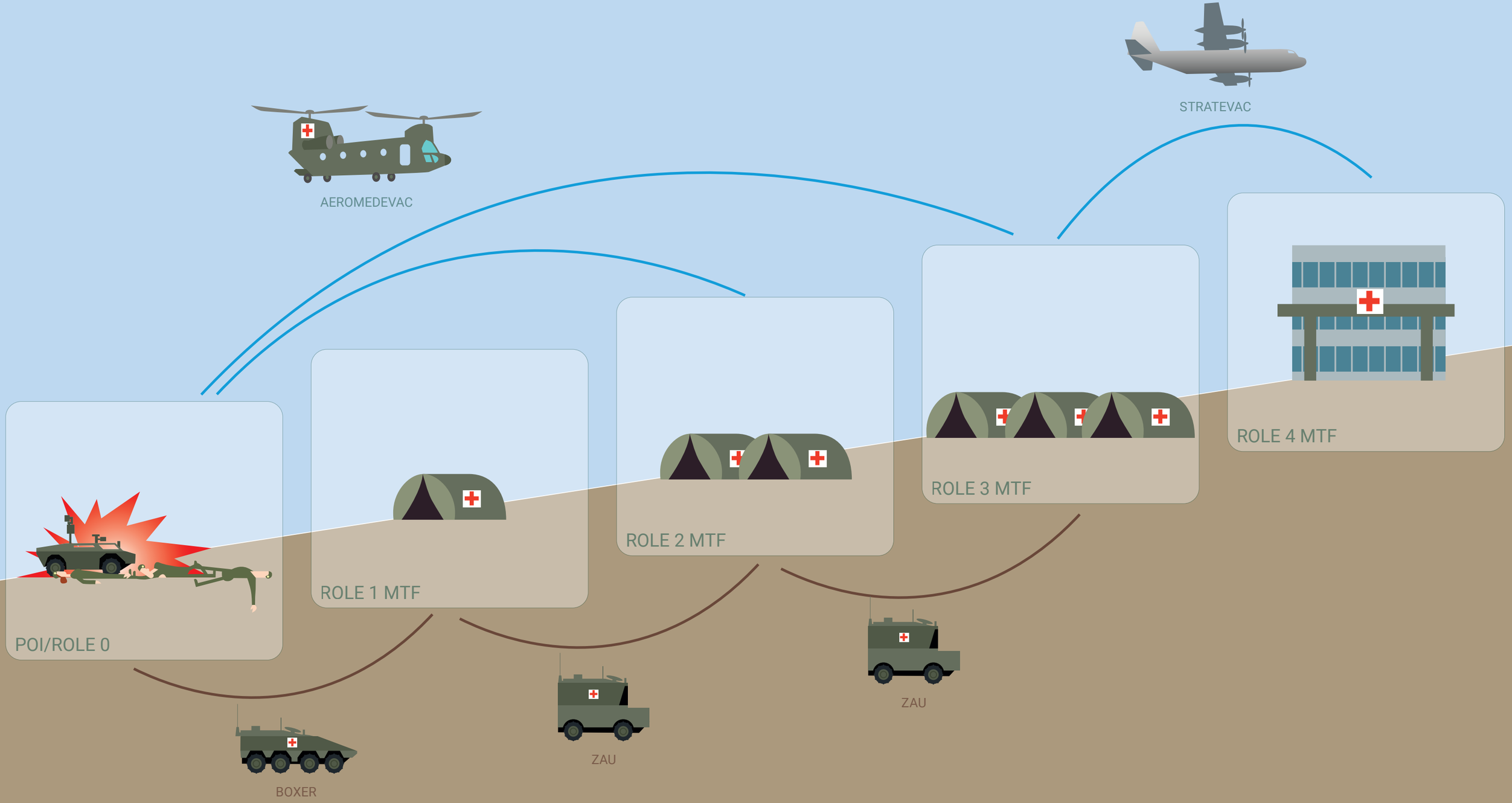
In Peace Support Operations medical evacuation can be done by either ground transport or air transport with a helicopter (AEROMEDEVAC) (see figure 5). In Combat Operations air superiority cannot be assumed and therefore FWMEDEVAC and TACEVAC are solely done via ground (see figure 5). In this case, FWMEDEVAC is done with a BOXER (an armoured vehicle for transport of wounded) and TACEVACs are done with ZAUs (non-armoured ambulances).

Jumping

Another difference relates to the mobility of the treatment facilities. In Peace Support Operations the work is done from static compounds. Combat Operations is a much more dynamic fight; the Medical Treatment Facilities need to be mobile in order to follow the pace of the manoeuvre. This results in the so called *jumping* of treatment facilities. As the frontline moves forward, the treatment facilities move alongside in order to maintain the fixed times within which patients need to be able to get treated according to the NATO standards and the Dutch doctrine (KL Doctrine, 2014; NATO Standardization Office, 2019a).

Patient regulation

The biggest difference between Peace Support Operations and Combat Operations regarding patient regulation is that, in case of PSO, a patient can skip multiple treatment facilities and be flown right to the MTF with the best available care possible for that specific patient. There is even the possibility to redirect the evacuation to another treatment facility in case of unexpected changes. In Combat Operations, the vehicles from the Wounded Transport Company (Gwtcie) commute back and forth between the same two treatment facilities all the time. This means that every patient taps every treatment facility of the chain, and is placed in a different vehicle at the Ambulance Exchange Point (AXP) of every medical treatment facility, either directly after arriving or after treatment at that specific facility.



POI/ROLE 0

In NATO terms: First Response Capability. The chain starts at Point of Injury (POI) in the field (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015; NSO, 2019). All Dutch military personnel is capable of providing self and buddy care (ZHKH). Only selected military personnel had extra medical education and training (Combat Life Savers), and is capable to deliver enhanced field care.

ROLE 1 MTF

Capabilities of the Role 1 includes a couple of primary healthcare capabilities: triage, specialised first aid, pre-hospital emergency care (PHEC) and essential diagnostics (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015).

ROLE 2 MTF

When arriving at a Role 2, there is a switch from pre-hospital emergency care to emergency medical care (EMC) (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015; NSO, 2019). The Role 2 MTF is the first Medical Treatment Facility with the capacity to perform Damage Control Surgery. In combat, Role 2 is split into two parts: the Role 2 Basic (R2B) and Enhanced (R2E).

ROLE 3 MTF

The Netherlands cannot single-handedly deploy a Role 3 MTF (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015). However, they can contribute to a multinational treatment facility. Role 3 delivers specialised surgery and care, and has additional diagnostics capabilities compared to a Role 2 (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015; NSO, 2019).

ROLE 4 MTF

Role 4 is the last facility of the Medical Chain, after repatriating (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015; NSO, 2019). It offers the full spectrum of specialist surgical care and medical procedures, reconstructive surgery and rehabilitation. In the Netherlands there are two facilities: the Central Military Hospital (CMH) in Utrecht, and the Military Rehabilitation Centre (MCR) in Doorn.

Figure 5: Overview of the roles of the Dutch Military Medical Chain and their goals

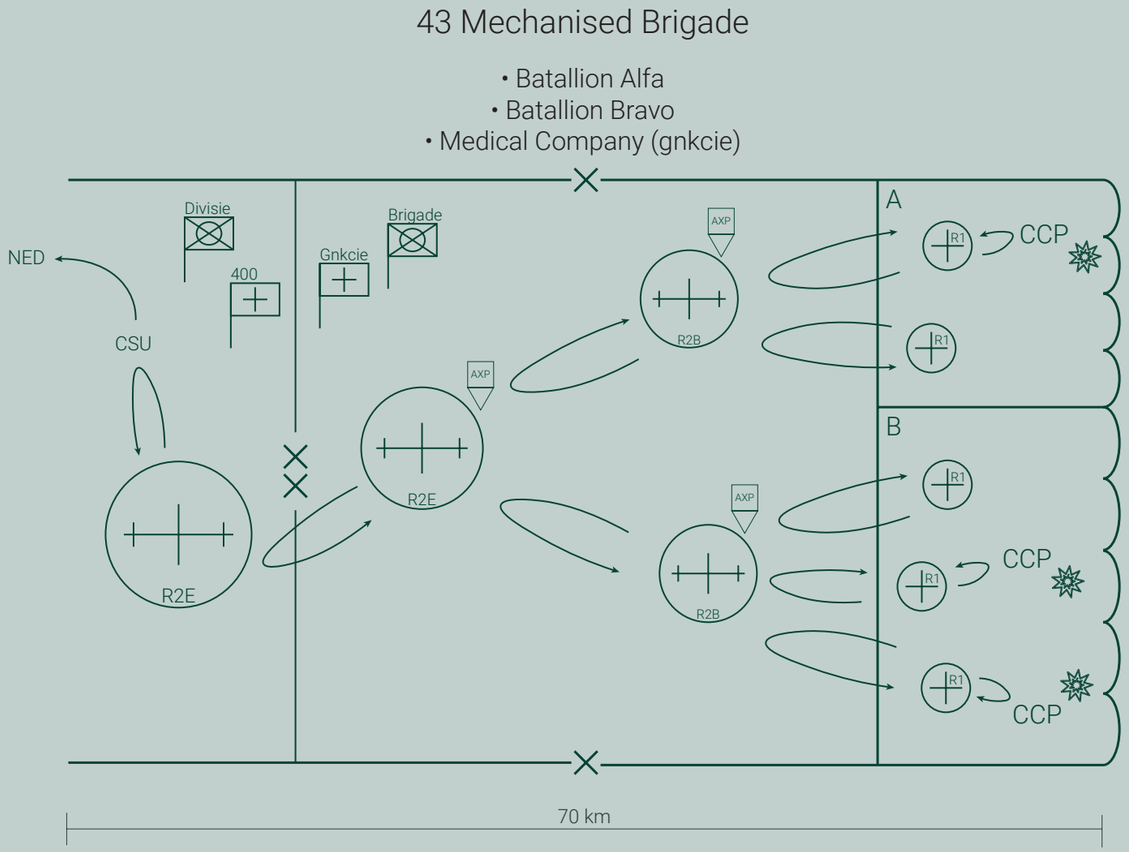


Figure 6: Overview of the Dutch Military Medical Chain as support to the tactical combat operation

Evacuation communication
Part of the patient regulation is the evacuation communication. In Peace Support Operations there is a PECC (Patient Evacuation Coordination Centre). In case of a wounded soldier, contact is made with the PECC, and the PECC coordinates where the patient will go by arranging the transport and destination. The PECC not only coordinates where patients go, they also keep track of the number of patients, severity, and recovery. In Combat Operations, there is no coordination from higher up. The loops of the Gwtcie are pre-set: they are aligned with and adjusted to the plan of the tactical operation. Medops (Medical Operations Centre, the PECC in Combat Operations) is only tracking the number of patients in the form of: how many entered the facility, how many are inside, and how many are discharged and transferred to a higher role.

Casualty Staging Unit
One of the other differences between Peace Support Operations and Combat Operations is the use of a Casualty Staging Unit in combat (see figure 5). Due to high number of patients, not all wounded can be evacuated via STRATEVAC at the same time. Therefore, they are staged at a point close to the location of evacuation-departure to free up space in the treatment facilities.

Important pillars in Combat Operations
The differences between Peace Support Operations and Combat Operations uncovered important pillars for the Military Medical Chain in combat. Since the medical chain is discharge- and transport-oriented, quick and correct triage is important, as well as efficient and effective treatment, and recognizing that a patient is stable enough for transport as soon as possible.

For a more elaborated explanation on how the Military Medical Chain supports the tactical operation see Appendix B.

3.4 Conclusion

The Military Medical Chain is part of a complex organisation. Before zooming in on the specific role of this project, this chapter looked at the bigger picture in which the Role 2 Basic is embedded: the Ministry of Defence as an organisation, the past and current developments within the organisation and their influence on the present and future. Insight in the background of the organisation, their developments, how they operate and how the medical chain supports the operation created an understanding of the context around the Military Medical Chain. This formed the foundation of the research and helped understanding the gap (and its importance) between the current (*where we are now*) and desired situation (*where we want/need to go to*). The background information on the organisation was fuelled by desk research and interviews.

Main tasks
The Land Operational Support Command supports operations and exercises with people and equipment. The 400 Medical Battalion is part of this unit and is responsible for providing operational hospitals and medical care during all types of missions for the entire armed forces. The Armed Forces have three main tasks:

1 The protection of own territory (physically and digitally) and that of NATO allies
2 The contribution to and encouragement of international legal order and stability
3 The provision of assistance during disasters and crises

Developments
The past decades, the focus lied on operations within the second main task. Due to geopolitical influences this is shifting to the first main task. Unfortunately, developments over the past decades, such as budget cuts and a focus on missions in the second main task, have resulted in a structure and state of the organisation that is not sufficient and not properly equipped for operations as a result of these changing threats. The consequences within the medical support are that, with the battalion's current personnel and equipment, it is not possible to independently move, deploy, and maintain a Role 2 Basic and/or a Role 2 Enhanced. In other words, 400 Medical Battalion is not capable of support in combat.

Differences between Peace Support Operations
The basis of the chain is the same for Peace Support Operations and Combat Operations. Nevertheless, there are significant differences. Where PSO can rely on AEROMEDEVAC with centrally controlled evacuations, air superiority cannot be assumed in combat. Therefore, every evacuation is ground based and done by pre-set transport loops. More importantly, the medical chain in PSO is treatment-oriented and meant to do the most for every single patient, while in combat the chain is discharge- and transport-oriented and meant to do the most for the most to increase the overall survival rate.

Important pillars
In order to achieve a discharge- and transport-oriented chain and to increase the overall survival rate, there are three important pillars within Combat Operations:

- Quick and correct triage
- Efficient and effective treatment
- Recognizing that a patient is stable enough for transport as soon as possible

Insights
Due to the fact the Dutch Army have not been on a main task 1 mission for the past decades, medical personnel that have recently been on deployment is experienced in Peace Support Operations. Interviewing them will therefore provide information about a different kind of mission than Combat Operations. In order to get feeling with, and understand the context of a Role 2 in combat operations it is necessary to speak to people who have combat experience. The challenge here is to place the obtained information in the right context and to be aware of the differences between the operations at all times. Furthermore, it is essential to take into account that the Role 2 Basic is still a concept in full development.

With a clear overview of the organisational context, the medical chain and the differences between Peace Support Operations and Combat Operations, the development of the Role 2 Basic and the R2B in its current form can be looked into.

4

CONTEXT OF USE

The Role 2 Basic Medical Treatment Facility

The previous chapter dived into the organisational context and developments to provide background information on the complex context in which the Role 2 Basic is embedded, creating a clear overview of the need-to-know basis. This chapter zooms in on the R2B itself. With the Role 2 Basic being this project's specific context of use, the goal is to gain insight in the current (development of) the R2B as part of the Military Medical Chain and the purpose of its facility. Looking at the different aspects of the R2B, exercises versus reality, the patient processes, the communication and information need provides insight in the current situation, the desired situation and the gap in between. It unravels areas for improvement of which one will be chosen to focus on.

Information on the context of use was mostly drawn from interviews with medical personnel working in the Role 2, interviews with combat-experienced personnel, and by reading the books 'Oorlog in de Operatiekamer' and 'Medic'.

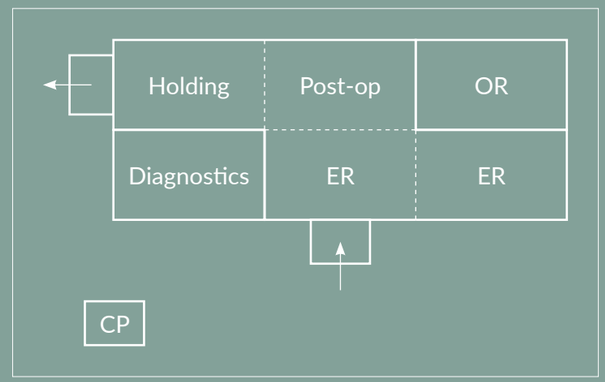
4.1 A treatment facility under construction

The Role 2 Basic MTF within the Dutch Military Medical Chain is a new concept, and therefore under construction (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015). Due to the shift to Combat Operations, the field hospitals need to be flexible and mobile in order to follow the pace of the manoeuvre (defined as jumping, to follow the frontline). Based on this, and the Forward Surgical Concept (being able to have patients on the operation table within 2 hours after injury), the Role 2 has been split into the Role 2 Basic and a Role 2 Enhanced. The R2B has less capacity than a R2E and is located closer to a R1 MTF and therefore closer to the frontline. NATO instructions in the Standardization Agreements are clear about what a Role 2 Basic must possess (NATO Standardization Office, 2019a). Described in capabilities, a framework has been provided. With this framework, the 400 Medical Battalion (400GNKBAT) started developing such a treatment facility to support the Army.

The capabilities that a Role 2 Basic must possess are defined in seven core modules (NATO Standardization Office, 2018):

- Emergency area
- Surgery (damage control surgery)
- Specified diagnostics
- Patient holding
- Post-operative
- C4I: command, control, computer, communication, and information
- Medical supply

Based on these seven core modules 400GNKBAT developed and tested multiple configurations with differences in layout and number of present personnel. This resulted in the current configuration with 35 employees to independently deploy, move, and maintain a Role 2 Basic. Figure 7 shows how it is constructed from the seven core modules, and what medical personnel is present.



CP = command post
ER = emergency room
OR = operating room
Post-op = post operative room

- Emergency Room - 2 patients
  1x ER doctor
  1x General Military Doctor (AMV)
  2x ER nurses
  2x General Military Nurses
  2x Caretaker Individual Health (VIG) or dedicated writer
- Operating Room - 1 patient
  2x surgeons
  1x anesthesist
  2x OR assistants
  1x anesthesia assistant
  1x OKT
- Post operative room - 2 patients
  2x ICU nurses
  2x VIG
- Holding - 4 patients
  2x AMV
  2x VIG

Figure 7: Overview of the seven core modules of the current configuration of the R2B MTF and the medical personnel present

4.2 Patient processes in the R2B MTF

The current configuration with the available medical personnel is developed to receive patients from Role 1 and transport patients to a Role 2 Enhanced. Patients arrive in a ZAU (ambulance), and before patients enter the tent, triage is performed according to protocol. This is done to quickly evacuate patients who don't need surgical care and/or are stable enough to get to the R2E. The classification system corresponds to the severity of the injury, and on that basis a priority (1, 2, 3 or 4) is assigned to the patient, in which T1 is the highest priority. Roughly said, only T1 patients enter the R2B, T2 and T3 patients are sent directly to the Ambulance Exchange Point (or to holding if the AXP has no place) to be transferred into another vehicle for transport to the R2E. T4 patients are victims who cannot be saved in the given situation. Figure 8 zooms in on the process in front of the tent.

T1 patients that enter the R2B go through a different process. They are first treated in the ER (emergency room). Here, the goal is to stabilise, diagnose and treat the patients before surgery. From the ER patients go into surgery. After surgery they end up in post-op and just before they are picked up by a ZAU for transport to a R2E, they are kept in holding. A simplified (single) patient process is shown in figure 9.

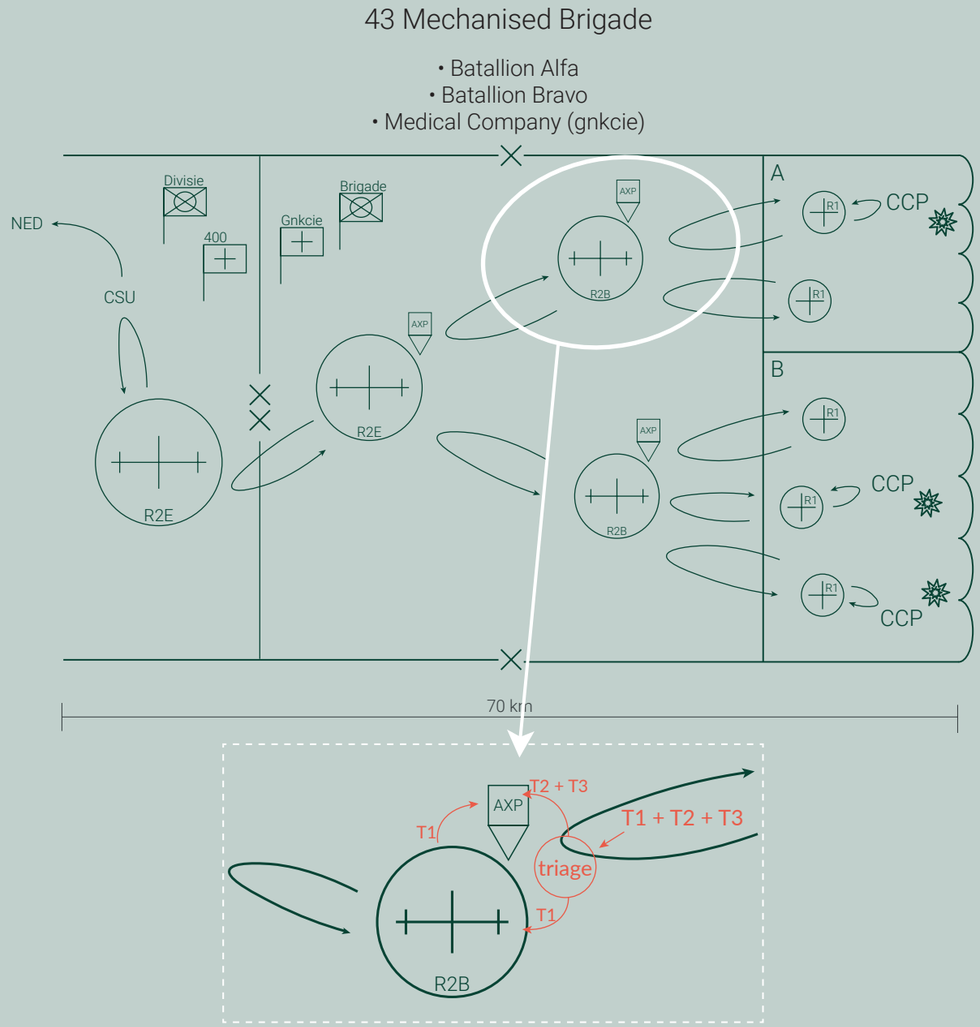


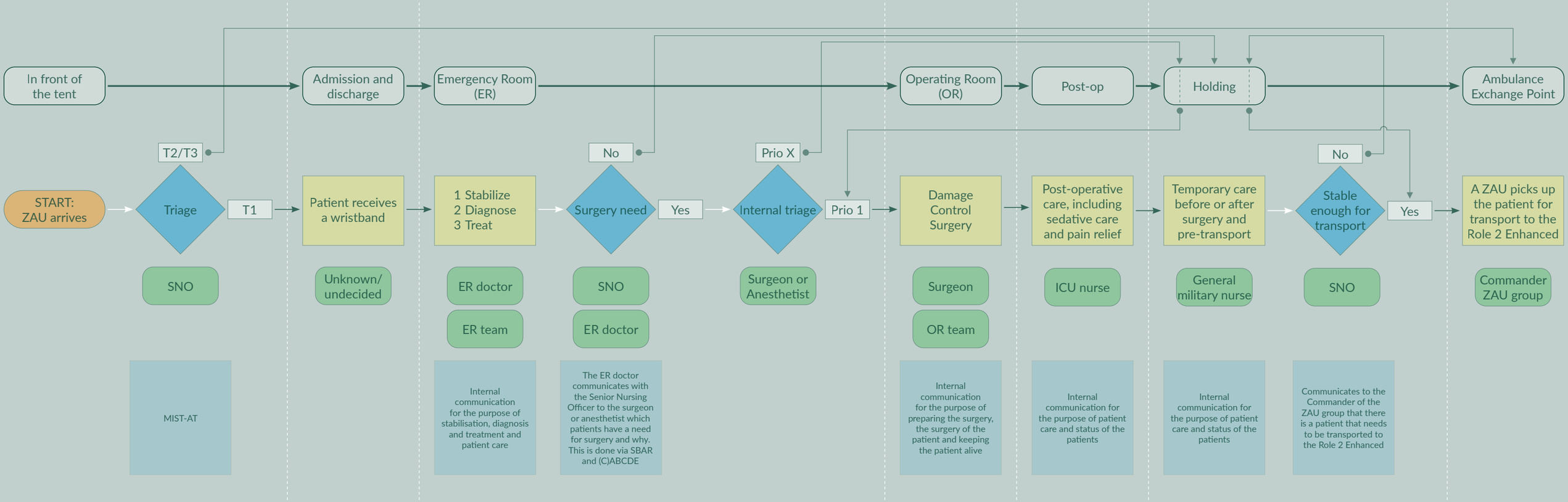
Figure 8: Overview of the triage process in front of the R2B MTF

From this single patient process map we can learn that every module has its own goal, and that there are different routes a patient can take within the Role 2 Basic Medical Treatment Facility. It's a constant puzzle which patient to allocate where in order to save the most. However, this puzzle, the complexity of a multi patient trauma, cannot be shown in a patient journey. The constant dilemma to choose between patients, they all come down to a decision-making moment. Is the patient a T1, T2 or T3? Is there need for surgery? Which patient has surgery priority? When a patient needs to be taken in, is there someone stable enough to transport further up the chain to make room? For every decision-making moment, someone is responsible. Who's responsible for which decision is shown in the single patient process map, as well as the way patient details are communicated and between whom.

In order to show the complexity, and map the interdependencies and relationships between functionaries and the different roles, a consolidated flow model was created (figure 10) (Holtzblatt et al., 2004). A flow model shows the responsibilities, communication and coordination necessary to do the job. When flow models are consolidated, they capture the different roles people play, their communication patterns and process work flow. Furthermore, consolidated flow models uncover key work groups, information need, and core activities. The consolidated flow model from the Role 2 Basic Medical Treatment Facility provided the following insights:

- The Senior Nursing Officer plays three roles at three different locations
- Per module there is one functionary responsible
- Ultimately, only one functionary is responsible, the functionary in the role of Clinical Director (CD)
- The CD is, at the same time, the connection between outside and inside the system (commuting back and forth between the facility and Command Post)
- The process work flow is based on Peace Support Operations and not adjusted to or improved for Combat Operations
- Communication of patient details internally is done differently than when external-internal communication of patient details takes place
- The information need that emerges from the flow model is the same information as is provided to the medical personnel in Peace Support Operations
- Every module consists of a key work group, they work together to reach the goal of that module and by doing so contribute to saving as many lives as possible

These previous mentioned aspects that can be learned from (but not always seen in) the single patient process map and the insights gained through the consolidated flow model will be elaborated further in the following paragraphs. The flow models per module can be found in Appendix C.



Decision moment

Goal of the area

Functionary who is responsible

What is communicated and how

Figure 9: Simplified overview of the process of a single patient

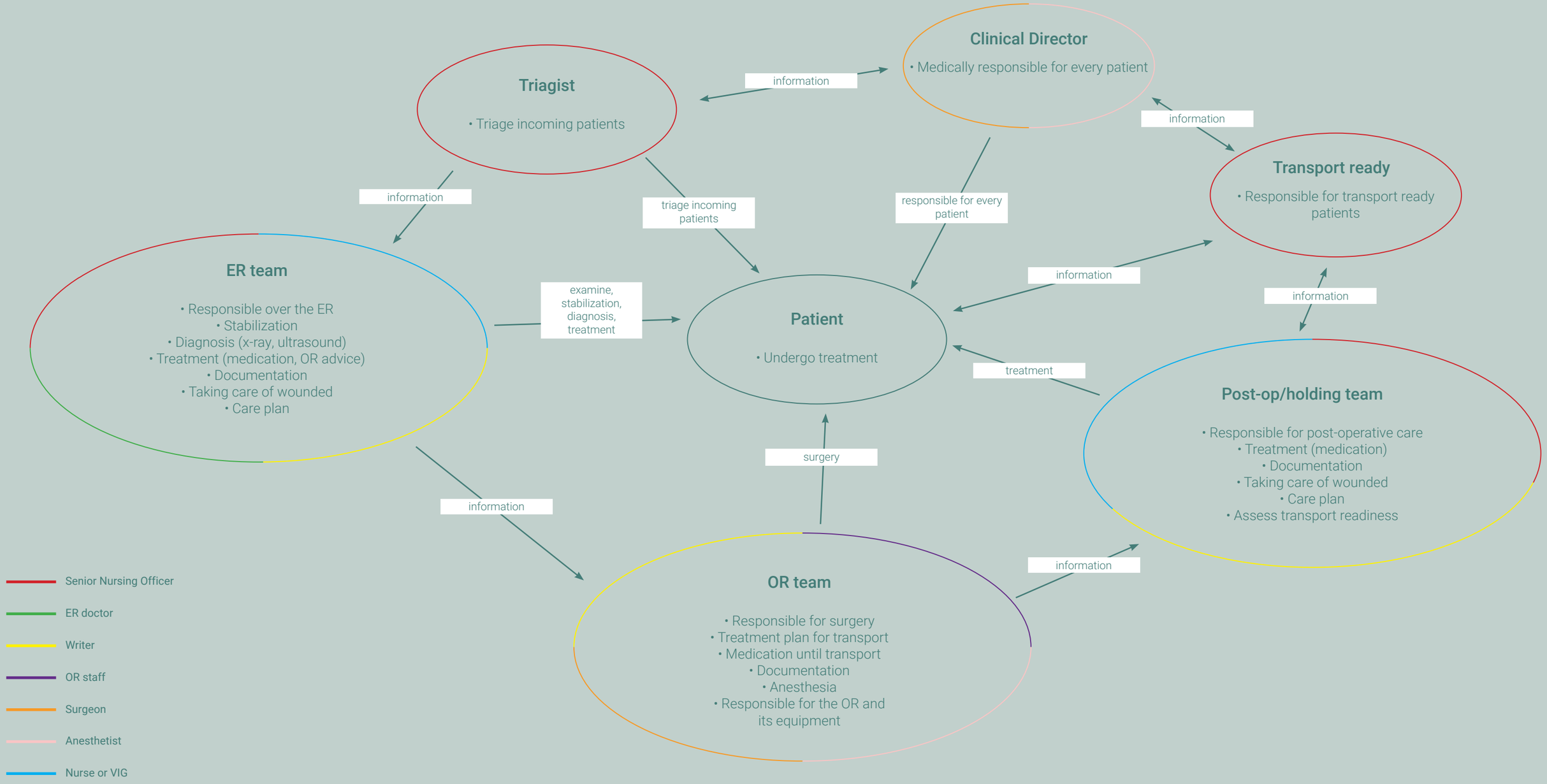


Figure 10: Consolidated flow model

4.2.1 Communication of patient details

The communication of patient details includes two levels: between treatment facilities, and within facilities Both of the levels are currently based on Peace Support Operations.

Between treatment facilities

At Point of Injury, a Field Medical Card is filled in by a fellow comrade, every soldier has one. This Field Medical Card is transferred with the patient to the Role 1 MTF. Within the R1 it is complemented and accompanied by a wounded-transport form. Both of these communication forms are transferred with the patient to the R2B MTF. In the Role 2 Basic a patient file is made, which consists of 57 pages to fill in. Adding this to the two documents already transferred with the patient, leaving the R2B a patient carries three documents. Figure 11 shows an overview of the forms between the different roles. As the figure shows, all three documents are on paper. There is one big advantage of paper: it always works. However, paper has disadvantages as well: it costs a lot of time and it can be lost easily.

Within the Role 2 Basic

Right now, the communication of patient details within the R2B is based on the communication within a Role 2 in PSO (shown in figure 9). At every handover (handing a patient over to the responsibility of someone else), patient details are communicated. Incoming patients (communication transition from outside the R2B to inside the system) are handed over with a MIST-AT. The MIST-AT covers the **M**echanism of Injury, **I**njuries found, **S**igns (vitals), **T**reatment given, **A**ge, and **T**ime of injury (thus: MIST-AT). The signs are communicated in the ABCDE format (Airway, Breathing, Circulation, Disabilities, Exposure) as *'was x, and now is y'*. At the moment a patient arrives in the ER, this process is already done twice (from ZAU to Senior Nursing Officer, and from Senior Nursing Officer to ER doctor).

The handover between an ER doctor and a surgeon is done via SBAR, which stands for Situation, Background, Assessment, and Recommendation. Situation includes what happened, what caused the injury. The background includes previous conditions, allergies, etc. The assessment is what has been done in the ER (what they found and what they did), and the vital signs in ABCDE format again. All this results in a recommendation: the ER doctor recommends the surgeon what to do, e.g., *"He is bleeding from his spleen, that needs to be stopped."*

In short, handovers between facilities are done via MIST-AT and vital signs in ABCDE format, handovers between medical personnel within facilities are done via SBAR and vital signs (ABCDE).

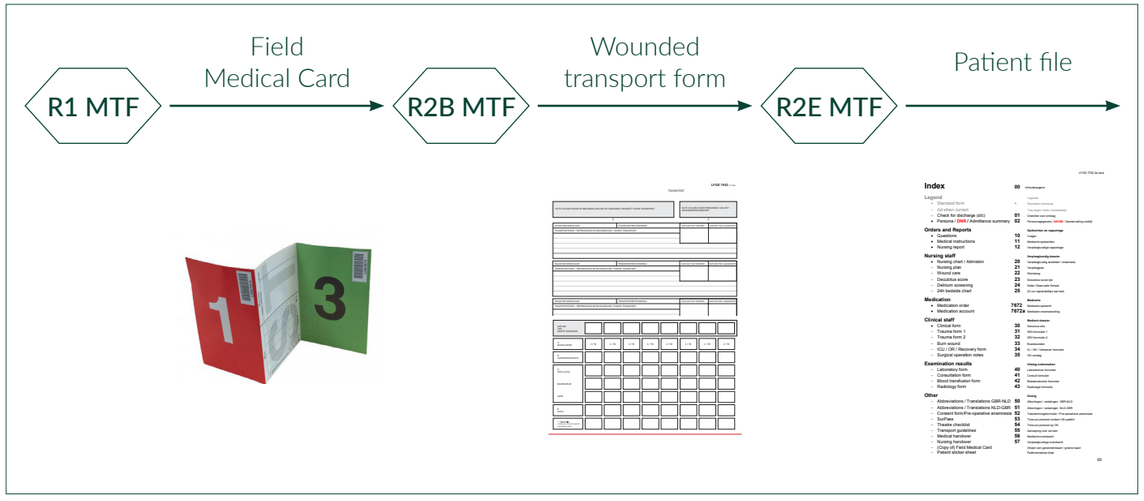


Figure 11: Overview of the different forms including patient details that all have to stay with the patient

4.2.2 Roles of the human actors

The communication and responsibilities shown in figures 9 and 10 also reveal a couple of crucial roles within a Role 2 Basic; the Senior Nursing Officer (SNO), one functionary at three significant places, and the Clinical Director who is completely missing in the single patient process map while being medically responsible over all patients that enter the R2B as can be seen in the consolidated flow model.

Senior Nursing Officer

The SNO is responsible for all care-processes (washing of patients, relocating patients), keeping track of stocks, keeping track of the bed-capacity, and the need to transport patients from the R2B to R2E. Besides these responsibilities, the SNO is also placed in front of the MTF to perform the triage of incoming patients.

Clinical Director

The Clinical Director is the communication line between the facility and outside the facility, often commuting between the command post and the facility. Another responsibility is being medically responsible for every patient entering the R2B. Besides those responsibilities, the Clinical Director adjusts planning and decisions to information from the outside (e.g., when they need to jump to follow the manoeuvre).

4.2.3 Information need

In order for every functionary to do their job best, they need information about the patients. As said, the information communicated now, is based on Peace Support Operations. Under the circumstances of combat, there is no time and capacity for extensive format on communicating patient details. To illustrate: when there is a group of 14 patients incoming, hearing and remembering the MIST-AT from all those 14 patients is not possible. However, every functionary needs information to prepare for the incoming patients as good as possible.

Currently, medical personnel have indicated the need for the same amount of information about single patients in combat as they receive in Peace Support Operations. However, interviewees with combat experience all say the same: *"there is no time!"* .The question is: what is possible in Combat Operations? And what is the minimum information needed to have the maximum outcome?

Take-aways

- The patient process described is the process of a Peace Support Operation
- The way of communication is done the same as in Peace Support Operations
- The specific information and the amount of information that is being transferred is the same as in Peace Support Operations

The most important take-away that sums it all up is that the work flow process and the communication are taken from the context of Peace Support Operations while combat-experienced personnel indicates that those processes, and mainly the amount of information that is being communicated, are not suitable for a combat situation. However, the concept Role 2 Basic Medical Treatment Facility is still being elaborated by the 400GNKBAT which asks for training and testing.

4.3 Exercises versus reality

Elaborating a new concept, such as the R2B, involves exercising. However, during the interviews it became clear that there are two important things up for improvement. First, the exercises held do not fully reflect reality. As one of the interviewees said: *"In exercises you know patients don't die, everything is a bit more chill"*. There is less pressure, it is a different mental environment, and the circumstances and physical environment are different from reality. Besides exercises not fully reflecting reality, there is also a scarcity in exercises. Due to employees needing to stay BIG-registered and having other responsibilities within the Medical Battalion, there is not much time left to practice. This results in employees with only a couple of exercises done being

deployed. As one of the interviewees said: *"During an exercise you soon enough realise with whom you do and do not want to go on a mission" and "Inexperienced employees show inner panic during an exercise, and that is not even reality"*. However, as Maaike Hoogewoning states:

"By regularly practicing your skills and drills, you know what to do and you act accordingly, but no one can predict in advance what it does in your head. That cannot be trained".

4.4 Three areas for improvement

All information gathered through the interviews and desk research have led to multiple, relevant themes: responsibilities, incoming patients & triage, discharge & transport, communication & information, and tactical operation.

Responsibilities
All tasks entail heavy duties, functionaries are obliged to make sure something goes well. This causes certain roles to ask for certain characteristics. E.g., the command post should not only consist of operation-oriented personnel, there should be the right mix of personnel looking at the tactical side and personnel looking at the medical side. Another example is the Senior Nursing Officer, performing the role of triagist, yet at the same time needs to have an overview of the medical supplies and keep an eye on which patients are stable enough for transport.

Incoming patients & triage
For incoming patients and performing triage there is a difference in the number of patients on their way. Quick and correct triage is of importance. One of the interviewees said: *"With a high turnover, sometimes you are up to your elbow in blood and then someone shouts, if you even hear it at all: three incomings! But then, what comes next, you have no idea"*. As another one said: *"Triage sometimes goes wrong. The question is who can be helped in the R2B in such a way that the chance of survival increases?"*.

Discharge & transport
Recognizing that a patient is stable enough for transport as soon as possible is one of the key pillars for combat operations. Discharge & transport is an important part of this. "In main task 1, there is no choice where the patient goes, there is no time for that, the chain has to be an automatism. Regarding discharge, interviewees said:

"When is someone stable enough? And what if this is not the case, but space still needs to be made?".

Communication & Information
Communication is essential and it must be effective. During operations information is communicated between personnel. The analysis so far shows the current processes have been transferred from the context of Peace Support Operations into the context of combat. E.g., medical personnel states that after an accident, a 9-liner is communicated, while combat-experienced personnel states: "No 9-liner is communicated, you just don't stop fighting".

Tactical operation
The tactical operation influences the medical operation. Therefore, as said, there should be a mix in personnel looking at the medical side and personnel looking at the tactical side. Medical personnel are "in their own hospital bubble, they have no idea what's going on around them" and therefore it is up to the SNO to "keep an overview of what is happening inside and outside the tent". The Clinical Director is the one communicating with the other units and operation centres outside the Role 2 Basic and the SNO within the R2B.

The analysis resulted in the division of three problem areas: the incoming patients area, the area inside the Role 2 Basic Medical Treatment Facility, and the discharge area. See figure 12.

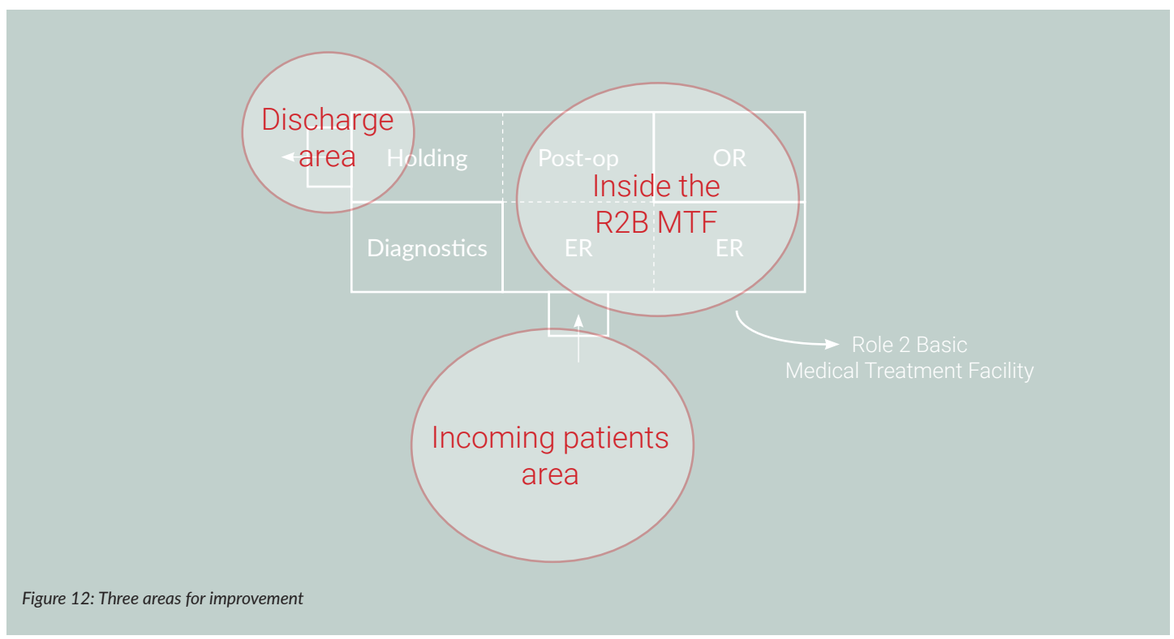


Figure 12: Three areas for improvement

4.4.1 Incoming patients area

The incoming patients area is the area just outside the tent: the area where is decided which wounded enter the R2B MTF and which don't. Incoming patients are now triaged by a Senior Nursing Officer. Triage is described as a dynamic process in which casualties are sorted by urgency for treatment and transport (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015). Thus, one term is used with two different meanings. To illustrate: a wounded soldier with treatment urgency 2 (T2) can have transport urgency 1 (T1). But T1 means treatment urgency 1 as well. Two employees can talk about the same patient in triage-language but mean something different. The analysis shows that triage therefore sometimes goes wrong.

Taking this event to combat, it is of great importance to get the patients at the right facility at the right time. As said, it is a discharge- and transport-oriented chain. Triaging is thus of great importance, deciding with patients go in and which patients are transferred to a higher echelon (and in which order). To run triage smoothly, there needs to be a clear language with clear definitions.

Besides having a clear language with clear definitions, situational awareness can support the triage decision making process as well. By only looking at the group of patients received at once, and not including the patients still in the system in front of the R2B, decisions to help a patient who would have made it to a higher role can result in the unnecessary loss of other patients.

4.4.2 Inside the Role 2 Basic Medical Treatment Facility

The communication of patient details inside the MTF is also based on Peace Support Operations. The advantage is that the information gathered is comprehensive, the disadvantage is that it costs time. While interviewees with combat experience say *"there is no time, patients just keep coming!"*. Within the current context, communication of patient details needs to be effective. Thus, it asks for adjustment to and improvement for Combat Operations.

4.4.3 Discharge area

The challenge within the discharge area, the post-op and holding modules of the Role 2 Basic, is to recognise as soon as possible when a patient is stable enough for transport to a higher role. Another challenge of this area is 'who to discharge in case of more incoming patients than we can place in the facility'. *"When is someone stable enough? And what if this is not the case, but space still needs to be made, then what?"*.

4.4.4 Focus: the incoming patients area

Based on the core of the Military Medical Chain in Combat Operations (being a discharge- and transport-oriented chain), most value lies in improving the incoming patients area of the Role 2 Basic. This area, where patients are seen and judged for the first time at the R2B, is the basis of getting the right patients at the right facility at the right time. Developing clearer triage-communication and decision support would increase the patient flow through the chain and the overall survival rate.

A deeper layer is to increase the communication of patient details within the R2B. However, this is seen as the next step in the journey of 'developing a combat-ready Role 2 Basic'. In order to improve the communication within to contribute to an efficient and effective chain, first, the right patients should come in.

In short, the focus area of this graduation project is the incoming patients area: the first place where patients can be correctly allocated to increase patient flow and overall survival rate.

4.5 Conclusion

Following the previous chapter that looked at the complex context in which the Role 2 Basic Medical Treatment Facility is embedded, this chapter zoomed in on the Role 2 Basic itself. With the goal to identify areas for improvement regarding medical communication within the Role 2 Basic, first insights needed to be gained on the current developments of the R2B, the purpose of the facility and the ins and outs. Furthermore, the patient processes were mapped to analyse to identify the different patient routes possible, as well as the different roles, communication and information need. This was used to get a clear picture of the current situation and the desired situation. The gap between those revealed areas for improvement. The areas for improvement were divided based on the physical areas in and around the Role 2 Basic.

Patient process
The R2B is a new concept, and therefore under construction. Following the patient process, communication of patient details happens on two levels: between treatment facilities, and within facilities. It became clear that both of the levels are currently based on Peace Support Operations and thus not combat-ready. Next to this, the patient process also shows the crucial roles of two functionaries: the Senior Nursing Officer and the Clinical Director. The Senior Nursing officer is at three significant steps in the process. The question that arises here is: is the SNO responsible for too much vitally important aspects within the R2B in combat? And on the other hand, there is the Clinical Director, who is the line between inside and outside the R2B and medically responsible for all patients that enter the R2B MTF, yet the Clinical Director is not visible in the patient process map.

Information need
During the analysis it became clear that the information need is based on the information provided during Peace Support Operations as well. Asking interviewees what the bare minimum of information is they need; the answer is literally *"the same as in Peace Support Operations"*. Though combat-experienced interviewees all said *"there is no time for MIST-AT's, patients just keep coming!"*. To conclude, there is a big gap between what is wanted by medical personnel and what is possible according to combat-experienced personnel.

Themes
The information gathered on the patient processes, communication and information need led to the themes: responsibilities, incoming patients & triage, discharge & transport, communication & information, and tactical operation. These themes all fall under two important user-pillars: clarity and preparation.

- Clarity
  Clarity is important to establish before a mission. It gets everyone started on the same basis. Setting ground rules, protocols and responsibilities provides the basis for the processes in the R2B. Deciding up front on what is done and what is not done in a R2B supports and facilitates triage. Clear responsibilities support smooth patient handovers.

- Preparation
  The second pillar is preparation. In order to increase the overall survival rate, and therefore increase the patient flow, the arrival of patients need to be prepared as good as possible. Preparation is the key to success. It supports fast and effective treatment and reduces the time a patient spends within the facility.

Areas for improvement
As a result of the analysis, three areas for improvement were identified: the incoming patients area, within the R2B, and the discharge area. Focus for the rest of this graduation project is on the incoming patients area. This area is the place where patients can be directed to the right locations, where discharge- and transport-orientation can be taken to a higher level. Developing clearer triage-communication and decision support will increase the patient flow throughout the chain as well as the overall survival rate.

However, while all the issues in the problem areas are relevant, there is one major underlying problem that hinders the 400 Medical Battalion from tackling the different problems on its own. The major conclusion is that processes have been transferred from one context to another, without taking into consideration whether they are suitable. Developing a new concept requires time and testing, time to develop with users and testing with users whether processes work and line up with the goal of the chain. The 400 Medical Battalion is developing the R2B concept, but there is a scarcity in exercises. Those exercises are the perfect time to test developments within the concept. Since there is a scarcity, 400GNKBAT must find an alternative to quickly develop and test to make progress at a rapid pace. Besides the scarcity of exercises, the exercises also do not fully reflect reality: *"In exercises you know patients don't die, everything is a bit more chill"*.

With the insights on the organisational context and the specific context of the Role 2 Basic, the next chapter will dive into the specific decision-making moment and process within the focus area.

5

INCOMING PATIENTS AREA

Mapping the decision-making process

The previous chapters have provided insight into the organisational context, the differences between Peace Support Operations and Combat Operations, and the development of the Role 2 Basic and its Medical Treatment Facility. Diving into the R2B made it clear that processes from one context have been transferred into another, without taking their suitability into consideration. Within the Role 2 Basic, three areas for improvement were identified, of which the incoming patients area will be the focus area from now on. This chapter dives into the process of decision-making within this area.

The goal is to map the decision-making process, define it sharply and find out the bare minimum information that medical personnel need to make the decision. First, the decision framework needs to be clear. Subsequently a clear definition of the desired result, or in other words: the purpose of the decision, needs to be formulated. Furthermore, this paragraph looks into the current process that is applied to make the decision, and its suitability regarding the chain-orientation of combat. The results will provide insights in the specific problems that arise in the focus area. The results will also reveal preconditions for the design phase, and thereby contribute to forming the design brief.

Information on the decision-making process and the bare minimum information need was mostly drawn from interviews and a simulation session with relevant actors from the focus area.

5.1 Mapping the decision framework and its goal

The mapping process started by looking at the map of the Role 2 Basic. Not just the treatment facility, but the map of the whole (mobile) compound (figure 13). Using this floor plan of the R2B is to visually display the patient flow: the lines of incoming patients into the decision area and the lines of outgoing patients (figure 14). The patient flow leads to the decision framework as shown in figure 15. Patients can enter the 'area of decision' from either a ZAU (ambulance) coming from a Role 1 or from the holding of the R2B MTF, ready for transport. The decision outcome per patient can either be *Ambulance Exchange Point* or *Medical Treatment Facility*. The blank space in the framework covers the decision, or more specific, the decision-making process for which data is needed. It's where information is collected to be able to act information-driven.

With the decision framework being clear, the goal of the decision (its purpose) can be looked into and be defined sharply. The purpose is the reason behind the decision, the why. By looking at the two possible decision outcomes per patient, the *why* is to allocate each patient to one of the areas for either treatment or further transport. However, when looking at the two possible decision outcomes in combination with the combat chain-orientation, the goal can be defined more sharply as: to filter and move aside as many patients as possible to transport them further up the chain without entering the R2B MTF for treatment. In other words, the goal is to forward every patient who can to the Ambulance Exchange Point and send as few patients as possible in.

5.2 The current decision-making process: the suitability of triage

Making a decision is a process. In order for this process to be result-oriented, it must be in line with the purpose of the decision. The decision-making process that currently takes place in *the blank space* is triage. Triage is one of the (decision-making) processes that has been transferred from the context of Peace Support Operations into the context of Combat Operations without taking into consideration whether they are suitable. As we have learned, there are significant differences between Peace Support Operations and Combat Operations. Therefore, the suitability of using triage for the decision in front of the tent is studied.

Triage is defined as a dynamic process in which casualties are sorted by urgency for treatment and transport (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015). One term is used with two different meanings. In practice, this means that the treatment urgency takes precedence. Thus, triage is done to prioritize patients regarding treatment. However, the Military Medical Chain in a combat context is not

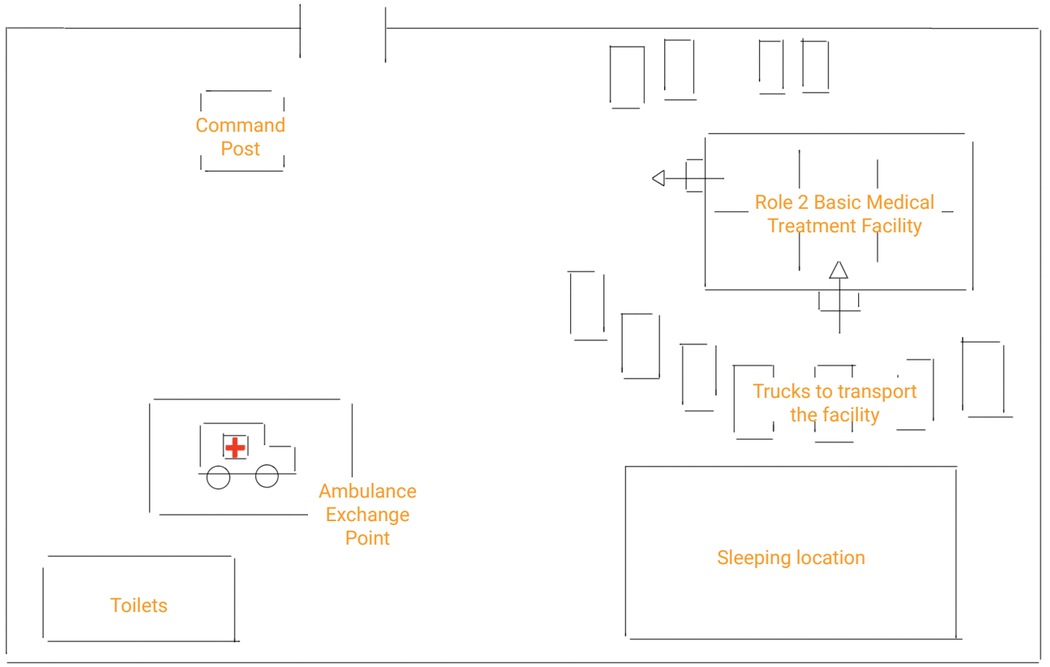


Figure 13: Floor plan of the Role 2 Basic Medical Treatment Facility

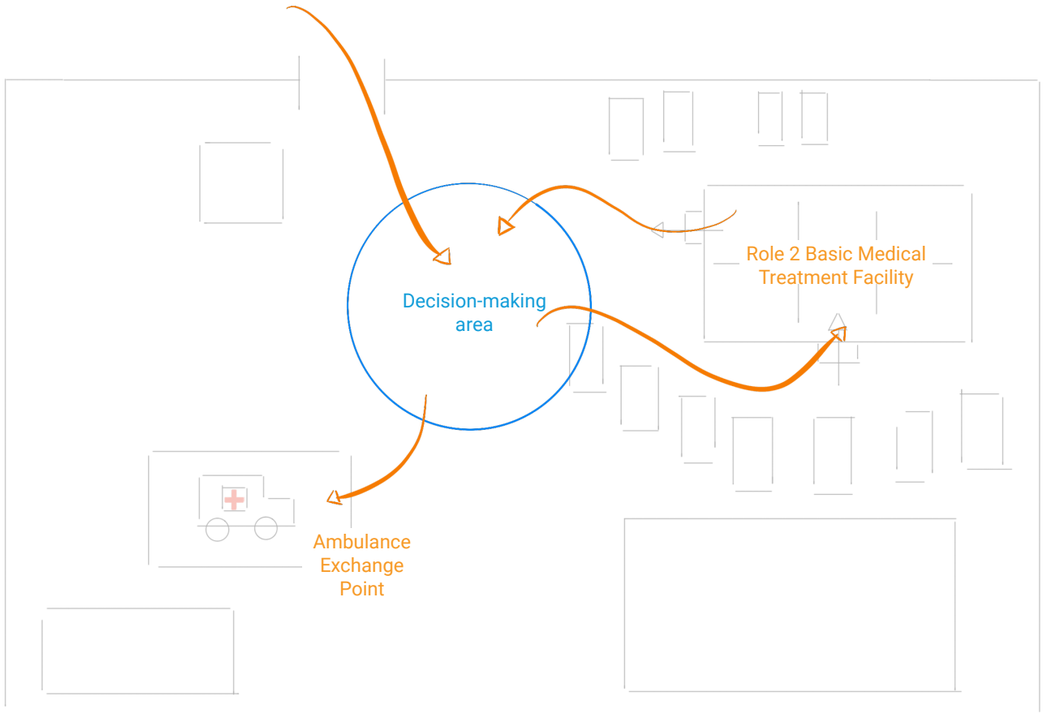


Figure 14: Patient flow in and out of the decision area

Figure 15: Decision framework, the blue blank space covers the decision-making

treatment-oriented.

By looking at the differences between the chain in Peace Support Operations and Combat Operations, a couple of things can be learned. In case of a treatment-oriented chain (peace support), the medical staff of the facility is aware of the fact that the patient(s) that are en route need to be treated at their facility, that's a given. Performing triage over the incoming patients is to prioritize them regarding treatment, who to treat first. In case of a transport-oriented chain (combat), every patient taps every facility during their way up to the last facility of the chain. This means that when patients arrive at a Role 2 Basic, it is not clear to the medical staff yet which patients need to be treated at their facility, and which patients can be transported further up the chain. Therefore, they need to ask another question previously to who to treat first, which is who needs treatment here? Or, more in line with the chain-orientation, who can be transported further without treatment?

In short, when patients arrive at a Role 2 in peace support context, the decision-making process is about prioritizing those patients regarding treatment. While in combat context, when patients arrive at a Role 2 Basic, the decision-making process is about allocating those patients. Since triage is a decision-making process to prioritize patients, while the decision-making moment in the blank space in front of the tent asks for a decision-making process to allocate patients, the current use of triage is not suitable at this place in the Military Medical Chain in combat.

5.3 Simulating the differences: uncovering the information need

Now that it has been established that the currently applied process (triage) is not suitable for the specific decision in front of the Role 2 Basic Medical Treatment Facility, a new research question is formulated. As said, the blank space in the framework covers the decision-making process. Part of the decision-making process is collecting information to be able to act information-driven. The research question

refers to the bare minimum information need of medical personnel, and is as following:

What are the most important data needed to make a decision about the allocation of a patient?

In order to dive deeper into the process of information gathering and the process of basing a choice on this information, a simulation session was held. In this session, only part of the framework was included (figure 18). Narrowing the framework down to one line of incoming patients (incoming from Role 1) provides the participants with a clear, manageable decision-making process in a session that most likely will pull them out of their comfort zone.

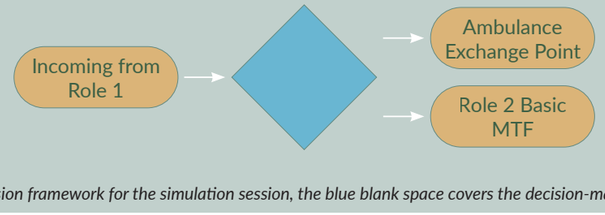


Figure 16: Narrrowed down decision framework for the simulation session, the blue blank space covers the decision-making

5.3.1 Simulation build-up

The relevant actors participating in the session were a Clinical Director, two General Military Nurses who also have Command Post experience, and an Emergency Room doctor. All of them can be put in the role of triagist.

The goal of the simulation was to trigger the relevant human actors into thinking in a different way than they are used to, and by doing so obtaining the answers to the research question. For the session, the research question was divided into two sub questions:

1 What are the most important data needed to make a decision about the allocation of a patient?

   a What is all the data that can be collected?
   b What is the necessary data in order to decide whether a patient goes to the Ambulance Exchange Point or to the Medical Treatment Facility?

The simulation consisted of two scenarios. By immersing the participants in different scenarios, they were stimulated to put into words what they normally don't consciously think about, but do automatically. Both scenarios came with two tasks to fulfill.

Scenario 1
Within scenario 1 the participants just rolled out their Role 2 Basic Medical Treatment Facility and they are waiting for the first patient(s) to arrive (note here that the MTF thus does not contain any patients yet). Suddenly, a ZAU drops off a patient and leaves straightaway.

Scenario 2
Within scenario 2, the participants are already fully operational, all 9 beds of the facility are occupied. However, multiple ZAU's arrive at the R2B. They drop off a total of 14 patients and leave straightaway, again.

For the first task, the scenarios were a means to uncover all possible data they can obtain about the situation/scenario and/or would want to obtain. So, if one patient arrives, what is all the information you can think of and want to collect? The participants were asked to put all data, separately, on post its and to write down as much as they can think of. This task was the same for scenario 2. The second task was performed to find out the most important data they need to be able to make a decision about the allocation of a patient. Therefore, the participants were asked to indicate by means of stickers what data they found most important to have. To guide and remind the participants of the decision they were dealing with, they were provided with a worksheet to stick all post its on. The worksheet provided was the narrowed down framework of the decision (figure 16). The red dots to indicate the most important data were sticked to the post its.

5.3.2 Simulation results

Results of the simulation can be structured into two parts: all possible information that can be collected, and necessary information in order to allocate patients.
After the simulation session, I processed the gathered information provided by the participants, and clustered them into 8 clusters.

- **In advance**
  Data the medical personnel would like to know in advance, thus before the patients arrive at the Role 2 Basic. For example, they want to know whether the patient is a CBRN patient or not and whether the patient has been searched (for grenades or other weapons), and cleared, already. In case of a single patient arrival, they also want to know if the patient is a T1.

- **Trauma**
  All data around the trauma that can be collected. What is the cause of the injury? Also known as the mechanism. What injuries have been found? And which ones are expected? What are the vital signs of the patient, heart rate, blood pressure, oxygen saturation (spO2), (C) ABCDE, catastrophic bleeding, respiratory rate, etc.

- **Personal data**
  Data such as a name, registration number, nationality, age, etc. In case of Peace Support Operations age is important since it makes a big difference if medical personnel need to prepare for the arrival of a child or for instance, an adult male above 70 years old. In combat age turns out to be less important since they only receive military casualties.

- **History**
  The cluster history is about the medical history of a patient. History can be divided in long term history and short-term history. Long term history relates to medical history that can be determined in advance, such as blood group and allergies, and previous surgeries or medical interventions. Short-term history is the history of the battle. E.g., what medication has the patient already received before arriving at the Role 2 Basic?

- **Patient group**
  The first four clusters are about one single patient. The fifth cluster, patient group, is about the complete patient group, consisting of all patients en route to the facility as well as all patients already present in de Medical Treatment Facility. This cluster therefore contains partially the same data as the cluster trauma, only in this case it is not about a single patient but about multiple patients. E.g., instead of wanting to know whether the patient is a T1, they want to know what the division T1/T2/T3 is of the patients that are on their way, or which patients are stable enough to transport further up the chain.

- **Tactical operation, the chain and its logistics**
  The cluster tactical operations and logistics includes data about the own system, about the system to which patients are discharged and transported, about the logistics and ambulance availability. For instance, what is the distance, expressed in time, to the Role 2 Enhanced? Yet also the pressure of the enemy is part of this cluster. Are we on track to win this battle? Should we take jumping into account?

- **Communication**
  More about how participants wanted information presented, rather than about specific data. Communication should be clear and notifications should alert medical personnel to new information.

- **Protocol**
  Contains the triage protocol and battle surgery as they know it now. It's their way of working, fixed agreements that everyone uses.

In scenario 1 the facility was still empty and only one patient got dropped off, in scenario 2 all 9 beds were occupied and 14 patients were coming their way. Although the (not completely truthful) scenarios evoked resistance, they have yielded multiple valuable results.

When there is one casualty, the most important data pointed out by the medical staff came from the first four clusters. In this case, they mainly want patient and trauma-oriented data:

- CBRN and search
- Classification
- Trauma: cause of the injury
- Patient: vital signs

In case of a group of patients en route, with the own facility full of patients, the information need shifts to medical vs tactical vs logistical information (the last four clusters), requiring more situational awareness:

- The division of T1/T2/T3 patients
- Deployment of the ZAUs (transport availability)
- Which patients can be removed from the own system?
- The distance expressed in time to the system to which the discharged patients are carried out
- Information about the tactical operation (is the front line moving?)

5.4 Conclusion

Following the previous chapter, this chapter elaborated on the focus area of this graduation project: the incoming patients area. The chapter zoomed in on the specific decision that is made in front of the Role 2 Basic Medical Treatment Facility, together with the associated decision-making process. It mapped the decision framework and sharply defined the purpose of the decision as *"to filter and move aside as many patients as possible to transport them further up the chain without entering the R2B MTF for treatment"*. With a clear goal and framework, the suitability of the currently applied decision-making process was looked into.

Suitability of triage
By looking at the purpose of triage and the purpose of the decision-making process in the blank space of the decision framework, it became clear that triage is not suitable for the specific decision at this specific place in the Military Medical Chain in combat context. The goals differ; triage is done to prioritize patient while the decision that needs to be made here asks for a process to allocate patients. As a result, the currently applied process does not contribute to the chain-orientation.

Information need
Part of the decision-making process is collecting information that contributes to making the decision. During a simulation session, the information gathering and basing a choice on the information was analysed. Two scenarios were used for this. The use of scenarios was to trigger the participants into thinking in a different way than they are used to, and it has yielded valuable results.

All information medical staff could think of as 'can be gathered' can be divided into eight clusters:

- In advance
- Trauma
- Personal data
- History
- Patient group
- Tactical operation, the chain and its logistics
- Communication
- Protocols

In response to the question what information medical staff needs to make a decision about patients was given that they would like to receive MIST-ATs (Mechanism, Injuries found, Signs, Treatment given, Age, Time of injury) about every patient. Asking interviewees what the bare minimum of information is they need; the answer

is literally “the same as in Peace Support Operations”. Though combat-experienced interviewees all said “there is no time for MIST-ATs”. However, due to the use of scenarios, it became clear that there is a shift in information need when the number of patients shifts from one to multiple patients. In case of a single patient, the information that medical staff has indicated as necessary is mainly trauma- and personal data. This information can be found in parts of the MIST-AT. In case of multiple patients, the information indicated as necessary shifts to information about the patient group and tactical operation, the chain and its logistics rather than trauma- and personal data. This means that the information need, in order to be able to make the decision in front of the tent, is different than previously indicated by the medical staff.

With the insights on the organisational context, the Role 2 Basic, and the problems within the incoming patients area, a design brief is formed.

6

DESIGN BRIEF

From insights to scope

The previous chapters have provided insight into the organisational context in which the Role 2 Basic Medical Treatment Facility is embedded, the differences between Peace Support Operations and Combat Operations, the development of the Role 2 Basic, and the problems that arise in the incoming patients area. Overall, it became clear that processes from one context have been transferred to another, without taking into consideration whether they are suitable there as well. This chapter will describe the design brief, which includes the problem definition, design direction and design goal for this project. The design brief is the stepping stone from the analysis to the design phase. It describes the exact problem to tackle, why it arises and why it is relevant. It will also give direction to developing concepts in the design phase.

6.1 Problem statement: the analysis consolidated

The results of the analysis are consolidated into the following problem statement:

The 400 Medical Battalion (400GNKBAT) is in a transition process to being Fully Operational Capable by 2027. This transition contains the reorganisation of the battalion, and the development of the Role 2 Basic Medical Treatment Facility. A lack of focus, lack of time for exercises, and lack of exercises (fully) reflecting reality resulted in the decision-making processes transferred from the context of Peace Support Operations into the context of Combat Operations. As a consequence, the currently applied decision-making process (triage) in front of the Role 2 Basic Medical Treatment Facility is not in line with the combat-goal of the medical chain (being a discharge- and transport-oriented chain), and is therefore not suitable. The 400GNKBAT recognizes the problem, but does not have the resources in time and knowledge to come up with a solution.

Decision moments aimed at the patient(s), and the associated decision-making processes are located throughout the chain. These processes need to be efficient (minimum input, maximum output) and effective (in line with the chain orientation). If not, it will result in unnecessary and preventable deaths.

The different aspects of the problem statement are explained in the following paragraphs.

6.1.1 Organisational background

Due to the shift to main task 1, the 400 Medical Battalion is currently in a transition process to being Fully Operational Capable in combat setting by 2027. This transition contains the reorganisation of the battalion, and the development of the Role 2 Basic Medical Treatment Facility. Ongoing developments in this transition process are:

- Digitalisation of patient data
- Optimisation of the communication of patient information

In their transition process, the 400GNKBAT is hindered by:

- The fact that 400GNKBAT prepares for a situation that the current (medical) staff have never experienced before. A situation like this (a combat operation) is difficult to imagine and empathize with. *"Talking to people who have not experienced it in practice makes no sense." "The pressure and impact of the real environment is impossible to train."*

- It is difficult to test the situation and possible improvements due to the scarcity of exercises. Employees needing to stay BIG-registered and having other responsibilities within the Medical Battalion leaves little time to practice.

- The exercises that they do carry out do not (fully) reflect reality: there is less pressure, it is a different mental environment, and the circumstances and physical environment differ as well. *"In exercises you know patients don't die, everything is a bit more chill."*

6.1.2 Problem definition

Analysis shows that, within the development of the R2B, there are no plans on decision-making processes. A lack of focus, lack of time for exercises, and the lack of exercises (fully) reflecting reality resulted in decision-making processes transferred from Peace Support Operations into the context of Combat Operations. One of the decision moments that emerged from the analysis as crucial around the Role 2 Basic is the decision moment in front of the treatment facility. This decision is the most important decision to make if you focus on a transport-oriented chain. Within the decision moment in this area two distinct problems were found:

1 Due to the fact that the decision-making processes are transferred from peace support to combat, the currently applied decision-making process in front of the Role 2 Basic Medical Treatment Facility is triage. Triage is done to prioritize patients, while analysis shows that the decision that needs to be made in front of the tent, in a combat setting, asks for a process to allocate patients. As a consequence, the currently applied process is not suitable. It does not contribute to, nor is in line with, the chain-orientation in combat.

2 Medical staff indicates the same information need as they receive about patients in Peace Support Operations, while veterans with combat experience state that "there is no time for MIST-ATs in combat, patients just keep coming!". Due to the use of scenarios, it became clear that there is a shift in information need when the number of patients shifts from one to multiple patients. This means that the information need, in order to be able to make the decision in front of the tent, is different than previously indicated by the medical staff. As a result, any decision-making process should be based on relevant data for combat context.

6.1.3 Why do these problems arise?

The 400GNKBAT recognizes the problem, but they do not have the resources in time and knowledge to come up with a solution for the fact that the decision-making processes are not (fully) in line with the goal of the medical chain within combat operations: being a discharge- and transport-oriented chain.

"The chain and the healthcare professionals can be so high quality, but if we can't get the patients to the right place at the right time, it will be of no use to us at all."

6.1.4 Why are these problems relevant?

Decision moments aimed at the patient(s), and the associated decision-making processes are located throughout the chain. These processes need to be efficient (minimum input, maximum output) and effective (in line with the chain orientation). If the uncovered problems are not addressed, the newest hardware will be developed (physical R2B) but will have to run on old software (communication of patient information and the decisions that are made on the basis thereof); it will be too slow and it does not support what it should support, which will result in unnecessary and preventable deaths.

6.2 Design direction and design goal

The chosen design direction to tackle the problems is decision support. Decision support is any application which helps users to make better decisions (Shim et al., 2002). As described in the Defensievisie 2035 (2020), decision support is part of the Ministry of Defence's desire to be a smart, high-tech organization by 2035. It fits with the ongoing developments *digitalisation of patient data* and *optimisation of the communication of patient information*.

Every decision-making process is different and therefore requires different input to deliver a certain output. From this output you have to recognize to whom it goes and what purpose it serves. Subsequently, this output must match the needs of the receiver.

This project will focus on developing a decision support system for 'in front of tent triage'.

6.2.1 Design goal

By reading the problem definition carefully, you will see that the two problems uncovered in the focus area are actually the result of an underlying organisational problem that is hidden in the why these problems arise (figure 17). Therefore, two separate goals are formulated for this project: a case design goal and a project design goal. The case design goal relates to the two problems uncovered in the incoming patients area, while the project design goal is related to the underlying organisational problem.

Case design goal
The design goal is to support the users (Senior Nursing Officer) in making the decision in front of the tent about which casualties will, and which will not, enter the Role 2 Basic Medical Treatment Facility while stimulating a combat mindset.

Project design goal
Behind the problems in the focus area lies the organisational problem that the 400GNKBAT does not have the resources in time and knowledge on how to adapt and innovate decision-making processes to a specific context. The project design goal is to provide 400GNKBAT with recommendations on how to address certain aspects in an innovation process in the future.

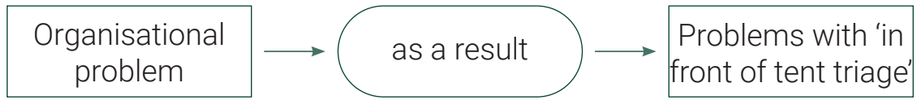


Figure 17: Organisation problem as cause of the case specific problems

6.2.2 Approach

Two design goals for two different layers ask for a distinct approach. The focus will lay on the case design goal. The first step of the design process is a creative session with all relevant human actors from within the incoming patients area. The creative session is developed around the following question: *What ideas do the relevant actors have on decision support tools?* The results of the session will form not only the basis for the ideation, it will also form the basis for the advice on how the 400 Medical Battalion could address certain aspects in an innovation process in the future. The ideation will yield concepts that will then be tested with relevant actors.

To gain more knowledge on decision making approaches, decision making in complex environments, and how to support people in making decisions, additional literature research was done.

6.3 Understanding decision-making and decision support

"We assign a moment to decision, to dignify the process as a timely result of rational and conscious thought. But decisions are made of kneaded feelings; they are more often a lump than a sum".

- Thomas Harris, Hannibal, p.162

There are two approaches to decision making: the intuitive and the analytic approach (Cook et al., 2007). According to Brewster (2002), "military commanders lean more on an intuitive approach versus an analytic approach when in a field environment". In case of ill-structured problems, uncertain or dynamic environments, time stress, and/or high stakes the intuitive approach tends to be chosen. Approaching a decision intuitively consists of recognizing patterns and having experience. It goes with 'fingerspitzengefuhl'. Within the research field of Naturalistic Decision Making (NDM), intuitive decision making is defined as "the way people use their experience to make decisions in field settings" (Klein, 1998). Although one of the two approaches seems to prevail in a decision-making process, such a process is rarely purely intuitive or analytical rather than more of a combination of both (Dunwoody et al., 2000). This combination is called quasi-rationality (Brunswik, 1956).

Studies show that military tactical command experts approach decision making as a problem-solving process (Cohen et al., 1998). Their first step is to collect available evidence and recognize which data is relevant. In order to interpret the data, an adequately judgement of the data is required (van den Bosch & Helsdingen, 2017). However, an increase in quantity of data is not automatically an increase in relevant data (Cook et al., 2007). Thereby, a complete overview of the available data will never be reached and the quality of this data depends on the quality of interpretation. Combining an information overload with the limited human memory displays the need for decision support.

According to Clayton and Hripcsak (1995), decision support can be defined as "any computer-based application which helps the user to make better decisions". In which better is described in terms of "improved quality of care and/or reduced costs without loss of quality". In case of the Military Medical Chain, better decisions will relate to improved quality of care.

Decision support can come in many forms. The most well-known computer-based application is to simply lay out the most requisite facts in "an organized and timely fashion". Examples of these facts can be blood type, drug allergies, test results, patient history, etc. Developing decision support calls for "an underlying model on how to represent the knowledge needed to build such systems" (Clayton & Hripcsak, 1995). However, with the increase in emphasis on applying advanced technology in military settings to improve decision-making in Combat Operations, there are some threats lurking (Bolia, 2005). Excessive dependence on technology is one of those threats (Cook et al., 2007). Although information technology can support decision-making, it can malfunction and/or provide incorrect or non-updated data. Another point to take into account is the fact that technology can disturb how roles are traditionally divided.

One sidenote should be made. All knowledge gained from literature research counts for tactical operations. Medical operations were not specifically named in those papers and books. In this project it is assumed that these decision-making characteristics count for decisions in the Military Medical Chain as well. Decisions in the medical chain are also in an uncertain and dynamic environment, they are subject to time stress and the stakes are high (lives are on the line).

6.4 A common starting point: setting the scene & design criteria

Before starting idea generation, a couple of ground rules and design criteria need to be set. It has become clear that there are multiple versions of the concept Role 2 Basic in circulation, thus this project must have a clear version of the situation described before idea generation. Having a clear version as starting point also ensures that the evaluation and testing of ideas and concepts is done within a clear context of use. The ground rules perform as framework in which to design, while the design criteria perform as guidelines for ideation and requirements for concept development. They are all formed based on the gained insights from the analysis.

6.4.1 Framework in which to design

Main task 1
The context for which a concept will be designed is an operation in main task 1. To be more specific, a concept will be designed for the decision within the incoming patients area of a Role 2 Basic Medical Treatment Facility as part of a rolled out Military Medical Chain in a combat setting. This combat setting entails a number of other conditions that set the framework.

Transport loops
Within the Military Medical Chain in combat every wounded soldier taps every role. In other words, ZAUs (ambulances) drive back and forth (loops) between the same two facilities every time. Beforehand, the deployment of ZAUs is agreed upon in the medical plan as well as between which facilities they commute (§3.3.2).

High patient turnover
In relation to the previous point, ZAUs cannot be rerouted to another Medical Treatment Facility when the pre-discussed facility is full. Therefore, patients will just keep coming to the facility even when it's full. In a civil setting the hospital would go 'op zwart', which mans that they will no longer take in patients. In a combat setting this is impossible. This will result in a much higher patient turnover than medical staff is used to from operations in main task 2 (Peace Support Operations).

Military casualties
Within Combat Operations, the rule of thumb is that the only patients that will be helped are military casualties of friendly troops and civilian casualties in case they are victimized by us. For this project, the casualties are narrowed down to Dutch military casualties, ruling out military casualties with a different nationality, children or civilian casualties. By focusing on one patient group, more specific development can be done. The choice to focus on the Dutch military casualties is based on the expectation that this will be the largest group of casualties passing through the chain.

Patient flow
Incoming patient flow consists of two parts, the incoming patients from a Role 1 and incoming patients from the inside the Role 2 Basic Medical Treatment Facility. For further progress of this project the incoming patient flow comes down to the patient flow coming from a Role 1. This is done to keep the decision-moment clear. Outgoing patient flow relates to the possible outcomes of the decision, patients can either go to the Ambulance Exchange Point for transport further up the chain or they can go inside the Role 2 Basic Medical Treatment Facility for treatment.

6.4.2 Design criteria

Support
In the Role 2 Basic as it is currently developed, the role of triagist is taken on by the Senior Nursing Officer. Therefore, the developed concept should support the SNO in making a decision, and help the SNO to make better decisions.

Combat mindset
The operation in which the chain is rolled out is a Combat Operation. The shift to missions in main task 1 asks for a shift in mindset as well. Therefore, the concept should stimulate a combat mindset. In other words, it expresses the need for the concept to work in line with the chain-orientation. The established differences between the chain-orientations in Peace Support and Combat Operations uncovered the urgent need for a concept that supports and helps the medical personnel to keep in mind that the first and foremost goal is to transport incoming patients as far up the chain as possible before treatment.

Analytic vs intuitive approach
In case of ill-structured problems, uncertain and dynamic environments, time stress, and/or high stakes, the intuitive approach tends to be chosen, which means that any decision support concept should provide a basis to support yet leave room for intuitive approaches.

Data
The first step in decision-making as a problem-solving process is to collect available data and recognize which data are relevant. The second step is to organize the data, which is the basis for decision-making. A concept should present the relevant data in a structured manner. Besides organizing the data, the data should be relevant and adapted to the combat context.

KISS (Keep It Simple Stupid)
In order to make it comprehensible for the user it should be clear and easy to use. If a tool can't be fully understood, it can't be properly used. Due to the complex nature, the focus should first lie on the basis. From there on it can act as a growth model, a decision support system to which units can be added along the way.

Fast
Assuming that many patients arrive in a short period of time, a concept that supports the users in making decisions should not slow down the decision-making process.

Easy to learn
During the analysis it became clear that a combat mindset is hard to achieve, over the past decades, the mindset has been treatment-oriented. In order for a concept to work, it should be easy to learn how to use the concept and to quickly master it.

6.5 Conclusion

This chapter elaborated on the different aspects of the design brief. All results from the analysis are merged into the following problem statement:

The 400 Medical Battalion (400GNKBAT) is in a transition process to being Fully Operational Capable by 2027. This transition contains the reorganisation of the battalion, and the development of the Role 2 Basic Medical Treatment Facility. A lack of focus, lack of time for exercises, and lack of exercises (fully) reflecting reality resulted in the decision-making processes transferred from the context of Peace Support Operations into the context of Combat Operations. As a consequence, the currently applied decision-making process (triage) in front of the Role 2 Basic Medical Treatment Facility is not in line with the combat-goal of the medical chain (being a discharge- and transport-oriented chain), and is therefore not suitable. The 400GNKBAT recognizes the problem, but does not have the resources in time and knowledge to come up with a solution.

Decision moments aimed at the patient(s), and the associated decision-making processes are located throughout the chain. These processes need to be efficient (minimum input, maximum output) and effective (in line with the chain orientation). If not, it will result in unnecessary and preventable deaths.

The chosen design direction for this project is to develop decision support. Following the design direction, a design goal was formulated. However, formulating a design goal for this project happened a little different than normally. Two separate goals were formulated: a case design goal and a project design goal. The case design goal is formulated for the two problems uncovered in the incoming patients area. These two problems are the result of an underlying organisational problem. The underlying organisational problem is the reason, the why, behind the two problems to tackle. For the underlying problem, a project design goal was formulated.

- **Case design goal**
  The design goal is to support the users (Senior Nursing Officer) in making the decision in front of the tent about which casualties will, and which will not, enter the Role 2 Basic Medical Treatment Facility while stimulating a combat mindset.

- **Project design goal**
  Behind the problems in the focus area lies the organisational problem that the 400GNKBAT does not have the resources in time and knowledge on how to adapt and innovate decision-making processes to a specific context. The project design goal is to provide 400GNKBAT with recommendations on how to address certain aspects in an innovation process in the future.

Before the framework in which to design and the design criteria were listed, additional literature research was done to gain more knowledge on decision making approaches, decision making in complex environments, and how to support people in making decisions. Key take-aways from the literature research are included in the design criteria. These will perform as guidelines for ideation and requirements for concept development.

The framework in which to design consists of the main tasks in which the operation takes place, also known as the context of the operation (main task 1). This adds the following aspects to the framework: ZAUs (ambulances) drive loops between facilities, they cannot be rerouted which results in the fact that patients keep coming even if a facility is full. Therefore, the patient turnover is much higher than medical staff is used to from peace support context. The only casualties that are included in this project are Dutch Military casualties based on the assumption that this will be the biggest group of patients. The flow of these patients is as following: incoming patients come from a Role 1, outgoing patients go to either the Ambulance Exchange Point or the Medical Treatment Facility.

Now that the framework in which to design and the design criteria are clear, the next step is ideation. Ideation is the first aspect of the synthesis part of this project.

PART II

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SYNTHESIS

Developing solutions

To understand how medical communication in Combat Operations could be improved it is important to first create a deep understanding of the organisational context, the context of use and the human actors. This part, the analysis, is used to indicate the gap between the current situation and the desired situation. At the same time possible starting points for improvements are identified. This all results in the design brief: the problem statement, design goal and design direction.

7

IDEA GENERATION

The previous chapter elaborated on the design brief. The design brief displayed the need for adjustment and improvement of the decision-making process in front of the Role 2 Basic Medical Treatment Facility to the context of Combat Operations. With a clear framework in which to design, and two design goals, the goal is now to develop ideas to tackle the problems.

This chapter covers the idea generation and concept development. Idea generation has been approached in the following way: instead of immediately starting to come up with ideas for decision support, this chapter started by defining components that are essential to a decision support concept. For each of these components, ideas were generated. These ideas were then assessed and will form the basis for concepts. The concepts will therefore consist of several ideas combined.

Part of the idea generation was a creative session with all relevant actors. This was done to keep the relevant actors involved in the design process and use their expertise of the context. With the results in mind, brainstorming was used to find multiple solutions to the essential components.

7.1 Defining service components

Through the research it became clear that decision support consists of multiple components that all play a crucial part. Solutions need to be found for these separate parts. Roughly said, there are three different components within decision support that follow each other. As said, the most well-known decision support application is simply laying out relevant data in an "timely and organized fashion" (Clayton & Hripcsak, 1995). Therefore, the last component within decision support is *organising data*. In order to offer decision support, the organized data needs to be provided to the users. Therefore, the second aspect is *providing data*. However, before data can be provided, it should be collected. *Data collection* is the first of three components to complete decision support. Besides these three components, there is a fourth important aspect, *support*, which relates to the underlying model of the decision.

Data collection
Decision support starts by collecting data. In order to support the Senior Nursing Officer (SNO) to make the decision whether the incoming patients go to the Ambulance Exchange Point or into the Medical Treatment Facility, data from various units need to be collected. During the simulation session it became clear that, in case of a single patient casualty, data needs to be collected from the specific patient and trauma. However, in case of a multi patient trauma, data also needs to be collected from the patient group, the tactical operation and logistics, such as the distance to the Role 2 Enhanced to which patients will be transported.

Data on single patients and their trauma can, for example, be collected via sensors. Data can also be collected via the Field Medical Card, or via transferring information from staff member to staff member. Data from the patient group can be gained by collecting data from individuals and processing this into group data. Since the data in this case comes from different aspects/units in the medical chain, it might be possible that multiple ways to collect data will be incorporated.

Providing data
The next step is to provide the data. When data is passed on verbally, the way data is collected and provided is the same. The verbal transmission of data can be done via, e.g., a walkie-talkie, or during a face-to-face conversation. When data is collected via sensors, the data can be provided through an application. This can be either on a phone, a laptop or a tablet. An indirect way of providing data is by writing it down on for instance paper or a whiteboard. In this case, data can be provided at one time and received at another.

Organising data
When data is provided, it should be organised in order to support the decision that needs to be made. The way data is structured depends on the goal and the preferences from the user. Ways to structure data are per patient, on alphabetical order, chronological (ETA, time of injury), injury severity, T-classification and so on. The structure should be clear and result-oriented in the sense of stimulating and supporting to transport as many patients as possible further up the chain instead of taking them in for treatment.

Support
The aspect support relates to the underlying model. Creating a framework that shows the process of decision-making and the data needed at which point ensures that the tool will work as needed. Such a framework can come in many forms. In order to develop the framework, there must be clarity about the desired result and the (relevant) available data, which has been established by mapping the decision framework and the simulation session. With this framework, medical personnel can be trained to apply the new way of working before simply using the tool.

7.2 Generating service component ideas

Using these topics, various ideas were created that could contribute to a concept to adapt and innovate the decision-making process in front of the Role 2 Basic Medical Treatment Facility to combat context, and to support the Senior Nursing Officer to make this decision. Brainstorming ideas consisted of a creative session with relevant actors to keep users involved in the design process, and an individual part. Results of the creative session will help to get the individual brainstorm going and will therefore be used as a stepping stone for the idea generation and concept development.

For the different service components ideas have been created and visualised. The ideas consist of a title that describes the core of the idea, a visualisation and a short explanation. Important to keep in mind is that ideas themselves should not be confused with concepts.

7.2.1 Creative session

Creativity is a complex and complicated phenomenon (Runco et al., 1999). Nevertheless, the ability to use creative and critical thinking to solve problems is present in everyone. Unfortunately, not everyone uses this powerful skill. In order to spark the creative soul within the relevant actors, a creative session was organised. A creative session provides simple, easy-to-use tools to systematically guide participants to be more creatively productive.

The session was facilitated by a creative facilitation student. The relevant actors participating in the session were a Clinical Director, two General Military Nurses who also have Command Post experience, and an Emergency Room doctor. All of them can be put in the role of triagist.

During the creative session, the participants contributed actively to the case design goal, developing a concept that supports the functionary in the role of triagist, while stimulating a combat mindset. The session was focused on the following question: *How to support the functionary in the role of triagist (Senior Nursing Officer) during the decision-making process regarding the allocation of patients?*

The session

The creative session was built up of methods and techniques (to generate ideas), and so-called session duties (Heijne & van der Meer, 2019). Session duties are activities that must be added to get the most out of the group. One of these duties is to start with a welcome and short group introduction. The purpose is to set the tone, the right atmosphere and promote honesty and collaboration. During the introduction, the context of the session is explained as well as what the session contains and what is expected from each other. Following the introduction, an ice-breaker was used to create a relaxed atmosphere in which everyone has the feeling that they can speak their mind. Subsequently, the participants were emerged in the first technique. Creative techniques make sure that a problem is considered outside a fixed thinking pattern; problems can be viewed differently for which solutions (creative ideas) are devised.

To loosen up the participants and get them in a 'write as much as I know' mood, the session started with a Criminal Round (Van Leeuwen & Terhürne, 2010). According to Heijne & Van der Meer (2019), the Criminal Round refers to "the secret wish people have to do things they are not allowed to". The goal is to share all illegal ideas that can put the participants in jail. In this case, it was focused on criminal activities during the war. They were asked to put down everything they could do to an enemy. Later during the session, this should help to uncover hidden options that normally would have stayed uncovered. The Criminal Round was followed by the Purge. First, the ultimate goal of the session was repeated in the form of the question *how to support the functionary in the role of triagist (Senior Nursing Officer) during the decision-making process regarding the allocation of patients*. The goal of the Purge was to write down all initial ideas/options/things that came to mind when hearing the question. After writing this down, the session continued with a Guided Fantasy (Heijne & Van der Meer, 2019). Within the Guided Fantasy, an appeal is made to the imagination of the participants. They are asked to close their eyes and listen to a story that takes them to a certain situation (for the story see figure 18). At the end, they are asked questions such as *what do you see, what do you feel, what do you need/want*. Guided Fantasy is used to put participants into a specific context before generating ideas. Subsequently to the Guided Fantasy, the session made use of the Flower Association technique (Heijne & Van der Meer, 2019). The Flower Association is a creative brainstorming technique which can be applied to any problem to generate ideas. The rationale behind the choice for this method was that the participants have no design background at all, so instead of generating ideas out of their head, they were asked to associate words so that new ideas can arise from there. It provided the participants with a couple of directions they could think of and associate further on. Seeing these examples lowered the threshold to come up with new directions. The directions already provided in the Flower Association were based on the four defined service components in order to semi guide the participants. However, this was done without limiting their creativity by maintaining their freedom to come up with new directions. At the end of the assignment, the directions and ideas were discussed together, and the participants were all asked to point out which ones they found most interesting. The session ended with a wrap-up and closing to thank the relevant actors for participating, answer questions that were still open, and to evaluate the session.

We zijn in een land hier ver vandaan. Het is buiten 40 graden, het zweet loopt langs je rug naar beneden en alles plakt. De zon is zó fel dat je je ogen dicht moet knijpen en de zon op je gezicht brandt. In de verte zie je lucht trillen boven de woestijnachtige grond. Je hoort luchtalarmen afgaan, de raketten jullie ko-men jullie kant op. Het geluid van schietende geweren is oorverdovend. Het front is omringd door vijanden en ligt onder vuur. De spanning stijgt en iedereen staat paraat. Je staat een uur van front af, waar de kogels en raketten rondvlie-gen. En dan opeens zie je een stofwolk in de verte. Je knijpt je ogen samen en ziet dat een ZAU is. Je roept naar je collega's dat er iets aankomt en iedereen verzamelt zich. De adrenaline borrelt op en iedereen is er klaar voor. Jij hebt de cruciale rol om te bepalen wie hier behandeld wordt en wie verder afgevoerd wordt. Jouw keuzes zullen bepalen wie overleeft en wie niet. 'Do the most for the most'.

Figure 18: Story from the Guided Fantasy. The session was in Dutch. Therefore, the story is in Dutch as well

7.2.2 Results of the creative session

The session did not deliver as many ideas from the experts as hoped in advance, the assumption here is that the techniques used were far outside the comfort zone of the participants. Nevertheless, the session provided a number of directions to look into during idea generation, and it provided a couple of ideas that are used as an inspiration for the individual brainstorm part of the idea generation.

Looking at the different creative techniques used during the session, the Criminal Round appeared to be a success. The Guided Fantasy was however the direct opposite. As a result of the Guided Fantasy, no extra ideas were generated or written down. During the Flower Association it became clear that the participants started using the technique in a different way than explained in advance. Instead of associating words, they started associating ideas within the directions and created new directions to associate ideas within. This resulted in the three main directions: analogous, digital, and physical.

7.2.3 Generating ideas

Now that directions and ideas are generated by the users during the creative session, the idea generation continues with an individual part. The goal of this ideation step is to find solutions for the different service components and, ultimately, to the case design goal that has been formulated in §6.2.1. This paragraph discusses the process of the individual idea generation as well as its results.

Three different phases can be identified within the individual idea generation: diverging, evaluating, combining.

In the diverging phase, the goal was to create as many ideas for the different service components as possible, without looking at the desirability, feasibility, and viability. The different techniques used to generate the ideas were formulating How To's and traditional brainstorming (Heijne & Van der Meer, 2019; Tassoul, 2009). How To's were created to keep the focus on generating ideas for the different service components instead of being tempted to generate ideas that cover decision support as a whole. Whereas brainstorming was used to do exactly the opposite: to create a variety of ideas beyond the borders of the service components, and to hitch on already generated ideas. The ideas that have been created using these techniques vary widely.

In the second phase, the ideas were evaluated on their feasibility and viability. The feasibility is the ability to deliver the concept, both technologically and operationally, where the viability is if the concept makes sense, whether it contributes to long term growth. This evaluation was done by assessing the ideas based on all previously gained knowledge during the analysis phase by e.g., interviewing the deputy battalion chief, interviewing the medical staff and the simulation session with relevant actors.

Examples of generated ideas are:

- **Idea example 1: collecting data – sensor measuring (idea 1)**
  Vital signs can be measured in multiple ways. Measuring with sensors means constant being aware of the latest vital signs of a casualty. This can be done for multiple patients at the same time in order to create an overview of the casualty group. See figure 19.

- **Idea example 2: collecting data – track and trace (idea 6)**
  Casualties will have a personal code that can be scanned. By scanning a patient, the system automatically recognizes at what place the patient is at that moment. This can be done by assigning scanners to a location. Tracking and tracing of patients creates an overview of who is where at what time.

- **Idea example 3: providing data – tablet (idea 12 + 40)**
  Collected data needs to be provided to the functionary in the role of triagist. This can be done via a tablet. The tablet receives all data that is, for example, collected by measuring vital signs of patients via sensors.

- **Idea example 4: providing data – push notifications (idea 19)**
  Another way of providing data is by push notifications. When a patient is placed in the ZAU at the Role 1, and the ZAU starts its route to the Role 2 Basic, a push

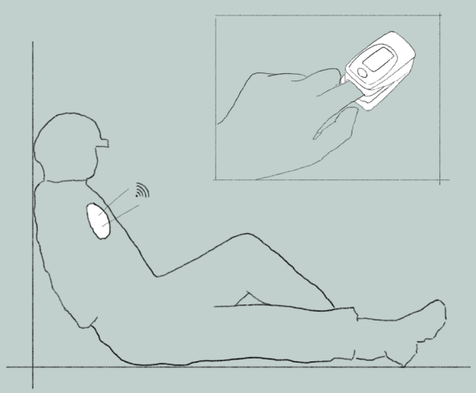


Figure 19: Drawing of the idea of sensor measuring

notification is sent to the Senior Nursing Officer to indicate which patient(s) is/are on the way and which data belongs to that patient.

- **Idea example 5: organizing data – per patient and chronological (idea 26 + 29)**
  The most common way to organize data is per patient. These patients can in turn be arranged in various ways. The chosen example is chronological. Listing patients in a chronological order shows which patients will arrive at the Role 2 Basic first. Within the patient section data can be arranged chronological as well. For example, vital signs can be shown in a graph that shows the course of the values over time.

- **Idea example 6: support – the ability to pre-sort incoming patients (idea 33)**
  Supporting the Senior Nursing Officer can be done with an application to pre-sort incoming patients. A list of incoming patients can be seen together with data on each patient. Besides a list of incoming patients, there is also screen-space left. This space is divided in two parts: the Ambulance Exchange Point part and the Medical Treatment Facility part. Patients from the list can be dragged into either one of these spaces in order to pre-sort the incoming patients. See figure 20.

- **Idea example 7: support – allocation protocol (idea 36)**
  Since the current (not suitable) decision-making process is documented in the form of a protocol, the idea is to document the 'to develop decision-making process' in a protocol as well. Developing a protocol ensures recognition in the way of working, and it ensures uniformity in decision-making within the Military Medical Chain, regardless the operation context (peace support or combat). See figure 21.

Following the assessment of the ideas, the idea generation moved on to the next phase. The last step of the idea generation consisted of combining ideas into design ideas that can be further developed into concepts.

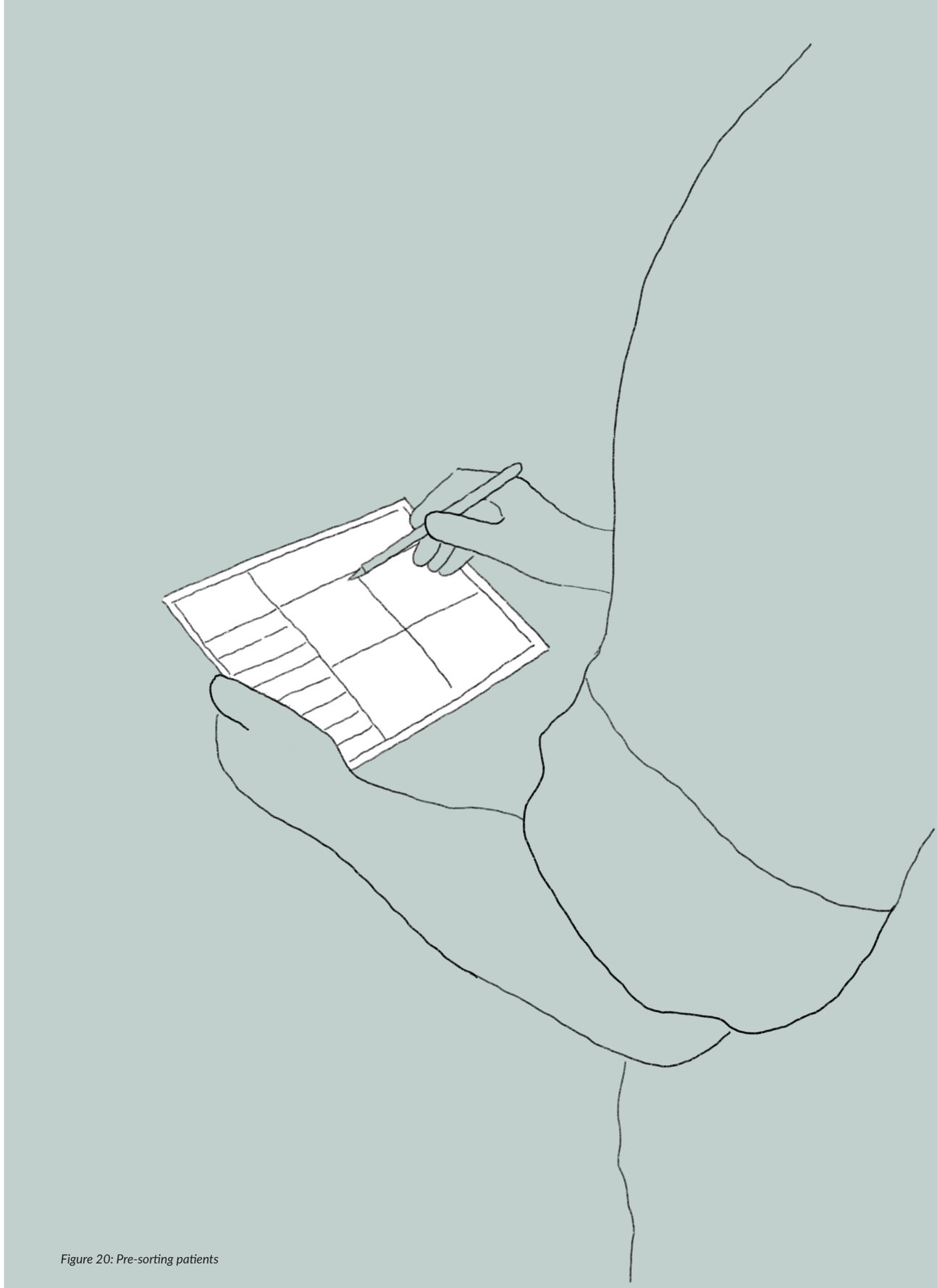


Figure 20: Pre-sorting patients

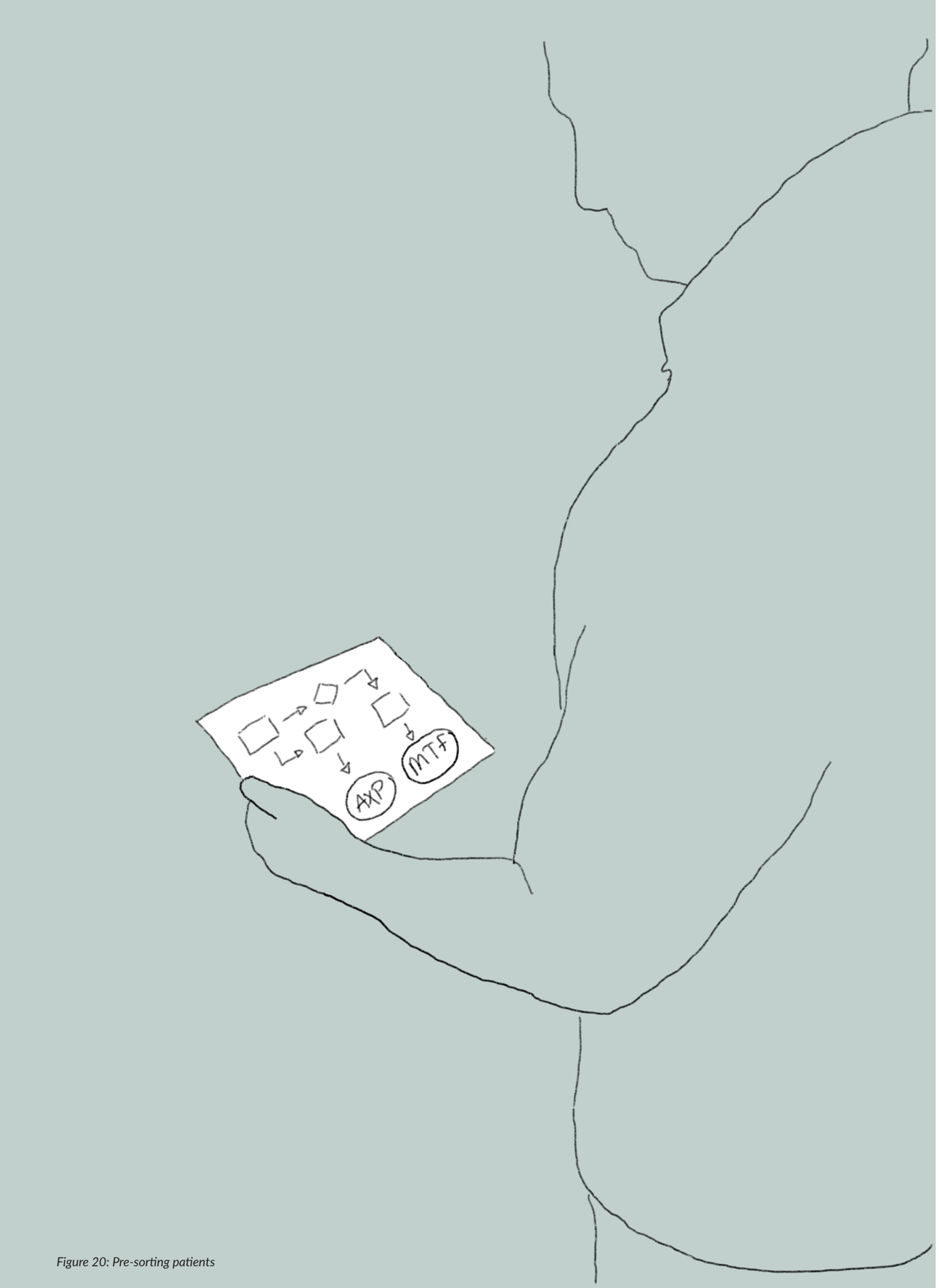


Figure 20: Pre-sorting patients

7.3 From ideas to design ideas

Various ideas have been created to support the Senior Nursing Officer in deciding whether an incoming patient should go to the Ambulance Exchange Point or to the Role 2 Basic Medical Treatment Facility. These ideas should not be confused with fully working concepts, since they are generated to only solve part of the problem (component solutions). This paragraph describes the last phase of the idea generation; combining and translating ideas into design ideas, which are the predecessors of concepts. Ideally, a design idea consists of one idea, or multiple ideas, from within each of the service components. Based on the solutions for the individual components, two design ideas were derived.

- **Design idea 1 - a new internal way of working (iww)**
  The first design idea is based on the ideas 4, 15, 29, 36, and 36 (Appendix D). Clayton and Hripcsak (1995) state that developing decision support calls for "an underlying model on how to represent the knowledge needed to build such systems". With this call for an underlying model in mind, the design idea arose to develop a new internal way of working in the form of a protocol. During the simulation and creative session, the word protocol was mentioned multiple times. Protocols were described as *"a clearly agreed way of working that everyone uses, which ensures uniformity"*. In other words, a protocol is a set of rules and guidelines. Looking at triage, the protocol is used to assign a T-classification to a patient. Now that it has been established that the triage protocol is not sufficient in combat situation, the idea is to develop an extension to the triage protocol to create a combat mindset. The key element to this idea is stimulating and supporting medical personnel to act combat-minded based on a set of rules. By using simple steps (statements) that can be agreed or disagreed on, a decision tree unfolds. The end points of the decision tree relate to the actual allocation of the patients.

- **Design idea 2 - a decision support tool**
  The second design idea is based on the ideas 1, 6, 12, 19, 26, 29, 33, and 40 (Appendix D). Decision support can be provided in various ways, including in the form of a computer-based application (Clayton & Hripcsak, 1995). The most well-known computer-based application lays out the most relevant data in "an organized and timely fashion". This design idea is developing an application that provides an overview of the incoming patients as well as the opportunity to pre-sort them.

  This application, used on a tablet, lays out the incoming patients accompanied by the most relevant data per patient. In case of new patients being added to the list, the application provides a push notification to the users. Besides a list

of incoming patients and push notifications, there is also screen-space left. This space is divided in two parts: the Ambulance Exchange Point part and the Medical Treatment Facility part. Patients from the list can be dragged into either one of these spaces in order to pre-sort the incoming patients. The pre-sorting will be done by the users based on the data provided. Then, when the patient arrives, the tag of a patient can be scanned, causing the application to quickly show the endpoint the patient is pre-sorted.

Before reinvolving the users in the design process, these design ideas will be further developed into concepts. Further developing the new internal way of working (the underlying framework) re-quires a deep dive into how to assign a location to a patient as quickly as possible, with as few questions as possible. Organising this process into a protocol that is effective and efficient is the basis of a working concept. Unfortunately, in case of acting purely based on a new protocol, situational awareness is left out. This however, will be present in the decision support tool.

7.4 Conclusion

The previous chapter elaborated on the design brief. The design brief described, among other things, the case design goal, a framework to design in, and design criteria. This functioned as starting point for synthesis, of which the first part is ideation. This chapter explained the different activities performed during the ideation phase of this project.

During the analysis it became clear that decision support consists of multiple components. In order to support users in making a decision, data needs to be collected. The collected data is provided in an organized way. The fourth component, support, relates to the underlying model of the decision-making; the decision-making process. Ideas were created for all four components.

A creative session was held to spark the creative soul within the relevant actors. The session provided tools to systematically guide participants to be more creatively productive. The goal was to let the relevant actors generate as many ideas as possible. Unfortunately, the session did not deliver as many as hoped in advance. However, as a result of the session, three directions to generate ideas within were created: digital, analogous, and physical.

The ideas that were created during the session, were used as an inspiration for the individual idea generation. The individual idea generation can be divided into three phases: diverging, evaluating, and combining. During idea generation, multiple techniques were used to generate a large number of ideas. These ideas were then assessed based on all previously gained knowledge. The last step of the idea generation was to combine ideas from each service component into design ideas. As a result of idea generation, two design ideas were created:

- A new internal way of working - a protocol
- A decision support tool to pre-sort incoming patients

These design ideas will be further developed into concepts. The development of the concepts will be discussed in the next chapter.

8

CONCEPT DEVELOPMENT

The previous chapter was the start of the synthesis of this graduation project: the idea generation. In the beginning of the idea generation, the relevant actors were involved. Subsequently, idea generation was done individually, using the ideas created by the relevant actors as an inspiration. This resulted in two design ideas, explained in §7.3. Before reinvolving the users, the design ideas are developed into concepts. This chapter covers the development of those concepts, and it elaborates on the key elements.

For the first concept, the underlying model of the decision-making is developed. This required a deep dive into the questions that need to be asked in order to stimulate a combat mindset. The underlying model will be presented in the form of a protocol, a new way of working. This way of working will be leading when using the second concept, the decision support tool. After developing the concepts, they were evaluated with users. By evaluating the concepts, points for improvement were revealed. These points contribute to presenting the final design in the next chapter, as well as the recommendations for further development and implementation.

8.1 Concept 1: a combat protocol

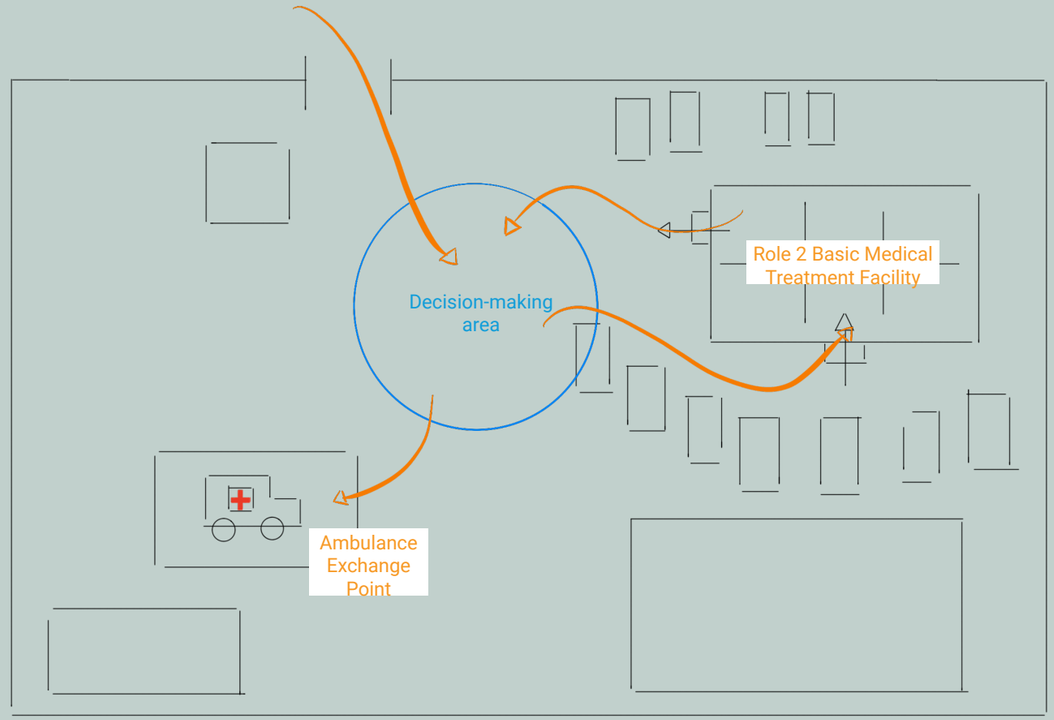
The concept *combat protocol* is derived from the idea to develop a new internal way of working. Research showed that medical staff values working on the basis of a protocol, but the current one is not suitable for the allocation of patients. With a large patient turn-over, unfortunately not everyone can be saved. Under the motto *'do the most for the most'*, the goal is to transport all casualties as far up the chain as possible before treatment. In order to do so, medical personnel need to shift their mindset from a treatment-oriented perspective to a transport-oriented perspective. Therefore, the essence of this protocol is to support medical staff to work combat-minded, and guide the users in the allocation of the incoming patients.

8.1.1 Developing the underlying model

Within the development of the underlying model of the decision-making, three variants of the combat protocol have been created. The development process started by going back to the patient flow and the decision framework (figure 22). When a ZAU (ambulance) arrives at the Role 2 Basic with one or multiple patient(s), the combat protocol should be used to allocate the patient(s). Therefore, looking at the decision framework and patient flow, the endpoints of the combat protocol are already clear. The endpoint of the protocol is either the Ambulance Exchange Point or the Medical Treatment Facility (figure 23). By means of a number of clear statements to which you can answer yes or no, the Senior Nursing Officer can walk through the protocol and allocate every patient in a structured manner.

Developing the statements

Incoming patients currently arrive at the Role 2 Basic with a T-classification that has been assigned to them at the Point of Injury or by the medical staff at Role 1. This knowledge formed the basis of the first protocol variant. However, the first question to ask when a ZAU arrives might sound cliché, but is whether the patient that just arrived is still alive or not. Unfortunately, not everybody will survive, and soldiers who do not survive will be removed from the medical chain to continue their way through another chain (the logistics chain). Filtering out these casualties first ensures a focus on the patients with a chance of survival (figure 24). After filtering out the deceased casualties, the protocol continues with the T-classification (figure 25). Rule of thumb is currently that only patients with a T1 classification (highest treatment priority) enter the Medical Treatment Facility (MTF), and all other patients are sent further up the chain. However, during the analysis it already became clear that not all T2 classified patients can be sent further without treatment, as well as the fact that patients with a T1 classification can have such (severe) injuries that cannot be treated in the Role 2 Basic MTF. E.g., in case of a head injury requiring neurosurgery.



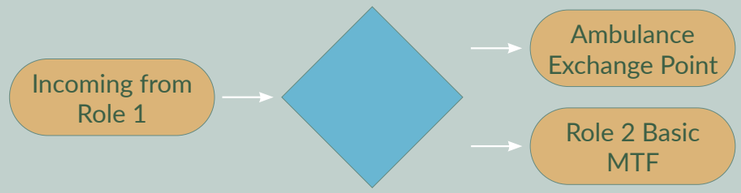


Figure 22: Patient flow and narrrowed down decision framework, the blue blank space covers the decision-making

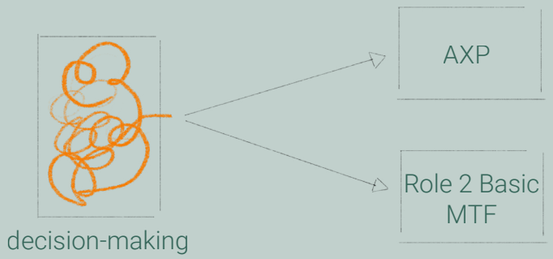


Figure 23: Endpoints of the protocol

Therefore, in case of a T1 classified patient, the question that should be asked first is if the injuries of the patient can be treated in the MTF. If so, the patient can be allocated to the treatment facility. If not, a second question should be asked, which will be the same question asked in case of a T2 classified patient. In case of T2 classified patient, the question that should be asked is if the patient will make it to the next treatment facility (the Role 2 Enhanced to which the R2B transports patients) without treatment. If yes, the patient will be allocated to the Ambulance Exchange Point. In case the answer to this question is no, the question is whether the Role 2 Basic MTF can treat the patient in order to make it to the next facility. This resulted in the protocol variant shown in figure 26.

By looking at the protocol variant shown in figure 26, one thing that stands out is the fact that the protocol is still not fully combat minded. Using the T-classification in the order from T1 to T3 is in contrast with the goal to filter out as many patients as possible that do not need treatment at the Role 2 Basic Medical Treatment Facility. A second striking point is the number of arrows, and the fact that both endpoints appear twice in the protocol. Based on the first protocol variant, protocol 1.0, a second version was created with a more combat orientation. In this variant, the T-classifications are used in reversed order to focus on filtering out the patients who can be transferred further up the chain. It is only after removing these patients from the group that this variant starts looking at whether or not the patients(s) that is/are left can be treated at the Role 2 Basic or not. This variant, protocol 2.0, is shown in figure 27.

What stands out now is that this variant is indeed more combat minded, and that there is a reduction in the number of times the endpoints are displayed. However, a third variant is created (figure 28). Reason to do so is because the question whether a patient is able to make it to the Role 2 Enhanced (R2E) without treatment is independently from the T-classification. Therefore, the classification is left out of this variant. Removing the T-classification significantly shortens the combat protocol, and limits the number of arrows that can be followed. The first question is still whether patients are alive, followed by the question if the patient will make it to the next facility without treatment. With this question, only patients who cannot make it without treatment are left. Within the group of patients that will not make it to the R2E without treatment, the question is now which patients can be helped in such a way that they make it to the next facility.

Since the protocol is based on the underlying model, it does not elaborate on the way data is collected, provided and organised in order to make the decision. It is more of a framework that covers the work flow. The second concept however, the decision support tool, does cover collecting data, providing data and organizing data.

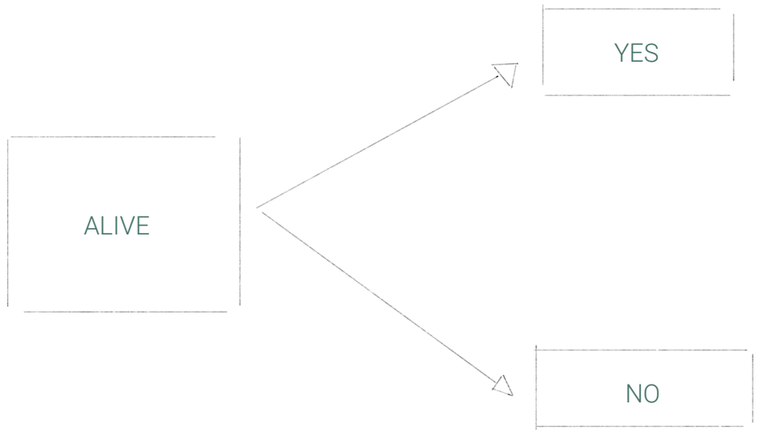


Figure 24: First question to ensure focus on patients that can be saved

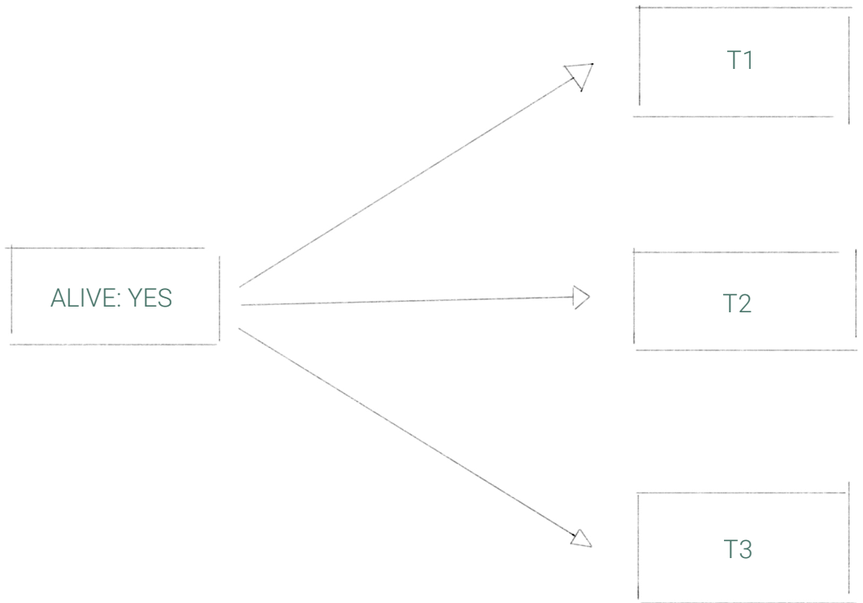


Figure 25: Dividing alive patients by T- classification

ADULT TRIAGE COMBAT EXTENSION

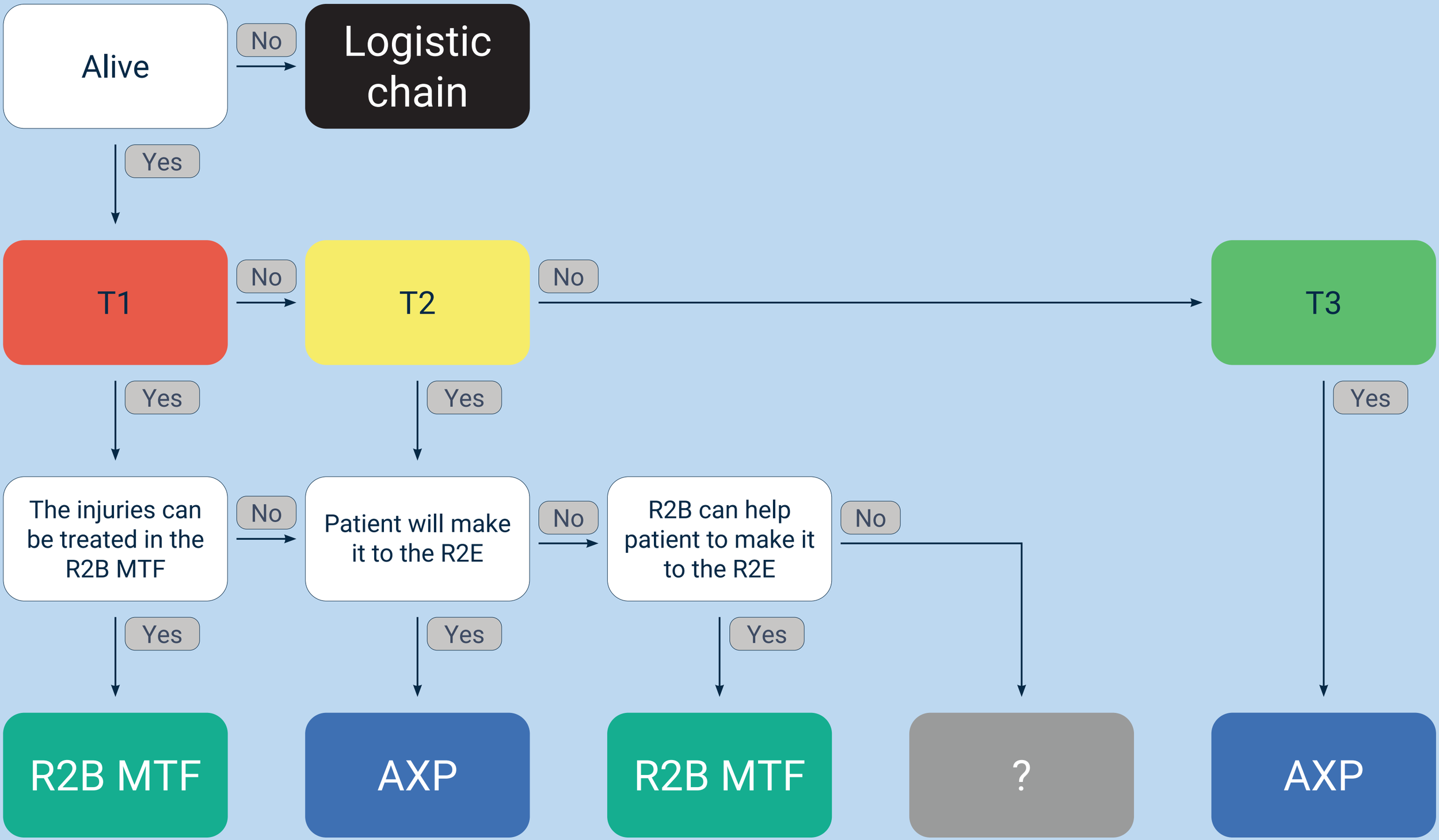


Figure 26: Protocol variant 1

ADULT TRIAGE COMBAT EXTENSION

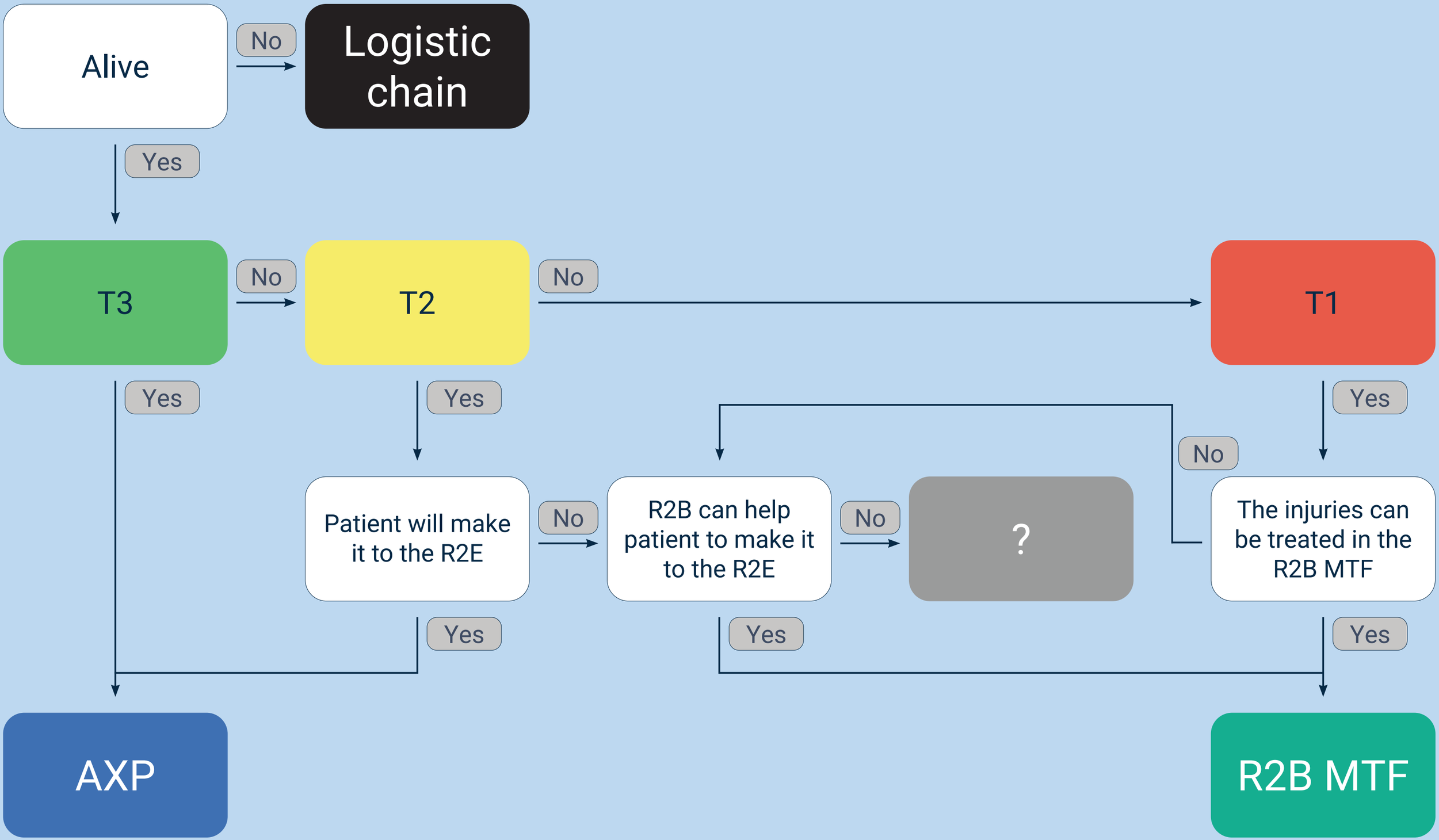


Figure 27: Protocol variant 2

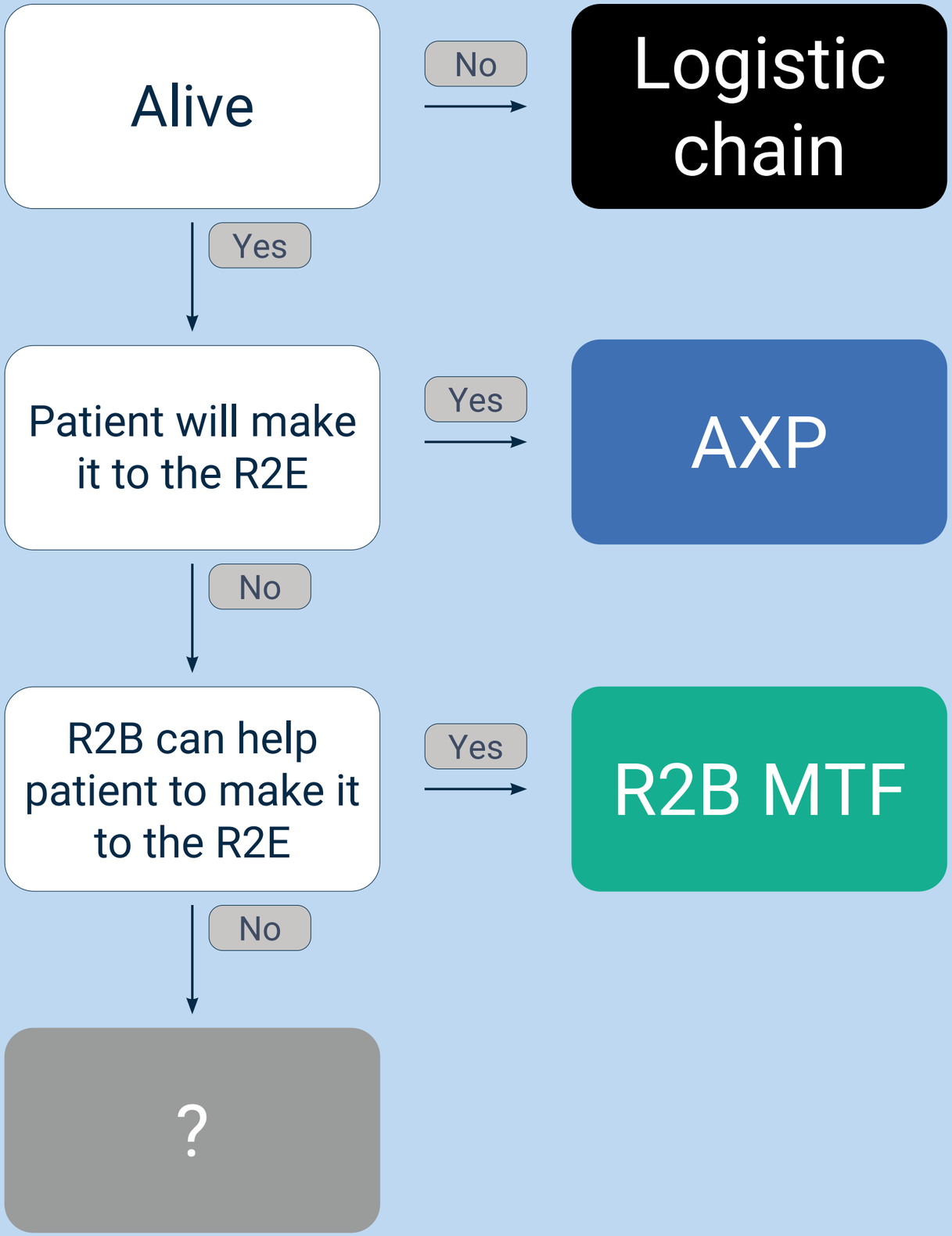


Figure 28: Protocol variant 3

8.2 Concept 2: a decision support tool

The concept *a decision support tool* is derived from the idea to develop an application to pre-sort incoming patients. The development of the decision support tool includes elaborating on collecting data, providing data, and organizing the data in order to support the users in their decision-making process. The ultimate goal stays the same: to transport all casualties as far up the chain as possible before treatment.

8.2.1 Collecting and providing data: VitalsIQ

The way data is collected and provided is based on VitalsIQ by Offroad Apps, the company that provided this graduation opportunity. VitalsIQ is a product service system that enables users to make better and faster decisions (Offroad Apps, 2019). It uses wearable sensors to collect data on the vital signs of a patient. Currently, the wearables that VitalsIQ uses to collect data are a pulse oximeter and an in-ear sensor. These two together provide a good overview of the vital signs of a patient. Besides data collection via wearable sensors, the first responder has the possibility to add data about, for example, the injuries found (figure 29). By using mobile devices (a tablet), VitalsIQ can provide users with the real-time data about the vital signs of a patient and its injuries. Via one device, the data of multiple patients can be read, which provides the users not only with multi patient data, but also situational awareness and decision support (figure 30).

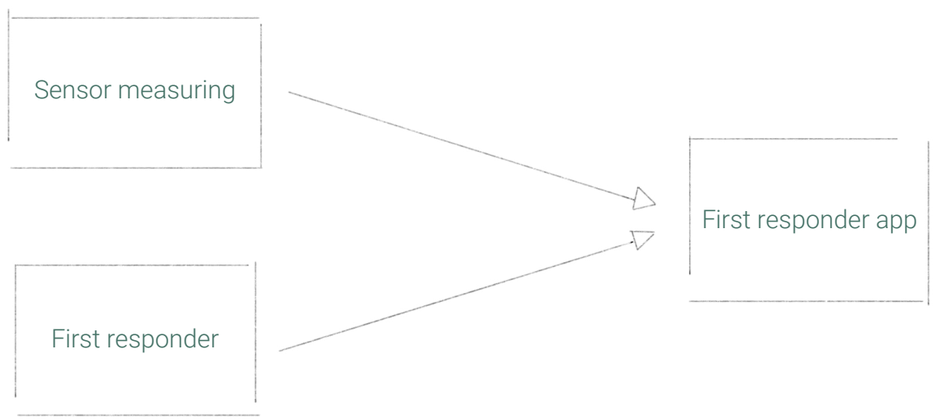


Figure 29: Data collection first responder app

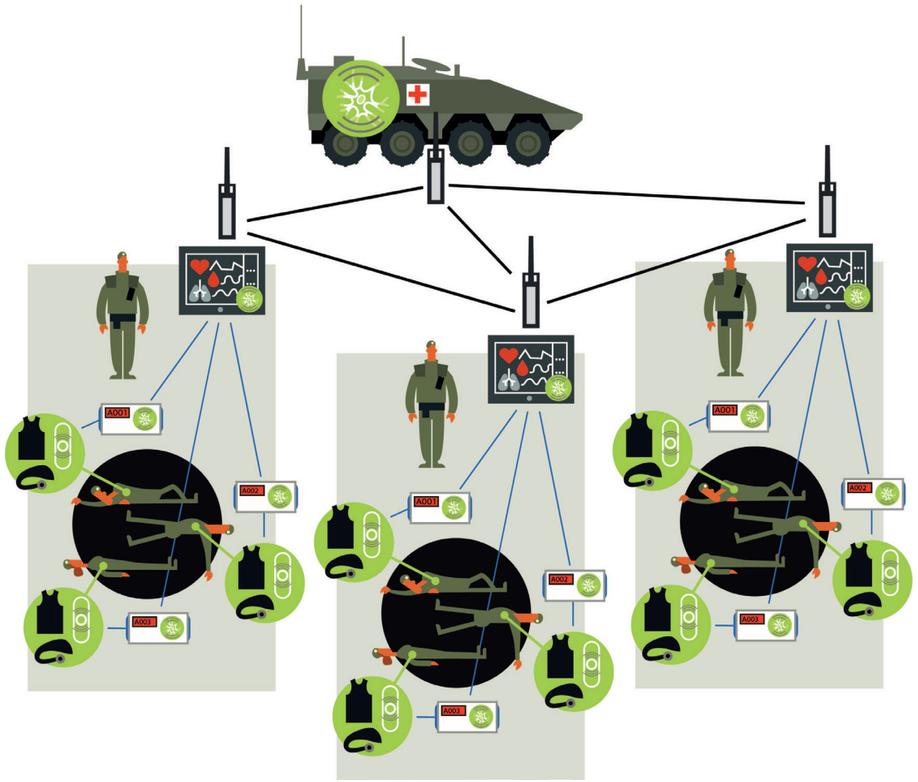


Figure 30: Collecting multi patient trauma data

Currently the application on this tablet (the First Responder App) allows users to quickly monitor the vital signs of the patients whose sensors are linked, and provide insight in the injuries found. However, casualties are constantly being transferred, e.g., from the field to evacuation, from a Role 1 to a Role 2 Basic. To ensure that the patient data is retained, it should be easily shared and passed on. Therefore, VitalsIQ includes seamless transfer of data between mobile devices via multiple protocols, including NFC and BLE. In case the sensors are not working, the patient data can be recorded manually.

The concept a decision support tool is based on VitalsIQ and its First Responder App. However, this tool will be used at a different place in the Military Medical Chain and therefore requires other functions, functions that fit the purpose with which the app is used. When used by users in the role of triagist at the Role 2 Basic, instead of purely monitoring the vital signs patients, the tool demands for providing data in order to pre-sort the incoming patients. Therefore, the data that is collected should not only be patient data, but also tactical and logistical data, and the function that should be added is the function to pre-sort the incoming patients (figure 31).

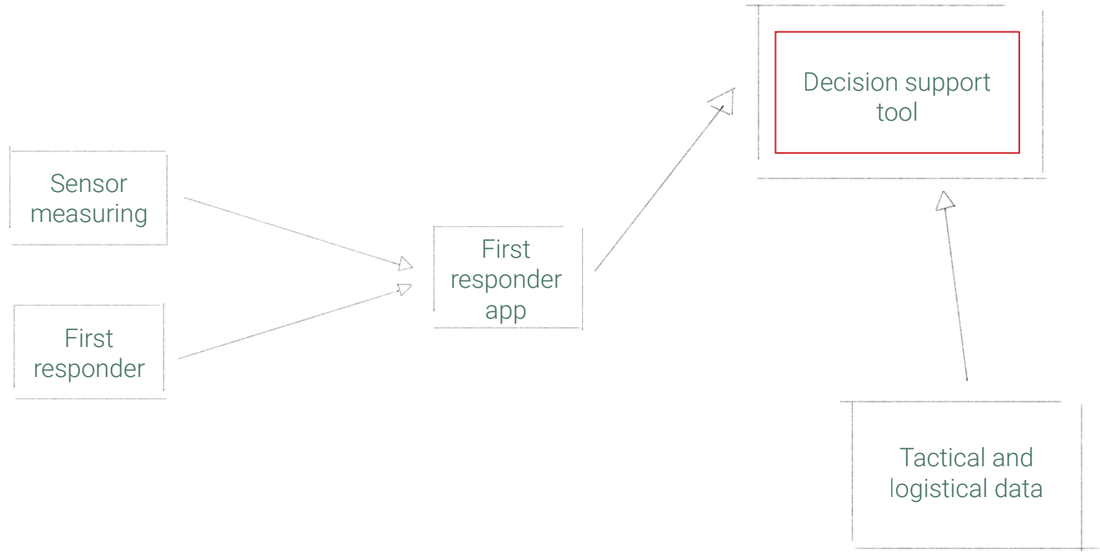


Figure 31: Data collection for the triagist app

8.2.2 Organizing data

The organization of the data relates to the user interface of the application. The aim was to develop a user interface (an organization of the data) that is easy to use and stimulates the combat mindset. First, the framework was developed. The application consists of 5 parts that all need to be visible at a glance:

- The number of incoming patients
- A list of incoming patients with patient data
- Pre-sort space
- Allocated patients
- Tactical and logistical data

The number of incoming patients
In the medical plan it is determined in advance which Role 1 Medical Treatment Facilities transport their patients to which Role 2 Basic. However, from which Role 1 the patient is coming is of no influence on the further course of this process. Therefore, the incoming patients are combined and this part shows how many patients are en route to the Role 2 Basic, regardless from which Role 1 they are being transported. The number of incoming patients is divided per T-classification

(figure 32). This is due to the fact that the simulation session has shown that, in case of multiple patients, medical personnel need an overview of the division of the T-classifications in order to be able to roughly estimate what to expect.

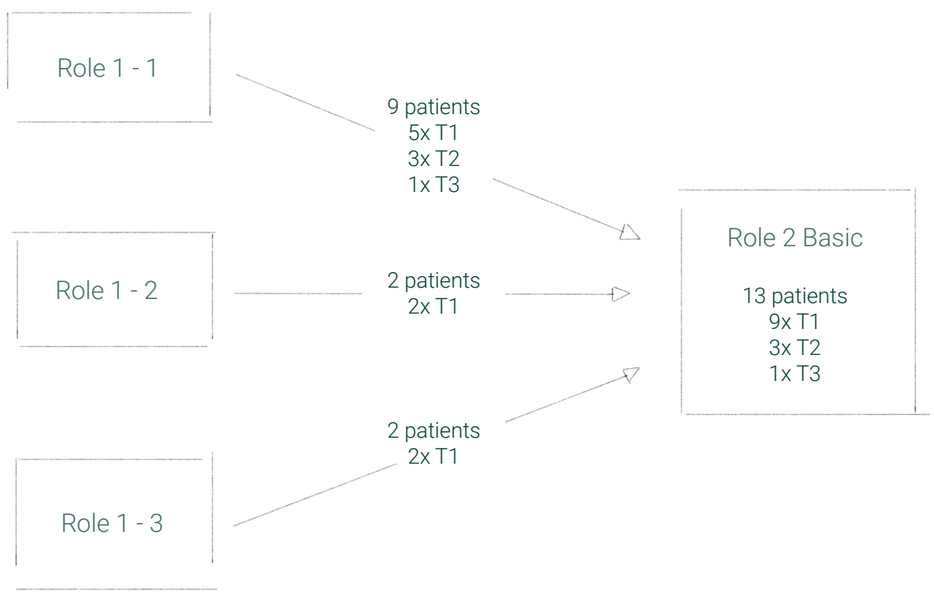


Figure 32: Combining T-classifications

A list of incoming patients with patient data

Besides a quick overview of the number of incoming patients, a list of the incoming patients is compiled. These patients are sorted based on their Injury Severity Score (ISS). The higher the score, the more severe the injuries are (figure 33). To list the patients, the patient ID is used. This ID will be accompanied by the type of injury (e.g., blast injury), and a visual representation of the T-classification so this can be seen quickly. With only a list of patients en route, their types of injury and their T-classification, the patient data is not complete. Per patient, the vital signs can be seen (figure 33).

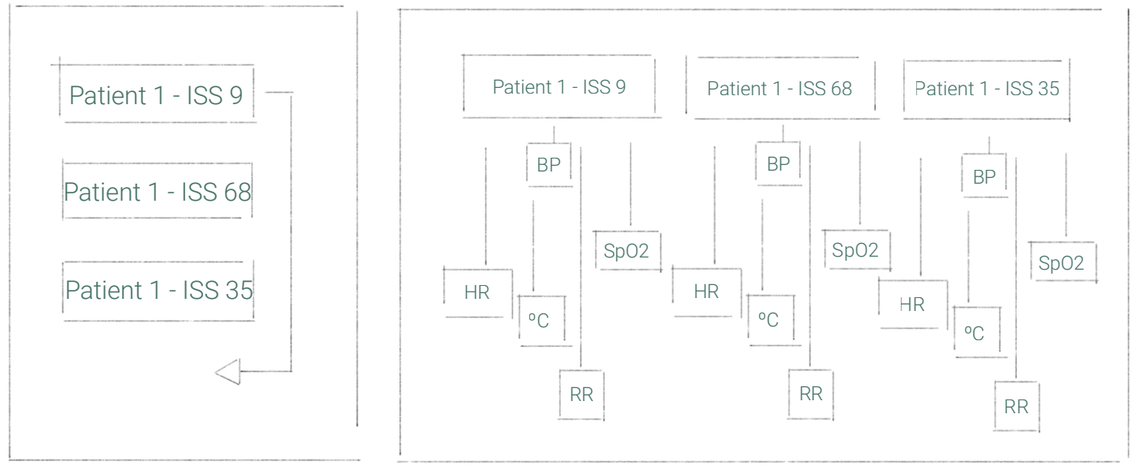


Figure 33: Organizing patient data

Pre-sort space

The third part that needs to be visible in the application is the space where pre-sorted patients are listed. Using the combat protocol, the incoming patients can be pre-sorted to either the Ambulance Exchange Point or the Medical Treatment Facility. Therefore, the pre-sort space is divided into two parts.

Allocated patients

When a ZAU (ambulance) arrives at the Role 2 Basic, the tag with patient ID can be scanned with the scanner on the tablet. By scanning the tag, the application will show to which location the users pre-sorted the patient. Subsequently, the allocation will take place, the patient will be moved to the Ambulance Exchange Point or the Medical Treatment Facility. When arriving at the destination (endpoint of the protocol), they are scanned again to confirm the arrival. In this case, the patient ID automatically moves from the pre-sort space to the space of allocated people. The space of allocated people is for the users of the application to maintain situational awareness on the patients within the system and the patients waiting for transport.

Tactical and logistical data
During the simulation session it became clear that in case of a multi patient trauma, the information need shifts to tactical and logistical data. Therefore, the fifth part of the application covers this. The simulation has shown that the following data is important to have in order to make a decision about the allocation of a patient:

- The distance to the next facility (the Role 2 Enhanced to which the patients are carried out) expressed in time
- The number of beds available in the own facility
- The transport availability
- Resources (still) available in the facility
- Jumping information: the time that is still left before the facility needs to be empty in order to pack up everything and move to another location to follow the manoeuvre

Combining all the different aspects of the application resulted in the interface that can be seen in figure 34.

As you can see, all aspects are present, as well as the key function to pre-sort patients to the Ambulance Exchange Point or the Medical Treatment Facility (bullet 4, figure 34). Besides the key function to pre-sort patients, the users can tap on a patient from the list of incoming patients to see the specific patient data, such as the vital signs (bullet 3, figure 34).

8.3 The concepts in relation to the research results

Both concepts originate from the design direction chosen in the design brief. Ideas were generated by users, which were used as an inspiration during my individual idea generation step. The generated ideas were combined into two design ideas that resulted in the concept as they are explained in the previous paragraphs. Since the concepts went through a development phase, they are now compared to the insights gained during the analysis phase of this project. Subsequently, in the next chapter, the concepts will be evaluated with and by users using the design criteria formulated in §6.4.2.

In order to show the relation of the concepts to the results of the analysis, a visual is created (figure 35). The visual displays the main research results and links them to one or both concept(s).

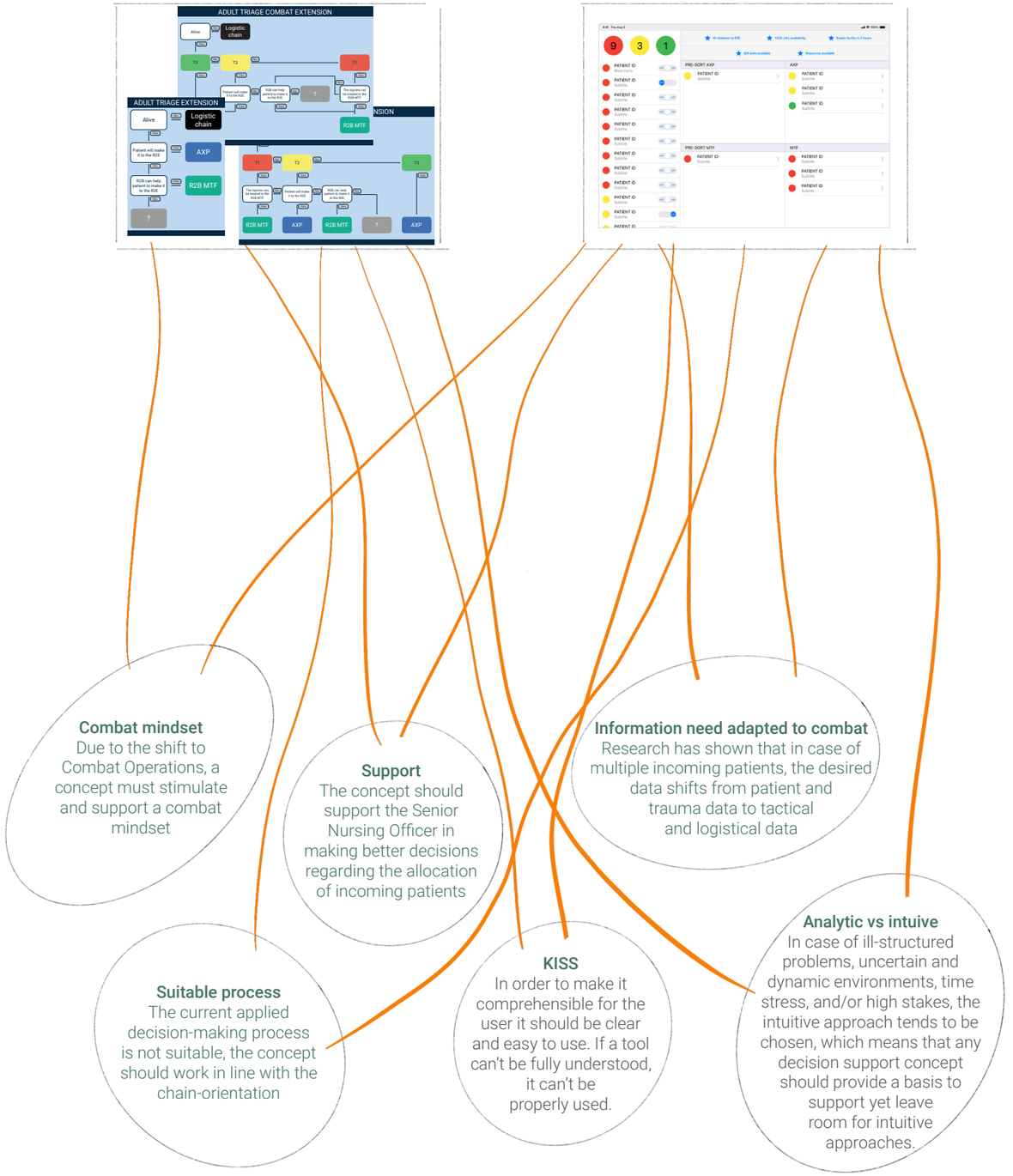


Figure 35: The concepts in relation to the research results

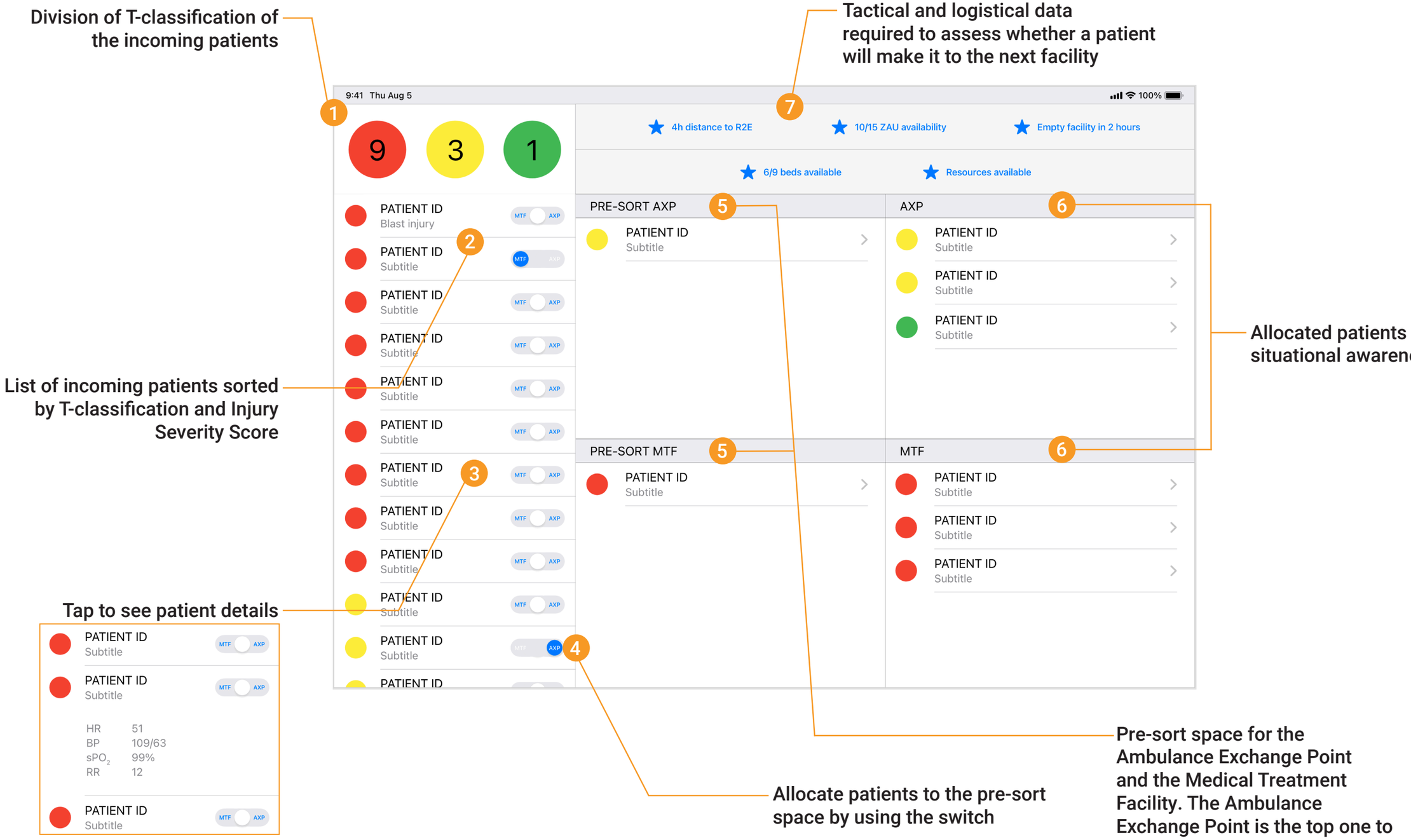


Figure 34: Interface design of the application for the decision support tool

8.4 Conclusion

This chapter elaborated on the development of the two design goals into concepts. Concept development was an iterative process, which can still clearly be seen in the fact that the concept *combat protocol* has three variants. The *combat protocol* is a newly developed internal way of working in the form of a protocol, a set of rules and guidelines in order to support and stimulate a combat mindset, and thereby allocate the incoming patients to either the Ambulance Exchange Point or the Medical Treatment Facility. The concept relates to the underlying model of the decision-making and is therefore the basis on which the second concept works. The second concept, *a decision support tool*, is an application in which an overview is created of the incoming patients and the patients already in the facility and at the Ambulance Exchange Point. By providing situational awareness, patient data, and logistical & tactical data, users are supported to pre-sort incoming patients to the Ambulance Exchange Point or the Medical Treatment Facility. When arriving at the Role 2 Basic, the final choice for allocation is made.

Both concepts were compared to the insights of the analysis phase of this project. This shows that both concepts correspond with multiple elements from the research. Combining the concepts ensures that all elements are processed. However, the concepts cannot be combined into one concept. The *combat protocol* should be used as a new way of working, the new way to make a decision, while using *the decision support tool*.

Now that the concepts are compared to the insights as a result of the analysis, the concept will be evaluated with and by users. This will be discussed in the next chapter.

9

CONCEPT EVALUATION

To see whether the developed concepts match with the needs and wants of the users, and whether they meet the design criteria formulated in §6.4.2., a concept evaluation with users has been done. In practice, this resulted in a double evaluation since there were two concepts developed. Both concepts were tested separately, but with the same users, because of the different goals and interactions the concepts aim to achieve. Due to the different goals and interactions, different research questions have been formulated for both concepts. The method used, however, was the same. This chapter describes the concept evaluation process. The results of the concept evaluations contribute to the final design, as well as to the recommendations for further development, that will be presented in the next chapter.

9.1 A combat protocol

Research questions

1 How usable do the intended users perceive the proposed combat protocol?

   a Which combat protocol variant is preferred?
   b Which sub questions should be asked?

2 What are the strong points of the combat protocol?

3 How can the combat protocol be improved?

Prototype
For the evaluation, a paper prototype was used. Since a protocol is not something tangible, all three variants were printed on an A4 paper in order for the users to have a physical handout of the protocol as shown in figure 36. By printing the variants on separate papers, the protocols could be looked at one by one, but the users could also look at all three at once.

9.2 A decision support tool

Research questions

The concept evaluation was designed to answer the following research questions for the concept a decision support tool:

1 What are the strong points of the decision support tool?

2 How can the decision support tool be improved?

3 What obstacles do you see for implementation?

Prototype
For the evaluation of the concept, a prototype was developed within Adobe XD. The intended mobile device to use the application on is a tablet, therefore, the users were presented with a tablet with the prototype of the application as shown in figure 37. Within the prototype of the application, parts were linked in order to achieve the highest level of reality possible within the prototype.

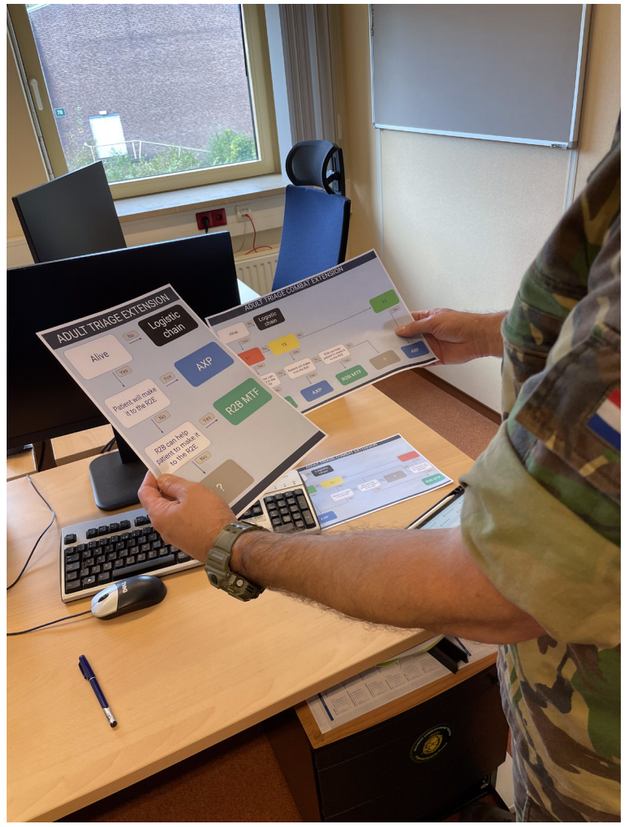


Figure 36: Prototype combat protocol

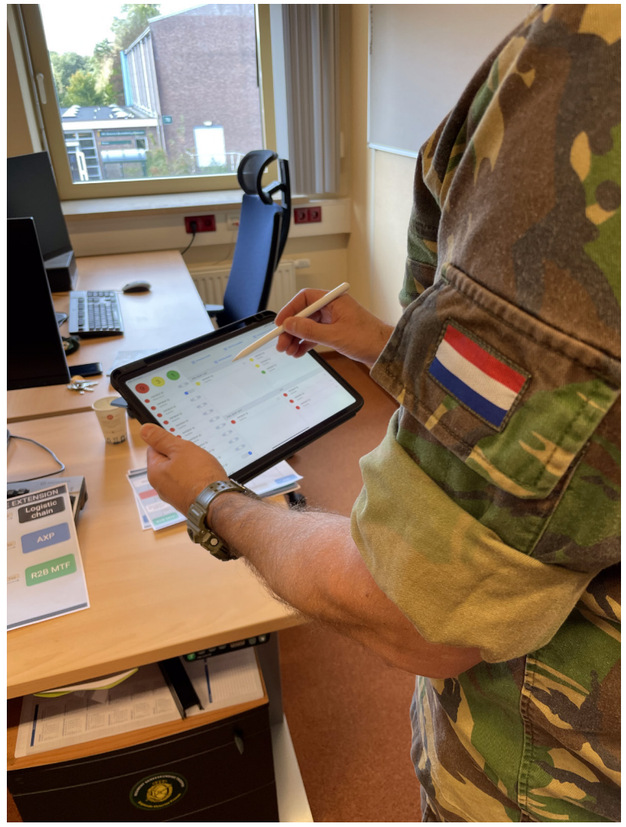


Figure 37: Prototype decision support tool

9.3 Method

For the evaluation of the concepts, participants that were recruited. The recruited participants were military medical personnel with the same roles as the military medical personnel participating in the simulation and creative session. Thus, the concepts were tested by the same roles/functionaries, only by different people. The chosen roles/functionaries are the roles of Clinical Director (CD), Senior Nursing Officer (SNO), and the emergency doctor (ER doctor). The Clinical Director is ultimately responsible for the patients regarding everything medical, the Senior Nursing Officer is the functionary who is currently in the role of triagist, and the ER doctor is the right person in the field for trauma assessment.

Concept evaluation
The evaluation of the two concepts consisted of three parts, in which qualitative methods were used to understand the wants and needs of the users, and to evaluate the usability of the proposed concepts. The parts of which the concept evaluation consisted were:

1 Setting the scene
2 Explanation of the concept
3 Evaluation of the concept

At the beginning of the evaluation, the situation was outlined to the participants. They were provided with a framework that sets the scene (context of use) to ensure that the participants were combat-minded, and their feedback is as accurate and relevant as possible. The context of use for both concepts is the same. Subsequently to setting the scene, the concept to evaluate is explained. The explanation elaborated on the rationale behind the concept, and on the specific moment of use. After the explanation, the participants were then asked to give their first thoughts and opinion on the concept. Next, a series of questions has been asked to evaluate the concept, and to answer the research questions. . This part of the concept evaluation was semi-structured. Furthermore, the participants were asked to shine their light on what still needs to be done/worked out to get the concept operational. This last question was meant to provide the users with free space and the opportunity to think about the future of the concepts.

Spontaneous testing in Germany by an ER doctor
Besides the concept evaluation that has been set up here in the Netherlands with relevant actors, the ER doctor tested the combat protocol during an exercise in Germany. This wasn't planned, since he was not the designated triagist. They tested the role of triagist with the Clinical Director, but as soon as he assigned a patient to the operating room, the Clinical Director was occupied in the OR. They had to switch and adapt to these circumstances, which resulted in the fact that the ER doctor took on the role of triagist. He still had the protocol in mind from the concept evaluation and he decided to use the protocol. This delivered results straight from the field.

9.4 Results of the concept evaluations

Although the method for both concept evaluations was the same, the results will be discussed separately. During the evaluation different insights were obtained that can be processed into the final design. First, the results of the evaluation of the combat protocol will be discussed. Second, the results of the evaluation of the decision support tool will be discussed.

9.4.1 Results of the evaluation of the combat protocol

The series of questions during the evaluation started by simply asking the users which protocol variant they preferred. At the end of the concept evaluation, they were asked the same question. Both times, all participants answered with: I prefer variant 3 (figure 28, page 60). The least preferred variant was variant 1. The reason behind the preference for variant 3 is the fact that it is the protocol with the least number of steps to allocate a patient, it is clear and easy to use and remember. Nevertheless, it was noted by the participants that the statements within this protocol are interpretable. In case of an experienced triagist, this should be of no problem. However, a triagist who just got out of training does not have the experience yet to answer those statements without having specific agreements. For the unexperienced, the protocol should therefore have fixed values.

Answering the statements
During the evaluation it became clear that the answers to the statements in white depend on a number of factors. Some of these factors still need to be determined for the Role 2 Basic Medical Treatment Facility. Two of these factors are *what is and is not treated in the R2B MTF*, and *what cannot be treated*.

The participants were asked to fill in the sub questions that need to be answered in order to answer the white statements from their preferred protocol variant. Since all participants preferred protocol variant 3, the statements that needed to be defined further are: alive, the patient will make it to the Role 2 Enhanced, and the Role 2 Basic can help the patient to make it to the Role 2 Enhanced. Although the participants shared their ideas on how to fill these statements in, they could not yet provide the specific data, the fixed values. Therefore, they said, they needed to consult with multiple colleagues. The statements will now be discussed. The results of the spontaneous testing by the ER doctor in Germany are incorporated with the results from the concept evaluation.

- Alive
  In order for a patient to be alive, he or she needs to have a heartrate and a blood pressure. The temperature of the patient is important as well. This can be stated in the form of: someone is alive in case the heartrate (HR) is x and the blood pressure (BP) is y. However, when looking at the temperature, beware of hypothermia. In order to be able to assess whether a patient is hypothermic, there must be listened to the information provided by the medical personnel on the ZAU (ambulance). E.g., if the story is that the patient got pulled out of the water, hypothermia is plausible.

- **Patient will make it to the Role 2 Enhanced**
  The first data looked at to answer this statement is patient and trauma data: what injuries are found and which ones are expected, and what are the vital signs? To be able to assess whether a patient will make it to the next facility, the users of the protocol should use MARCH[2]. March stands for: **M**assive bleeding, **A**irway, **R**espiration, **C**irculation, **H**ypothermia. When there is a problem in either one of these areas, the answer to the statement is no. For the airway there should be made a distinction between an obstructed airway and an endangered airway. In case of an obstructed airway, immediate treatment is necessary, but in case of an endangered airway the situation will have to be assessed on the severity of the endangerment. E.g., in case of a head injury and an EMV-score below 9, it should be assumed that the airway will be a problem soon.

  Besides patient and trauma data, tactical and logistical data should be taken into account. One of the aspects that influences the decision is the distance to the next facility. The distance to the next facility has multiple links. First, it links to the severity of the injury of the patient. Some patients will make a three-hour drive, but will not survive a four-hour drive, or that the status of the patient will deteriorate to such an extent that he or she cannot be helped at the next facility. Second, it links to the amount of oxygen available and necessary during transport. What also influences this decision, in relation to the distance to the next facility, is whether it is day or night. The same route will take longer during the night than it will during the day.

  Another aspect is the transport availability, as well as the transport capability. As one of the participants said: *"when we have ambulances with ICU capability, patients will make it to the next facility way sooner than in case we only have the normal ambulances"*. Looking at the transport availability, the availability does not only consist of the amount of means of transport, but also of the number of places per means of transport.

- **The Role 2 Basic can help the patient to make it to the Role 2 Enhanced**
  This statement includes the factors: *what is and is not treated* in the R2B MTF, and *what cannot be treated*. The factor what is and cannot be treated is strongly related to the equipment that is included in the Role 2 Basic Medical Treatment Facility. However, the possibility that the Role 2 Basic is able to help the patient is also dependent on the patients already inside the facility. E.g., in case the patient needs surgery, and therefore an ICU bed with a ventilator for after surgery but non available, the patient cannot be helped at that time

  Besides evaluating the statement, one last question was asked. This question is about the question mark in the protocol. The question mark represents the casualties that do not make it to the Role 2 Enhanced, and cannot be helped in the Role 2 Basic Medical Treatment Facility in order to make it to the R2E. The question here is: where do these patients go to? What happens with them? All participants answered more or less the same. They are not aware of any plans on these patients yet.

9.4.2 Results of the evaluation of the decision support tool

The results of the concept evaluation of the decision support tool are divided into three parts. The first part consists of the number of incoming patients, the list of incoming patients with patient data, and the pre-sort space. The second part consists of allocated patients, where the last part is the part with tactical and logistical data.

Incoming patients and pre-sorting
At the start of the session all participants were really enthusiastic about the list of incoming patients and the ability to pre-sort them. However, a question that arose was whether they will get a notification when one of the pre-sorted patients deteriorates. This question was mostly for the patients pre-sorted to the Ambulance Exchange Point in case that a specific patient will not make it to the Role 2 Enhanced without treatment anymore.

Besides the need for a notification, the users expressed the need for the ETA of patients. Although the ETA was not mentioned during the simulation session, during the concept evaluation it turned out to be a must. Having the ETA present for each patient resulted in the option for the list of patients to be sorted by ETA. In case of sorting the patients by ETA, the patients that arrive in one ZAU (ambulance) together will be listed together. This means that sorting the patients by T-classification can be done, but only within a ZAU.

Nevertheless, one of the participants said the following about organising the patients by their Injury Severity Score or their ETA: *"I am not sure whether I would like the patients to be sorted on injury severity or ETA, that is something that should be tested during a large-scale exercise"*. The expectation of this participant was to organise patients by injury severity as long as the ETA per patient is visible. However, the participant also expressed that the ability to set personal preferences would be nice to have in the future. But also stated: *"first you should let everybody get used to the new way of working preparatory to adjusting settings to one's preferences and develop their own small distinction within the internal working method"*.

[2] MARCH is the replacement of the (c) ABCDE protocol since January 1, 2021. https://magazines.defensie.nl/landmacht/2021/01/10_zhkh-nieuwe-stijl

Another improvement is to develop a complete list of the 'type of injury'. This categorization should work, but not be too extensive. Examples that participants came up with are: blast injury, amputation, gunshot wound thorax, gunshot wound abdomen, gunshot wound limbs, head injury, and CBRN. This is something that should be further developed.

Allocated patients
Positive about the list of allocated patients divided in patients at the Ambulance Exchange Point and the Medical Treatment Facility is the fact that it still provides situational awareness although these patients are already allocated. Point for improvement is to not only show the allocation, but in case of the Medical Treatment Facility already show in which module they are, e.g., the emergency room or the operating room. One of the participants said: *"maybe it can be labelled where in the Medical Treatment Facility patients are, to already take into account the possibility that a patient worse off than the patients already inside needs to enter the facility, and one of the patients already inside needs to make place for this patient"*.

Tactical and logistical data
The last part covered the evaluation of the part with tactical and logistical data. Although all participants got really excited by seeing this data in the application, they all expressed the same concern: how accurate is the data?

The concept stands or falls with the accuracy of the data on which the decision is based. E.g., when the distance to the Role 2 Enhanced expressed in time says three hours, but in fact it is four, this could be the difference between life and death.

Besides the accuracy of the data, the data on transport availability (ZAU availability) needs more details. The questions asked were: how many patients and what kind of patients can be transported? Are there spots available to transport patients while they are on a ventilator?

9.5 Conclusion

Both concepts were evaluated with a similar approach, but with a different course of events and outcome. Evaluating the combat protocol started by indicating which protocol variant was preferred. Subsequently, the evaluation started to turn into a discussion on how to improve and complement the protocol in order for non-experienced medical personnel to work with it. Therefore, sub questions and statements were developed. In order to assess whether a patient is still alive or not, the users should look at the heartrate, the blood pressure and the temperature of the patient. Whether a patient makes it to the next facility should be assessed based on MARCH (massive bleeding, airway, respiration, circulation, and hypothermia), and tactical and logistical data such as the distance to the next facility expressed in time and the transport availability. The last statement of the protocol relates to the questions what is and is not treated in the R2B MTF, and what cannot be treated. The answers to these questions depend on what is decided by the 400 Medical Battalion.

Another aspect of the combat protocol for the 400 Medical Battalion to consider is what to do with patients arriving at the Role 2 Basic, not being able to make it to the Role 2 Enhanced without treatment, but also not being able to be treated in the Role 2 Basic Medical Treatment Facility. These patients are now covered in the question mark of the protocol.

Evaluating the concept decision support tool was more an evaluation of the details. Every part of the tool and all details were discussed. This resulted in a couple of points for improvement for the application. The first point for improvement is to add a notification in case of patients deteriorating. This was mostly for the patients pre-sorted to the Ambulance Exchange Point in case that a specific patient will not make it to the Role 2 Enhanced without treatment anymore. The second point for improvement is to add the ETA to the patients that are listed in the incoming patients list. Although the ETA was never mentioned during the simulation session, this turns out to be necessary data.

Two aspects the participants did not have an answer to yet is whether the patients should be sorted by their Injury Severity Score (ISS), or their ETA. And the categorisation of the types of injury. These aspects ask for further testing. The list of allocated patients was positively received, however point for improvement is to label where the patients are within the Medical Treatment Facility.

The biggest concern regarding the decision support tool is whether the data is accurate. Basing a decision on inaccurate data can be the difference between life and death.

10

FINAL DESIGN

The adult combat allocation protocol

The insights gathered from the concept evaluations led to the final design. For the final design of this graduation project, it was decided to continue with the combat protocol. This chapter explains how the insights from the concept evaluation have been incorporated in the updated protocol. Furthermore, the aspects that (still) need to be further developed will be discussed. These will be presented in the form of recommendations.

10.1 Adult combat allocation protocol

Compared to the previous version, nothing has changed in the framework of the protocol. The statements and endpoints are the same. What did change was the title of the protocol. Where at first it was the *combat protocol*, it has now a more specific title to indicate what the protocol is for. Therefore, the concept is now the *adult combat allocation protocol*. Besides the title, a lot has been added to the background of the protocol. What is meant by this is the fact that behind the shown statements, sub questions are developed in order to answer those statements. Nevertheless, it has not been fully completed yet, most of the fixed values have yet to be established. The adult combat allocation protocol and its improvements compared to the previous version can be found in figure 38.

10.2 Recommendations for further development

As previously said, most fixed values have yet to be established. This should be the focus point of further developing the *adult combat allocation protocol*. As shown during the spontaneous testing in Germany, this concept works really well in case of an experienced triagist. To ensure that the protocol can also be used by less experienced medical personnel, fixed values to some statements need to be established. The recommendation is here to start by defining these fixed values with a small group of relevant actors within the medical staff, both experienced and unexperienced. From there you can test, and after evaluation of the fixed values they can be adjusted if necessary. What should be kept in mind here is that the protocol should leave room for intuitive decision-making, and not only the analytical decision-making. Therefore, the fixed values will be a guideline.

Although the first recommendation is to develop fixed values in order for less experienced medical personnel to be able to work with the protocol as well, an honest recommendation is to have an experienced staff member be in charge of the allocation of incoming patients. Research showed that this is the most important decision to make in order to keep the chain in line with the combat-orientation: being discharge- and transport-oriented.

The third recommendation relates to the question mark in the protocol. This question mark stands for the patients that will not make it to the next facility without treatment, but they cannot be treated at the Role 2 Basic. Research has shown that there are no plans yet on what to do with these patients. This should be discussed and decided.

To be able to use this protocol on a mission, it will have to be practiced frequently to further develop the protocol. Furthermore, all medical staff should be trained to use the newly developed protocol.

1

A couple of vital signs
Heartrate is x
Blood pressure is x
Temperature is x

2

MARCH
In case the answer to any of these medical questions is yes, the answer to the statement if the patient will make it to the Role 2 Enhanced is no.

M Massive bleeding

A Airway
In case of a obstructed airway: no
In case of an endangered airway: consult surgeon

R Respiration

C Circulation

H Hypothermia

Tactical and logistical
Besides patient and trauma data, the following tactical and logistical data is of importance:

1 Distance to the Role 2 Enhanced expressed in time. The closer the R2E is, the more patients will make it there without treatment

2 Type of transport. E.g., a ZAU (ambulance) with ICU capabilities offers the possibility of earlier transport, and therefore transport of patients who are less stable

3 Transport availability. How many ZAUs are available, but more specifically: what type of places do they have? Patients lying down versus sitting patients

3

What do we do in the Role 2 Basic?
What is treated?
What is not treated?
What cannot be treated?
Depending on which surgeries are offered and the resources available in the Role 2 Basic

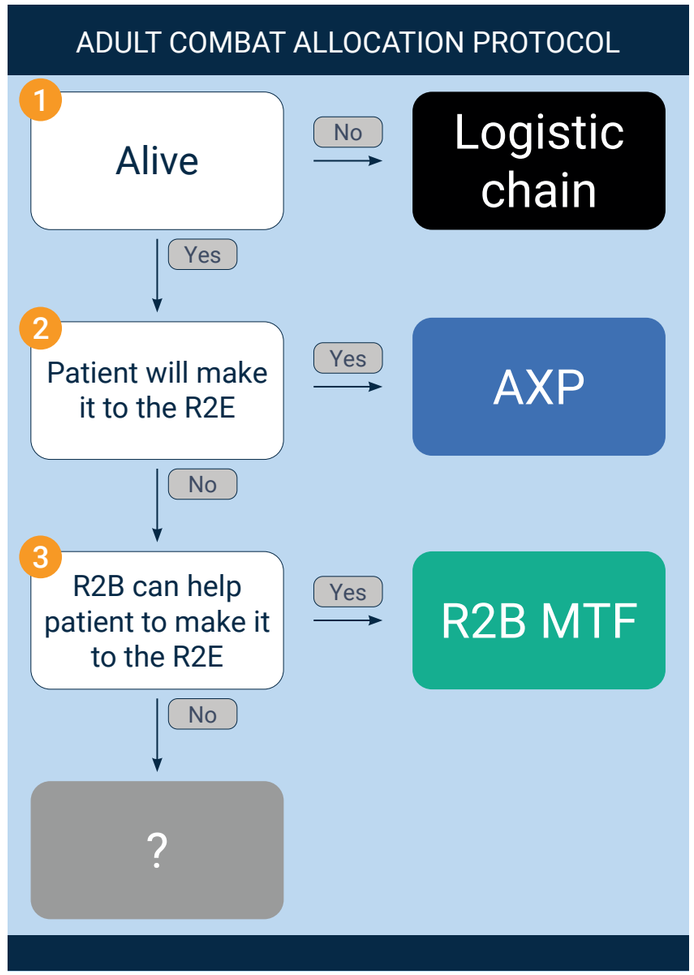


Figure 38: Adult combat allocation protocol

11
PROJECT EVALUATION

The goal of the last phase of this graduation project is to evaluate the entire project. This will be done on various aspects. First, general conclusions throughout the project will be presented. Subsequently, some limitations of the project will be discussed, and lastly, general recommendations for the Ministry of Defence will be provided.

11.1 Conclusion

The focus of this graduation was the improvement of medical communication within the Role 2 Basic Medical Treatment Facility during a Combat Operation. Based on this, a deep dive has been made into the context of combat. During this graduation project, the Ministry of Defence as an organisation has been looked into to get acquainted with the organisational context. Diving into the Ministry of Defence as an organisation made it clear that past and current developments within the organisation are of influence on the Army and the Military Medical Chain. Budget cuts in the past resulted in a decades-long focus on missions within main task 2 (Peace Support Operations). More recently, there has been a shift in focus to main task 1 (Combat Operations). As a consequence of the budget cuts and decades-long focus, the 400 Medical Battalion is currently not capable of supporting an operation within main task 1. The 400 Medical Battalion is therefore in a transition process to being Fully Operational Capable by 2027. This transition contains the reorganisation of the battalion, and the development of the Role 2 Basic Medical Treatment Facility.

Following the organisational context, the project zoomed in on the development of the Role 2 Basic. During the analysis, multiple research activities were performed, such as desk research, interviews and a simulation session. Research has shown that Peace Support Operations differ significantly from Peace Support Operations. One of the most important differences the different orientations of the chains. In Peace Support Operations the chain is treatment-oriented, while in Combat Operations the patient turnover is much higher so the goal the goal is to transport patients as far up the chain as possible without treatment; being a transport-oriented chain. From this it can be concluded that military medical staff should operate with a different mindset: a combat mindset.

However, during the analysis it became clear that a lack of focus, lack of time for exercises and a lack of exercises (fully) reflecting reality resulted in the decision-making processes transferred from the context of Peace Support Operations into the context of Combat Operations without taking into consideration whether they are suitable. One of those decision-making processes takes place in front of the Role 2 Basic Medical Treatment Facility, the focus area chosen for this project. This decision is the most important decision to make if you focus on a transport-oriented chain. For this decision, a decision framework was developed. Looking at the currently applied decision-making process (triage) in combination with the chain-orientation of combat it became clear that triage is not suitable. The goal of the triage protocol differs from the goal of the decision framework. Triage is done to prioritize patients, while the decision that needs to be made asks for a process to allocate patients.

Based on all the gathered information and the chosen problem, the following design goal has been formulated:

The design goal is to support the users (Senior Nursing Officer) in making the decision in front of the tent about which casualties will, and which will not, enter the Role 2 Basic Medical Treatment Facility while stimulating a combat mindset.

Ideation was done in two phases. It started with a creative session with relevant actors. The session resulted in a couple of ideas that were used as an inspiration for the individual idea generation. The individual idea generation started by defining the service components of decision support: collecting information, providing information, organizing information and support. For all these components, ideas were generated. These were then evaluated before they were combined and translated into design ideas. These design ideas were then developed into two concepts: a combat protocol and a decision support tool. Both concepts were evaluated with and by users which provided multiple, valuable insights for further development.

A combat protocol

From the combat protocol concept, three variants were developed. Participants expressed their preferences. Subsequently, the evaluation started to turn into a discussion on how to improve and complement the protocol in order for non-experienced medical personnel to work with it. All statements from the protocol were addressed during the evaluation and for all of them sub questions were defined. This resulted in the following points for improvement:

- In order to assess whether a patient is still alive or not, the users should look at the heartrate, the blood pressure and the temperature of the patient.

- Whether a patient makes it to the next facility should be assessed based on MARCH (massive bleeding, airway, respiration, circulation, and hypothermia), and tactical and logistical data such as the distance to the next facility expressed in time and the transport availability.

- The last statement of the protocol relates to the questions what is and is not treated in the R2B MTF, and what cannot be treated. The answers to these questions depend on what is decided by the 400 Medical Battalion.

A decision support tool

The decision support tool works on the basis of the developed combat protocol. This application allows the users (Senior Nursing Officer) to have an overview of all incoming patients and provides the users with the opportunity to pre-sort them. All details were discussed and the following points for improvement were identified:

- Adding a notification in case of patients deteriorating. This was mostly for the patients pre-sorted to the Ambulance Exchange Point in case that a specific patient will not make it to the Role 2 Enhanced without treatment anymore.

- Adding the ETA to the patients in the incoming patients list.

The biggest concern regarding the decision support tool is whether the data is accurate. Basing a decision on inaccurate data can be the difference between a patient's life or death.

Final design: adult combat allocation protocol

For the final design of this graduation project it was decided to continue with the combat protocol. The protocol describes the new internal way of working. All insights from the concept evaluation resulted in the following final design.

1

A couple of vital signs
Heartrate is x
Blood pressure is x
Temperature is x

2

MARCH
In case the answer to any of these medical questions is yes, the answer to the statement if the patient will make it to the Role 2 Enhanced is no.

M Massive bleeding

A Airway
In case of a obstructed airway: no
In case of an endangered airway: consult surgeon

R Respiration

C Circulation

H Hypothermia

Tactical and logistical
Besides patient and trauma data, the following tactical and logistical data is of importance:

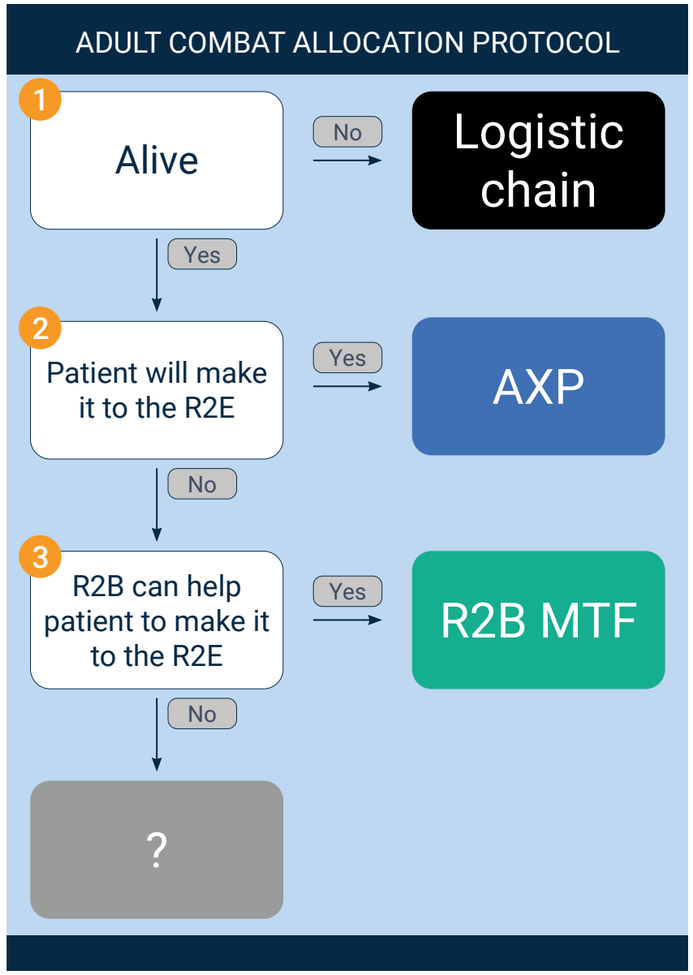
1 Distance to the Role 2 Enhanced expressed in time. The closer the R2E is, the more patients will make it there without treatment

2 Type of transport. E.g., a ZAU (ambulance) with ICU capabilities offers the possibility of earlier transport, and therefore transport of patients who are less stable

3 Transport availability. How many ZAUs are available, but more specifically: what type of places do they have? Patients lying down versus sitting patients

3

What do we do in the Role 2 Basic?
What is treated?
What is not treated?
What cannot be treated?
Depending on which surgeries are offered and the resources available in the Role 2 Basic



11.2 Discussion

All results should be seen in the light of some limitations.

Purely based on personal experiences
Due to COVID-19, there were no exercises to attend in order to observe the current course of events within the Role 2 Basic Medical Treatment Facility. Therefore, all information gathered on the ins and outs is purely based on desk research and stories from military medical staff that attended the Medic Diamond 2019, the only large-scale exercise with a Role 2 Basic so far. Although the search for honest stories was explicitly stated, bias will have to be taken into account. Interviewees all spoke from their own experiences, which can differ from the experiences from others who were not interviewed.

No combat experiences
Besides taking into account that the insights were based on experiences from only one or two people per functionary, it should also be taken into account that those people do not have combat experience. Therefore, all information they shared was based on Peace Support Operations.

However, this can be seen as a positive point as well, since the project manager of Studie Doorontwikkeling 400 does have combat experience and is in charge of redeveloping the battalion and closely involved with the development of the Role 2 Basic Medical Treatment Facility. This provided on the one hand insights into the processes within Peace Support Operations, the way they transferred these processes into the chain in combat, and the fact that operations in combat context are significantly different from operations in peacekeeping context.

Creative session
The creative session did not result in as many ideas as hoped in advance. One of the reasons could be that the session was led by a student and not by a member of the Ministry of Defence or the 400 Medical Battalion. Therefore, the developed concepts are based on ideas generated by me instead of ideas generated by users. In order to enhance co-creation, in the future I would have the session led by someone from the inside.

Continued development by the 400 Medical Battalion
During this project, the 400 Medical Battalion did not stop the development of the Role 2 Basic Medical Treatment Facility and the processes within. Therefore, by the time this project is delivered, it may be based on somewhat old news or plans that are already off the table. One of the examples here is that this project is supporting the Senior Nursing Officer in the role of triagist, but in the latest version, the Senior Nursing Officer does not take on that role anymore. This however, is not of any influence on the concepts. The adult combat allocation protocol should be used by whomever is in the role of triagist.

11.3 Recommendations

This project focused on developing a decision support tool for the Senior Nursing Officer in order to make better decisions regarding the allocation of the incoming patients. However, analysis showed that the SNO has a crucial role at three different places within the Role 2 Basic. Talking with medical personnel made clear that the SNO is super busy and needs to be supported. Support can come in multiple forms. One of the forms is to develop a protocol or a decision support tool. Another way is to free the SNO from the role of triagist and to let another functionary take over this role, in order for the SNO to focus more on the other two responsibilities he/she has.

As a follow-up to the previous recommendation, it is recommended to let the role of triagist be fulfilled by experienced medical personnel. The allocation of the patients is the most important decision to be made in order to maintain a combat mindset. In expectation of a high patient turnover, one will find themselves in an uncertain and dynamic environment. In this case, the decision to be made is subject to time stress and high stakes. Research has taught us that in situations like just described, an intuitive decision-making approach tends to lead over an analytic approach. To be able to make the most of this, the staff member in the role of triagist should have enough experience to rely on under these circumstances.

A third recommendation relates to the lack of time for exercises, and the lack of exercises (fully) reflecting reality. During the simulation session, working with scenarios turned out to be a valuable method to retrieve information. Providing users with different scenarios forces them to take the scenario as a starting point for their thinking process. Looking at the simulation session it shows that it delivers real different results than just asking or interviewing people. In a time where still a lot needs to be developed, with only so little time, this is an excellent way to maintain progress and test concepts.

The last recommendation is to develop a language for the decision-making process in front of the Role 2 Basic Medical Treatment Facility. Looking at the decision framework for which the adult combat allocation protocol has been developed, all casualties that do not need treatment are filtered out and transported to the next facility. A term that could be used for this is treatment necessity. Only if a patient

really needs treatment to make it to the next facility, the patient will enter the Role 2 Basic Medical Treatment Facility.

Subsequently to assessing the patients for treatment necessity, the allocation takes place. When the patients are then allocated, based on their location, the following terms can be used: treatment priority and transport priority. Treatment priority prioritizes patient based on their treatment urgency, while transport priority prioritizes them based on their urgency for transport. In practice, this should mean that the patient that needs to get to the next facility as soon as possible will get the highest transport priority and will be transported first. This goes the same for treatment priority

However, this language and terms have not been evaluated yet. But it is recommended to develop a clear language and to look into the mentioned terms.

12

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