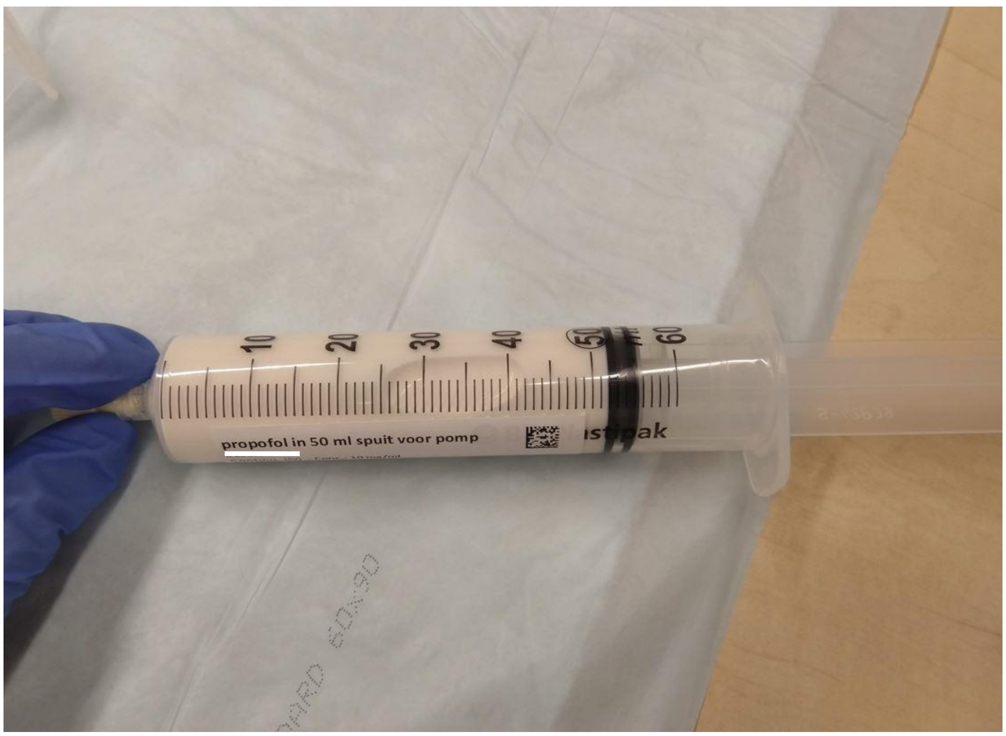
Sustainability and perfusion medication wastage

How do behavioural choices on the work floor affect medication wastage?



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Colophon

This document is a Master thesis for the completion of Master Environment and Society Studies at Nijmegen School of Management, Radboud University, The Netherlands.

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Summary

Sustainability is a global issue appearing in every aspect and work environment around us. Food and water scarcity, water and air pollution, medication scarcity are just some of the topics connected with it. While often looked for solutions and improvements on different levels, it is rarely looked at how our behaviour contributes to the global problem.

This research aimed to explore sustainability from a different angle in a unique environment. The focus was on looking if there is a medication waste issue on the ICU floor to begin with and what could be the contributing factors. Examining the behaviour connected with this issue and looking for limitations and reasons behind them was the goal of the research. In order to look for the answers, the practical research design consisted of several methods. Sample collection of the discarded syringes and creating a database was needed to validate that the problem exists and is real. It also provided several insights which were, later on, looked more deeply into with the help of direct observation and semi-structured interviews. Both of those methods were key to understanding the work-based environment and were necessary in the context of the chosen theoretical model. Which was chosen to help look into the behavioural aspect of this issue and highlight the limitations that might be surrounding/influencing said behaviour and therefore seek answers to the research question:

"*Which factors shape the individual work-based behaviour of nurses and other medical personnel with regard to medication wastage? To what extent as well as how does this work-based behaviour affect the amount of medication that is being wasted/not used to its full potential?*"

The research looks into a very specific work environment, where this issue has not been looked at, at this angle before. Therefore, it answers questions, previously unasked for a very specific situation. It also shows that sustainability is a huge concept that concerns everything and everyone and can be applied to any field.

In the end, the results from the practical part of the research were analysed with the help of the chosen theoretical model and gave answers to the research question and recommendations.

Preface

In front of you is the Master thesis “Sustainability and perfusion medication wastage: How do behavioural choices on the work floor affect medication wastage?” The core of this thesis is the investigation of medication wastage conducted in the Intensive Care department at RadboudUMC. It has been written to fulfil the graduation requirements of the Master's programme Environment and Society Studies at Nijmegen School of Management, Radboud University Nijmegen.

As a person with a background in Ecology and Environmental Protection, sustainability is something that always has been interesting to me. Sustainability is in everything around us, therefore I wanted to connect my master thesis with it and explore it in any environment or situation that was possible. Searching for an internship was a hard and difficult process. Eventually, I was connected with dr. Hugo Touw, who was interested in investigating sustainability on the ICU floor and more precise to look into the medications that were not been used to their full potential. This was a very interesting opportunity so I decided to take on that challenge. However, with the Covid-19 outbreak in March 2020 the scope of the research had to go through several transformations due to unforeseen worldwide circumstances. What was originally intended to be a comparison study of different practices when it comes to the syringe medications in two different hospitals could not follow through. Due to the outbreak, the second part could no longer be executed in the hospital Katarina Ziekenhuis Eindhoven. Luckily the whole process of collection and observation was already completed in RadboudUMC and there was enough data available so a change in the scope was possible. This lead to turning this research’s attention into the behavioural aspect of medication waste and the limitations it presents. Therefore teaching me another valuable life lesson and indeed the necessity of being flexible and resilient.

I would like to thank first the whole team at the Radboud University Medical Centre for agreeing to let me behind the curtain at the Intensive Care Unit and allow me the privilege to experience and observe the dynamics of this special environment.

A big thank you to all the nurses who participated in the collection of the syringes for those five weeks.

I would also like to express my gratitude to all the nurses who took an hour of their time in their busy schedules to participate in the interviews and thus allowing me to see their perspective and learn more about their day-to-day activities on the Intensive Care floor.

To Pieter Reintjes for all the help and organization of the collection process, ensuring that everything went as smooth as possible and scheduling the interviews.

To dr. Hugo Touw, for the supervision, advice and being the driving engine on the Intensive Care Unit floor when sustainability and improvement is concerned.

To my supervisor dr. Duncan Liefferink for the incredible never-ending patience, understanding and guidance through all the difficult moments surrounding this research process. Without that guidance and advice this research, with an ever-changing scope would have never been completed.

Last, but not least I would also like to thank my husband and family for surviving my master’s and never stopping to believe in me and support me. Thank you for keeping telling me to push through and motivating me, even in the most difficult times.

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Abbreviations

EML – World Health Organisation Model List of Essential Medicines aka Essential Medicines List

HIP – Hygiene and Infection Prevention

IBM/IM – Integrated behavioural model

IC – Intensive Care

ICU – Intensive Care Unit

IV – Intravenous

NaCl – Natrium chloride (physiological solution)

RAA – Reasoned Action Approach

Radboud UMC – Radboud University Medical Centre

TPB – The Theory of Planned Behaviour

TRA – Theory of Reasoned Action

UN – United Nations

WHO – World Health Organization

WIP - Werkgroep Infectie Preventie (from Dutch – Workgroup Infection and Prevention)

1. Introduction & Research Problem Statement

1.1.Introduction to the research.

Living in the current age not only as professionals but as humans as well, we are surrounded by the noise of words such as environmentally friendly, sustainability-minded, humane, and of course responsibility amongst many others. However, what is sustainability and why is it so important?

Being such controversial subject sustainability has many definitions and can apply to almost any field. However, in 1987 the United Nations Brundtland Commission gave it the following definition: “meeting the needs of the present without compromising the ability of future generations to meet their own needs. “(Our common future). Since then, sustainability slowly is picking up popularity in the “hot topic subjects’ ladder”, especially in the last decade. It comes as no surprise that humankind is the ultimate inventor, but with that also has become the ultimate consumer. Besides, while in the past that has mainly meant food for basic survival, today we consume so much more. As we evolve, we have started to require much more than just basic survival. Today we not only consume to sustain our bodies, but as humans with emotions, feelings, and opinions, we consume/require different things than food in order to feel happy and fulfilled. We strive to improve our lives and our immediate surroundings, often without thinking about what that means in the end, or how does it affect some other part of the world that is far away from us and does not influence our day-to-day life directly.

Even today in many parts of the world, we encounter and fight scarcity of different forms and shapes. Water scarcity, food scarcity, power scarcity, knowledge and of course, medication and medical care scarcity are just a few amongst many others. In addition, while food scarcity and water scarcity are “older” known issues for decades and receive focus and attention to a certain extent, medication scarcity and unnecessary wastage are not so talked about within a broad audience. Not until there is a certain crisis to put them in the spotlight.

Living in the 21st century the question of medical care is incredibly delicate but also incredibly important. Often there are news reports of medication shortages even in the most developed countries. For example, earlier in September 2019, the Dutch minister of healthcare has stated that for the upcoming year the medication shortages are expected to double. Therefore, it is incredibly important that a resource as valuable as this is used to its full capacity and is not wasted in vain. However, this raises the question “how aware are hospitals if they unintentionally produce such wastage and are they willing to look for solutions to solve it?” or even the bolder “can it be solved without compromising the quality of patient care?” and “how their behavioural practices that are in place directly or indirectly affect this issue?”

This research was thought of and started right before the Covid-19 outbreak. Its design has changed multiple times during its course, due to unforeseen circumstances considering the global pandemic, however, after the past year of chaos and the constant threat it is even more important today.

The research originally was thought to examine and compare the practices concerning the perfusion IV medications in two different intensive care departments (ICU) in two different hospitals in the country of the Netherlands. One being the Radboud University Medical Centrum (Radboud UMC) in Nijmegen and the other being Katarina Ziekenhuis Eindhoven. Due to the medications being prepared on the floor by the nurses in Nijmegen versus the medications, being prepared by a pharmacist in advance in Eindhoven it was thought that this would give a good idea for comparison if there was a difference in the number of medications that were being wasted. However, due to the Covid-19 outbreak in March 2020 and the incredible pressure, this put on all medical personnel, the research was only being able to be carried out in Radboud UMC. Therefore, the scope and shape of the research had to be adjusted in a correlation of the data that already was collected.

The Covid-19 outbreak to some extent validated the need for this research. Already in the early weeks of the outbreak in March 2020 in the Netherlands and not only here, but the focus of attention was also forced to shift towards the healthcare system, the hospitals, and the medical staff. This event, from which the world is still recovering put them right into the spotlight and a lot of issues known only to the people working in the field of healthcare became visible to anyone following the news and paying attention to the situation around them. The first issues appearing were the shortages of medical materials such as the protective FFP1 and FFP2 disposable facemasks. And while on one hand those scarcity issues are related to the global production and supply chain, on the other hand, it seemed to make the hospitals' management and personnel look more closely into what is used and why.

At the end of March and beginning of April 2020, the management of the Intensive Care Units at Radboud University Medical Centre (Radboud UMC) hosted a series of online webinars for their staff to keep them informed about the developing situation around Covid-19. Even though at that point of time the collection period for this research at Radboud UMC was completed, I as a researcher had access to those webinars and found that some of the information shared there overlaps with early estimations of the raw numbers given from the collection. What was interesting to see and hear was that at that time, there was no mention of medication shortages in the ICU, but there was a shortage of disposable facemasks and disinfectants. It was mentioned that since the staff was more on alert of what they are using and how since there might not be enough to use soon it was noticed that the usage of those materials lowered by 40%. This meant that those 40 % were wasted/not used to full potential prior. It also shows something very interesting and indeed if something comes into focus, an overall change of staff behaviour is possible for it to be corrected. It means that awareness of an issue is a big step toward correcting that issue (Webinars Corona; Radboud UMC).

1.2. Research problem statement

For this research, I would like to examine the behavioural practices in place and the factors affecting them connected to the medication wastage in the ICU department of Radboud UMC Nijmegen. The focus is on reviewing the individual behaviour of nurses and other medical personnel, to see and understand what factors determine and shape this behaviour, but also to look into how/if is possible to have changes to improve this behaviour. All of this without reducing the quality of patient care, but with reducing the number of wasted medication resources and working towards sustainability in this direction.

Knowing that sustainability is in everything around us, the question of sustainable behaviour in the work environment has a certain validity. Being aware of medication scarcity, environmental pollution and care for the environment are aspects of the behaviour of the medical personnel that this research will investigate and touch upon. Also, to what extent the nurses can be more sustainable based on examining their behaviour. How much can be achieved with a change of behaviour alone?

In the last thirty years, sustainability is indeed increasing in popularity amongst the people, not only in daily life but in the professional one as well. However, the hardest part as always remains to make people understand how important this subject truly is. That is often due to pushback and lack of knowledge and awareness. Refusal to believe in which that is not visible.

Therefore, when it comes to sustainability and health care, is it possible that this is also a case, we have something similar? Is it more awareness of that certain behaviour that is needed to reduce medication wastage? To what extent are the nurses aware of this problem? Are they aware at all? Do such a challenge even exist in the first place?

This is what this research aims to highlight based on the collected data from the Radboud UMC.

1.3. Research aims and research question(s)

The research aims to investigate the procedures, policies and routines in the Radboud UMC Intensive Care Unit department connected with the medications used in the perfusion systems at the ICU. Also looking into how those procedures and the behaviour behind them may affect the amount of medication wastage. The research will be based on the following main research question:

Which factors shape the individual work-based behaviour of nurses and other medical personnel with regard to medication wastage? To what extent as well as how does this work-based behaviour affect the amount of medication that is being wasted/not used to its full potential?

The research will investigate the different groups of factors that shape this type of behaviour such as economic, time, cultural, efficiency, and knowledge amongst others and see how they can be influenced to trigger a change. The research will not look into changing legal factors since that is not possible for this type of research, however when found, those factors will be acknowledged and examined to what extent they play a role in determining this work-based behaviour and the attitudes towards this behaviour. The research will also look into if indeed there is an issue with wasted medications, what the reasons behind that might be and as well as what results of that waste.

1.4. The scientific and societal relevance of the proposed research

1.4.1. Societal relevance

The waste of medications can have many different consequences depending on the point of view. Medication scarcity – wasting a good useful resource, which may be very much needed somewhere else to save a life is only one of amongst them. According to the World Health Organization report published in 2016 “In a large European survey, 21 percent of hospital pharmacists reported experiencing a shortage of medicines every day, a further percent every week. One in five pharmacists felt that they could not manage the shortage at all or most of the time, suggesting that medicines shortages cause patients to suffer disruption to their treatment" (WHO, 2016). While that is the case for Europe the report cannot even provide proper data about low and middle-income countries, just stating that based on different meetings "in ensuring access to needed medicines " is a problem.

Another aspect is the environmental pollution being caused by those unnecessarily wasted medications.

According to Alistair B.A. Boxall in "The environmental side effects of medication" (EMBO reports) this problem is not to be ignored or underestimated. "A wide range of human medicines, including antibiotics, statins or cytotoxins used in cancer treatment, is produced and used, some in the range of thousands of tons per year." (A. Boxall, 2004) This report was one of the first in the field back in 2004 when research on the subject was emerging. The point it raises is valid today as well since many of those medications might end up in the environment around them in one form or another. There are concerns for polluting water ecosystems and their inhabitants but also polluting the soils, air, etc.

Another consequence is of course the plastic. We hear so much about plastic pollution all the time in our daily surroundings. In many countries, we separate our household waste with care. However, that is a small scale considered how much plastic is used by the health industry. Part of that is of course the plastic syringes amongst many other consumable goods. To a big extent, plastic use in the medical industry is justified by the need for sterile conditions to stop spreading or creating infections. However, the scale is very big for the plain observer. Most of the time of course it is utensils used to perform different procedures on the patient such as the dental tools, which are discarded after every patient, tools used in operation rooms, packages from bandages etc. However, there is a bigger "darker" side to this that patients do not normally see. For example, each bed for the ICU units is prepared and covered in plastic also to be ready for the next patient. Often when not used, those beds are returned in the same state, only to be made again and send again to the ICU. (Source Interview №1;5)

In 2008 in the World Health assembly is adopted a resolution on climate change, which not only explains the consequences of climate change above human health but also suggests how the health sector should respond to it (WHO, Sixty-first health assembly; Geneva, 2008). Also, according to the World Health Organisation in 2018 from 85% of the waste generated by health care activities is normal waste, the other 15% is hazardous, toxic waste and over 16 billion injections are administered worldwide. Many of those syringes and needles not being disposed of properly after and presenting an issue. (www.who.int/factsheets).

However, after an extensive literature search, concrete data about sustainability in health care is difficult to find. While there are many reports on the necessity of the reduction of the carbon footprint of health care due to transportation, there is no concrete literature that looks into the behavioural aspects and looking into the perfusion medication wastage. Therefore, this research will try to outline and pinpoint the behavioural differences or similarities within the medical personnel when confronted with the task of the perfusion medication. It will attempt to show what other factors and boundaries limits that behaviour and to what extent. Many medical professionals try to live more sustainable in their everyday lives, like everybody else. They separate their garbage, they watch what they eat, they are aware of solar energy. However, how does this translate into their work-life? A life that is different, because it has made different by rules and restrictions of the outside environment. Does that alter their behaviour on this subject and to what extent?

We can take the hospital and look at it as a small province. Each floor is home to a different department, which has different wings and units. Those units have all different needs, therefore even within the hospital the rules and regulations differ based on those different needs. In a very dynamic work environment like this, even at first glance, we can say that time always matters. In addition, having the vital task of saving as many human lives as possible, patient care and comfort is priority number one.

We are left to wonder however where this leaves the sustainability issues on the priority ladder. Is there awareness about the medication wasted, or their disposal? Is there room for such issues to be tackled and paid attention to? The Intensive Care department is one of the busiest and extremely crucial within the entire hospital. The dynamics on the floor often translate into "every second matter". Breaking the rules may mean losing a life. It means an environment where mistakes matter more and should be avoided at all costs.

Another consequence is the economic one. Healthcare is extremely expensive all over the world, intensive care is one of the most expensive forms of health care there is. According to "zorgwijzer.nl", it is difficult to give an estimate due to the different procedures, equipment and medication that might be needed for each different case and patient. However, prices per day can start as low as 2800 euros. Wasting resources in one of the most expensive branches of health care and the most crucial one is simply another aspect of consideration.

1.4.2. Scientific relevance

The current research is practice-oriented, therefore it aims to seek improvements in the practice routines in the ICUs and see how, by optimising those practices, the ICUs can become more sustainable. In today's world, sustainability, and the way to live more sustainable affects everything around us – from our food products, water, energy etc. While the healthcare sector has its difficulties and challenges that they are facing, there is no reason why it should not also investigate this issue and thrive to do better. In many hospitals, there are already many initiatives about improving their sustainability – like using clean energy to run all life-saving machines. The sustainable issue of medication wastage is no different and just as important in a world where medication shortage is a well-known scene and a frequently rising topic. Therefore, the usage of the current medication supplies to their full potential is essential.

After looking through various sources, it is difficult to find concrete information on the subject. There are a few reports that touch upon those hospitals' green initiatives, or desire for such. For example, the Green Healthcare EPA report on Reducing Waste in Irish Healthcare Facilities. However, this report looks very generally and into Irish hospitals and the main goal is more broad waste reduction and proper separation. As far as I searched no reports or literature has looked specifically into the wasted medications of perfusion systems in the ICU, there is little research into wasted sedatives in operation room theatres. No literature has investigated the behavioural aspects of the routines looked into how the work-based behaviour might influence or contribute towards the issue of the subject matter. The set-up of the current research aims to peek behind the curtain of such behaviour in a work-based environment where not much has been looked at this exact angle. It will aim to provide insights as to what drives the personnel there and uncover some of the challenges they experience, which might directly or indirectly influence their behaviour when it comes down to performing the examined task at hand.

For those reasons, the literature used to help analyses this research will be adapted as much as possible for its conditions.

This research will aim to give a rare insight into the health professionals work behaviour and help pinpoint which aspects might contribute to medication waste and is there a way to be influenced and to what extent.

1.5. Short outline for the rest of this paper

The rest of the text will aim to guide the readers through the process of the research and giving a complete picture at the end of the achieved results and an explanation for the problem.

Chapter 2 will focus on the theoretical frameworks and analysis of the literature used in the process of the research in order to help understand the subject matter better and look for possible solutions.

Chapter 3 will focus on the methods used and the process of creating the experiment design in order to make the research valid and stable.

Chapters 4 and 5 are very linked to each other, so it is appropriate to mention them together. Those are indeed the analysis of the research based on the collected data and observations and a discussion with rising important questions based on analysis findings, while chapter five aims to give a short summary of the whole process with conclusions and recommendations.

2. Conceptual and theoretical framework and literature analysis

The following chapter aims to outline the literature used throughout this research and give an explanation as to why it was chosen. It will mainly focus on the literature used to create the theoretical framework and the model chosen for the research.

2.1. Conceptual and theoretical framework

As mentioned already in the introduction the scope of the research followed multiple changes due to unexpected circumstances. Therefore, the literature and the conceptual model had to be adjusted accordingly in order to be able to accommodate the new scope of the research. After extensive literature research, it could be seen that there is not one specific theory or model that was already accommodated or used in such type of research in an ICU environment. Has to be said that this study looks into a specific type of human behaviour happening in a very specific environment to help understand how exactly it contributes to a "silent" problem, which on its own does not look big, but in the end, it contributes to a global issue – sustainability.

Different known concepts and theories were explored to see, which might be suitable to accommodate this issue and help its unravelling in order to gain a better understanding and being able to pinpoint actions that unconsciously might contribute towards the problem. Amongst them was also the book of Elisabeth Shove "The dynamics of Social Practice". Since in the book the authors mention that "…Theories of practice have as yet untapped potential for understanding change. Realising their potential depends on developing a means of systematically exploring processes of transformation and stability within social practice between them" (Shove, Pantzar, & Watson, 2012) it was indeed interesting to see if Shove could be used to understand more about the practices on the ICU floor. However, the more time that was spent on the ICU floor and the more knowledge that was collected there it became clear that perhaps Shove is not the correct approach for this research, since here we will take policies as a given and will not look into how to change policies. It comes down to the point that when agency and structure are concerned Shove supports the Giddens point of view. Indeed Giddens Structuration theory, which essentially "…revolves around the conclusion that human activity and the social structures which shape it are recursively related. That is, activities are shaped and enabled by structures of rules and meanings, and these structures are, at the same time, reproduced in the flow of human action." (Shove et al., 2012). Giddens also states that humans capability to go with the flow social life, which is full of routine depends on the forms of practical knowledge. Therefore, they guided by structural features such as rules and resources of the social systems, which shape daily conduct (Giddens, 1984). Together with the fact, that Shove's work aims to "…argue that policy initiatives to promote more sustainable ways of life could and should be rooted in an understanding of the elements of which practices and systems of practice are formed, and of the connective tissue that holds them together." (Shove et al., 2012), it became clear that it is not very well suited for the issue that this research aimed to explore, however it still raises good points and perhaps could be used in a future research, which aims to examine this issue from a different angle. As stated multiple times through this research due to the nature of the work environment the existing policies for practice have to be taken and looked at as a given. This research does not aim to look into how to change policies in order to change practice and human behaviour. The policies existing in that environment are there to prevent mistakes and save human lives, the reasons behind them come from safety measures and cannot be ignored. Therefore, this research aims to look into human behaviour on an individual level and attempts to understand what are the triggers behind certain actions that may be contributing to the problem of sustainability and medication waste.

So after extensive literature research, it seemed that the Reasoned-Action Approach (RAA) by Martin Fishbein and Icek Ajzen is more suitable for the purposes of this research. The reasoned-action approach (RAA) is an integrative framework for the prediction (and change) of human social behaviour. The reasoned-action approach states that attitudes towards the behaviour perceived norms, and perceived behavioural control determine people's intentions, while people's intentions predict their behaviours (Fishbein & Ajzen, 2010). The reasoned-action approach is just the latest of the theories developed by the two authors and builds upon other of their works such as the theory of reasoned action (TRA) and the theory of planned behaviour (TPB). Reading about both of those theories seemed to come closer to what was needed for the purpose of the research and understand this specific behaviour. Both theories focus on individual motivational factors, which determine the likelihood of performing a specific behaviour. It seemed that a combination of both theories would be suitable to utilise such specific behaviour and help us break it down. That is when we encountered the Integrated Behavioural Model (IBM or IM) in “Health behaviour: Theories, Research and practice”, chapter 6 (Montano & Kasprzyk, 2015), which seemed very suitable for our research because it seemed to combine all important elements of the TRA and TBP that seemed to be applicable for the behaviour we wanted to observe and analyse.

There is a lot written for the TRA and the TBP theories in many articles and journals both by the authors themselves and by others that have built upon their work. This research will not try to look in-depth into all these works, frankly, that is both impossible and unnecessary. This research, however, will use the books “Predicting and changing behaviour: The Reasoned Action approach” (Fishbein & Ajzen, 2010) and chapter 6 “Theory of reasoned action, theory of planned behaviour and the Integrated behavioural model” (Montano & Kasprzyk, 2015) in “Health Behaviour: Theory, Research, and Practice” (K. Glanz, B.K. Rimer and K. Viswanath (eds), 2015). In order to look for answers for the behaviour connected with the medication wastage in the ICU environment. Those two books will be used as pillars in order to separate and highlight some of the aspects we will look into for this specific behaviour within the frame of the IBM, which later on will be customised for the purposes of this specific research in chapter four: Analysis.

In the “Health Behaviour: Theory, Research and Practice” it is stated that: “The TRA and TPB rest on an underlying assumption that the best predictor of a behaviour is an intention, which is determined by attitudes toward and social normative perceptions regarding the behaviour” (Montano & Kasprzyk, 2015). TPB is an expansion of the TRA and it includes an added construct in the form of “perceived control” over the performance of the behaviour. Those two theories were used by the authors of chapter 6 in “Health Behaviour: Theory, Research and Practice” in collaboration with Fishbein and other colleagues to create the Integrated Behavioural Model (IBM) (Montano & Kasprzyk, 2015). Even though in their works TRA, TBP and IBM(IM) are used in order to explain “…a large proportion of the variance in intention and predict a number of different behaviours connected with human health such as smoking, drug or alcohol abuse, STD prevention and other medical conditions.” (Montano & Kasprzyk, 2015, p. 95) the concepts seem suitable to also help understand behaviours of different nature, like the one this research is looking into as well. It seemed appropriate to look into attitudes if we want to attempt to understand what lies behind the problem with the medications being wasted in the ICU and how those attitudes influence behaviour on daily basis on the work floor. Moreover, the expansion adding “perceived control” with the combination of the TBP helps to see how much is dependent on attitudes alone and how much other constraints such as “perceived control” can add to influencing the behaviour in question. To what extent the nurses have the freedom to execute things the way they want to vs. the way they must.

2.2. The Integrated Behavioural Model in the context of this research.

If we go back to the research question that is the main point of this paper: “Which factors shape the individual work-based behaviour of nurses and other medical personnel with regard to medication use and medication wastage? To what extent as well as how does this work-based behaviour affect the amount of medication that is being wasted/not used to its full potential?” we want to see how the Integrated Behavioural Model can help us in answering it in the end. If we look at the figure №1 below, showing us the IBM we can see that it essentially consists of several “boxes”, which are connected with each other, influence each other and at the end influence the behaviour, which is essentially the outcome of all those intertwined interactions between so many different groups of factors. This text will try to outline and briefly explain the ones that are deemed necessary for the analysis while trying to explain why they are important and have been chosen as the conceptual starting point for this research.

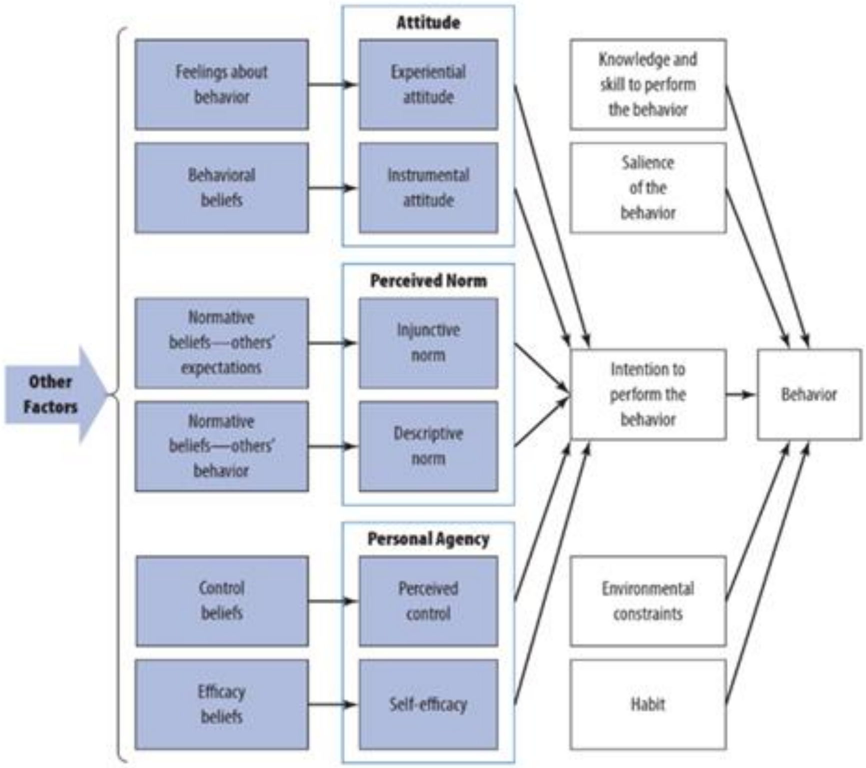


Figure 1:"The Integrated Behavioural Model" (Health Behaviour: Theory, Research, and Practice, Chapter 6, p.104)

All human behaviour is influenced by different factors in the different settings where it occurs. According to M. Fishbein and I. Ajzen attitudes, subjective norms and intentions can be used to predict human social behaviour in a variety of settings (Fishbein & Ajzen, 2010). This is according to the TRA structure, however with the evolving of the IBM model (see figure №1) those constructs slightly change and attitudes, perceived norms and personal agency are the determinants used to explain behaviour in the context of the IBM.

This is also the model that will be used for the course of this research and later on will be adapted by the author based on the research findings as mentioned earlier.

Every behaviour follows constraints and adjusts to fit certain parameters depending on the situation. There are some of the parameters, which people who exhibit this behaviour can control and adjust, but there are also others, which are not under their control. However, to what extent is it possible to change a certain behaviour, what is needed and how such changes can be triggered to occur?

2.2.1. Attitudes

According to Fishbein & Ajzen "attitude is a latent disposition or tendency to respond with some degree of favourableness or unfavourableness to a psychological object" (Fishbein & Ajzen, 2010). However, a lot of theorists have argued that attitudes have low correspondence with behaviours, therefore over the years have been discussions of eliminating attitude as a factor underlying behaviour. (Abelson, 1972; Wicker, 1969). Due to the course of the development of the TRA however, Fishbein splits attitudes into two groups: attitude towards an object and attitude toward a behaviour with respect to the object. For example attitude towards a disease in respect of getting a test for that disease vs attitude towards the test in respect of the disease. This is known as the principle of compatibility described by Ajzen (1985; 2012) (Montano & Kasprzyk, 2015). The IBM also makes a distinction between attitudes, splitting them into experimental and instrumental attitudes. Experimental attitude is the affect – meaning that behavioural performance is associated with either positive or negative feelings, while instrumental attitude is associated with outcomes, results of the performed behaviour (Montano & Kasprzyk, 2015).

Attitudes are determined by individuals' beliefs about outcomes or attributes of performing the behaviour (behavioural beliefs) and by the feelings, those individuals have towards the behaviour. For example, a person with a positive disposition, feeling, towards a result of a certain behaviour will have a positive attitude toward the behaviour (Montano & Kasprzyk, 2015). In the context of this research, we wanted to see the attitudes of the medical personnel working on the ICU floor regarding sustainability. It was important to see the general disposition towards the issue, in order to understand if that is one of the "blocking" points contributing to the medication wastage problem we were investigating. It was necessary to explore if their attitudes towards sustainability were positive first in a broader aspect – such as their home lives, to measure if that changes when it comes to their work environment and what the reasons for those changes may be. Therefore, in the course of the interviews and the direct observation, attitudes were something that received special attention and close investigation.

2.2.2. Perceived Norms

According to Fishbein and Ajzen, social environments can exert a strong influence on people's intentions or actions (Fishbein & Ajzen, 2010). That influence is captured most frequently in the concept of social norms. On another hand, social norms refer to what is acceptable or permissive behaviour in a group or a society (Fishbein & Ajzen, 2010, p. 129). Norms could be used to structure the behaviour or the situation. They can be used as strict guidelines, general guidelines or just an empirical regulation depending on the situation.

Normative beliefs determine a person's subjective (injunctive) norms. Those are cases when for example an people who are important in the eyes of the individual performing the behaviour approve or disapprove of performing the said behaviour and in those cases, it is possible to influence the motivation to comply from the first said individual (Montano & Kasprzyk, 2015).

For example, wanting or not wanting to please/obey someone. This can be looked at as a motivation to comply with certain behaviour and actions, it is often measured with agreement or disagreement towards a said statement. Norms can be seen as *perceived*

social pressure to perform or not to perform a given behaviour (Montano & Kasprzyk, 2015).
One aspect of such perceived social pressure in the case of the current research is the phenomenon of being collegial, which we will explore later in chapter number four – analysis. In the IBM model, two different types of norms can be seen as descriptive and subjective (injunctive) norms. Subjective (Injunctive) norms as mentioned above follow of what others think of a certain behaviour on approve, disapprove basis and the motivation to comply. Descriptive norms follow whether others perform or not perform the behaviour (Montano & Kasprzyk, 2015). However, in the scenario that we are looking at in the ICU, those two groups overlap to an extent and a very closely linked – do other nurses prepare for the next shift, so I should too for example in combination that all of them perceive it as a nice gesture. Therefore will be grouped together and just looked at as "norms".
The TRA and TPB have a chain flow which links behavioural beliefs, normative beliefs, and control beliefs to behavioural intentions and behaviours via attitudes, subjective norms, and perceived control (Montano & Kasprzyk, 2015). Perceived control will be explored in the next section of this chapter elaborating on personal agency. TRA/TPB have many strengths as approaches but one of the most vital ones is that different causal relationships between the components of the model are very well specified (Bleakley & Hennessy, 2012; Fishbein & Ajzen, 2010; Hennessy, Bleakley, & Fishbein, 2012). On another hand "Behavioural, normative, and control beliefs are those who help us understand what drives behaviours while providing intervention vis different communication modes or channels (Fishbein & Cappella, 2006; von Haeften, Fishbein, Kasprzyk, & Montano, 2001)" (Montano & Kasprzyk, 2015, p. 102)

2.2.3. Personal Agency

Another construct in the TRA, TPB and the IBM is the Personal Agency.
Perceived control of the individual – what can a nurse do on an individual level to influence changes in that behaviour and to what extent they have control over their work in the case of the current research.
Personal Agency in the context of the TRA, TPB and later in the IBM as well is based on the descriptions by Bandura (2006) as "…bringing one's influence to bear on one's own functioning and environmental events." (Bandura, 2006). Regarding the IBM Montano and Kasprzyk (2015) states that personal agency consists of two constructs – self-efficacy and perceived control. In this case, self-efficacy is sought to be "one's degree of confidence in performing the behaviour in the face of various obstacles or challenges, measured by having respondents rate this behavioural confidence on bipolar "certain I could not"–"certain I could" scales" (Montano & Kasprzyk, 2015, p. 106).
In the frame of the IBM model attitudes, perceived norms and personal agency can have different relevant importance towards a specific behaviour, when it comes to determining the behavioural intentions. Based on Montano and Kasprzyk (2015) intentions may vary for different populations and different scenarios. Therefore it is suggested that is important to determine the degree to which attitude is influencing certain behaviour and then the same for the perceived norms and the personal agency (Montano & Kasprzyk, 2015, p. 106).
This is also the flow that this research will aim to follow in order to understand more

about the specific work-placed behaviour that is being observed in a correlation of the sustainability/wastage problem.

2.2.4. Other factors and environmental constraints.

A lot of other factors might influence behaviour in different situations such as time, age, location, experience, laws and regulations, cultural factors. So many different things can influence different types of behaviour. Therefore, they are never the same in two different cases and logically are classified and grouped as “Other” factors. What is considered “other” factors in the context of the current research will be elaborated on later. It is necessary to mention that “other” factors can be distinguished as “hard” – meaning that no changes could be possible based on them and “soft” – meaning that some changes might be possible. According to literature “other factors, including demographic and environmental characteristics, are assumed to operate through model constructs and are not thought to independently contribute to explain the likelihood of performing behaviours” (Montano & Kasprzyk, 2015).
The reason is that they are interconnected to each other and while on their own might not seem like a “big” contributor towards a behaviour together they do amount to matter.

In the case of the ICU, those factors overlap with the environmental constraints – i.e. what is allowed and what is not at the ICU. That can include all the rules and regulations of course, but also small things surrounding those rules and regulations, such as the current amount of patients, the number of staff members present that day, time management etc. Therefore, they will be looked at together. This research will not aim to change policies or regulations, this is not possible with this environment. However, where they are found and it is noticed that they do have a certain influence on the behaviour connected with the medication wastage/spillage and may have contributed towards the sustainability issue they will be acknowledged and given as reasons.

2.2.5. The customisation of IBM in the context of this research.

The most important determinant in the IBM is the intention to perform a behaviour, this doesn’t change from the TRA&TPB. As mentioned by Montano and Kasprzyk (2015) without a motivation of any kind, a person is unlikely to carry out certain behaviour. There are four other important components, which can have a direct affect on a behaviour (Jaccard, Dodge, & Dittus, 2002):

- skill and knowledge to carry out the behaviour,
- no or few environmental constraints making said behaviour difficult or impossible (Triandis, 1980),
- the salience of the said behaviour (Becker, 1974) – how important it is for the person to do this
- experience in performing certain behaviour – It has the possibility to make it a habit and turn it into a routine (Montano & Kasprzyk, 2015, p. 106).

When habits and routines occur intention drops in the priority ladder for those individuals and become less important in determining their behavioural performance (Triandis, 1980). This is something that from the start seemed present in the specific behaviour observed by this research. The whole environment of the ICU floor and the nature of the work inevitably from the start contained several indications of routines and habitual

behaviour.
All of the components mentioned above are important, but the interactions between and within them are important as well. Moreover, even though this is a model, different behaviours and different populations and settings may require different strategies of examinations (von Haeften et al., 2000). Therefore, there is no one-size-fits-all approach when it comes down to examining behaviours. Adaptations and customisations are always needed depending on the settings of the specific behaviour, even if it is the same behaviour looked in at different settings.
A borrowed table from "Health behaviour, 2015, 5th edition, chapter 6, p." giving a summary of the constructs looked above in the context of the TRA, TPB and TBM can be found in appendix №1 giving an overview of their definitions.
The constructs discussed in this chapter will be used as a frame of this research's analytical part and will aim to help clarify underlying challenges when it comes to the behaviour and actions of the nurses at the ICU involving/connected to medication wastage and possibilities to improve sustainability.
With the help of the models and theories briefly touched upon in the chapter the current research aims towards a tailor-made version of the IBM specifically adapted for the needs of the research question stated earlier.
Figure №2 shows again the IBM, but it aims to highlight some of the constructs that will be paid special attention to in the course of this research to understand more about the specific behaviour that is being looked into.
In the context of the IBM, every behaviour has three pillar groups of factors – *Attitudes, Perceived norms and Personal Agency,* which are constructs connected with behaviour, not for the first time with the IBM, but also exist in different works and adaptations of Fishbein and Ajzen's theories throughout the years. (Fishbein & Ajzen, 2010; Montano & Kasprzyk, 2015).
In the customised model below those are the boxes highlighted in red, as the pillars of the behaviour we cannot ignore or overlook them. In fact, we have to start from them in order to untangle the web and gain a better understanding. They create the base of the behaviour.
The green boxes are the most interesting ones since they are the silent drives behind the scenes. In this sense silent meaning that on first look they will not seem as important in regard to this behaviour, and in any case will not be suspected as the "main" cause. They are found and their effect is seen with a deeper examination into the behaviour. Could be looked at as more indirect causes. For example, environmental constraints and other factors such as legislation, time, occupancy on their own will not determine how something will be executed, or just the feelings towards the behaviour. But together with the different limitations, they all present it adds up to the end result and how a behaviour is performed. Knowledge to do something and the amount of skill acquired for that task together with the salience of the behaviour – is it important or not to the person performing it, how do they feel about it (positive, negative) – help us understand better why people act as they do. They and the connections between them all add towards the result at the end – i.e. are medications wasted, how much and why therefore are of importance and the focus will be on them.
The light green circles highlight both the "other factors" and the "environmental constraints" of the model. In the case of the behaviour, we are looking into both

categories overlap; therefore, we will look at them together in order to understand the limitations they present and is it possible to overcome them. Some of them will be “hard limitations/factors” meaning that they cannot be changed, or that will be extremely difficult. Others will be “soft limitations/factors” meaning that even though challenging, a modification could be possible, of course without compromising patient care in this particular case.

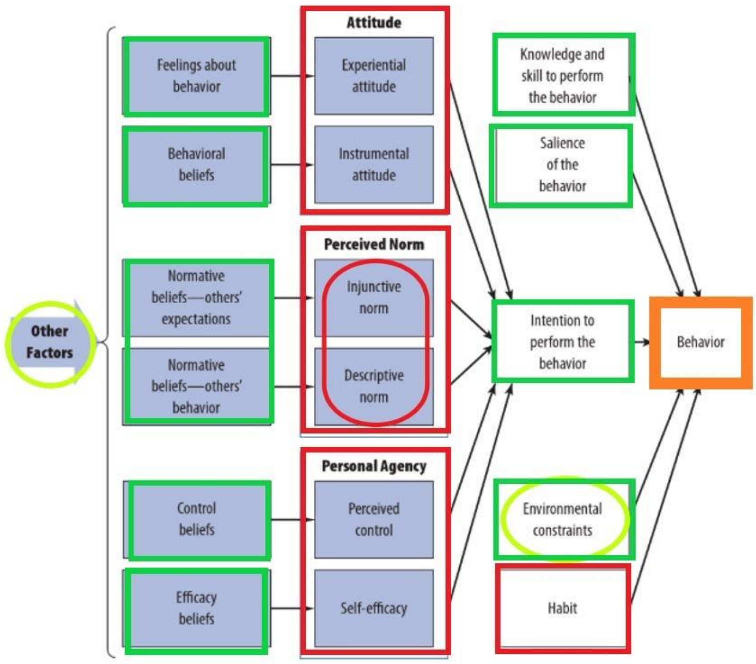


Figure 2: “The Integrated Behavioural Model” (Health Behaviour: Theory, Research, and Practice, Chapter 6, p.104).Highlighted version by the author for the future use of the model in the course of the analysis.

3. Methodology and experiment design

The current chapter aims to outline the reasoning behind the methods chosen for carrying out this research. The research was compiled out of various interviews with some of the nurses at the ICU, a period of data collection and direct observation of the working environment as much as the situation and the flow of the work environment allowed it.

Due to the essence of the work performed at the ICU and it is high life-saving importance the research and research strategy had to be tailored around it in order to not cause any disturbance in this high-pressure working environment. Flexibility proved to be an essential part of the process. It also showed from the beginning how important and how vital time management is in the whole department.

3.1. Research strategy

Due to the rise of Covid-19 the parameters of the research had to be altered corresponding with the limitation of this worldwide crisis. Therefore, when initially the research was thought out as a comparison study between two different hospitals' Intensive Care Units (in two different hospital locations), due to unforeseen circumstances that had to be altered and with it, the aims of this research as well. Therefore, once again it shows that research often does not turn out as intended but that with flexibility and adaptation it is still possible to be conducted to a certain extent in a different way in order to still gather information and seek answers for the questions at hand.

The research strategy behind it contains a mixture of both qualitative methods – such as direct observation and semi-structured interviews and quantitative methods in the presence of the data collection created by the collected samples during the period of the research. According to A. Abbot, some of the strongest research projects are built on both qualitative and quantitative methods (Abbott, 2004) to back up the findings from the direct observations or interviews for example with numbers. It can only make a research stronger.

3.1.1. Research philosophy

This research does not follow a single research philosophy. Trying to peal Saunders et al., 2015 "research onion" (Saunders, Lewis, & Thornhill, 2020) and looking at the nature of the issue creates premises for both ontology and epistemology. When an ontology is concerned with what type of things exist and what is the nature of a social reality – In this particular case, is there a medication waste issue, to begin with. Epistemology on another hand is concerned with the nature of knowledge and different ways of knowing and learning about that social reality – how do we know that there is a medication waste issue and what is contributing to it. Therefore, in this particular research case, the epistemological aspect is more relevant and strongly connected to the subject matter.

The research strategy behind it contains both qualitative methods – such as direct observation and semi-structured interviews and a quantitative method in the presence of the data collection created by the collected samples during the period of the research.

The approaches that we can distinguish are the positivistic approach – describing the phenomena that were observed i.e. medication wastage exists and a constructivist approach. Not only taking in information passively (i.e. only literature studies) but also observing interactions with the participants of the specific environment, allowing to take in different points of view and draw conclusions.

3.1.2 Research design.

This research looks at several things, on one hand, if there is a problem with medication waste and how this problem can contribute towards sustainability and on the other hand, what is the root cause of that problem, shall it exist. What part of the overall behaviour on the ICU floor triggers and contributes to its presence?

The starting point of the research was aimed at gathering proof of the existence of the problem. Without such a starting point, it is not possible to establish the direction of the current research. Therefore, even though it is research looking essentially into human behaviour it is not strictly or exclusively qualitative research.

The collection of the medications with the purpose of confirming that there is medication waste is the quantitative part of this research.

Another part, the qualitative part of the research was aimed to observe the individual work-based behaviour of the nurses and medical personnel in ICU units connected with the procedures around the continuous medication pumps and looking into the factors that trigger attitudes connected with this type of work behaviour. That way after analysis of those factors behind them, we can see how and if those factors can influence to change certain traits in behaviours, therefore help to modify practices and improve sustainability. A big part of the observational part of the research was also noting and understanding the feelings and reactions of the participants towards their actions. It gives hidden indications of the motivations. To enhance the results of the observation and get a better understanding of the working environment and its limitations several semi-structured interviews were conducted with some of the intensive care nurses.

To create a proper profile for the hospital observation of the working routines/environments were conducted with the help of the methods below.

3.2. Research methods, data collection and data analysis

The quantitative part of this research included sample collection of the syringes used in the perfusion systems on the floor of the ICU wards. More about the collection process and the sample size of the data collected can be found a little bit further in this chapter, explaining the whole process. For now, we can say that such collection was necessary as mentioned earlier to establish the presence of the problem in the first place. However, as will be shown from the analyses the collected and analysed data from those samples showed much more than just establishing the presence. It also hinted towards specific actions, timeframes that might contribute the most and therefore gave ideas for expanding the interview questions in order to understand more about those phenomena's and been able to look deeper into the issue at hand.

As mentioned, multiple times throughout the text a big part of the research is based on direct observation on the ICU floor, whenever the situation allowed it. The practical part of the experiment also took place on the ICU floor. All of this was necessary to observe and understand better how a working day for the nurses looks like in this exact environment.

According to S. Tracy "Qualitative research is about immersing oneself in a scene and trying to make sense of it" (Tracy, 2013). Therefore, I as a researcher had to do exactly this. As an outsider, who has never been to such a working location everything was unknown to me. Learning the flow of the floor, observing the interactions within the staff members and immersing in this new environment naturally triggered many questions, which were unthought-of at the start of the project, but helped it is further development, nonetheless.

Direct observation of the specific tasks connected with the changing of the medications was not possible. Due to the working nature of the nurses, the time limitations and of course the patient's well-being and comfort it is not possible to follow and observe the nurses from close by all the time during those tasks or always ask them questions. Those procedures require a lot of concentration to reduce the number of mistakes as much as possible.

However, being on the floor itself and being able to observe the dynamics and workflows, also gave an adequate idea of the processes taking place, as well as some interesting insights.

3.2.1. Quantitative methods

3.2.1.1 Sample and Data collection

To gather a proper sample collection a plan was created and followed. The collection process looked to collect different insights – its purpose is not only to show the total number of medications wasted but also to highlight which medications might be the ones that are being wasted the most and give some hints as to why that may be. Since the dynamics of the ICU floor are ever-changing and not two days are the same, the collection needed to be taken in a proper timeline to look for consistency and be able to paint an adequate picture with the found numbers. It was decided that the best baseline for the collection period would consist of a period of five consecutive weeks. That way it would be able to follow the number of medications wasted for each week and observe different correlations as to how many patients, how long the patients have been staying there and other factors that may contribute towards the increase or decrease in the found raw numbers and explain any fluctuations that may occur.

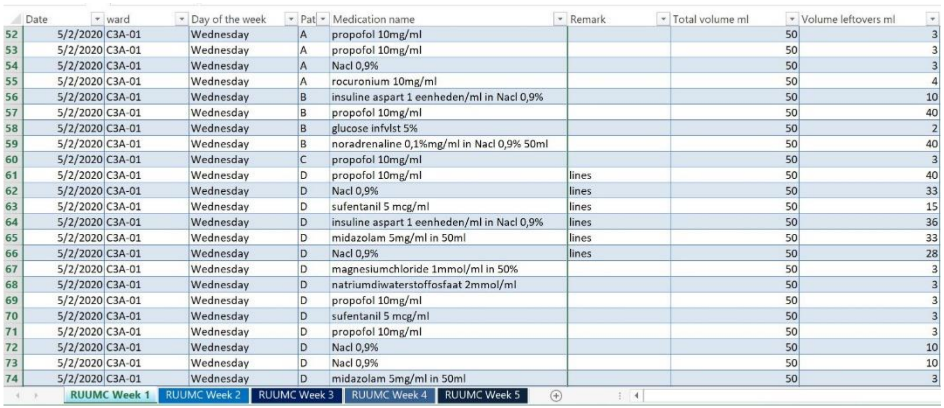
For creating, the database samples were collected from two different units on the ICU floor. The sample collection exists of discarded syringes used in the perfusion systems at the units C3A and C1A located respectively on floor one and floor three of the hospital grounds.

This includes all syringes containing medications for the perfusion pumps that are prepared, used or not and then discarded when deemed not safe to be used anymore.

For the duration of five weeks, samples were collected from those two units every day between two and four in the afternoon in a form of discarded syringes with medications used in the perfusion systems. For that time period, the nurses were asked not to discard them in the trash but instead in special boxes, which were later during that day in the same period of time collected, counted and catalogued.

Each day the syringes from the rooms of those two units were collected, counted, photographed and documented in an Excel Database file, which was specially created by the author for the purpose of this research. Since one of the main aims of this research is to see to what extent the medications are being wasted the volume of the medications that were leftover in each syringe was written down as well as the total initial volume. In the end, a total of 1181 samples were collected for the duration of those five consecutive weeks with an average of between 160 and 400 samples per week.

For examples, see the figures №3, 4 below. More examples can be found in Appendix 3.



	Date	ward	Day of the week	Pat	Medication name	Remark	Total volume ml	Volume leftovers ml
52	5/2/2020	C3A-01	Wednesday	A	propofol 10mg/ml		50	3
53	5/2/2020	C3A-01	Wednesday	A	propofol 10mg/ml		50	3
54	5/2/2020	C3A-01	Wednesday	A	Nacl 0,9%		50	3
55	5/2/2020	C3A-01	Wednesday	A	rocuronium 10mg/ml		50	4
56	5/2/2020	C3A-01	Wednesday	B	insuline aspart 1 eenheden/ml in Nacl 0,9%		50	10
57	5/2/2020	C3A-01	Wednesday	B	propofol 10mg/ml		50	40
58	5/2/2020	C3A-01	Wednesday	B	glucose infvlst 5%		50	2
59	5/2/2020	C3A-01	Wednesday	B	noradrenaline 0,1%mg/ml in Nacl 0,9% 50ml		50	40
60	5/2/2020	C3A-01	Wednesday	C	propofol 10mg/ml		50	3
61	5/2/2020	C3A-01	Wednesday	D	propofol 10mg/ml	lines	50	40
62	5/2/2020	C3A-01	Wednesday	D	Nacl 0,9%	lines	50	33
63	5/2/2020	C3A-01	Wednesday	D	sufentanil 5 mcg/ml	lines	50	15
64	5/2/2020	C3A-01	Wednesday	D	insuline aspart 1 eenheden/ml in Nacl 0,9%	lines	50	36
65	5/2/2020	C3A-01	Wednesday	D	midazolam 5mg/ml in 50ml	lines	50	33
66	5/2/2020	C3A-01	Wednesday	D	Nacl 0,9%	lines	50	28
67	5/2/2020	C3A-01	Wednesday	D	magnesiumchloride 1mmol/ml in 50%		50	3
68	5/2/2020	C3A-01	Wednesday	D	natriumdiwaterstoffosfaat 2mmol/ml		50	3
69	5/2/2020	C3A-01	Wednesday	D	propofol 10mg/ml		50	3
70	5/2/2020	C3A-01	Wednesday	D	sufentanil 5 mcg/ml		50	3
71	5/2/2020	C3A-01	Wednesday	D	propofol 10mg/ml		50	3
72	5/2/2020	C3A-01	Wednesday	D	Nacl 0,9%		50	10
73	5/2/2020	C3A-01	Wednesday	D	Nacl 0,9%		50	10
74	5/2/2020	C3A-01	Wednesday	D	midazolam 5mg/ml in 50ml		50	3

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5

Figure 3: Sample of the created excel database, (Source: Author)

Figure 4: Syringe sample full of propofol. Part of the created picture catalogue in the sample collection process. (Source: Author)

3.2.2 Qualitative methods

In the end, the experimental and observational part of the research as well as some of the interviews was carried out in two of the Intensive Care Units at Radboud University Medical Centre (RadboudUMC) in the city of Nijmegen, The Netherlands. The experimental part took place during five consecutive weeks in February and early March 2020 at Intensive Care Units C1a and C3a of RadboudUMC. The two different ICU units are located respectively on different floors on the RadboudUMC hospital grounds – floor one and floor three. Even though both units are intensive care, they slightly differ from each other. The intensive care unit on floor one usually receives more trauma patients, who might need to stay there for a longer period of time. The intensive care unit on floor three most often receives patients before and after recovery from cardio surgeries, who often will have shorter recovery time, therefore shorter stay on the floor of the unit.

Both the interviews and the observations fall under the umbrella of qualitative research methods. Qualitative methods "…need not include long-term immersion into a culture or require a holistic examination of all social practices" (Tracy, 2013). That of course is not only not possible, due to the diversity of work overall that happens on the hospital grounds, but it is also not necessary since this research is interested in only one aspect of the working day. Therefore, the focus was concentrated only on the tasks connected with the perfusion medications and the participants of the interviews were asked questions that were in a way connected with that process but also questions connected with sustainability in order to create a general picture of where sustainability stands on the ICU floors.

3.2.2.1 Direct Observation

The direct observation took place while collecting and cataloguing the syringes every day for those five weeks and also having the opportunity to experience the dynamic of the ICU working environment, to observe the floor even while in passing. Direct observation is challenging on the ICU floor, due to the many regulations and restrictions but also the sensitivity of their type of work and sensitivity towards the patients. It is not possible to follow every step of the nurses all the time. However, several tours were given that helped to understand better how one working day looks like and what does the procedure of changing the perfusion medications entail.

3.2.2.2 (Semi) Structured Interviews

During the period of five weeks, several interviews were conducted with nurses working on the ICU floor to understand and learn more about their work, but also the experiences they have in their working environment and how they perceive certain topics such as sustainability and especially their point of view on the medication waste.

The Interviews were based on a specially created interview guide with open questions that can be found in Appendix 2, as well as their transcriptions. They were conducted between eight different intensive care nurses of different ages, genders, and amounts of work experience. All subjects were asked all questions from the initial interview guide, however, in some of the later interviews, other questions were asked as well or were adapted based on information or feedback from one of the earlier conducted interviews. Even though the number of the conducted interviews is just eight, the sample was diverse.

Each interview started with questions concerning the station of the employee. From the eight nurses that were interviewed, four were men and four were women. They all had different backgrounds, different years of experience and some different functions. Two of the interviews were with floor managers, while the other six were with full-time nurses. The difference between the two functions is that floor managers have more leader and office functions and spend less time on the wards, an average of four days a month (Interviews №4&№8), while the full-time nurses spend all their time on the ward and with the patients. The team leaders oversee coordinating the team, organize; they also look at the quality and safety of the working environment. They look at documents and protocols for procedures and update everyone if there is a need.

The questions and the interviews, in general, aimed to learn and understand more about the working day of the nurses and understand what limitations they encounter during their working day. It also aimed to discover and observe their general outlook on sustainability and resource waste.

3.3. Validity and reliability of the research

The validity and reliability of the research will depend a lot on the cross-referencing of the different interviews and the information obtained through them as well as information obtained from the data collection and cross-reference.

The sample size from the interviews even small is diverse enough to give perspectives on the same behaviour from different subjects. The sample size of the collection process is big enough to show the existence or absence of medication waste and the duration of five weeks allows to see if there is consistency in trends or not. The nature of the different methods by itself makes sure of the internal validity of the research. By choosing and using different methods, we try to see and confirm the existence of the issue – for example, the data collection from the syringes but also the data collection from the direct observation and the semi-structured interviews. The interviews, the interactions and the direct observation not only also confirm that there is an issue but give insights as to how and why it occurs. By interviewing different people from the staff, we gather different points of view, which allow us to see the issue from different angles and try to disentangle it. Looking at an issue that occurs in a specialised environment and prior studies in that direction could not be found, the design created specifically for this environment can be applied for future studies on the same topics in different locations where this environment exists, confirming the external validity of this research – i.e. its model being applicable for future studies. By going to gather information directly from the sources living in that environment – i.e. asking the nurses who perform the actions connected with the medication changes we make sure about the internal reliability of this research. Making sure that we received information from the right sources, which later on is most likely to lead us to a better understanding of the examined phenomena. By choosing the IMB as a tool for this research, which is a tool used very widely in different studies concerning different types of behaviour, we make sure about the external reliability of this research – having the right things to measure in order to establish if there is an issue.

4. Data findings and Analysis

The following chapter aims to explore and present the results and findings from the practical part of the conducted research. It also aims to connect them to the theoretical framework and literature discussed in chapter two "Theoretical framework and literature research" with the goal of answering the research question at the end and adapting the Integrated Behavioural model presented in chapter two towards the needs of this research based on the discussed findings.

The practical part of the research as mentioned earlier in the text was compiled of two main activities – data collection and semi-structured interviews with different representatives of the ICU staff – nurses and floor managers.

As explained in the experiment and methodology design part of this text, the data collection part of this experiment took place over five consecutive weeks on two different floors at the Intensive Care Unit department at Radboud University Medical Centre. For that period all the syringes that were used and discarded at those two Units were collected, photographed, and catalogued in an excel database for the purposes of this research. That collection was necessary to determine if there is actually an issue with medication waste and at a later point help illustrate to what extent is that wastage if it proved to exist. While working on the database the results also were able to give insight into the most used and of course, the most wasted types of medications at the ICU. As some of the medications are not harmless for the environment their disposal should be taken with care, so the results furthermore arose new questions concerned with their save discarding and the whole sustainability issue at hand. Based on some of the findings from the collected samples some of the interviews conducted after the start of the collection also had to adjust to ask and look for answers from those newly aroused questions.

Since the beginning, this research has suffered several major trajectory changes and shifts of focus based on unforeseen events and therefore need of adaptation. Due to that in this chapter, there will be findings from different perspectives, that may not always seem connected with starting questions, but have proven interesting and worth mentioning in due course of the development of this research.

This whole research has been as a big, intertwined web and from the start by trying to find answers for one question, more and more questions have developed, proving and exposing the complexity of the different dynamics happening on the floor of the Intensive Care Unit.

4.1. Data and Sample collection

As mentioned, several times the samples for this research were collected in a span of five consecutive weeks on the grounds of two of the intensive care units at Radboud University Medical Centre. The major point of this collection was to first and most establish if there was a medication spillage and if there was one how big it is. The duration of five weeks was in order to see continuity, but also due to the different dynamics of the intensive care units where every day is different to observe how the amount varies depending on occupancy and in the different scenarios that take place every day.

The first step after collecting the samples was to describe them to create the database. After the collection period has ended the database was used, first as a reference to establish if there is indeed a medication waste and based on the size of the sample collection to try to determine to what extent as accurately as possible, considering different factors that may have played a role in those numbers.

Already in due course of the collection, the answer to the first question was getting clearer even with the naked eye and after cataloguing, it was confirmed. Based on the conducted research and the data collected during that period of five weeks the short answer to the question if there indeed is a medication spillage is yes, there is. After looking more detailed at the numbers it could be seen that the values of the total volume of medication wasted per week for this period varies between 28% and 40%. (Absolute numbers can be found in appendix №3 – Samples database extracts). The sample size clearly showed that there is indeed medication waste, therefore validating the problem in the first place.

Other findings that were also noted during the collection was the most used medications and the most spilled medications. Many of the liquids used in the perfusion medications at the Intensive Care Units can be harmless such as NaCl (physiological solution), glucose etc. Those medicaments/supplements are also some of the most inexpensive in prices. However, many others are heavy chemicals, often used for sedation and very harmful to the environment. Therefore, when observed and such medications were concerned another question arouse and indeed how are they disposed of, how are they supposed to be disposed and what is happening with them.

This enhances, even more, the sustainability question and issue regarding medication waste. It cannot be seen just from the perspective if there is indeed a waste or unnecessary spillage. Of course, not using a resource as important and in part of the world scares such as medications to their full potential is a big concern, but the sustainability question does not stop there. The correct disposal of those medications is just as important in this case, due to all the harm that could be done to the environment via those medications.

Apart from the medications being harmful due to their own nature and chemical composition, the way of inserting them adds to the whole sustainability issue. All those medications are being delivered to the patient via syringes most of the time of 60ml. Those syringes are made from very hard plastic. Due to the nature of the liquids, they contained (the medications themselves) and of course because they had been in contact with patients those plastic syringes are not deemed safe to be recycled. Therefore, adding to the complexity of this whole issue. The only “safe” way to be destroyed is to be incinerated at a special temperature and treated as another type of biohazard waste.

Extracts and graphs based on the database and collection clearly show and illustrate the problem. On the first graph found it can be seen how big part of all the medications being prescribed during the period of those five weeks is. Just seeing this already indicates and confirms that there is a problem.

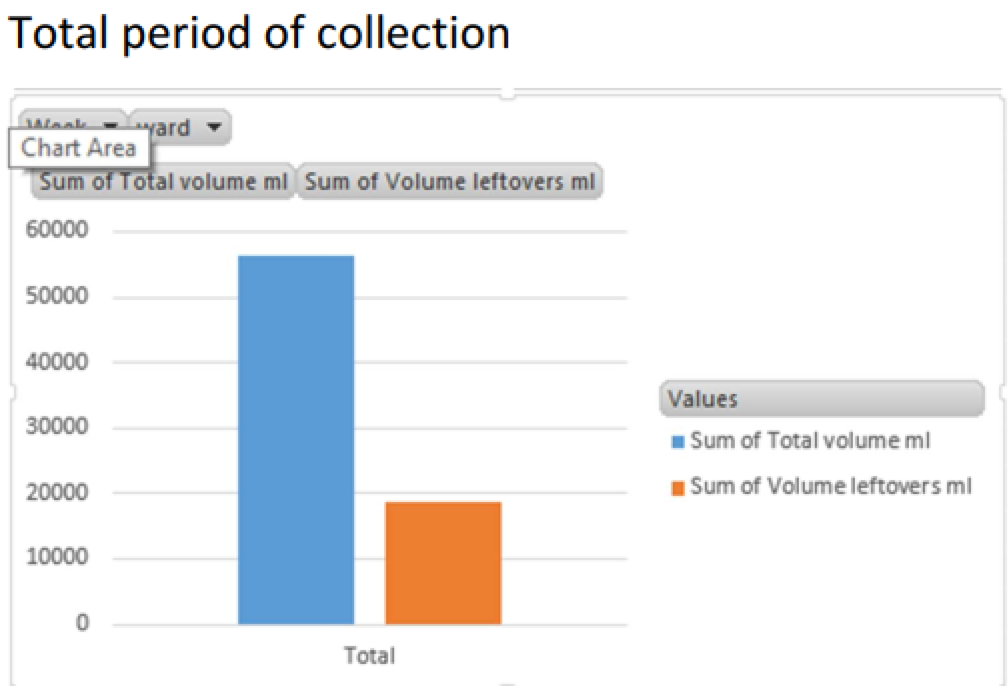


Figure 5: Graph showing the comparison of the total volume of prescribed medications vs. the total volume of discarded medications. (Source author database)

Even though due to the course of collecting it has been visible that there is a problem with the discarded medications, after collecting all the data and sorting through it the numbers were speaking of themselves.

The numbers were different for each week, depending on the number of patients currently in the two ICU units. However, a certain trend remained the same.

For example, in week one the samples were collected from 45 patients, while in week five they were collected from 41 patients. However, the total number of syringes collected in week one amounts to 292, while for week 5 only to 162. Week two on another side was by far the busiest week for collecting when over 381 syringes were collected from a total of 42 patients. There are slight differences, but also many similarities. To make a distinction between unique patients can give specific insights on the wastage for specific medicines; the distinction does not contribute towards answering the research questions of this paper

Some of the differences may be contributed to the different states of the patients during those weeks – for example, change in conditions requiring more or fewer medications, rotation of patients but of course also human errors. The nurses have not been under observation when they discard the syringes and make the change of the medications, therefore, it is difficult to say if every discarded medication has been put in the collection bin for counting, or if there is also a loss of some because of them being discarded in the normal waste bin. Those differences also illustrate the dynamics of the ICU environment. Of course, in such a place it is not realistic to expect or think of static numbers that don't change. Patients are going in and out of there every day, sometimes within hours. To be able to illustrate and understand that the interviews that were conducted with some of the nurses helped a lot and it will be discussed further later in this chapter.

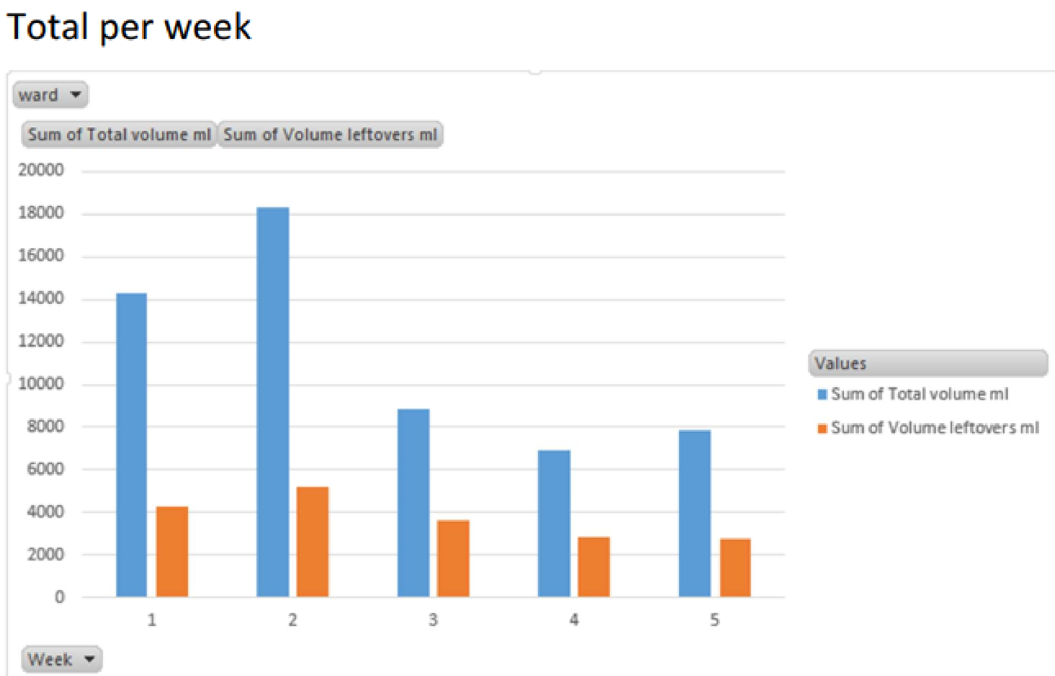


Figure 6: Graph showing the comparison of the total volume of prescribed medications vs. the total volume of discarded medications for each week of the conducted research. (Source author database)

Even if there might be some undetermined data losses, this does not mean that the results are useless, since there is a certain stability in the collected numbers. The sample pool was big enough to not be rendered useless even if there are some unknown losses.

If we think logically, we could be tricked to think that fewer data weeks, may also mean less wastage. However, the correlation between the number of collected syringes and the amount of the wasted medications shows that in the week where fewer samples were collected the number of wasted medications was the same or even increased. That also hints already that the losses do not only come from just preparing too many medications that were not needed or that more medications are wasted when there are more patients.

In weeks one and two when we had respectively the most collected syringes – 292 for week one and 381 for week two the total volume of waste medications varied between 25% and 28% of the total volume of prescribed medications for the collected syringes. In weeks three, four and five when the average collection per week was lower varying between 200 and 160 the percentage of the wasted medications rose to 40% of the total volume of prescribed medications.

This indicates clearly, that even though there might be periods in the ICU when fewer medications are needed, used and prescribed for various reasons this does not decrease the number of medications that have been unused to their full potential.

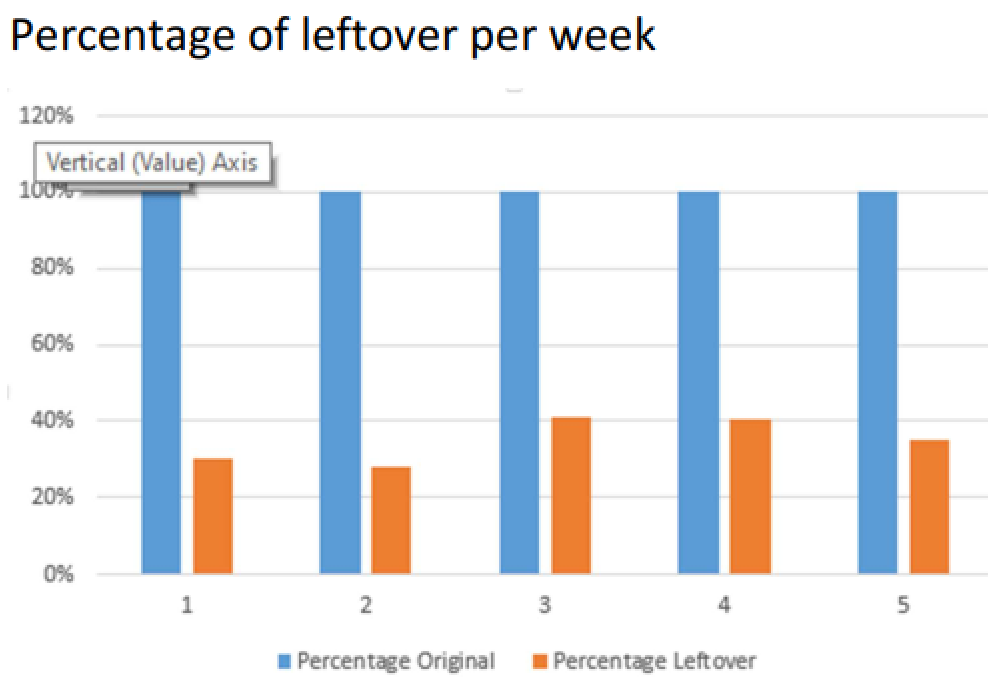


Figure 7: Graph showing the percentage of leftover medications per week (Source: Author)

As touched upon earlier the collection process was helpful also to show some of the most used medications on the ICU floor, which have the potential to be harmful to the environment.

Some of the most present medications/solutions were NaCl, Insulin, glucose and propofol. As we can see this that is a variety of different solutions. Some seemingly harmless such as the NaCl versus some with more harmful potential such as the propofol, but none the less they do contribute to the general problem. And when the case with the propofol requires more special attention, the issue with the harmless NaCl needs to be touched upon at least. When NaCl itself is not dangerous or that expensive, the added wasted amounts over time is a concern for pollution even if simply due to the number of plastic syringes that need to be discarded due to that. The wastage of plastics is an interesting topic for durability research, but not part of this paper.

However, one of them being the propofol deserves a closer look due to its heavy chemical nature.

4.1.1 Propofol

As mentioned earlier some of the other things that became visible due to the data are the types of some specific medications, which were more present than some others. An example of one of the most discarded and wasted medications is the sedative propofol. Due to its structure, the medication has a very short expiration time after being opened and prepared in the syringe for the patient (10-12h due to the danger of bacterial growth).

Propofol is a sedative with the chemical name 2, 6-Bis (1-methylethyl) phenol and molecular formula $C_{12}H_{18}O$, very harmful for the environment. It is also on the list of the world health organization for essential medicines (EML). Propofol is an intravenous anaesthetic agent used for induction and maintenance of general anaesthesia. IV administration of propofol is used to induce unconsciousness after which anaesthesia may be maintained using a combination of medications (Drugbank.com). A study conducted by Russell F. Mankes back in 2012 in Anaesthesia & Analgetica highlights some of the issues with wasted syringes of this exact medication. Some of the dangers of it lie in the fact that it is very toxic to aquatic life and may cause long-term side effects in the aquatic environment. The drug also has high mobility in soil, high potential for bioaccumulation and is not biodegradable in water or under anaerobic conditions. (Mankes, 2012). More about the ecotoxicity of propofol can be found in the figure below. The study conducted by Mankes although having a different aim than this one had a focus to determine how much of the wasted medications in the operating rooms are contributed by anaesthesia. The result was that more than 45% of the collected medications from eight operating rooms for a year were due to propofol.

Table 1. Properties and Amounts of Drugs Bedside Wasted at a Surgical Care Center

Generic name	PBT	Environmental risk	Ecotoxicity
Propofol	6	Low	Very toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment. LC50 Bluegill Sunfish 96 hr, 0.62 mg/L. Propofol has a high potential for bioaccumulation and high mobility in the soil. No evidence for biodegradability in water. Not biodegradable under anerobic conditions. For complete destruction of Diprivan(R), incineration >1,000°C for at least 2 sec required.
Lidocaine	3	Insignificant	Low toxicity to aquatic organisms. EC50 green algae 72 h 780 mg/L, EC50 Daphnia magna 48 h 112 mg/L, LC50 Zebra Fish 96 h 106 mg/L, EC50 (microtox test) 15 min >1,000 mg/L. Not readily biodegradable, has low potential for bioaccumulation. Disposal of waste material via high-temperature incineration is recommended.
Succinylcholine	ND	Not rated	ND
Bupivacaine	5	Cannot be excluded	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. EC50 (microtox test) 15 min >1,000 mg/L. EC50 Daphnia magna 48 h 39 mg/L. No observed effect concentration Daphnia magna 48 h 7.5 mg/L. Not readily biodegradable. Disposal of waste material via high-temperature incineration is recommended.
Ephedrine	3	Not rated	Readily biodegradable (according to OECD criteria). Acute and prolonged toxicity to fish: golden orfe/LC50 (96 h): approx. 460 mg/L. Acute toxicity to aquatic invertebrates:

PBT = persistance, bioaccumulation, and toxicity; ND = not determined, no data available. Y = yes, N = no. OECD = Organisation for Economic Co-operation and Development.

The column "PBT" recounts rankings (0–9, where 9 is worst) that express the inherent environmentally damaging characteristics of the substance. Persistence is the ability to resist degradation in the aquatic environment; bioaccumulation is the accumulation of pharmaceuticals in adipose tissue of aquatic organisms; and toxicity is the potential to poison aquatic organisms. Each of these characteristics is assigned a numerical value from 0 to 3. The total of these 3 values constitutes the PBT index for the substance (http://www.janusinfo.se/v/About-the-environment-and-pharmaceuticals/About-classification//?id=9933).

The data presented in the column marked "Risk" is also derived from the Stockholm County Council (http://www.janusinfo.se/v/About-the-environment-and-pharmaceuticals/About-classification//?id=9933). Environmental risk is based on the ratio between the predicted environmental concentration of a substance (PEC) and the highest concentration of the substance that does not have a harmful effect in the environment (PNEC). Risk is defined as insignificant if PEC/PNEC <0.1; low if PEC/PNEC 0.1–1; moderate if PEC/PNEC 1–10; and high if PEC/PNEC >10.

Column headed "Ecotoxicity" contains data derived from the Material Safety Data Sheets (MSDS), prepared by the manufacturer (Astra-Zeneca). Diprivan® (propofol) MSDS, Astra-Zeneca, 2006; Propofol MSDS United States Pharmacopeial Convention, 2006; West-Ward Epinephrine Injectable MSDS, West-Ward Injectables, 2011; Bupivacaine Hydrochloride Monohydrate MSDS, Astra-Zeneca, 2005; Xylocaine® Solutions with Epinephrine (lidocaine/epinephrine) MSDS, Astra-Zeneca, 2009; 2% Xylocaine® Viscous Solution (lidocaine) MSDS, Astra-Zeneca, 2010; (−)Ephedrine Sulfate Powder MSDS, BASF Canada, 2006; Epinephrine Safety data sheet according to Regulation (EC) No 1907/2006 (MSDS), Boehringer Ingelheim, 2008; Hospira Atracurium Besylate Injection MSDS, Hospira, 2011; Proparacaine HCl MSDS According to 91/155 EEC, Siegfried, 2010.

Figure 8: Propofol Wastage in Anaesthesia (Source: Mankes, R..; Anaesthesia & Analgesia114(5):1091-1092, May 2012. doi: 10.1213/ANE.0b013e31824ea491)

Important to know is that the breakdown of propofol leads to the formation of phenol, which is classified as ‘2’ on a list ranking from 0 to 3 (0: no environmental damage, 3: the highest environmental damage). That means that there is an environmental impact of total intravenous anaesthesia with propofol (Marx, 1999).

The samples from this research also show that propofol is one of the medicaments that appear most often in the collection pool.

Looking through the graphs we can easily see that the amount of wasted propofol is in sync with the number of wasted medications overall. The trend is the same. In week one 25% of the propofol being prescribed based on the collected syringes was thrown out, while in weeks three and four it reaches above 40% of the total volume of propofol that has been prescribed. During the collection and the sorting of the syringes, propofol was also the first one to make an impression. The colour and texture of the medicament make it very easy to recognize straight away (It has a milky white colour and texture).

Figure 9: Graphs showing the amounts of propofol being collected and the percentages of discarded propofol (Source: Author)

For the five weeks, a total of 8750 millilitres of propofol has been prescribed based on the collected syringes and the description of their contents from their labels. More than 2385 millilitres were the propofol found in the syringes after being discarded.

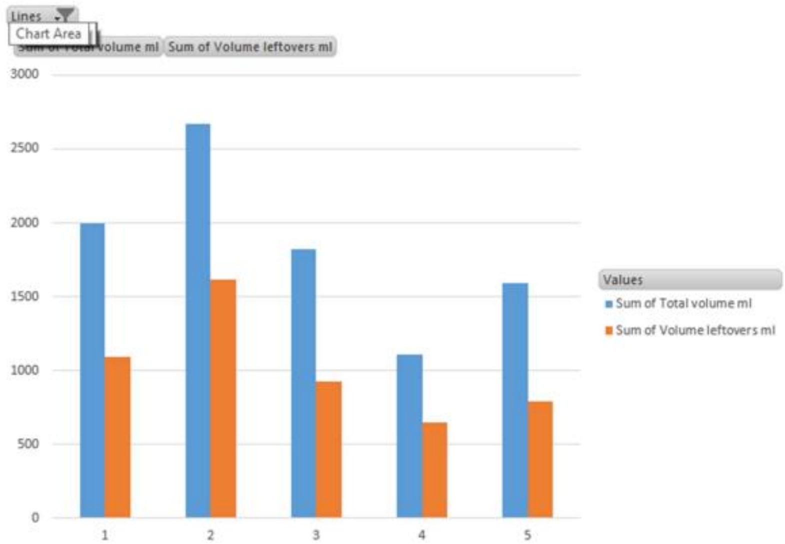
Figure 10: Picture of a syringe full with propofol, which has been discarded. (Source: Author)

4.1.2. Lines

Another finding that the collected data was able to outline were some of the moments when most medications were being wasted. Each 96h the lines of the perfusion systems are changed (HIP internal regulation). This is a process when all the lines from all the syringes connected with a patient from the perfusion systems are being replaced. It is a process that takes a lot of time for the nurses. Between an hour and an hour and a half (Interviews №1:8). It is done to prevent line sepsis – an infection. For that, the nurses can not only change the line and attach the same syringe, but it is also necessary that they change everything. Attaching an old syringe, even if it is full to a new line is something that absolutely cannot and should not be done to prevent sepsis. This is controlled by regulations and procedures. When such syringes were discarded it was very easy for them to be identified due to having the lines still connected to them. As mentioned above it is a time-demanding task and when discarding, no more time is wasted to detach the syringes from the lines. That makes it very visible and easy to determine the reason why those syringes have been discarded.

Lines

Totals



Percentage

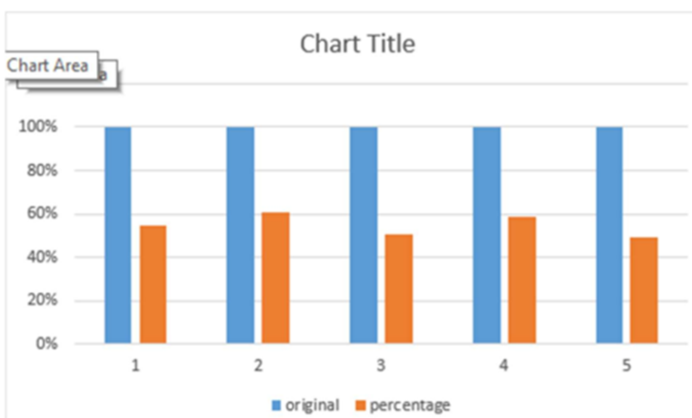


Figure 11: Graphs showing the total and % volume of leftovers vs the volume of leftovers in syringes with lines (Source: Author)

As can be seen from figure №11 above, a very big part of the leftovers that we can account for is due to line change procedures in correlation with the total volume of leftover medications. In some weeks it reaches and exceeds half of the total volume of leftovers collected for the whole week. Therefore, making it a heavily contributing factor in the medication waste that was being observed.

This observation about the lines and the propofol already early in week one and two even with a naked eye required that a question concerning this exact moment in the process of the perfusion medication to be included in the interviews with the nurses, which were to be conducted in the later stage of the research.

4.2. Interview's analysis

The whole interview guide can be found in Appendix №2 and full transcripts of all conducted interviews are provided in a separate file (see appendix №4), which will be used to give clarifications and help to perform this analysis.

Even though the interviews were structured based on an interview guide, in the process of conducting the interviews this guide was slightly changed or adapted depending on the flow of the current conversation.

To gain a general understanding of how one working shift does look like there was a question asking this. Due to the similar nature of the work, the responses to this question were quite similar, allowing us to see it in a broad picture. From the conducted interviews, it was understood that in general the shift starts with a briefing of the patients from the previous shift, proceeded with going on the ward and looking after the patients, reading their files and taking vital signs. Each nurse has one or two patients per shift. The vital signs are being checked once every two hours and of course executing the plan for that patient for that day, which also includes following and changing the medications, etc. (Interviews №1:8). It is a dynamic working environment; therefore, it is not always possible to schedule how the working day will look like. There can always be changes due to unexpected circumstances therefore it requires flexibility and adjustments "on the go".

This first question and the answers to it can already give a slight idea of how much time is valued in this working environment. And we can determine that time is one of the factors that influence or change the work placed behaviour of the nurses to a certain extent.

The more we look at the interviews and some of the questions and the answers to them, time always seem to be a common concern in all of them.

For many questions such as "where do you discard the wasted medications", the answers were also always connected with time. Coming down to the point that if it is not too busy there will be time to throw it out in the proper bin, but if it is too busy that will not be the case and they will discard them in the normal trash (Interviews №1, 3, 4).

As with anything else in the hospital, there is a guide that describes, which sort of waste how and where should be discarded. Most of the nurses admit being familiar with it, but also said that they had looked through it at the start of their careers at the ICU and that it is not something that they review or look if there was a slight change. Since that guide has differences in how syringes with or without content should be treated it rises even more questions, such as what is considered "with or without content". It is obvious that a syringe full or half-full is thought of to be with content, but what is considered a syringe with just five, ten or fifteen millilitres left. When being asked about this the nurses gave different responses. (Interviews №1, 3, 6, 7). Some of them were straight forward admitting that for them the five or ten millilitres is not content, it doesn't look a lot, so they consider those syringes empty when they discard them, and they do not discard those syringes in the special bin for hazardous materials (Interviews №3). Others reluctantly admitted that it is a grey area, where perhaps it is more correct to be considered that these are syringes with content, but that most of the time they do not think about it and also discard them in the normal trash. The reasoning behind was always "It is faster and easier and saves time". (Interviews №1, 3, 5)

Since from the data collection the line changing procedure was easily spotted to contribute towards many of the wasted medications, the nurses were also asked about it and what exactly it entails.

They were asked to describe the whole procedure briefly (for more information see Interviews, transcripts) in order to give a general idea of it.

Based on the information provided by them it can be determined and confirmed that it is a necessary, unavoidable procedure, which adheres to certain guidelines. It is fact that they are obliged to change the lines of each patient once every 96hours. This comes from an internal regulation (HIP regulation) and is done to prevent line sepsis (Interviews №1:8). While at the beginning it was thought that this is the rule for the whole hospital while conducting the interviews and with some explanations from the nurses it became clear that this is the rule for the ICU and that other departments have different periods which they follow for line changes. The patients in the ICU being some of the most fragile ones and often in critical conditions have determined this shorter time for changes of the lines in the ICU necessary. Also, from the interviews became clear how time and concentration consuming this procedure is, and that some preparation for it is necessary in advance. For example, a nurse cannot start changing the lines of the patient if the new syringes that are going to be connected after are not prepared. They have to be ready, so the transition is smooth and there is no waiting time (Interviews №1:8). This opened another question and indeed how much in advance, and how many medications are being prepared.

The preparation in advance of syringes has been a very confusing and controversial topic. Being very situation-dependent it is not easy to be unified. Yes, in some cases and the line change specifically it is necessary to have everything prepared and on hand, in other times however it seemed that things are being prepared very early, with a big risk that when it is time to change them, that they might no longer be necessary. For example, if there was a change in patient condition, or there has been a visitation from a doctor and the medications were stopped altogether or being changed. The nurses were asked to elaborate on this process to make it easier to understand.

While some nurses originally have said that they start each shift by preparing the medications for the whole shift, it was difficult to find the exact reason why. Is it based on a rule or guideline, or is it due to habits and convenience? This question was difficult to be determined for a long time, after carefully searching through multiple sources. Some of the nurses were saying that it is necessary to have the medications for eight hours in advance, others for four. Some were saying that it is a regulation, others that is more of a matter of personal organization for the working day (Interviews №1, 2, 5, 6, 7) After a lot of reading and looking if such regulation existed to understand what exactly the case is, such one was not found. So, it could only be determined that it is a matter of personal preference and preparation for the working day. It is to a deep extent a habit, which dictates part of the behaviour connected with the working environment.

Time and time management were often talked about with concern that due to the dynamics on the floor, sometimes there simply is not enough time.

However, a certain controversy appears when looked at their responses. A lot of them mention that if the care for the patient is priority number one, then having enough time is the next most important thing. When being asked however if they feel that, they have a certain flexibility and freedom in organizing their own working day the majority answers positively (Interviews №1:8). However, they also mention that sometimes it is hard to plan for a day at the ICU, all the different dynamics happening can make a day unpredictable and that for example often medications are prepared in advance when they have felt like they have free time, even if it was too early.

Why is it such an issue however if a medication is prepared too early? Well, the answers to this question are several again. On the one hand, the already mentioned change that may be needed in due course of the treatment of the patient. On another, because when those medications are already prepared, they are labelled with the patient's information, and then put aside in a special drawer in their room to wait for the time of change. Once they are in that drawer even if they never get to be used on that specific patient they would have been in contact with the patient's environment and cannot be used for another patient that needs the same medications for example. So they can only be thrown away. (Interviews №1:8)

The speed at which each medication is given also determines how often it will need to be changed, therefore medications running at a higher speed per hour such as propofol for example are more likely to be needed to be prepared more often and in bigger quantities in advance. That to a certain extent can also contribute to the big amounts of propofol wasted as could be read above. Besides that, the packages in which it comes, together with the very short expiration period after opening due to the possibility of bacterial growth, contributes towards this wastage. Currently was explained that the nurses at the ICU work with propofol bottles of 120ml. Once such a bottle is open, it needs to be used in no longer than 12h. So that also determines to a certain extent how much of it the nurses prepare.

The medication preparation process is also another activity that requires time from the nurses and concentration because mistakes are unacceptable. Each prepared syringe is double-checked by two nurses to make sure that the concentrations and quantities are correct with the prescription from the doctor for this patient. Due to that, a lot of them mention that they often choose to do it when it is quiet on the floor, in order to avoid mistakes and when they find the time. From the answers often can be seen that time is something that dictates and leads their behaviour on the floor. The fear of lack of time is also something that can be perceived from the conducted interviews as well.

Early preparation is however not always due to concern for time later in the day. In many cases nurses say that before they end a shift, they look through what might need to be changed soon from the next shift and that they prepare it to be collegial and to lighten the load for the shift coming in. With the lines' procedure, which is always done during the day it is often the night shift that has prepared the medications. It was also mentioned several times from different sources that if they see that only 1h hour is left on a syringe before their shift ends, they will change it, for the colleagues not to worry about it in the first hour of their shift when they are getting briefed for the day. However, if that is the night shift and the next morning shift has line change, often such change in advance is unnecessary and wasteful because the contents from the original syringe would have been enough until the lines and everything is changed again from the morning shift.

That triggered the question are the nurses from the previous shift aware that there will be line change in the next shift so they can take it into account. It was understood that the computer system Epic does give a notification that a line change is needed six hours in advance and later on the screen of the shift that needs to do the procedures. Many of the nurses said that the pop-up is often unnoticed. Some of them shared an opinion that more often pop-ups to alert might be helpful if they appear also in different intervals. Others however argued that this would not help with the preparation and considering it more than it is now and that is a matter of culture. They argued that if a person is interested to take this into account they will, like some of them are already doing and will look for it, while if they are not more pop-ups will not be helpful, but rather annoying since there are already many alarms and sounds going on at the floor. This question was meant to explore if a technical solution might help the way the line changes are handled on the ICU floor and will be further touched upon in the discussions section of this paper.

The interviews also aimed to understand the general idea towards sustainability in the mindset of the nurses. Therefore, such questions were asked. In general, most of the interviewed nurses shared the idea that sustainability is important in general and shared some of the sustainable things they practice in their everyday life – such as recycling and separating their home waste, using solar power, preferring to cycle rather than drive a car as a method of transportation. Some of the mentioned attempting to eat less meat. Overall different examples of activity showing certain respect towards sustainability and care for the environment (Interviews №1:8). However, when asked if sustainability has a place in their work environment the answers were different. Some were certain that it does and that as a team they can and need to do more in that direction (Interviews №1, 2, 4, 5, 7). Others said that priorities of intensive care are different, and sustainability is most likely not a high concern as long as the primary goal of saving patients and giving them the best care is met (Interviews №3, 6). In a way, this can show some cognitive dissonance, with having inconsistent thoughts for the same behaviour in different fields. While paying attention to sustainability at home, when there is no pressure and constraints was always present in the answers and concerns for the environment were expressed in general, when the question was brought down to the work-based environment there was a certain contradiction, due to all other factors and constraints on that behaviour.

Then there were questions concerning the medication waste and again answers varied. When asked if they have noticed such medication waste some of them answered determined that they have and expressed unhappiness about it, while others said that it is not something they pay attention to. When informed of the volume of the medications there was a general surprise observed in both groups that it is so high. Even the ones that were aware of the problem shared they did not imagine it being so high. (Interviews №1:8)

To see what drives them when it comes to that issue, they were asked which aspect of that waste is the one that bothers them the most. The answers to this question had a very different nature. The interviewed floor managers shared the joint opinion that in the first place is the financial resources being wasted bothers them, while the nurses who practice on the floor had different perspectives (Interviews №4,8). Some of them said it is the fact that these medications are perfectly good to be used to other patients that need them, others had concerns for all the unnecessary garbage they create and all the plastic, while finances were low on their list of concerns. This clearly also outlined the different perspectives between the functions of the different nurses. The floor managers are in charge of organizing everything and everyone on the floor they are responsible for, they are in charge of ordering the supplies and making sure, everything needed is in stock. Most importantly, they also know what costs how much. While the nurses, who only work on the floor with the patients shift their focus towards having what they need for that exact patient for that day. They have everything they need on the floor provided for them, therefore most of them admitted that the prices of the medications are not something they look up as long as the medications they need are available for them. However, there were also some who said that even if it is not necessary for them to know, they pay attention to that out of personal interest and incentive, so they are aware of the prices of the medications (Interview №7).

Even though at first sight it is perceived that the routine around the floor is the same for all nurses, from the interviews could be understood that personality and personal drive matter and contributes towards different acts in the same work based behaviour specific for the individual. It is often shown from the answers that if a nurse has the realisation on a personal level that there is a waste of medications, they already have taken some action to correct their own behaviour. For example in interview №7 the nurse admits that they indeed know the prices of the medications, due to personal interest. They follow what is used and what is not used and always try to consider if the medication that they prepare will be needed and used later and that is something that guides them in their own decision-making process and time management of their shift.

4.3. Behavioural interactions and the Integrated behavioural model at play.

All of this allows us to look a bit more closely and start connecting some of the information acquired towards the Integrated behavioural model discussed in the literature and theoretical framework chapter.

This research as mentioned several times aims to look at the drivers for the behaviour of the nurses connected with the medication waste and look at predispositions.

4.3.1. Other Factors

It is important first to mention the “other” factors. What this research takes as other factors in the scope of the IBM was mentioned already in chapter 2. However, a brief reminder is needed that in the case of this research we take “other” factors and “environmental constraints” under one umbrella, due to the overlap of the two in this particular environment. What is meant by that term are often factors which are seemingly on the outside to relate to that behaviour but give it limitations to a certain extent. On another side, those “other” factors can be divided as mentioned in chapter two earlier into “soft” and “hard” depending on the room they give or not for changes.

On one side, there are all types of “other”, external factors - such as time, finances, laws and regulations, personal preferences etc. All of them can influence a behaviour in a certain way. Some of them could be bypassed and others cannot.

In this case, the economic factor is a “soft” one. Hospitals work with budgets, there is a certain budget for different things with different priorities. Even though medication is wasted, doing some optimization to change the system might not be possible because of those set budgets, while the budget for medications is not harmed, even with the spillage. However, with having more awareness, and creating less medication waste, the budget will benefit as well and may present opportunities for implementing other improvements.

Other factors are also the guidelines, protocols and regulations. Most of the procedures in the hospitals follow certain in-house protocols. There are also outside regulations from higher places, which are there for safety. For example, the changing of the lines procedure follows the hospital infections and prevention team guideline for the 96 hours change in the Intensive Care Units. (HIP richtlijnen). In that case, we can see that not a lot can be done differently by the nurses but indeed to change the lines and all syringes connected with them once every 96 hours. That is a “hard” factor that cannot easily be altered.

However, that limitation doesn’t have any impact on the decision of how long in advance they should prepare the medications.

In this chapter we aim to further adapt the “customised” Integrated behavioural model found at the end of chapter 2, enhancing it with the empirical findings from this research and trying to structure those findings in the “boxes” of the model. In that way, it is easier to highlights the drives and the priorities when it comes to the task of changing the perfusion medications in the ICU.

4.3.2. Attitudes

In the case of this research project, we are looking into the behaviour that is connected with medication waste. For that, we can say that attitude could be the response towards that behaviour. Are the nurses even noticing that there is such a problem, if so, what are they doing to improve or even what can they do to improve when following under procedure protocols and other restraints.

As we can already see patient safety and comfort is a big concern that is always considered when executing that behaviour. It is one of the factors that cannot be skipped in any circumstances, so it can be seen also as a “hard” factor. Even though to a big extend it is perceived as a feeling contributing towards the attitude of the behaviour; it is a constant ever-present one. It is a fundamental thing in the ICU environment that comes above everything else on the priority ladder.

This model also shows that a behaviour is not a straight-line process, but it is rather a web. A never-ending intertwined web of multiple threads, which can overlap and entangle with each other.

On another side, we have attitudes that are very important in the execution of a certain behaviour. However, the attitudes have some determinants of their own. Those determinants often can be described as feelings. Feelings, which are deeply embedded to an extent they are a type of conditioning. However, there are also other more “free” feelings, feelings of the individual, which can be the ones encouraging/wanting/creating, a direction for change.

The feeling of concern for wastefulness and unsustainability in the work-based environment is something else entirely. It is not a constant feeling, that is present all the time or in every employee doing that task as we also can see from the interviews. Some of the personnel would have seen it and realise it, while others might be oblivious towards it and not been even able to see that there is a problem as we also already saw from the interviews. Since it is not something that obstructs their primary task of changing the medications and giving good care for the patient. It is a drive, however, that can be contributing towards a change in that behaviour, first on an individual level and slowly spreading further creating a cultural change on a communal level. Such changes however automatically receive the original limitations of the behaviour. Even though patient safety and comfort are the two pillars of “hard factors” as mentioned above, there are some of the “other factors” connected directly with them that can be looked at as “hard” as well, therefore showing another entanglement and overlap in this situation. When there is a “hard” factor that determines the well-being of human lives, changes in the whole process can never be radical or compromising the primary objective in any way. Therefore, we have the “other factors” mentioned above inhibiting and restraining the changes to keep the “order” such as regulations, protocols and guidelines. Those can be considered as “hard” also since they are there in order to assure the success of patient safety. They cannot be easily altered for other reasons different than looking after that safety. To what extent they do restrict and is there room at all for changes can be understood a lot from the interviews conducted with some of the nurses on the ICU floor. Even though such guidelines are there for reasons and cannot be ignored or disregarded it was seen that they do not completely restrict all behaviour and some actions even small can be altered in order to bring even a little positive step towards change.

Then of course there is the ease of operating in an established routine. Even though there is a difference between the exact routines of the nurses since as seen from interviews for some points they are quite free to make choices, a big part of the changing of the medications is indeed a routine with certain steps. Due to the repetitive execution, it is something that has turned to autopilot. Changes in that routine even small ones such as walking few extra steps to dispose of the medications in the biohazard bin can be a challenge in the start because it will require certain paying attention to at the start and interrupting the autopilot of that embedded routine. Collecting syringes in a special collection bin for the purpose of this research was relatively smoothly added to this routine. Indicating that change can be initiated.

Another strong feeling that could be derived from the interviews and from the observation is not surprising – again the fear of lack of time in a future moment. Having extra time is preferred more than anything else by the nurses. Therefore, even spending 30 extra seconds to make those few steps can be frowned upon by some of them.

Most of the factors mentioned above can be considered as feelings towards that behaviour it is the personal desires or no desires towards certain activity.

Personal feelings towards something however are not the only ones that can influence a behaviour. If we look back to the IBM model, we can see how important feelings are in shaping said behaviour. The model alone shows how everything is linked and a lot of those feelings are under the arrows of connecting the different constructs.

4.3.3. Normative beliefs.

Normative beliefs also can play a big role in not only the predisposition but also towards the execution of certain actions. For example, being nice and collegial towards the next shift by preparing the medications for them in advance. It is a social occurrence that is not only driven by altruism but by peer pressure as well. No one wants to be considered a bad colleague and everyone wants to make and leave a good impression for their co-workers. That can be categorized in this case towards the normative beliefs connected with the behaviour. While on the surface seems unimportant or not connected enough towards the medication wastage problem it is influencing to a certain degree. As seen from the numbers a lot of that medication wastage can be contributed to the overall amount due to the line changing procedure. And often when full syringes were found without any lines but brand new, when asked for the most likely reason the nurses answered similar – preparing too much in advance. Which on one hand could be enhanced by the time and time-saving factor and on the other the another of being collegial, which follows some unwritten rules of society and ethics. It is an unwritten silent norm.

Since the procedures follow certain protocols doing things exactly by the book is another normative belief that can be applied towards the model for this behaviour. There is a certain amount of perceived safety in always doing things the same way and comfort in routine.

The added guidelines and regulations such as HIP and WIP are yet contributors towards another type of belief that does not depend on the individual's control, will or feelings towards how they want to ideally see things done, or be able to execute certain behaviour. The regulations are seen as a rule, and as such, they are to be followed. However, the beliefs connected with those rules is the understood necessity that you need to follow them. Such beliefs for the purpose of this research and model we can classify as control beliefs. They are there to keep things in check and provide safety. They cannot be altered like for example the 96h interval change. That is an established rule, and the nurses cannot avoid it.

Perceived norms and control beliefs are two different sections of the IBM model, which however we will also group together under one umbrella due to the similarities which surround them. Perceived norms together with the control beliefs are sections of the model that are surrounded by "hard" constraints. From all the gathered data the expectation of all the patients having all the medications that they need is what matters. Such expectation can be categorized as a perceived norm. This is an objective that needs to be met and does not depends on the nurses' feelings towards the medication spillage. It is something that they need to deliver, therefore it is not surprising that it can be looked at as a perceived norm.

4.3.4. Personal Agency

To make the whole web even more intertwined and complicated it is also necessary to peek towards the personal agency. When asked if they feel they have control over their working day and its organization most of the nurses who were interviewed agreed that to certain extents they do have some freedom and control how to organize their working day. The controversial issue of when exactly should be prepared the syringes in advance confirms that. Many choose to do it at the beginning of the day to "check it off the list", others as mentioned earlier share that they do try to prepare when they see that soon it will be necessary rather than doing it way too in advance and risking having to throw medications out. This is an illustration of the perceived control they have of their working life. However, another side of it is that they are restricted to follow certain procedures and protocols where they do not have a lot of "wiggle" room to make changes. It can be looked at as loop following again in the category of controversial statements and findings in this research making the whole web even more twisted and intertwined. Often when controversy is concerning changes of behaviour, which are difficult, to begin with, are made even harder, because one can always be used to excuse the other.

There is a third group of beliefs as well that can influence the behaviour – efficacy beliefs. For example, some of the nurses were observed to take initiative in their own hands and perform changes that were not restricted by any of the rules or regulations (Interview №1, 2, 5, 7). Many of the interviewed admitted to trying to manage their time better and think more in advance and perspective when they prepare the medications if they really will need everything made in advance and adjust the amounts they are preparing. Many shared the general belief that two hours in advance is a reasonable time to have everything set and ready and that earlier was unnecessary, agreeing that it is a big contributively factor towards the medication spillage. However, this thought is not shared by everyone or such efforts made by every nurse on the floor (Interview №1,2,5,7). As with any drive, this is a choice, and a choice is not always accepted or even thought of by everyone. As mentioned earlier for another group following the book and not having to think too much while executing a routine is something rooted and valued as well.

However, such efficacy beliefs and the controversy they show are often the first small drives towards change. In this case, questions about it split the group in two during the interviews. When asked what can be done to influence a lot of people to make such small changes like some of them were doing already a lot of them answered that it is a need for a cultural change. That the mindset of their fellow colleagues needs to shift towards first understanding the issue and then slowly look for ways to correct/improve it. Others while also agreeing that there is indeed a need for a cultural change also expressed reluctance towards changes even small in daily routines admitting that sometimes it is easier to do things the way they always have been done. And thought that it will be a difficult thing to change the perspective overall on the whole floor.

4.3.5. Overview of the IBM regarding findings.

As mentioned in the theoretical chapter attitudes pay big attention towards the execution of any behaviour. In the early days of behaviour research, it was assumed that attitudes are the key to human behaviour (Fishbein & Ajzen, 2010, p. 255). Attitudes like everything else can have different strengths, therefore, giving different predispositions towards certain behaviour.

The need and want to change on an individual level noted amongst some of the interviewed nurses can certainly be seen as a type of attitude towards that behaviour. Perhaps this is a case where attitude is looked at in a general, broader way than in the IBM. They expressed a desire for making a change and being part of it. It is also an acknowledgement of the existence of the problem. Those are both positive intents, showing that there is already a certain awareness created towards the problem and a willingness for change in order to contribute towards "fixing" the problem can be looked at as a positive attitude towards that problem.

Most often exactly such acknowledgement is the first small step in direction of changes being they big or small. Contrary to early research by Fishbein & Ajzen, where it is determined that attitude is important as a driving force behind behavioural changes, it however is only a starting point and change in attitude alone is not enough. There also needs to be an observation of how that change of attitude affects the actions around the behaviour. How the incentive translates towards actions. For example, admitting there is an issue is already a change of attitude, but it can also just stay like that with the admittance. What actions can and will be taken towards changes due to that admittance/realisation of a problem is another topic.

During the observation period, several things were noticed, one however made a very strong impression already from the start and were later confirmed in some of the conducted interviews. That indeed was the need and want to change on an individual level in several people of the personnel, which was instantly followed with the desire to transfer that need/want for change to the collective. If we try to classify this within the IBM boundaries we can easily link this towards the experimental attitudes, which are often the first drives behind initiated changes.

When asked in the interviews what do they think will help the most common answer by far is "more education and cultural changes". There was also certainty in which some of the interviewed nurses believed that their fellow colleagues would want to change once they are more informed on the subject and the impact it does have. Even the nurses who appeared to have more interest in the medication waste and already had done some changes to their own behaviours to prevent or reduce it were all surprised at how much higher the real percentage is. None of them expected results of 40% medication waste per week. This already gives a first glance towards the attitudes and more specifically towards the instrumental attitude of this workspace behaviour. This can be seen as the first of the acknowledgement needed for change.

Aside from the experimental attitude, we can also detect an instrumental attitude of this behaviour and indeed the fight to create new habits. Creating new habits is not an easy task. Habits are usually deeply embedded in people's behaviour and to be changed/altered people have to want that change in the first place. They also have to know and understand why they should be willing to do a change. However, the simple desire that was shown from even part of the personnel for a change, not just at a personal level of what they themselves can do help the change, but also the fact that they were willing to transfer the change on a higher level and influence their colleagues, can be seen as an instrument of that behaviour. It is an action necessary, towards the goal of change. If there is no action taken, the goal cannot be achieved, to begin with.

Those also follow in the boxes in green that can be seen in figure №12 on the next page. They express indeed the salience of the behaviour, the instrumental attitude and the self-efficacy of the personal agency according to the model. As we remember from chapter two motivation is essential in performing any kind of behaviour (Montano & Kasprzyk, 2015). However, apart from that we also saw that four other components can influence behaviour directly and salience of the behaviour is one of them (Becker, 1974). That is the reason why they are highlighted in green since they bring some interesting findings and insight towards the end result. In this case, we did see from some of the interviews that are indeed important for the nurses to reduce the amount of medication that has been wasted, it bothers them and they have noticed that there is a problem.

In an attempt to bring some order into all of the information mentioned above the Integrated Behavioural Model (IBM) from the theoretical chapter was altered to fit the findings and observations and present them more clearly. This model as mentioned earlier can be found on the next page and will be used to draw the final conclusions from this analysis in the discussion part of this chapter and chapter five conclusion. The boxes highlighted in red represent indeed the other factors, environmental constraints together with the "fear of lack of time". They were identified as the major limitations and will be looked at again in chapter five. They are crucial findings for answering the research question.

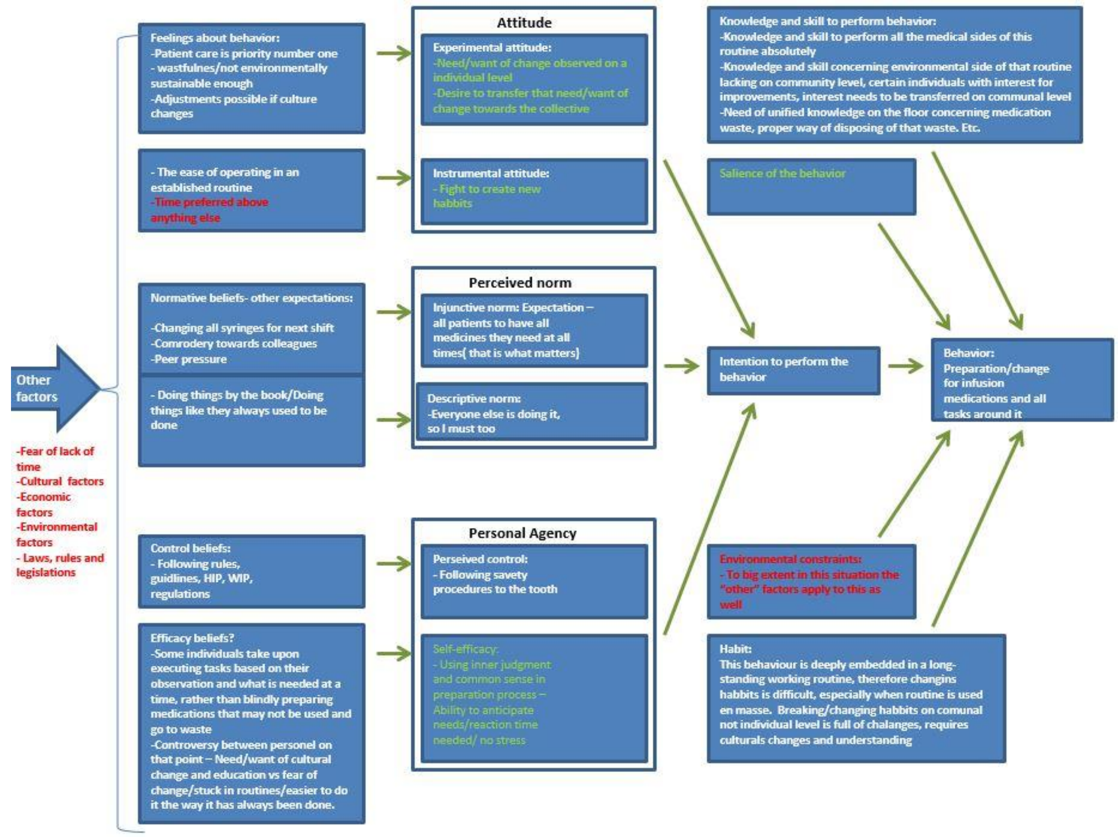


Figure 12: A customised model of "The Integrated Behavioural Model" in line with findings of the research. (Source: Author)

4.4. Discussion

The following discussion is connected closely to the analysis found above. It aims to expand and build on it. It will attempt to raise and highlight some important points while evaluating the practices found and exploring opportunities to change. In essence, it is more a practical discussion but will also relate and reflect on the theoretical literature from chapter two.

As already hinted, a single factor alone never influences the outcome of a certain behaviour. It is not possible to point out and say for example only the time limitation and restrains contribute towards the number of wasted medications. It is an intricate web of interactions between the boxes of the model. This is something making a seemingly straightforward issue very complex in reality. The links between the boxes also create a possibility for an infinite loophole, which often leads to running in circles and on its own prevents easy change.

During the analysis, one of the present and often referred to factors is "time". Time seemed to be a prime concern on the ICU floor both from observations, but also from the conducted interviews. Moreover, what is underlying when it is spoken of time on the ICU floor is not just in general terms as durations – seconds, minutes, hours. The answers outlined something else and that is the "fear of lack of time in a future moment", which can directly be linked to the IMB under feelings to perform a behaviour, which as discussed in chapter two have a direct influence on the attitude towards that behaviour.

Often the unknown of the future, due to the ever-changing dynamics on the ICU floor has given a feeling of a certain pressure to do certain tasks when it is possible to do so (even if that means being unnecessarily early), rather than when it is needed. In the case this research was looking into, indeed the medication waste, this meant that sometimes nurses prepare a lot of medications for the specific patient in advance. Even though it may mean that later when they must be changed, they may not be needed anymore. One could argue that addressing the perception of time and possible future lack of time within that perception should create awareness. This awareness is itself already a trigger that leads to less wastage. This is supported by the observations during the start of the Covid-19 pandemic and acknowledged during the webinars. Where the use of medical equipment drastically decreased due to the awareness of future shortages.

Admittedly, some of the interviewed nurses confessed that they prepare things only two hours in advance because they have experienced that if they do it for longer periods the medications might go to waste. Those nurses already show a certain attitude towards the waste medication issue. They have already an awareness of the issue and show that this is important for them – salience of the behaviour from chapter two. Often, they were the ones who also have admitted that they pay attention to the prices of the medications and are aware that there is indeed unnecessary waste happening. Overall, those are also the nurses, who believe that a change regarding sustainability is possible, but it goes down to culture and understanding from their fellow colleagues. Expressing opinions that awareness is important and are hopeful that more knowledge and education on the subject will help for a positive change. Some of them were already doing changes on a personal level and expressed hope that eventually leading by example will motivate their colleagues to follow them.

Another aspect that was outlined within the analysis was that certain procedures on the hospital grounds and on the ICU floor specific are surrounded by different safety regulations and protocols. The perfusion medications and the line changes are good examples. The regulation says that the lines must be changed once every 96h. (HIP), which represents one of the "hard" factors/environmental constraints shown within the IBM. This is not something that the nurses can avoid; it is a task that must be performed at that certain period. This certain thing around the changes of the medications cannot be changed and must be performed as required, however many other actions surrounding it are not restricted by rules or guidelines, but a matter of personal choice and management of the nurses' daily routine. Again, one could argue that creating awareness will affect the personal choices in time management around the line changes. Discussing the personal choices between the ICU personnel gives insight into motivations. Sharing the personal choices between the ICU personnel creates the conditions in which the personnel can learn from each other. The best practices can be shared, and information is exchanged, which will already reduce wastage as a result.

Actions such as when to decide to prepare the medications for the change are up to the nurse as it turned out. As seen in the analysis it was also one of the most disputed topics in the interviews with this question receiving different answers such as "need to be done at the beginning of the shift"; "four hours in advance"; "two hours in advance". This leads to the cultural factors intertwined in this whole web, however are more in the category of the "soft" other factors, since a change is up to the individual.

Essentially, it is up to the nurses to decide how long in advance they would like to prepare the medications. However, the web of factors surrounding this simple on first look choice makes it not so simple after all. The whole interaction between the time management and the regulations and the cultural aspect of it seemed to have driven most of the nurses into a routine of how they perform that task. In addition, in the end, it comes down to personal comfort, which ensures them having the required medications for change at a later point in time. Making this a specific habit on a personal level is different for all of them, yet also the same.

Another part of the cultural aspect is the confession of being collegial in most of the interviews. Meaning that even if not a written rule it is customary to prepare the medications in advance for the next shift, to give them time at the start to get familiar with the situation on the floor. This however can be looked at more like a perceived norm in the light of the IMB model and follows under normative beliefs and indeed what others expect, what others do. If they do it, I must too.

These actions that are altruistic in nature, are perceived as collegial. The validity of the actions taken is not regularly evaluated. With corresponding wastage due to unawareness as a result.

Even though it is a very nice incentive, there were also many admittances that often when it is time for that change, the medications that are prepared have a big risk of not being needed anymore for various reasons. Such as – doctor's visitation has happened, and medication was stopped or changed; the discharge of a patient and of course for the most unwanted reason the passing away of the patient.

The adapted version of the model at the end of the Analysis section of this chapter attempts to show all the factors found and the connections between them that affect and essentially create this behaviour.

There are also other opinions that even though most of the interviewed nurses agree that cultural change is needed in order to improve sustainability on this matter and work on reducing the number of medications wasted, they also expressed reluctance when suggested that more education is needed coming down to the time argument yet again. The motivation was that the nurses are already very overwhelmed with their day-to-day responsibilities on the ICU floor that requesting more, even if it is a one-time seminar on the subject might be too overwhelming and instead of motivating people might have the opposite effect (Interviews 1,3,8).

There was an observation that even though from certain parts change is wanted and desired when presented with suggestions that might take them away from their comfort zone they seemed to fall back to the time argument and of course the regulations.

It is a web of intertwined main factors – time, regulations, and culture, that none of them can be really separated from one another. Some of them as already explained such as the regulations cannot be influenced to change on an individual level, others such as the cultural factors and the "fear of lack of time" could be influenced on a personal level to a certain extent. However personal change requires motivation and understanding of why it is needed to happen. What is observed right now to a big extent however is rotating in an infinite loop within those factors.

In short, creating an infinite loop which dictates essentially their behaviour when it comes to the process of the medication changes. Answers to the question “Is time management an issue” was controversial once again. Some said yes, some said no, but that it can be optimized. The answers however were not controversial between the participants but also within the same participants sometimes. For example, when asked if they feel they have freedom in their work environment the initial answer was always positive. However, when asked to elaborate a bit more than they could change by themselves if the change required too much effort or more thinking in advance the answer changed again towards the time pressure and limitations they seem to experience. Then there was also the most used fallback to “we need to follow the regulations and procedures”. Therefore, creating that loop of the desire of change to a certain level, realization that the change is needed yet falling back to what is known and comfortable because it has been working well for a long time.
Awareness and explanation of reasoning will help to break the infinite loop. The way this research was conducted underlines the findings of this research. When asking the personnel on the ICU floor to discard the syringes into special collection bins for this research, the change was accepted, and the syringes were collected in the special collection bins. The research question in this paper created the needed awareness, the explanation of the research setup provided the argumentation for the special collection bins.

As we can see, the IMB model is indeed appropriate in applying in this issue and many of the findings do align with the literature explored in chapter two. Even though it is a very widely used tool for different behavioural researchers, it has certain limitations when it comes down to the behaviour that we were exploring in this research. As we mentioned earlier and also saw from the analysis in this case it is very difficult to separate and make a distinction between “other” factors in the model and “environmental constraints” in the model, which lead to grouping them together for the purposes of this research. This helped us understand that huge “web” of factors and interactions, which otherwise would be very confusing since the same things would have appeared several times, under different “boxes” and making the connections even more difficult to follow and understand.

5. Conclusion and recommendations

This last chapter will answer the research questions together with highlighting the findings during the course of the research. This chapter will also look into recommendations for further research.

5.1. Conclusion

The research questions to be answered are:

Which factors shape the individual work-based behaviour of nurses and other medical personnel with regard to medication wastage? To what extent as well as how does this work-based behaviour affect the amount of medication that is being wasted/not used to its full potential?

First, it needs to be said that the research did establish with certainty that medication waste exists as a problem on the floor of the ICU. As mentioned in the analysis chapter an average of 28% to 40 % a week of the medications used in the perfusion systems are not used to their full potential. (Appendix 3).

There are many factors in general that shape human behaviour and this specific case is no exception. However, some always show with higher importance than others do. In our case, the most important factors found that shape the individual work-based behaviour of nurses and other medical personnel are:

- fear of lack of time at a future moment
- Cultural factors (Altruism, Collegial, Normative, Awareness, Reasoning)
- Regulations & Procedural constraints

As seen in 4.4. Discussion they are identified as the bottlenecks preventing change, but also contributing to the issue. They are also strengthening and leaning on each other making it difficult to attempt a change in just one of them.

Looking into to the second part of the research question and indeed:

"*To what extent as well as to how this work-based behaviour affects the amount of medication that has been wasted/not used to its full potential* "

We can answer that several choices made during the process of this work-based behaviour do influence the number of wasted medications.

Choices are made for different reasons as each of the factors outline. However, as seen from the analyses and the discussion those three key factors are interrelated. Being in such entanglement with each other they enhance each other as mentioned in creating that infinite loop, which to some extent is the fall-back towards the comfort of routine. To be acknowledged all of them are contributors to the problem.

Regulatory & Procedural factors. Even though those factors cannot be altered for safety reasons, they, however, can lead to systematic wastage and needs to be mentioned. As can be seen i.e. in the line changes procedure, every 96 hours. In this situation there can be no exception this procedure must be performed every 96h as we saw earlier, the rule is there in order to prevent line sepsis and altering such a rule may add a risk concerning the patient's life. However, it directly adds to the "fear of lack of time" mentality, because as a procedure requires a lot of time. Causing on one hand early preparation of the medications from the nurse doing the line changes to occur more likely. On another, it connects with the too early preparation of medications caused by "being collegial" for the next shift, which in days with line changes as seen from the data results was often obsolete and causes a lot of full syringes to be discarded.

The choice of how long in advance to prepare the medications is an example of an action connected with this process, which can have a big influence on the outcome. Looking at the numbers especially on the days with line changes, we see a spike in the wastage on the days of the line changes. This indicates a systematic wastage. Whereas the personal choice on the time in advance is a more random form of wastage. Both fear of lack of time and the cultural factors such as "being collegial" are walking hand in hand in those situations being enhanced by the regulatory factor that in 96h the lines need to be changed, therefore making the nurses expecting/fearing to have less time for another task at that point. Therefore, yes choices made under those factors do affect the amount of medication that has been wasted. Small things that on their own seem not to make a difference, when added up contribute a substantial amount as can be seen from the analyses.

5.2. Practical opportunities and barriers:

This research can be used to find directions for the solutions on wastage of medicine. For example, rules around the changes of medications cannot be changed, but more emphasis on how much medications and how long in advance to be prepared can be given on a wider scale. This can slowly start breaking the long-rooted habits in some of the nurses not to prepare medications for their whole shift at the start of the day, but to prepare enough for the next two hours since that was the period given as sufficient from some of the interview's nurses but also from one of the floor managers.

Another factor is breaking the peer pressure of being collegial. Although the incentive of caring for your colleagues and ensuring a smooth start for their shift is very nice, this exact preparation of medication in advance has a risk to contribute towards the medications that are being wasted. Perhaps will take more effort from the side of the nurses, but encouragement to check if the next shift must do a "line" check and when exactly it will happen can help with reducing the amount of unnecessarily wasted medications and contribute towards a more sustainable approach on the subject matter. However, that also could be challenging since it does present an extra step in an already automated behaviour, which has turned into a strict routine.

Breaking routines is challenging, not only because that means to change the way of doing something familiar, but also because it means to step outside the comfort zone. Often such routines are executed the same way by the same people for years. They are also often transferred among generations. For example, often when asked why they do something in a certain way the nurses admit that it is because this is how it was always done since they were shown this specific procedure in their first days on the floor. Therefore, there is also a certainty that there is a passing knowledge from the older to the newer.

This is also what makes it difficult to review a routine. With so many nurses on the floor, it will present many challenges to instruct just to change one aspect in some of their routines. To alter something seemingly unimportant in their behaviour and moreover to pay attention to something, that they are used not to because it is not necessary for the execution of their primary task – patient care. It is also a reason for some pushback and running into the infinite loop.

Technical solutions such as the suggested pop-up for the shift before that the next shift will have line change also were met with mixed responses. Some said that such pop-up exists but even if it is made to remind them more often might not be helpful due to creating yet another alarm and causing more stress with noise. Here we see the factor awareness (pop-up is handy) is applicable for some nurses, whilst 'lack of time' (to click the pop-up away) is driving others. Others said that if a person wants to consider this and check if their colleagues have line change, they will do it regardless of the pop-up. Turning back to the cultural aspects of awareness, the desire and willingness of the individual for a change.

So then again it comes down to needing to change the perspectives and point of view of the personnel on a wider level, but without adding more pressure regarding time to them or requesting more from them.
For such changes to happen first, the cultural challenge needs to be dealt with. Leading by example can help, but cannot reach 100% of the audience. For achieving changes and seeing a decrease in the amount of medication wasted it is not enough if five, ten or twenty out of the 130 nurses on the floor see the need to change and alone pay more attention to how much they prepare in advance and what they throw out. Leading by example from all team leaders can help, but it still is necessary to be found the right format to address the whole staff why those changes are needed and what is the issue. If a seminar presentation is thought of to be too overwhelming then perhaps management needs to find a platform for transferring this knowledge and information, which they think that the staff will be the most receptive to. Information sharing on processes, work to be done and improvements in way of working could be part of the already existing daily stand-ups.

Going back to "the fear of lack of time" this research has shown that time, in general, has a very special place in the whole ICU floor. It seems to be the most valued and craved resource, and even the anticipation of having not enough time puts a lot of pressure and pre-determines the actions of the nurses to great extent. Optimizing time management is something that can be worked on in this regard. It can help relieve the stress of "lack of time on a future moment" and indirectly influence other things as well. For example, if the nurses are not so stressed all the time that they might not have time in the future, they could start thinking about issues they normally put out of their minds. Therefore, having more time might contribute to better planning of how to do and prepare things and in that way also indirectly influence the number of medications wasted.

Another issue is the fact that once the medications prepared and labelled with the patient's name and laid in the room cannot be used for anyone else, even if they are never administered to this specific patient due to being in "contact". Some nurses had ideas of how to store them in potentially neutral space so they might be used for someone else, but then again, such a solution will create requirements of new actions in their routine and were immediately dismissed by another part of the nurses. The bottom line is that this is also a regulation that cannot be changed. It is not allowed for safety reasons; therefore, a solution within the boundaries of this restriction is more viable versus attempts to changing such a policy.

In this case, the easiest and painless way to improve sustainability and reduce the amount of unnecessarily wasted medications is to approach the culture and try for changes in behaviour when it comes to preparation. Preparing less in advance and applying forethought towards what might be needed and what might not be needed in the future is the first very important step that could be taken in this regard.

5.3. Suggestions for further research

This research shows that change can be achieved when all factors are considered. As for recommendations for future research, the findings of this paper can be used. Possible directions are to focus on different medications, either pollution, scarcity or cost-wise. For this type of research, a more in-depth analysis per patient condition and corresponding medicine use and wastage can be of value.

This research investigated the wastage of medication. As observed, besides medication, also other medical equipment is being used. E.g. the plastic syringes themselves. In those, other area's further research on waste and waste management can provide additional insights into preventing and decreasing wastage towards a sustainable ICU.

Also, the interaction between the procedural and personal aspects can be researched further to get a better understanding and creating possibilities for decreasing wastage. Perhaps further research to focus on the distinction between the different "hard" and "soft" factors. Looked through a different level some of the "hard" factors described here might be less "hard" than others therefore there might be opportunities for changes and alterations in those.

As seen in the analysis results, the preparation of medication is a factor to consider. This raises questions on wastage in situations where the preparation of medication is significantly different. The original idea for the research setup was to compare the findings between two different ICU setups. Preparation of medication on the floor by the nurses versus preparation of medication by an Apothecary.

The cost factor has not been part of this research paper. Medication and ICU care are costly. Seeing the amount of wastage is above the expectations of the ICU personnel, this angle is worth researching further. The potential savings can be beneficial to ICU care in general and be applied towards other areas, besides the realization of a decrease in medicine wastage.

Something else that was found during the research but was not looked at in-depth in the analysis since it is not directly connected with why and how the medications are being wasted. However, as an environmentalist and since this is a research that looks into improving sustainability it is worth mentioning and paying attention in the future. That is indeed how those syringes are disposed of. And to make their correct disposal easier. (Interview №1)

Since I had to get familiar with how to dispose of the collected samples after they have been catalogued it was only natural to ask this question of the nurses as well. Even though there is a guide on how to dispose of all kinds of materials on the hospital grounds from the answers could be seen that some of them are open to interpretation. The clearest example is with the definition of empty syringe and syringe with content. How much is considered as content? Most often answers were that if it is less than 10 millilitres left in the syringe the nurses will consider it empty and through it out in the normal trash. That is a topic that needs some more thought and clarification. Of course, even its improvement again will circle back to time, culture and habits since there is a normal trash container in every room versus one container for hazardous materials on the floor. So, throwing out each syringe will require again a change of personal behaviour, few more steps and ultimately a few more seconds spend on that activity.

Perhaps future research can look more in-depth at this specific aspect of the medication waste, and even though it will not help with reducing its amount, it will help to improve sustainability on the Intensive Care Floor.

5.4. Final remarks

There are three pillars when it comes to sustainability in a broader term that is heard over the world every day, used in different campaigns, commercials, and platforms to promote awareness and those are indeed "Reduce, Re-use, Re-Cycle". Or we can also call it the mantra of sustainability. In the specific case of medications, we cannot of course talk about recycling in a sense commonly understood. We also saw that due to regulations it is also not possible to reuse medications, even if in this case reusing will mean something new but used not on the originally intended person. Reducing however is left to be a very viable option and such a course is possible as explained above. It will require however cultural changes both on individual and communal levels and willingness for a change. It will require adjustments of the separate strings creating the web of behaviour observed throughout this research.

In conclusion, we can say that work-based behaviour is a very complex phenomenon. When the work environment is as stressful as the one on the ICU floor it is only natural that forming a certain behaviour will not be straightforward. That there will be multiple factors affecting choices of how to perform a certain task. In the case of this research, we were able to expose how such factors influence behaviour that indirectly contributes towards an issue connected with sustainability. Sustainability is not an easy challenge to solve. It is very diverse; it can mean different things in different fields. However, the first step towards improving it is the will for change as mentioned multiple times.

The fact that the personnel at the ICU stood behind this project and research and contributed towards it shows that there is a desire for change, shows curiosity for subject matter not so familiar to them and that is the first and most important step on the road towards further improvements.

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Appendix 1. Tables and Models.

1. A table containing the constructs and their definitions of Attitude, Perceived Control and personal Agency in the context of TRA, TPB and IBM. Borrowed from "Health Behaviour, 2015, 5th edition", chapter 6 "Theory of Reasoned Action, Theory of Planned Behavior, and the Integrated Behavioral Model" (Montano & Kasprzyk, 2015). p. 101-102.

Table 6.1 TRA, TPB, and IBM Constructs and Definitions

	Construct	Definition	Measure
	Behavioral intention	Perceived likelihood of performing the behavior	Bipolar unlikely-likely scale; scored −3 to +3
Attitude	**Experiential attitude (affect)**		
	Direct measure	Overall affective evaluation of the behavior	Semantic differential scales: for example, pleasant-unpleasant; enjoyable-unenjoyable
	Indirect measure		
	Behavioral belief	Belief that behavioral performance is associated with certain positive or negative feelings	Bipolar unlikely-likely scale; scored −3 to +3
	Instrumental attitude		
	Direct measure	Overall evaluation of the behavior	Semantic differential scales: for example, good-bad; wise-foolish
	Indirect measure		
	Behavioral belief	Belief that behavioral performance is associated with certain attributes or outcomes	Bipolar unlikely-likely scale; scored −3 to +3
	Evaluation	Value attached to a behavioral outcome or attribute	Bipolar bad-good scale; scored −3 to +3
Perceived Norm	**Subjective (injunctive) norm**		
	Direct measure	Belief about whether most people approve or disapprove of the behavior	Bipolar disagree-agree scale; scored −3 to +3
	Indirect measure		
	Normative belief	Belief about whether each referent approves or disapproves of the behavior	Bipolar disagree-agree scale; scored −3 to +3
	Motivation to comply	Motivation to do what each referent thinks	Unipolar unlikely-likely scale; scored 1 to 7
	Descriptive norm		
	Direct measure	Belief about whether most people perform the behavior	Bipolar disagree-agree scale; scored −3 to +3
	Indirect measure		
	Normative belief	Belief about whether each referent performs the behavior	Bipolar disagree-agree scale; scored −3 to +3

	Construct	Definition	Measure
Personal Agency	**Perceived behavioral control**		
	Direct measure	Overall measure of perceived control over the behavior	Semantic differential scales: for example, under my control–not under my control; easy-difficult
	Indirect measure		
	Control belief	Perceived likelihood of occurrence of each facilitating or constraining condition	Unlikely-likely scale; scored −3 to +3 or 1 to 7
	Perceived power	Perceived effect of each condition in making behavioral performance difficult or easy	Bipolar difficult-easy scale; scored −3 to +3
	Self-efficacy		
	Direct measure	Overall measure of ability to perform behavior	Certain I could *not*–certain I could scale for overall behavior; scored −3 to +3 or 1 to 7
	Indirect measure		
	Self-efficacy belief	Perceived ability to overcome each facilitating or constraining condition	Certain I could *not*–certain I could scale; scored −3 to +3 or 1 to 7

Appendix 2. Interview guide questions and interview index

The interviews can be found in separate files: see Appendix 4.

Interview Questions Guide

- Can you tell me your name and function at the ICU? How long have you been working at the ICU?
- Can you tell a little bit how does your working day look like?
- As you know, we have been looking at the syringe's medication waste and the different aspects of it. Can you briefly explain the process that takes place concerning this type of medication – from start to end (preparing the medications changing the syringes throwing them out)? (Insight of attitude and the working routine for this process).
- Which aspect of this medication waste you would say bothers you the most?
  - ✓ The economical one – money spend for nothing
  - ✓ The plastic – all this extra plastic waste from the syringes that cannot be recycled
  - ✓ Waste of medications, when around the world there is a shortage of medications.
  - ✓ Extra medications ending up in the environment – soil and groundwater, atmosphere etc.
- Would you say that sometimes you have a feeling you are pre-making too many syringes of the same medication for the same patient that in 24h. is highly likely to change and for them to be discarded?
- Does it make an impression to you when you change a syringe while still full or almost full?
- What do you think are the most common reasons for syringes to be changed while still full or almost full? Therefore, what are the most common reasons for this type of wasting medications?
- Do you know what is behind this working routine – can you explain it? (What rules, legislations, and hierarchy you follow with it?)
- Have you ever thought of what becomes of those medications after you discard them?
- Could you tell me what exactly do you do with the syringes ones when you remove them from the perfusion systems? Where would you throw out an empty syringe? What about an almost empty syringe? And the full syringe? Do you do different things throwing out syringes containing NaCl and glucose vs. Syringes containing propofol and other medications for example?
- If there is 3 ml left in a syringe will, you define it as empty?
- What is your outlook on sustainability in your work environment? What is your perception about sustainability in your work environment from your colleagues? Is sustainability talked about or mentioned on the ICU floor?
- Do you think your work environment can be more sustainable and environmentally friendly? If

so, what do you think can be changed to achieve that in your opinion?

- What would you say is the biggest limitation and challenge in order to change to more sustainable ICU care? – (finance; time; rules & regulations for procedures; desire for change for the people working there)

- Are you aware of the prices for the medications that you administer, or it is more an automated process of needing to give that medicine and everything else around it is irrelevant?

- What is the thing you value most in your workday and is there room for changes with it?

- This question is hypothetical: Imagine an ICU without any rules. A clean slate. Just you making the decisions, how would the team look like, how would you care for the patients? What would be significantly different? (this question aims to give an idea of what the current limitations the personnel is experiencing and see their triggers for a change) How is sustainability going to be addressed in your utopia ICU? Will it be addressed? (Letting go of the descriptive Norms that are influencing and dictating the current behaviour and levelling up with the individual's real attitude towards the problem of sustainability)

- Talking about change, would you say that your work environment does or does not execute and take on changes easily? Why do you think that is?

- In your opinion do you think with changes in time management is possible to still execute that task, without any changes for the patient care, but perhaps with an effect on sustainability? (For example, I have observed from the syringes collected the last few weeks that many times when lines are changed – every 96h for most medication and every 12h for medications such as propofol, the syringes that are changed with the lines are in big per cent full or almost full. Therefore, the syringe has been changed minutes before the decision to change the lines. Do you think it is possible to optimise this, with better planning and time management so much waste is prevented?). If no – why not, what are the reasons preventing such optimisation? If yes – how would you do that and what is the reason to currently not be done this way?

- How would you rate the general attitude and knowledge of the people around you concerning sustainability?

- Would you say that education for the importance of sustainability and care for the environment in any aspect and in this case in healthcare could reach more people from your work environment and therefore triggering changes towards more sustainable behaviour on the ICU floor?

- If there was a rating needed for priorities, after providing the best care for the patient, in what place would you rate the need for more sustainable choices on the ICU floor?

- If you had to list all pros and cons for performing the task of changing the syringes, for example, what would they be? Think of it as a philosophical question and add things that matter for you as a person, apart from I do it because it has to be done. After all, the patient needs to get better. (Attitudes toward certain behaviour (behaviour beliefs)).

- If you hear the statement: Sustainability now is key to the future, what would you think about it? That is highly unlikely; very unlikely; unlikely; neutral; likely; very likely; highly likely.

- What about the statement: From next month improving sustainability is a high priority of the ICU? That is highly unlikely; very unlikely; unlikely; neutral; likely; very likely; highly likely
- Would you say that you feel that you have control over the topic of sustainability at work? Do you feel empowered to change things in this regard? (Perceived behavioural control also can refer from questions 5-6.)
- If there is a new guideline or regulation for a certain procedure in the future what will be your first thought about it? – Something changed I need to know why, or it is changed I just have to do it this way from now on?
- What is your general outlook on sustainability? Do you try to live more sustainable in your day-to-day life? If yes in which aspects and what actions do you take to be more sustainable and environmentally friendly?
- Is there something else that you want to share or ask?

Interview guide for referencing

- Interview №.1 – JvK. (ICU nurse)
- Interview №. 2 – BV. (ICU nurse)
- Interview №.3 – GB. (ICU nurse)
- Interview №.4 – P.R. (ICU floor manager nurse)
- Interview №. 5 – MvM (ICU nurse)
- Interview №. 6 – RK. (ICU nurse)
- Interview number №.7 – JvH (ICU nurse)
- Interview number №. – MvED (ICU floor manager nurse)

Appendix 3. Syringe database collection

The complete data set and images are available in separate files, see Appendix 4.
Images from the created excel database from all collected syringes during the collection period of this research and few pictures of collected samples.

	Date	ward	Day of the week	Pat	Medication name	Remark	Total volume ml	Volume leftovers ml
274	7/2/2020	C1A-01	Friday	J	glucose infvlst 5%		50	10
275	7/2/2020	C1A-01	Friday	J	propofol 10mg/ml		50	5
276	7/2/2020	C1A-01	Friday	J	propofol 10mg/ml		50	3
277	7/2/2020	C1A-01	Friday	J	glucose infvlst 5%		50	10
278	7/2/2020	C1A-01	Friday	J	kaliumchloride 1mmol/ml		50	3
279	7/2/2020	C1A-01	Friday	J	sufentanil 5 mcg/ml		50	5
280	7/2/2020	C1A-01	Friday	K	propofol 10mg/ml		50	50
281	7/2/2020	C1A-01	Friday	K	magnesiumchloride 1mmol/ml	lines	50	10
282	7/2/2020	C1A-01	Friday	K	noradrenaline 0,1%mg/ml in Nacl 0,9% 50ml	lines	50	46
283	7/2/2020	C1A-01	Friday	L	propofol 10mg/ml		50	50
284	7/2/2020	C1A-01	Friday	L	Nacl 0,9%		50	0
285	7/2/2020	C1A-01	Friday	L	propofol 10mg/ml	lines	50	13
286	7/2/2020	C1A-01	Friday	L	sufentanil 5 mcg/ml		50	22
287	7/2/2020	C1A-01	Friday	L	noradrenaline 0,1%mg/ml in Nacl 0,9% 50ml	lines	50	30
288	7/2/2020	C1A-01	Friday	L	Nacl 0,9%	lines	50	25
289	7/2/2020	C1A-01	Friday	L	noradrenaline 0,1%mg/ml in Nacl 0,9% 50ml		10	7
290	7/2/2020	C1A-01	Friday	M	ropivacaine/sufentanil 2mg/1mcg/ml		50	3
291	7/2/2020	C1A-01	Friday	M	noradrenaline 0,1%mg/ml in Nacl 0,9% 50ml	lines	50	35
292	7/2/2020	C1A-01	Friday	M	insuline aspart 1 eenheden/ml in Nacl 0,9%		50	3
293							14300	4291
294								30.00699301
295								
296								

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5

	Date	Ward	Day of the week	Pat	Medication name	Remark	Total volume ml	Volume leftovers ml
361	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
362	14-02-2020	C1A-01	Friday	I	NaCl 0,9%		50	3
363	14-02-2020	C1A-01	Friday	I	noradrenaline 0,1mg/ml in NaCl 0,9%		50	3
364	14-02-2020	C1A-01	Friday	I	midazolam 5 mg/ml		50	3
365	14-02-2020	C1A-01	Friday	I	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	3
366	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
367	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
368	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
369	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
370	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
371	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
372	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
373	14-02-2020	C1A-01	Friday	I	noradrenaline 0,1mg/ml in NaCl 0,9%		50	3
374	14-02-2020	C1A-01	Friday	I	noradrenaline 0,1mg/ml in NaCl 0,9%		50	3
375	14-02-2020	C1A-01	Friday	I	propofol 10mg/ml		50	3
376	14-02-2020	C1A-01	Friday	I	sufentanil 5mcg/ml		50	5
377	14-02-2020	C1A-01	Friday	J	propofol 10mg/ml	lines	50	35
378	14-02-2020	C1A-01	Friday	J	propofol 10mg/ml		50	10
379	14-02-2020	C1A-01	Friday	J	propofol 10mg/ml		50	4
380	14-02-2020	C1A-01	Friday	J	kaliumchloride 1 mmol/ml	lines	50	33
381	14-02-2020	C1A-01	Friday	J	furosemide 10mg/ml 5mg/ml in NaCl 0,9%		50	5
382							18330	5174
383								28.22695035

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5

	Date	Ward	Day of the week	Patien	Medication name	Remark	Total volume ml	Volume leftovers ml
178	21-02-2020	C1A-01	Friday	F	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	3
179	21-02-2020	C1A-01	Friday	F	glucose infvlst 5%		50	3
180	21-02-2020	C1A-01	Friday	F	glucose infvlst 5%		60	60
181	21-02-2020	C1A-01	Friday	G	remifentanil 0,05 mg/ml in NaCl 0,9%		40	3
182	21-02-2020	C1A-01	Friday	G	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	50
183	21-02-2020	C1A-01	Friday	G	labetol 5 mg/ml		50	5
184	21-02-2020	C1A-01	Friday	G	magnesiumchloride 1 mmol/ml	lines	50	5
185	21-02-2020	C1A-01	Friday	H	NaCl 0,9%		50	50
186	21-02-2020	C1A-01	Friday	H	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	25
187	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%	(nor - 10; nacl - 40 ml)	50	50
188	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%		50	50
189	21-02-2020	C1A-01	Friday	H	NaCl 0,9%		50	3
190	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%		50	3
191	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%	lines	50	50
192	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%	lines	50	20
193	21-02-2020	C1A-01	Friday	H	magnesiumchloride 1 mmol/ml	lines	50	3
194	21-02-2020	C1A-01	Friday	H	metoprolol 1 mg/ml		50	50
195	21-02-2020	C1A-01	Friday	H	noradrenaline 0,2 mg/ml in NaCl 0,9%		50	3
196	21-02-2020	C1A-01	Friday	H	NaCl 0,9%		50	3
197							8885	3637
198								40.93415869
199								
200								

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5

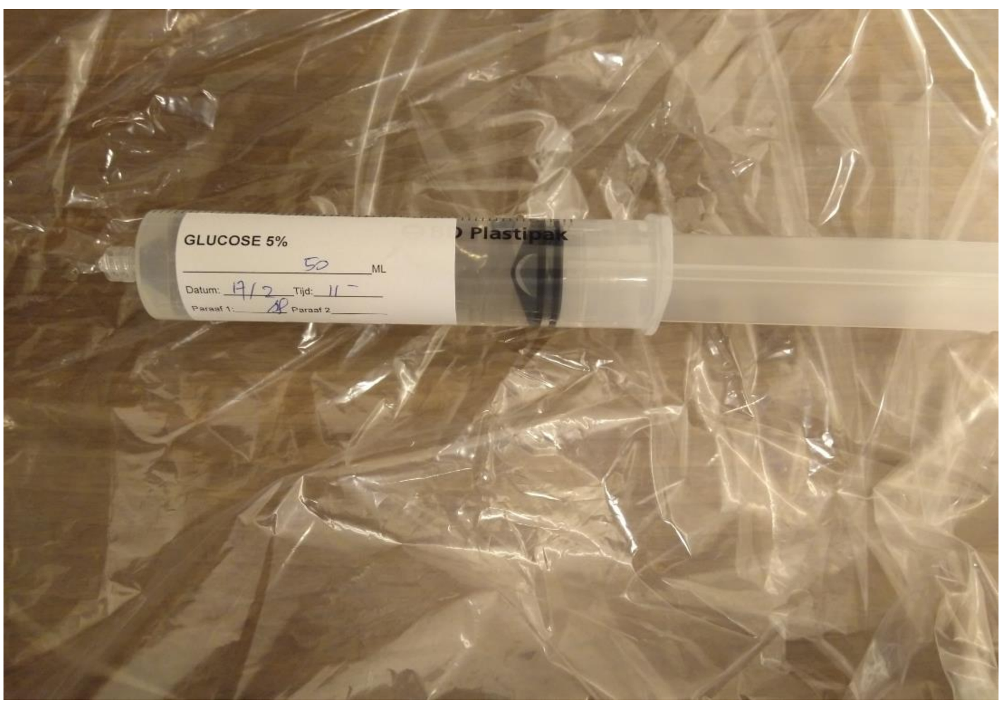
	Date	Ward	Day of the week	Patient	Medication name	Remark	Total volume ml	Volume leftovers ml
136	28-02-2020	C1A-01	Friday	E	NaCl 0,9%		50	2
137	28-02-2020	C1A-01	Friday	E	magnesiumchloride 1 mmol/ml	lines	50	25
138	28-02-2020	C3A-01	Friday	F	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	50
139	28-02-2020	C3A-01	Friday	F	NaCl 0,9%		50	33
140	28-02-2020	C3A-01	Friday	F	insuline aspart 1 eenheden/ml in NaCl 0,9%	lines	50	35
141	28-02-2020	C3A-01	Friday	F	natriumdiwaterstoffosfaat 2mmol/ml	lines	50	10
142	28-02-2020	C1A-01	Friday	G	propofol		50	4
143	28-02-2020	C1A-01	Friday	G	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	3
144	28-02-2020	C1A-01	Friday	G	remifentanil 0,05 mg/ml in NaCl	lines	50	37
145	28-02-2020	C1A-01	Friday	G	fibrinogeen infvlst 20mg/ml		50	2
146	28-02-2020	C1A-01	Friday	G	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	2
147	28-02-2020	C1A-01	Friday	G	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	3
148	28-02-2020	C1A-01	Friday	H	midazolam		20	15
149	28-02-2020	C1A-01	Friday	H	propofol	lines	50	42
150	28-02-2020	C3A-01	Friday	I	sufentanil 5mcg/ml		50	5
151	28-02-2020	C3A-01	Friday	I	propofol		50	2
152	28-02-2020	C3A-01	Friday	I	noradrenaline 0,1 mg/ml in NaCl 0,9%		50	2
153	28-02-2020	C3A-01	Friday	I	midazolam 5mg/ml		50	10
154	28-02-2020	C3A-01	Friday	I	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	4
155	28-02-2020	C3A-01	Friday	I	glucose infvlst 5% viaflo zak		50	7
156	28-02-2020	C3A-01	Friday	I	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	4
157							6943	2821
158								40.63085122

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5

	Date	Ward	Day of the week	Pat	Medication name	Remark	Total volume ml	Volume leftovers ml
142	6/3/2020	C3A-01	Friday	H	Magnesiumchloride 1 mmol/ml	lines	50	5
143	6/3/2020	C3A-01	Friday	H	glucose infvlst 5%		50	20
144	6/3/2020	C3A-01	Friday	H	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	50
145	6/3/2020	C3A-01	Friday	H	NaCl 0,9%		50	3
146	6/3/2020	C3A-01	Friday	H	noradrenaline 0,1mg/ml in NaCl 0,9%	lines (nor 1mg/ml - d-5mg-v-5ml; Na(	50	43
147	6/3/2020	C3A-01	Friday	H	insuline aspart 1 eenheden/ml in NaCl 0,9%	lines	50	8
148	6/3/2020	C3A-01	Friday	H	natriumdiwaterstoffosfaat 2 mmol/ml	lines	50	10
149	6/3/2020	C3A-01	Friday	I	noradrenaline 0,1mg/ml in NaCl 0,9%		50	50
150	6/3/2020	C3A-01	Friday	I	glucose infvlst 5%		50	3
151	6/3/2020	C3A-01	Friday	I	insuline aspart 1 eenheden/ml in NaCl 0,9%		50	13
152	6/3/2020	C3A-01	Friday	I	glucose infvlst 5%		50	5
153	6/3/2020	C3A-01	Friday	I	Magnesiumchloride 1 mmol/ml		50	4
154	6/3/2020	C3A-01	Friday	J	glucose infvlst 5%	lines	50	45
155	6/3/2020	C3A-01	Friday	J	glucose infvlst 5%		50	2
156	6/3/2020	C3A-01	Friday	J	noradrenaline 0,1mg/ml in NaCl 0,9%		50	37
157	6/3/2020	C3A-01	Friday	J	natriumdiwaterstoffosfaat 2 mmol/ml	lines	50	2
158	6/3/2020	C1A-01	Friday	K	sufentanil 5mcg/ml		50	50
159	6/3/2020	C1A-01	Friday	K	sufentanil 5mcg/ml	lines	50	50
160	6/3/2020	C1A-01	Friday	K	sufentanil 5mcg/ml		50	3
161	6/3/2020	C1A-01	Friday	K	dexmedetomidine 10 mcg/ml in glucose 5%	lines (dex 100 mcg/ml - dosis 600mcg	60	30
162							7840	2760
163								35.20408163
164								

RUUMC Week 1 | RUUMC Week 2 | RUUMC Week 3 | RUUMC Week 4 | RUUMC Week 5


insuline aspart 1 eenheden/mL in NaCl
0,9% 50 ml spuit voor pomp # [redacted]


GLUCOSE 5%
50 ML
Datum: 17/2 Tijd: 11
Paraaf 1: Paraaf 2
Plastipak

Appendix 4. Overview guide of raw data materials

Overview of files connected to this research paper.

#	Filename	Filetype	Filetype inside folder	Description
1.	KDamyanova_Master thesis Environment and Society Studies_Raw Data	Folder	Folder/zip Folder/zip .pdf .xlsx	Contains all files mentioned below.
2.	KDamyanova_Database_Photocollection	Folder/zip	.jpeg	Contains all the photos taken from all the syringes that were collected during the collection period
3.	KDamyanova_Interviews recordings	Folder/zip	.wav	Audio recordings of the conducted interviews
4.	KDamyanova_ICU database sample collection - raw data	Excel	.xlsx	The created database from the collected syringes
5.	KDamyanova_Appendix_Interviews transcripts	Word	.pdf	The transcripts of the interviews audio recordings