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Decentralization and Digitalization of a Healthcare Process:

An assessment of the healthcare intervention through normalization process theory

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The structure of the thesis

This thesis is organized into eleven parts. The first part of the thesis is about the background of the project that contains information about the collaborating partners and the authorities who initiated the project. It also contains useful information about what problems the project is intended to solve and how the facts based on findings will be used.

The second part is the introduction of this specific study which contains the aim of the study, the research objectives, and the research questions. The third part is the literature review which contains valuable theories relevant to this research project, the research gap, and the relevant definitions of the concepts used.

The fourth part is the methodology part, which deals with the research method, the sampling method, data collection and data analysis, quality issues in research, and ethical approval for this study.

The fifth part is the discussion based on the research findings. The sixth part is the implications of this research study for practitioners and researchers. The seventh part is the research limitations of this specific project. The eighth part is the future recommendations to researchers. The study is concluded in the ninth part. In the tenth part, referencing is given used for all the citations used. Some appendices are attached in the eleventh part.

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Abstract

Decentralization and Digitalization of a Healthcare Process:

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This study is based on the invitation to the CoTech project in USN to study the implementation of a digitalized healthcare logistics system at hospitals in Norway. Today, healthcare organizations face the persistent challenge of improving the quality and efficiency of the healthcare system. Through digital technology applications in health logistics, both service efficiency and healthcare quality can be improved. Research suggests that some work environment challenges e.g., workload pressures and time management can be dealt with the help of technology-based interventions that have valuable patient outcomes. The Medical Research Council (MRC) has indicated the importance of evaluation plans and systematically studying the feasibility of a given intervention in its framework for evaluation and development of a complex intervention, before going for an expensive evaluation program.

The aim of this study is to investigate and understand the implementation and routinization of a complex intervention in a healthcare setting on one hand and to highlight the experiences of healthcare employees with this intervention that how this has affected their routine work and how the practices surrounding this intervention can be improved for better outcomes on the other hand. The intervention to be studied is the blood sampling application, one part of the digital healthcare system implemented in one Norwegian hospital.

To fulfill the objectives of this study, a qualitative approach using the constructivist research lens has been used. For this purpose, a single hospital has been used as a case to evaluate the outcomes of a healthcare intervention. Data has been collected through observations and semi-structured interviews with healthcare professionals. For data analysis, NVivo 1.6.1 was used for deductive thematic analysis based on the normalization process theory (NPT). The research findings show, partial routinization of the intervention in the hospital. Some challenges related to the variation of routinization, infrastructures problems, and patients' perspectives on digital intervention, have been explored.

The study has useful implications for practitioners who can use the findings based on intervention evaluation for improvement of the intervention. It also provides useful insight to researchers who can use the findings based on NPT to study other social systems, social roles, and the dynamic elements of the context.

Keywords: Complex interventions, Implementation process, Health logistics system, Normalization process theory (NPT)

Decentralization and Digitalization of a Healthcare Process:

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1. Background of the project

This study is based on the invitation to the CoTech project in USN to study the implementation of a digitalized healthcare logistics system at hospitals such as Østfold, Bergan, and Vestfold Sykehus, etc., where most parts of the digitalized system have already been operationalized. Thus, it must be implemented at the Drammen Hospital, where the Drammen hospital is part of Vestre Viken HF (VVHF). This investigation was required by the Technology Director Cecilie B. Løken via Research Director Kristine Kleivi Sahlberg.

In the board meeting, held in April 2021, the board of South-Eastern Norway Regional Health Authority decided that healthcare logistics would be tested in individual departments at different hospitals in the region and Vestre Viken HF, the Vestfold Hospital, the Telemark Hospital, and the Oslo University Hospital HF would pilot the Healthcare Logistics. It was decided that after the 18-month test period, the regional solution would be scaled up to full deployment, production, and implemented throughout the region. However, there is a significant delay in the completion of the Drammen Hospital project. This information has been obtained from the websites of Helse Sør-Øst and Vestre Viken[1].

For recall, the healthcare logistics system is about improving the efficiency of the healthcare system to have an overall positive impact on public health. In this case, DNV Imatis and Ascom are the main technology developers and providers who work in partnership with the hospitals to implement the digitalized health logistics system. This improved system mainly deals with check-in and settlement of patients and Management of patient flow and resources and the technology provider for these two is DNV Imatis, while Ascom (the technology supplier)

[1] https://helse-sorost.no/

mainly deals with internal communication and notification on mobiles. This is just in line with the goal in the development plan that more time should be spent on patient-oriented work[2].

Such technological solutions are required to optimize patient care at hospitals. Also, the health enterprises that are to start the new building like Drammen Hospital, require these technological solutions to operate more efficiently. This system will lead to a better overview of the patients' data, their check-in and settlement requirements, better hospital resources control, better capacity management, and faster test results that would eventually help to reduce the treatment time and lead to a better public health. Through improved digitalized health logistics systems, mobile phones, and digital electronic boards a better overview of healthcare personnel will be provided on a busy day.

From operational point of view, Åse Lexberg is one of the project team's co-workers who works to continuously improve the project "Vestre Viken HF (VVHF)". It is critical to mention some input from her about the project's goals and development. According to her, Vestre-Viken is one of four pilot hospitals in South-Estern Norway to introduce digital Health Logistics with three pilot departments (ward, emergency department, and outpatient clinic) at Drammen Hospital.

As some of the hospitals have already operationalized the digital health logistics system, the team for continuous improvement in VVHF has planned to capitalize on lessons learned from this implementation for learning, sharing, and improvement. At present, the team alone does not have the capacity or research experience to do this scientifically based. Furthermore, it is critical to find the effects of new organizations because of implementing new technology in complex systems such as hospitals and healthcare using scientific methods. This can assist in delivering significantly generalizable knowledge for the effective digital transformation of healthcare services.

It is critical to make systematic changes in the system and processes before, during, and after the introduction of digital solutions by DNV Imatis and Ascom to realize the fruitful effects of

[2] https://vestreviken.no/Documents/Utviklingsplan%202035%20(Revidering%202021-22)/Regional%20utviklingsplan%202035%20(2018).pdf[2]

the health logistics system. This project would lead to knowledge transfer and experience sharing that would help to improve the health logistics system further.

This overall health logistics system includes using electronic digital boards, mobile phones, Imatis Systems, and some integration of Dips and MetaVision systems. We notice that the Blood sampling application is one small part of this broader system that is to be studied as a health intervention in this piece of work. The blood sampling system, at Østfold Hospital, was decided to be decentralized in 2015, where the blood sample-taking task was shifted from laboratory staff to the nurses in their respective departments. This decentralization was originally initiated by the laboratory staff who reported some challenges related to insufficient manpower and the difficulties of handling many samples. Once the decision was approved, the laboratory was responsible for training the nurses to take blood samples. In 2021, the laboratory observed the error rate was quite high and that most of the blood samples were being taken from the wrong patients. Then it was decided to digitalize the blood sampling system so that ID errors can be reduced to enhance the effectiveness and efficiency of the blood sampling system. This app is very much in practice since September 2021 at Østfold Hospital. This is important to investigate the outcomes and effects of this intervention on staff at Østfold Hospital so that it can be improved and introduced in other hospitals which are the part of VVHF project.

2. Introduction

Today, healthcare organizations face the persistent challenge of improving the quality and efficiency of the healthcare system (Tlapa et al., 2022). Overcrowding and delay in the provision of healthcare services (de Barros et al., 2022) can impact patient and staff satisfaction and the overall quality of healthcare service, which may be caused by inefficient patient flow management and insufficient resource utilization (Yu et al., 2022).

The challenges like demographic changes that result in a discrepancy between the numbers of people in need of healthcare and the resources available to meet those needs, more people with chronic diseases, and growing healthcare costs are some of the challenges necessitating transformation of the healthcare sector. Thus, technology is an important factor, but only when correctly aligned with an integrated healthcare process. (Johansen & van den Bosch, 2017; Kroezen et al., 2018).

If we check the statistics for the year 2022, the total population in Norway is around 5.5 M till the end of the fourth quarter of 2022, and almost 2.067M patients were registered in all the somatic hospitals around the whole country. Among these patients, 783,172 were recorded to be as in-patient stays (*Statistikkbanken, Patient Statistics*, 2022). These statistics may demand the efficient patient management to be one of the crucial strategies for hospital management and health sector to fulfil the overall goal of public health improvement.

The digitalization of the supply chains guarantees to improve several components of logistics by enabling real-time, autonomous, and decentralized management (Kayikci, 2018). The advancement in information technology has made it possible to shift nurses away from centralized workspaces to more decentralized workstations nearby or inside the patients' room. To improve nursing efficiency and patients' care, it is essential to provide a supportive working environment that fulfils their functional and psychological needs (Zborowsky et al., 2010).

Supply chains in hospitals and health logistics management activities are not just about the material flow of physical goods, but it encompasses many other activities in the healthcare chain such as different services and patients flow as well. Here a number of medical and administrative tasks of interdisciplinary and multidisciplinary nature need to be considered for patients' management to ensure controlled synchronization to prevent problems associated with resource misuse and patients' wait time (Ageron et al., 2018).

Through digital technology applications in health logistics, both service efficiency and healthcare quality can be improved (Tlapa et al., 2022). Although digital tools enable the work, technology may impede the free flow of knowledge from source to recipient (Paulin & Suneson, 2015). The development of the health sector through digital lean logistic practices necessitates sufficient feedback from stakeholders so that its contribution can be evaluated properly (Mazzocato et al., 2010).

It is argued that some work environment challenges e.g., workload pressures and time management can be dealt with the help of technology-based interventions that have valuable patients' outcomes. They provide assistance in improving the healthcare processes through changing the roles of professionals instead of changing patients' behavior (Keyworth et al., 2018; S. Ross et al., 2013).

This is vital to understand the implementation process of complex interventions and to know if interventions have been taken up in practice in order to maximize the planned outcomes in the course of improving patient care (Durlak & DuPre, 2008).

The Medical Research Council (MRC) has indicated the importance of evaluation plans and systematically studying the feasibility of a given intervention in its framework for evaluation and development of a complex intervention, before going for an expensive evaluation program. Complex interventions are those that include various components that can act both interdependently and independently. Evaluating such interventions can be challenging because of the difficulties in developing, identifying, documenting and reproducing such interventions (M. Campbell et al., 2000).

As blood sampling application, as one component of the overall health logistics system, is a complex intervention because of this involving many stakeholders like, IT professionals, nurses, bioengineers, laboratory staff, doctors, and patients themselves, therefore, it is crucial to evaluate the outcomes and possible effects of such complex interventions in a hospital so that further improvement can be considered if deemed necessary. For this purpose, this study considers the application of Normalization Process Theory (NPT).

Normalization Process theory proposed by May and Finch (2009) offers a mechanism for explanation and evaluation of the implementation process of healthcare interventions in healthcare settings. It has been suggested for practitioners and academicians who can benefit from this theory and use it as a tool to evaluate the outcomes of a given intervention in an organizational setting and use this evaluation to further develop and improve the intervention

through implementation planning. NPT specifically studies the interventions in a healthcare setting though it has been recommended to use the theory to study dynamics of implementation processes in diverse settings. In their review studies, they came up with the fact that the use of NPT is acknowledged into the protocols of the given study by the researchers who intended to use NPT in their studies (C. R. May et al., 2018).

2.1 The aim of the study

The aim of this study is to investigate and understand the implementation and routinization of a complex intervention in a healthcare setting on one hand and to highlight the experiences of healthcare employees with this intervention that how this has affected their routine work and how the practices surrounding this intervention can be improved for better outcomes on the other hand. The intervention to be studied is the blood sampling application that is one part of the digital health logistics system.

2.2 The research objectives

This study has the following objectives.

1. To provide an understanding of how the decentralization and digitalization of blood sampling system has been implemented in a hospital setting.
2. To explore the impacts of new blood sampling system on healthcare employees' work and the outcomes of the overall implementation process
3. To help improve the intervention (the blood sampling application) via investigating various challenges in the implementation process.

2.3 Research questions

The research questions, therefore, are;

1. How a complex intervention i.e., blood sample taking application is implemented and routinised in a healthcare setting like a hospital? How do employees understand and describe this intervention?
2. What are the effects of this intervention on healthcare employees' work routines and what are the possible outcomes of this intervention (digitalized blood sample taking) in the overall implementation process?
3. What are the possible challenges in the implementation process?

3. Literature review

The healthcare sector faces many challenges today which calls for new and disruptive innovations in the healthcare (Albers Mohrman et al., 2012). Today, organizations, in almost every field, take advantage of digital opportunities as digitalization assists speeding up the logistics activities effectively and efficiently and it has minimized several logistics problem by offering instant solutions (Bardakci, 2020).

Research studies in supply chain management and logistics are increasingly drawing attention to healthcare services (Landry & Philippe, 2004). Healthcare logistics, like any other industry has two chains: internal and external supply chains (Pan & Pokharel, 2007). The internal supply chain is associated with healthcare providers and actors that need services in short time while the external chain involves manufacturers and distributors (Kritchanchai & Suwandechochai, 2010; Mustaffa & Potter, 2009). Healthcare logistics consists of networks or systems which perform different activities aimed at service provision to patients (Kim, 2005; Kumar et al., 2008).

The logistics function in the hospital management has been given a strategic place (Volland et al., 2017). Hospital managers have been able to achieve significant results such as error reduction, process quality improvement and reduction in wait time through continuous improvement approach by applying various lean management methods (Mazzocato et al., 2010).

Several studies emphasize the significance of inter-site patients transfers and efficient logistics management between the partners that include hospitals, blood transfusion centres and laboratories etc. because there can be a possible risk of information loss. The studies on patient flow also highlight the administrative issues related to monitoring of patients' medical data during the treatment. New technology solutions have been proved beneficial in hospital flow management e.g., high added value IT tools as RFID (radio frequency identification), and mobile applications for different medical, financial and administrative tasks (Ageron et al., 2018; Patel et al., 2000; Shen et al., 2007). New technological solutions help the information flows between different service providers in a hospital such as doctors, nurses, laboratory, and blood transfusion center etc. and contribute to improve medical practices especially related to patients flow but for hospitals, this internal external integration can be challenging (Ageron et al., 2018).

These ICT solutions can be taken as digital interventions and are among those complex interventions which have been difficult to implement because of several factors for example, disruptions to interactions between the patients and health professionals, integration within the existing systems, and poor planning. As more and more digital interventions are in place in the health sector, it is important to understand how best to implement them (C. May, 2006; Murray et al., 2011; J. Ross et al., 2018).

Whenever a new technology is implemented in an organization, it impacts the ways the employees perform and organize their work and change the power relations. But there is a potential risk of failure while introducing some change because of insecure management and insufficient project management efforts ((Kapsali, 2011).

Some scholars argue that although digital technology offer freedom and autonomy through enabling mobility and flexibility, still it may demand an always on-mode where employees must respond immediately. This may require work penetration into employee's leisure time and it may be challenging for many employees if they feel they do not find time between working hours to recharge (Barber & Santuzzi, 2015; Wajcman & Rose, 2011).

Digital healthcare interventions are complex interventions that are hard to implement because of interoperability, integration in the existing systems, distraction of interactions between patients and healthcare professionals, costs, and problems with implementation planning (Murray et al., 2011; J. Ross et al., 2016).

The effectiveness of interventions such as digital technologies in healthcare system can be measured through several outcomes (Glenton et al., 2022) for example patient waiting time (Chan et al., 2014), boarding time (Artenstein et al., 2017) and satisfaction of different stakeholder as patients and staff etc. (Glenton et al., 2022). The attitude and satisfaction of staff members towards implementation of new methods of work could lead to positive or negative outcomes for an organization.

As more and more public and private organizations are fostering, embedding, and integrating innovations, the practical value of implementation theory is becoming significant. Innovations introduced as interventions in the health care are complex and are broader and diverse in scope (Finch et al., 2013) that may include professional behaviour transformation through evidence based medicine (Pope, 2003), telehealth and telecare systems (Whitten & Collins, 1997) and service redesigning to enhance professional governance (Kuhlmann & Burau, 2008) etc. These

innovations lead to transform practices that would enhance the quality of healthcare and organizational efficiencies (Finch et al., 2013).

Complex interventions are crucial features of healthcare practices that consist of several technological, behavioral and organizational elements but they pose special evaluation challenges because their elements can work independently or may interact together to work interdependently, and it is difficult to find out the relationship among them. This leads to difficulties in assessing these interventions (N. C. Campbell et al., 2007; Oakley et al., 2006). Therefore, process evaluation is an important phenomenon that can lead to understand if the desired outcomes of interventions have been reached or what are the factors that may promote or inhibit these interventions (May et al., 2007).

3.1 Research gap

As healthcare organizations are attempting to reorganize processes, improve staff education, and training and design new digital services for improvement of overall healthcare services. This is crucial to understand the effects of digitalization of healthcare services on reorganization of processes (Lapão, 2019).

Most of the work on NPT has been done for E-health interventions (Finch et al., 2012a), telecare for chronic diseases and telehealth ((Davidson et al., 2013; C. R. May et al., 2011) and systematic reviews on the applications of NPT in healthcare settings ((Huddlestone et al., 2020; May et al., 2018; O'Connor et al., 2016). Other work on NPT has been mostly done to develop either the theory itself or scales for its measurement in quantitative studies (Finch et al., 2012, 2013, 2018; May et al., 2016). No study considers the application of NPT for evaluation of a digital healthcare intervention to improve the health logistics process.

Advocates of NPT recommend the NPT measures to be used in diverse setting to fulfil different objectives like designing, monitoring and implementation of interventions. They suggest that complex interventions implemented in a healthcare setting can be improved by knowledge and experience dissemination through application of NPT measures to real world problems (Finch et al., 2013).

3.2 Definitions and explanations

3.2.1 Healthcare Logistics

Healthcare logistics can be defined as, “operational handlings for the delivery of care, including its supportive services, from origination to recipient.” When we look at recipients’ side, healthcare logistics can be either material-centric or patient-centric. Patient-centric aspect is related to patient flows, and it encompass efficiency, safety, and quality of healthcare services for patients through healthcare system (Zhang et al., 2018, p. 2).

The blood sampling system and the application is one part of this broader, “Health logistics system” where the main objective was to reduce the error rate and enhance efficiency to control the overall patients’ flow that can ultimately lead to early discharge of patients from hospital.

3.2.2 Implementation

Implementation includes “all the activities that occur between making an adoption commitment and the time that an innovation either becomes part of the organizational routine, ceases to be new, or is abandoned. (and the) behavior of organizational members over time evolves from avoidance or non-use, through unenthusiastic or compliant use, to skilled or consistent use.” (Linton, 2002, p. 65).

Where May and Finch (2009), argue that Linton’s definition of implementation is all about innovation but in real world it is not so. It can be anything even conservative that needs to be standardized and regulated as a practice in any social context.

3.2.3 Interventions and complex interventions

An intervention can be defined as a crucial event in the history of a system that leads to the development of new shared meanings and new configurations of interaction. Interventions can be, “a time limited series of events, new activity settings and technologies that have the potential to transform the system because of their interaction with the context and the capability created from this interaction” (Hawe et al., 2009, p. 274).

Complex interventions is a term that is used to describe projects with several interacting integral components, where actions or discretionary behaviours are required of the agents or the recipients of the intervention, where several groups or people are targeted, need substantial flexibility in adapting the intervention and require a specific skill set of those delivering or receiving the intervention (Craig et al., 2008; Hawe et al., 2009, p. 269)

The blood sampling system that has been initially decentralized (in 2015) and then digitalized (in 2021) can be viewed as a complex intervention as it involves multiple components (physical resources, the application, the pipe post system, the laboratory testing, and reporting system etc.) and multiple stakeholders (doctors, nurses, laboratory, patients etc.).

3.2.4 Decentralization

Decentralization here is referred to as functional decentralization, which is seen as, the shift of power between authorities that operate in parallel (Bray, 2012, p. 202). Decentralization can be seen as the spread of power from higher to lower levels in a hierarchy (Aas, 1997, p. 103). Whereas delegation means transferring tasks from superior to subordinates thus increasing the responsibility of the subordinates but the main responsibility still resides with the managers (Aas, 1997, p. 105).

As the blood sampling system was decentralized where the main responsibility of taking blood samples was transferred from laboratory staff to nurses in the departments, so we can say that decentralization happened, and blood sampling task was delegated to the nurses in their respective departments.

3.2.5 Digitalization

Healthcare digitalization can be classified into three dimensions as internal efficiency, disruptive change, and external opportunities. Internal efficiency means improving process efficiency by eliminating manual steps through using improved digital resources and re-planning internal organizational processes (Kim & Lee, 2021).

3.3 Normalization Process Theory

A theory is a set of principles that are proposed to structure and analyse our observations and explanations of the world (Wacker, 1998).

It can be defined as, “A theory is a coherent conceptual arrangement that, when it is operationalized, makes possible a rational description and taxonomy of phenomena and constructs by which their systematic explanation is possible.” (May & Finch, 2009, p. 539)

Implementation theories are the those that have been proposed by the implementation researchers to provide basis for explanation and understanding of some aspects of implementation e.g., The Absorptive Capacity Theory, Organizational Readiness Theory and Normalization Process Theory (Nilsen, 2020, p. 58). In this study, we are using the

Normalization Process Theory to explain our observations and data collected in a healthcare setting where a complex intervention is in place to be studied.

Normalization Process Theory is originally an implementation theory that assists in identifying the work processes in healthcare settings where complex interventions are embedded into routine practice. To improve health and healthcare sector, it is crucial to understand, develop and evaluate complex interventions so that the sustainability of the intervention can be ensured from the very beginning and for this purpose researchers suggest the evaluation of a given complex intervention using NPT (Murray et al., 2010).

Normalization Process Theory proposed by May and Finch (2009) deals with how work can be socially organized and how practices are routinized into daily work and sustained in their social context. In other words, it is concerned with implementation and integration of practices in routine work in a social context.

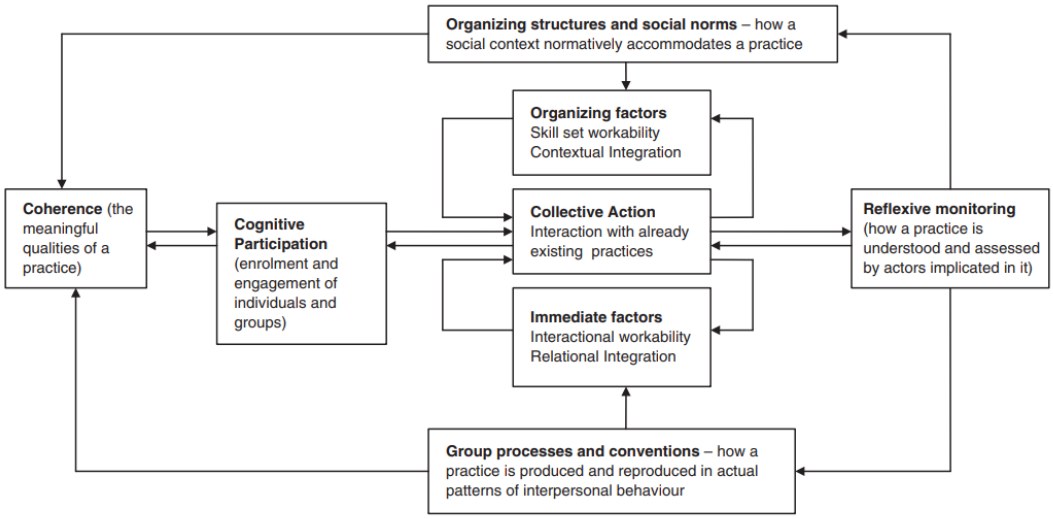


Figure 1 Model of the components of normalization process theory

(May & Finch, 2009, p. 541)

Normalization means the work that individuals perform when they are involved in several activities, this can be any new way of performing, organizing, or thinking, and how this work is embedded into already existing practices or knowledge. NPT includes only those practices that are deliberately planned and organized into a formal social setting and exclude all informal practices that could have been evolutionary and those that lead to cultural forms (Camic, 1986).

The theory proposes three main points:

a. The practices are embedded into routine work in a social context when people work both individually and collectively with one another to implement them.
b. This implementation process is operationalized via four mechanisms, which are coherence, collective actions, cognitive participation, and reflexive monitoring.
c. The production and reproduction of these practices seek agents' continuous investment in sets of actions that happen in a specific time and space.

The theory helps to understand what people do and how they do it. The implementation process is affected by several promoting or inhibiting factors in a social context that in turn affect the embedding of the practice. The implementation and routinization of a practice thus depends on organizing agency and the expressions of human agency that contains dynamic and contingent interactions in a particular social context. The integration of any practice depend on the agent's investment and all the processes are dynamic and they are evolving in time (May & Finch, 2009)

3.3.1 The four mechanisms of the theory

a. Coherence

This component means that how a new practice is understood by actors of the practice i.e. sensemaking. This deals with can actors see the practice different from the existing or past practices, can they differentiate it, what they think about the utility, meaningfulness, and use of the practice. Coherence has further four constructs. The actor's investment in the process is through giving meanings to the intervention.

Differentiation	The actors or participants are (are not) able to differentiate the old and new practices
Communal specification	The participants have (not) the shared understanding of the aims, objectives, or the benefits of a practice
Individual specification	An assessment of individual's perception of the practice with respect to new tasks and responsibilities
Internalization	The teams' perceptions of the benefits and utility of the new practice

(May & Finch, 2009; May et al., 2009)

b. Cognitive participation

This relates to how actors come to take part in the practice and what motivates them to keep on participating in the practice. The actor's investment in the process is through being committed to help routinize the intervention.

Initiation	Reviewing if the key members are driving the change or if they are contributing to direct the new practice.
Enrolment	Organization and reorganization of participants and teams to mutually contribute to make a new practice work
Legitimation	Confirming that participants believe it is appropriate to be involved in the practice and that they can reasonably contribute in it.
Activation	Participants are committed to the new practice and mutually define processes and actions to sustain it

(May & Finch, 2009; May et al., 2009)

c. Collective actions

This is related to how actors try to make the practice work or progress and is associated with organization and structuring of participants' activities. The actor's investment in the process is through putting efforts to routinize the intervention.

Interactional Workability	Participants working in teams to using different elements of practices to operationalize them in the context so that they become a routine
Relational Integration	Maintaining trust and confidence in the team and the practices and building accountability
Contextual Integration	Allocation of management resources and execution of policies and procedures
Skill Set Workability	Assigning tasks that emphasize the division of labour enforced by new practices

(May & Finch, 2009; May et al., 2009)

d. Reflexive monitoring

This reflects the evaluation of the practice, measuring its effects and how it is evolving or changing over time. The actor's investment in the process is their ability to comprehend the intervention.

Systematization	Establishing how useful the practice is for participants and actors
Communal appraisal	Evaluating the value and usefulness of the practice by formally or informally working across the teams
Individual appraisal	Assessing the context and the effects of the practice on team members
Reconfiguration	Assessment by individual participants or groups that can lead to improvement and modification in the given practice and redefining the procedures

(May & Finch, 2009; May et al., 2009)

3.3.2 Why applying Normalization Process Theory?

The reason to apply Normalization Process Theory (NPT) for this study is that it is related to the implementation process and its evaluation. When we look at Diffusion of Innovation theory, by Rogers (1995), it is particularly focused on the adoption process of innovations and on early adopters who are engaged in new products (Rogers, 1995; Strang & Meyer, 1993). Some psychological theories, as Theory of Planned Behaviour (Ajzen, 1991) intend to explain relationship between intention and action of actors regarding specific practice in a particular context. It has been criticized for assuming too much about the relationship amongst attitude and intention (Ogden, 2003) and it focuses too much on correlation while ignoring causes (Weinstein, 2007).

Many theories are intended to predict the outcomes of an event and move beyond the explanation this event which is a significant theoretical challenge, and many theories fail to meet this (Gorski, 2004). The reason can be difficulty associated with taking into account the causation in a social process, i.e. complex interaction between elements of the process (Kern, 2009). The advocates of NPT argue that all social processes are emergent (Sawyer, 2005) and they are evolving, so predicting the outcomes can be problematic. The social processes are complex that may involve many cofounders and actors that may affect the outcomes as the processes are continuously produced and reproduced so transformation happens (May & Finch, 2009, p. 548).

4. Methodology

4.1 Research Method

This study uses the epistemology of constructivism and theoretical framework of Normalization process theory as research lenses to explain the research questions (Savin-Baden & Major, 2012). Constructivism is about constructing knowledge through experiencing. Research argue that individuals construct knowledge when they experience something, develop understanding of it and then they reflect on these understandings or experiences (Honebein, 1996).

This research is a qualitative case study, and a single hospital has been taken as a case where a complex intervention (Blood sampling application) has been introduced to improve the health logistics process. More specifically, this is an exploratory pilot case study that is the part of an initial phase of a significantly larger longitudinal study. As far as classification based on research methodology is concerned, this is an evaluative case study where the evaluation of an implementation process is executed and its consequences on employees' work are studied (Savin-Baden & Major, 2013, pp. 157, 284). The findings will be valuable to adjust the intervention, the implementation process, and the system accordingly so that it can be established in other settings (hospitals).

4.2 Sampling Method

The sampling method used for this case study is non-probability sampling where initially, the IT team was approached through purposive sampling as they were thought to be information rich sources of data and who could possibly guide us to some other useful participants. So, the rest of participants were selected based on snowball sampling approach. Snowball sampling is considered when participants belong to a hard-to-find population (Heckathorn, 2011; Renjith et al., 2021).

4.3 Data Collection Method

In research a term, "triangulation" is used and it is one way to enhance the validity and credibility of research (Cohen et al., 2017). Denzin proposes four types of triangulations that include, data triangulation (includes different time periods, space, and people), theoretical triangulation (using different theories and frameworks to support the research), investigators triangulation (using a number of researchers) and methodological triangulation (using variety

of data collection methods e.g., observations and interviews etc.) (Denzin, 2017; Noble & Heale, 2019).

Triangulation was used for this study by collecting data from various stakeholders (IT team, laboratory staff, nurses from different departments) who were either involved in initiating and developing the intervention or those who are actually working on it on daily basis. Observations and interviews were the main data collection approaches for this study. A lot of useful information was gathered during three observation sessions in the hospital where data was collected from different stakeholders of the blood sampling application.

Observation No.	**Date**	**Description**	**Duration**	**Type**
1.	15.02.2023	Showcasing of the overall Digital Health logistics system, PowerPoint presentation, visit of different departments	240 minutes (09.00-13.00)	On-site
2.	21.04.2023	Observation and discussion with nurses from the cardiac medicine department and an IT professional trainer nurse.	75 minutes (9.15-10.30)	On-site
3.	21.04.2023	Observation of the Laboratory, how the digital and decentralized blood sampling system works and is organized at the laboratory	20 Minutes (13.00-13.20)	On-site

To answer the research questions, semi-structured, in-depth interviews were conducted with eight health care employees during six sessions in a Norwegian hospital. The interview guide along with consent forms were already sent to the participants through emails before interviews. The duration of the interviews was between 30-60 minutes. Four interview sessions were organized through “Microsoft Teams” while two interviews were held on-site. In semi-structured interviews, some questions were pre-set while some additional questions were asked according to the responses of the participants. Semi-structured interviews are a valuable source to collect data when the investigator knows that he has only one chance to interview a given

respondent, when there are many researchers collecting data for projects and time is limited (Savin-Baden & Major, 2013, p. 359).

No.	Interview Type	Department	Date	Duration	Note
1.	Group Interview (2 participants)	Klinisk IKT (Imatis)	27.02.2023	48 minutes	Microsoft Teams
2.	Individual Interview	Gastro-surgery	31.03.2023	36 minutes	Microsoft Teams
3.	Individual Interview	Cardiac medicine	05.04.2023	43 minutes	Microsoft Teams
4.	Individual interview	Cardiac medicine leader	21.04.2023	32 minutes	On-site
5.	Group Interview (2 participants)	Laboratory	21.04.2023	60 minutes	On-Site
6.	Individual Interview	Gastro medicine	28.04.2023	40 minutes	Microsoft Teams

4.4 Data analysis

Interviews were audio recorded and were transcribed with the help of software, "Microsoft Word Transcribe". Some interviews conducted on the "Microsoft Teams" were auto transcribed with the help of "Record and Transcribe" function available in it. These transcriptions were further corrected verbatim through listening the audio recordings again. As the interviews were in Norwegian, the corrected files were translated into English with the help of "Translate" feature in the Microsoft Word. The translated versions were further validated by two of our colleagues who knew Norwegian. Deductive Thematic Analysis was performed for analysing and interpreting data using Normalization Process Theory by May and Finch (2009).

4.5 Quality issues in research

4.5.1 Validity

Validity in qualitative research, can be explained by primary criteria which are necessary requirement of a qualitative study and it include, credibility, integrity, criticality, and authenticity (Whittemore et al., 2001) and choosing the criteria depends on research question and philosophical stance of the researcher (Koch, 1994).

4.5.2 Credibility and Authenticity

Credibility means establishing confidence that interpretations of the data are accurate and are true reflection of participant's descriptions of the context (Carboni, 1995). Authenticity refers

to depiction of research that reflects the meanings as perceived by the participants (Sandelowski, 1986). Credibility and authenticity are closely related and demonstrate the descriptive and interpretive validation of the data (Maxwell, 2012). By credibility and authenticity, some issues of validity e.g., inadequate depiction of the participants, distortion, and biases can be addressed to ensure the quality of research (Whittemore et al., 2001).

For this research, it was presumed that it would have been difficult to approach the hospital staff once again after interviews in a short period of time, therefore, credibility was made sure by making the transcriptions available on the Microsoft Teams for all the participants in online interviews. During the other interviews the participants were asked to explain a bit more about certain situation/issue or challenge so that the meanings are clear. The analysed data and themes were discussed with one of our research fellows who was also the part of the project. The findings were also discussed with the supervisor. To ensure credibility, most of the statements with explicit meanings have been considered through semantic coding and several statements with hidden meanings have not been included (latent coding).

4.5.3 Confirmability, Subjectivity and Integrity

Confirmability means that the researcher has been neutral throughout data analysis and interpretations. (Savin-Baden & Major, 2012). Interpretive research is characterized by subjectivity that values the unique interpretation of data by the researcher (Johnson, 1999), but integrity should be there in the process to make sure the validity of interpretations. The subjectivity issues related to interpretations of data require a conscious effort to assure the integrity in the research. To ensure integrity in findings, the ambiguities were recognized and cleared by triangulation and data checks with colleagues (Whittemore et al., 2001). Throughout analysis and interpretations, all these three domains have been taken care of by being neutral, through unique interpretations and by making sure that interpretations reside in the data.

4.5.4 Transferability

Transferability means the research findings can be applied to other situations with similar contexts (Savin-Baden & Major, 2012). This study is basically about the evaluation of outcomes of a complex interventions like decentralization and digitalization of the blood sample taking process. Many issues and challenges have been explored with respect to the implementation process and impacts of these interventions on employees. So, anyone dealing with the similar context can apply the research findings, but the responsibility lies with that person.

4.5.5 Dependability

It means the research finding are dependable and will endure over the time but it is required of the investigator to mention the context of research (Savin-Baden & Major, 2012). As this research study deals with the implementation of intervention and implementation processes are always dynamic and iterative in nature (May, 2013), therefore, the research findings in this time window may not persist longer.

4.6 Ethics and Ethical Approval

Generally, in-depth interviews are either unstructured or semi-structured, and are held with either one person or pairs/team. The interviewer may want to discover fine details of the participants' experiences. The in-depth nature of such interviews would require critical observation and analysis by the ethical committees and these interviews are subjected to scrutiny by the concerned ethics committee. Some important ethical issues are related to privacy, confidentiality, and informed consent of the interviewee (Allmark et al., 2009).

For this research project, NSD approval has been obtained from Norwegian centre for research data, reference # 997018, attached in the appendices. Some ethical principles have been taken care of for this study such as the informed consent, confidentiality and anonymity of the informants (Gajjar, 2013).

Before primary data collection, the informants/participants of the research were sent the information letter, the consent form, and the interview guide so that they would be aware of the research objectives and be able to provide their consent to participate. The participants gave their consent that they were voluntarily participating in the research process and that they could withdraw their participation if they wanted. The informants were informed that their interviews would be audio recorded and be transcribed later. For online interviews, the informants were informed that their interviews were going to be recorded and transcribed in "Microsoft Teams" and they gave their consent. Prior to the interviews, the consent forms, information letter and the interview guide were sent to the participants. The names of the participants are kept anonymous in the findings and results. All the recordings or any data that can identify the participants would be removed from the system in June 2023. The audio recorded and transcribed files containing the names of the participants were not shared with anyone else other than the research associates, the participants and the supervisor.

Further, during the first field session held with the hospital, an agreement was signed with the hospital where the privacy concerns of the hospitals were agreed upon that the patients' data or any sensitive information would not be disclosed in the research report. Some names appeared in the quotes were just random names used by participants to explain the concepts and they cannot be traced to any specific individual, employee, or a patient.

4.7 Research Analysis and Findings

4.7.1 Findings based on observations

In the first round, we were invited to the hospital as the IT resource management had planned to showcase the digital solution to health logistics system.

4.7.1.1 First session

Date: 15.02.2023	Observations
1.	We attended the presentation held by "Imatis asset management team" who gave the briefing about the overall digital "Imatis" system and explained how it has contributed to the improvement of overall health logistics system. The system primarily helps in ordering porters, cleaning, food, blood sample taking, guards etc. The system has helped in efficient patient management regarding transferring patients from emergency to wards, transferring aged patients or patients with acute diseased quicky from waiting areas to other zones, treating risk groups and infectious patients separately, managing hospital capacity, arranging for patients' discharge out of the hospital etc. It has also helped in efficient human resource management by giving an overview of how much staff is available and how many more need to be there to fulfil the demand.
2.	We were taken on a hospital round where we visited different departments and could see how digital system is assisting the healthcare staff in their routine work. We could see how porters, cleaning and food are ordered and how it looks like on the digital electronic boards.
3.	Most interestingly, we could observe how the Pipepost system (Rørpost) works that brings the blood samples to laboratory i.e., how blood samples taken in the respective departments by the nurses are put into the pipepost.

4.7.1.2 Second Session

In the second session we got an opportunity to talk to leader of Cardiac department as well as some specialist's nurses in the cardiac department. Following observations were recorded.

Date: 21.04.2023	**Observations (Cardiac medicine Department)**
1.	We were shown how employees scan their cards to log in to their mobile phones (rollefoner) provided by the hospital. And how the interface looks like on the digital boards and on the mobile phone. There they can check for which patients, blood sampling has been ordered, which blood samples have been taken at what time, which are waiting to be answered and which have been answered. There are different colours (yellow, blue, red and green) that separate all these categories to give a clear picture so that blood sampling system can be made efficient e.g. red and green are those that are answered (have been analysed), green with having values within range and red anomalous answer.
2.	After discussion we could get an impression that a few nurses forget to log in, as they have "shift switches" (from quarter past seven to quarter past seven), so "logging in" is the first thing that one must do while starting the shift. They have one deviation from the digitalized practices where they take signatures of nurses on a paper who have logged in to their mobile phones (rollefon). This is to make sure that all have logged in on the specific mobile phones (provided by hospital). But for blood sampling application, they must log in, otherwise they cannot proceed with the blood sampling process.
3.	There is no integration with other systems like DIPS or MetaVision. For DIPS, there is a simple icon in the Imatis system. By clicking on Dips Icon one can jump into Dips but still there is a lot of double work in this regard.
4.	There is still manual work in an attempt to keep records of important things because they cannot rely solely on technology. For example, at moments if the app goes down, they need to have an alternative. They go to the patients with their notes and pencils.

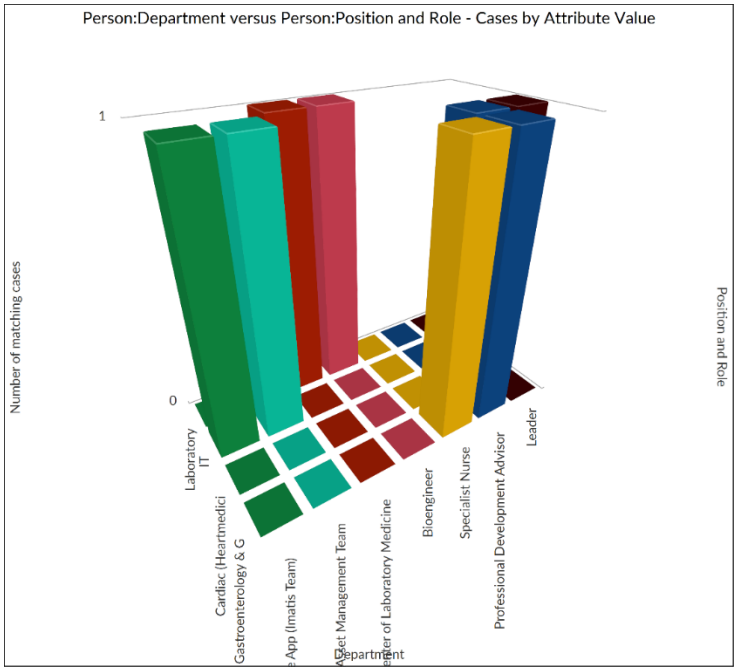
4.7.1.3 Third Session

Third session was with laboratory staff where we could observe how the system looked like in that setting.

Date: 21.04.2023	Observations (Laboratory)
1. Observation of the digital board, it included less patients' details than those being shown down in the departments' boards. For example, just the patient's personal number but down in the department, the name, the age and other stuff is shown on the digital boards.	
2. They can observe how many "etterstikker" are ordered. How many patients need help with blood sample taking by the laboratory so that they can send one of the laboratory persons down to help with sample taking.	
3. We observed how blood samples are received from the pipe post system (rørpost) by a laboratory person which are then manually put onto the sorting machine. The tests are performed, and the results are posted in Dips by the laboratory staff. Once the results are entered, they are available down in the respective departments.	
4. If there is a little queue down, the laboratory helps by sending their people to help with blood sample taking. The system is updated every day.	

4.7.2 Interviews

For analysis of data NVivo 1.6.1 has been used. In total eight participants were interviewed during six sessions. The roles of the participants and their respective departments are shown in the chart.



Out of 8 participants, two participants were from laboratory, two were members of IT department, two participants belong to cardiac medicine department, and one was from gastroenterology and one participant was from gastro surgery department. The participants included one departmental leader, two professional development advisors, one specialist nurse, one bioengineer, one trainer on the app, one member of the asset management team and one advisor for the centre of laboratory medicine.

For analysis of qualitative data, thematic analysis has been used that requires the data to be searched for identification, analyses, and reporting recurring patterns in it. Thematic analysis is not restricted to be used for any specific research paradigm, but can be used equally well in constructivism, post positivism etc. (Braun & Clarke, 2006).

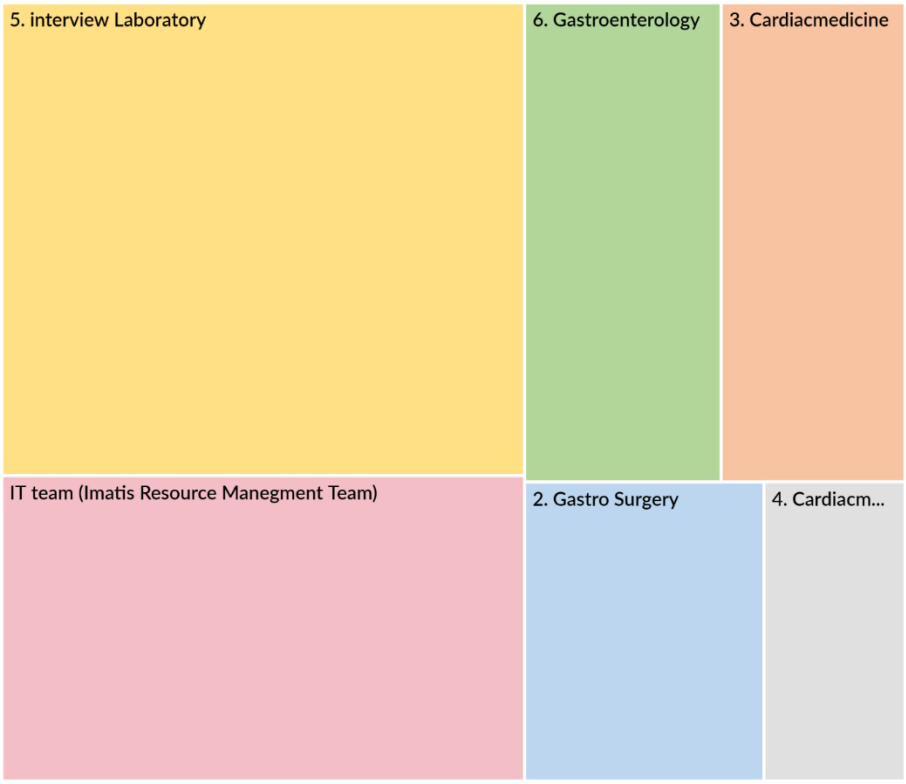
A theme is defined as, “a patterned response or meaning” (Braun & Clarke, 2006, p. 82) where this theme emerges from the data set that helps answer the research question (Kiger & Varpio, 2020). Themes can be categorised as semantic or latent themes. Semantic themes relate to more

explicit meanings of data and latent themes exhibit deeper inherent meanings, beliefs and assumptions (Braun & Clarke, 2006).

Thematic analysis involves describing and interpreting data while picking codes and creating themes. Thematic analysis is flexible method, and it can be used in several epistemological frameworks and can be applied for a variety of research questions, and study designs with different sample sizes. But the choice to choose thematic analysis should be based on the research goals (Kiger & Varpio, 2020). It is argued that this is an appropriate method for a data set that includes participants' behaviours, experiences, reflections and judgments (Braun & Clarke, 2012).

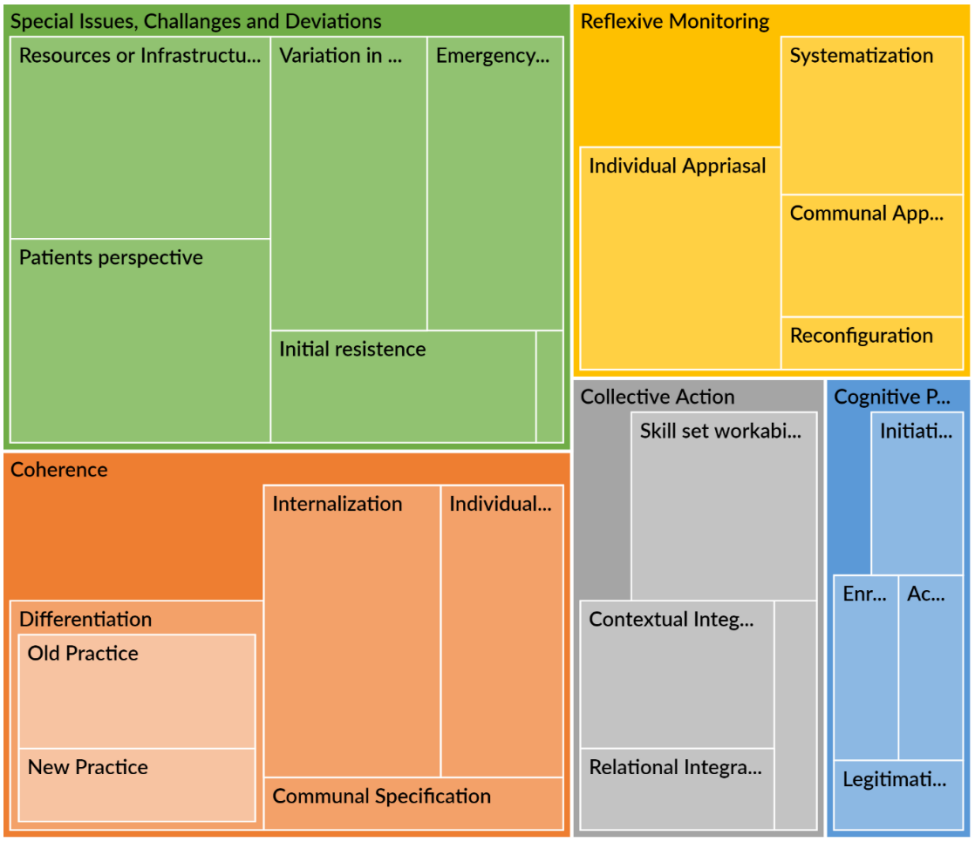
For coding of data, either deductive or inductive approach can be used. In deductive approach, coding framework is guided by specific theory or theoretical framework, whereas in inductive method, significant issues in data are identified and the themes are derived explicitly from the entire data coded. In deductive thematic analysis, themes are derived from the theory or theoretical framework and the main focus is on specific portion of the data or relevant questions (Braun & Clarke, 2006). For analysis, the deductive thematic analysis is used where the themes have been organized in the data according to constructs of normalization process theory.

The proportion of coded data contributed by each interview session can be seen below.



Most of the coded data can be traced to the laboratory at first and the IT team at the second place. They had more to share because laboratory was the key driver who initiated the process and IT team was also involved along with laboratory in the development and training of the intervention. They had a general picture of the overall implementation and routinization of the process in the whole hospital.

Below are the themes with respect to the coding references.



Detailed coding references for each sub-construct are given in appendix 3.

4.7.2.1 General findings based on NPT constructs

Here are some general findings regarding NPT's basic constructs, coherence, cognitive participation, collective action and reflexive monitoring.

1. Coherence	*"because earlier we had to... There was a bit of work around that. For earlier so ... even though I've got 2 glasses, it kind of ruined the lines of DIPS then. It looked like I've taken all, maybe, or not taken all. But now it's changing through the app."* **Participant 4** *"So I also find that if you also know the reason for doing it, don't just think that this is a system that gets pulled over your head because you just have to. But if you tell why, you should actually use it. So, I find that better understanding back then from the users."* **Participant 1** *"Yes, at first it was a bit like that. Wow, do we have time for that? but we saw that soon it was that things went a little faster compared to taking blood tests on the night shift, and it was finished to the doctor's visit, so things got clarified faster then."* **Participant 8**

2. Cognitive participation	*"Now it was rolled out, we chose to take it on teaching day to meet all at once. We divided staff into 2 groups and had classes every six weeks, so we chose to bring them in there to get everyone to be informed equally about this here so that she had as many as possible and my manager too, we have kind of talked about it and thought that there is good then for patient safety."* **Participant 8** *"Yes, there were day courses and there were 2 days of training in the department. So, it's very systematic, and when there was the introduction of the blood test app, we were trained on it. Then they were here in the department some days in a row I remember, where we got the introduction of it, and then it was kind of like going to shoulder training afterward"* **Participant 3**

3. Collective action	*"Then it is yes, must cooperate, and notify each other who is taking the blood samples, and it is often the health science professionals who take the blood test, but if someone did not get taken, or can you help me with it, because it's a little too much or that you collaborate. So we have a beautiful responsibility and a nurse who goes who is on duty, who is responsible for the whole department and who contributes and assists with blood testing very much"* **Participant 5** *"We've got 2 people there that are kind of out there a lot, and I certainly felt that way when I was out that they feel like it's a very short distance to contact you guys that you're very much like that known among out on the posts has sort of. That, I think, they feel like it's easy to ask you guys something and get in touch if it's something somehow."* **Participant 6** *"Yes, I get a lot of emails and calls and sending samples and stuff like that yes. I think, they feel, that it's a short distance to you. Then it's a short distance to "etterstikk". We've put a phone and stuff like that. So, it is possible to contact us."* **Participant 7**

4. Reflexive monitoring	*"I took a little round now in the department before we started the meeting. So, it was unanimous that they were very happy with the app."* **Participant 4** *"If you're going to extract statistics, then I think maybe the lab is the best starting point to be able to do it"* **Participant 4** *"we probably don't have very good statistics in terms of how much it uses the app."* **Participant 5**

Participants showed great degree of coherence, cognitive participation and collective action. But as far as reflexive monitoring is concerned, the departments are mostly aware of the

informal appraisal of the app. There is no formal appraisal system. Participants agreed that the nurses and healthcare professional are very satisfied with the application.

Below is the detailed analysis based on the sub constructs of NPT constructs.

a. Dimensions of coherence

1. Differentiation	**Old practice** *"We have a system called Synergy for reporting errors in the hospital. A source of error is what we call ID errors, i.e. blood tests on the wrong patient. The error rate was probably high in the hospital "X", so they needed to improve it."* **Participant 1** *"There are a lot of different discrepancies, but in this context then, and that was part of the reason for the app and was that what we got was an increase in the number of ID errors."* **Participant 6**
	New Practice *"With the new blood test app, Per (random name) will scan the sample with his ID card so that the system can link the correct sampler to the sample. Then he picks up those notes, finds the right glass, and starts by opening the blood sampling app."* **Participant 1** *"And then he scans the labels and gets hits if it's the right label he's brought with him. If he has been wrong, he will get the error message that this is not the right test for this patient."* **Participant 1**

2. Communal Specification	*"While we felt more that it will ease our working day so that we can take the blood samples ourselves when needed."* **Participant 8** *"But it is about changes then and being willing to change and introduce changes. And I think we have a great willingness to change if we now only have health service in general. It has to say that. It's constantly changing, and we're in on it too mostly positively."* **Participant 3**

3. Individual Specification	*"Then you can order "etterstikk" on the app, and if I take a blood sample from then such a catheter that I have on in my throat for example, then I can on the app as we add a comment that the sampling is taken from another place. Then I don't have to print it out here as I explained."* **Participant 3** *"That is. It's kind of like that. Yes, that's an advantage. There is a certainty that you are taking it right and that there will be no trip with the lab. If it gets sudden, then the blood samples can hang in that one called the rørpost (pipe post), and then maybe it's too late, and then the lab thinks it's been too long (late). You have actual proof that you have taken it."* **Participant 5** *"At that time, a label was printed from the computer system with which samples should be taken and the personal ID of the patient. And then you went with equipment and that label to the patient and got a double check by the patient seeing what he had and full social security number then. Whereas today, we scan the label."* **Participant 4**

4. Internalization	*"And then it will be the exact time before sampling…."* *"which is also safe with the blood test app is, that it is the correct sampler."* **Participant 3** *"The operation is much smoother and there are both advantages and disadvantages With that, but It's a lot about finances"* **Participant6** *"The advantage is that you have a phone, which you have everywhere anyway, okay to print the label content bases and what we feel, it is pretty safe compared to scanning a little short scan of the patient. And if you have other comments, then you post them directly in the app instead of before we printed somehow the whole requisition written on sheets, if it was something like that in particular, and see everything inside the app"* *"But I think the quality assurance is there in that you scan the patient and scan the labels and you kind of get notified."* **Participant 8** *"it is first of all, traceability is important."* *"if you want to follow the correct work process and use the blood test app, if you get the correct identification of yourself, the patient and the time of the test."* **Participant 1**

The participants can differentiate the new practice from the older one and are aware of its potential value (Differentiation and Internalization). Informants showed positive impacts on their individual work and stated that they have developed a shared understanding of it. They confirmed the ease of use and positive effects of the app on their individual work as well as on the overall department. They can take the blood tests as and when needed and can update the time in the app immediately. Moreover, they can order "etterstikk" (help from laboratory) immediately through the app if they are unable to prick some patients. For some the app is time saving as they can save time from printing out the labels by moving back to workstation and can directly update the time of sample taking in the app. For some employees, the app is useful in tracing which patients lack an arm band (with QR code). This is obligatory to scan the

patients' arm band to proceed in the blood sample taking app. as they use the patients' arm bands for multiple tasks in the overall digital health logistics system (Imatis system), there they can trace which patient lack or lost the arm band. So, they can print a new one (Individual and Communal Specifications).

b. Dimensions of cognitive participation

1. Initiation	*"now it is the laboratory that has been responsible for introducing this here with the blood test app."* **Participant 3** *"Yes, it's all about leadership. As I said, those in the emergency (Acute) geriatrics have clear leaders, and they use it the way they should. They love this system"* **Participant 1**

2. Enrolment	*"Yes, all new arrivals must complete a fairly comprehensive e-learning module. You read a large user manual, and then you have to do a practical test together with the biomedical laboratory scientist before you can be allowed to stick."* *"Yes, I think we rolled out on pretty much the entire hospital. So the laboratory had one and one department inside at a time,"* **Participant 1**

3. Activation	*"I think the vast majority of people now are a lot of young people who work there, and they're used to wearing phones and stuff, so I guess it's just a tool that gets used simply."* **Participant 8** *"some users also use our biomedical laboratory scientists, so even though there are no decentralized samples, the app is in use."* **Participant 6** *"There's a little bit more acceptance of that, because now it's become part of the routine. Now it's gone... yes, now, yes it's been 8 years, so a lot of the new is coming now"* **Participant 4**

4. Legitimization	*"We have a lot of documentation requirements on us. We are certified and accredited, and we have quite high requirements for traceability on all processes."* **Participant 6** *"And then it's like that when we also have courses like that for new employees once a month, where also this is the blood test is also mentioned then, so we talk a little about it also in the course. It is important to clarify the background for the importance of notification in the event of an error and why you actually do it. It's about patient safety. We use this very often in courses. And that is why Imatis is a mandatory course in the hospital"* **Participant 1**

According to the participants, the employees are aware of the key persons who are driving the intervention that include the laboratory and the IT team (Initiation). They are aware of the purpose of the intervention as all the new commers go through a training course (Enrolment) on the intervention (both on blood sample taking and application) where they are told what problems the intervention will solve. Those who have positive attitude towards the app are actively engaged with it, have positively recognizing its role in their routine work and find it easy to use (Activation and Legitimization).

c. Dimensions of collective actions

1. Contextual integration	*In relation to we three (Imatis team), now we have it in the laboratory that has in a way been responsible for sort of training and stuff on the app. They just made a new movie using the app.* *If we create a new look, we have a dialogue and send emails and ask that this be distributed to the employees in a type of Friday letter. When we changed something in the app now, it was a slightly different way to receive such alarms. Then we created a new description and asked all the section heads to make it known in the department.* *If we see by the numbers that some areas do not actually use the app, we then have to go in and just ask the section leader and ask if we should come on a professional day. There we can emphasize the importance of this and ask how we can help them to make it easier.* **Participant 1** "*but I had to sort of talk to people here at the same time and then we were out there a little bit ourselves as well in a way and or so like that exactly will it be something kind of be trendy*" **Participant 6**

2. Interactional workability	*"Then we have some useful criteria that we've put in the system that make it linger for a manual review. And then it goes into dips and then it's available because there's no manual handling beyond the tests that hang through having an assessment from a doctor then."* **Participant 6**

3. Relational integration	*"And then there was also a lot about the fact that we weren't as good at taking blood samples as the lab was."* **Participant 4** *"No, it was kind of the thing about the quality. It's like sort of afraid to give this up compared to so this was sort of a task that you have learned a lot about in the study, and that we've had for a long time, and that in a way the bioengineers ducked a little bit like that, because, with the quality of the blood tests, you were afraid that it would deteriorate."* **Participant 6** *"I don't think we got any worse training for that reason, then you felt like they had landed, and maybe oh yes, some people still think that's not okay. But still, we were well trained, and they didn't feel anything about it when we were trained by them then."* **Participant 8**

4. Skill set workability	"*We were trained in this when we were given the competence that we can take blood samples, because it is a delegated task because it is actually the laboratory that did it before, and then it has been delegated to us then nurses and health care workers. Then we were trained on which glass is the right one to use for. So very nice, and it is a very easy digital tool to use."* **Participant 3** *"We have health science professionals that have blood test training that takes blood samples and the nurses. So, everyone must go through a kind of training, with learning and theory, and then 2 days of training."* **Participant 5** *"not everyone works in all phases, etc. It's divided."* **Participant 6** *"Thus, it was great work that meant that everyone had to go to training. In addition, nurses must be re-certified every two years to check that they can still maintain the correct glass for the correct sample."* **Participant 1**

According to the participants, all the employees collaborate with one another to work on and routinize the intervention. Some parts of the intervention are integrated with the past practices e.g. the pipe post system (courier at hospital), and partial integration with DIPS (where the test results are shared and assessed), and some parts are completely unique where employees collaborate to work on them (Interactional workability). The IT team's support is there who frequently ask the department leaders if they have any difficulty practicing the app and arrange professional training courses for the specific departments if needed. The laboratory support is there in case some patients are hard to prick, the "etterstick" (help) comes from the laboratory to assist. Moreover, if there is a little queue down in the departments, they can always call the laboratory for assistance (Contextual Integration). Most of the departments have rescheduled their blood sample taking activity and it is done around 5.00 or 6.00 am early morning, so that the samples are sent earlier to the laboratory (who start their shifts at 7.30 am) and analysis is performed and updated on DIPS before the doctors' visits (10.00 am). For this rescheduling, different healthcare employees have divided the tasks between them. But the training is must for everyone (Skill Set Workability). The laboratory is responsible for training the staff (on both blood sample taking and the app) and maintains confidence in the workforce abilities to take blood samples and work on the app (Relational Integration).

d. Dimensions of Reflexive Monitoring

1. Systematization	*It's just so that I take out the number of samples on the apps used, and then I take out, yes, the total number of samplings and then I've put them against each other. It's nothing, so it's not the kind of finished report that I get out. There are only some Excel extractions I've done so I've kind of patched them together."* **Participant 6** *"We have not taken out any statistics on the use of the number of samples in relation to the use of the app. we've talked to the lab about that, and we're going to try to get some numbers out."* **Participant 2** *"No, we haven't any number on it other than I know we had a bit more trouble with it before Where when the lab called us often, they were taken off, and then it says here it's wrong or a little more like that phones and requests"* **Participant 8**

2. Individual appraisal	"*Whereas now when we have the blood test app, it's absolutely superb. It may not see anything negative with that blood test app."* *"I think it doesn't save that much time, but it increases the quality then."* **Participant 3** *"It will be the distance between the workstation and the patient room. We save time by [not] going back and forth there. We also save time by not having to print requisitions and send blood samples, so that's what we save time on."* **Participant 4** *"So, would at least say less manual work for us then for correction in terms of changing time and stuff. The timing of sampling it is updated at least so. Em, there will be less manual work there."* **Participant 7** *"I think that this app is the only real solution to internal errors,"* **Participant 6** *"Yes, it's a comfort into my routine to use that app."* *"then we've noticed that there are fewer samples that we get back that aren't analyzed then because of that time window."* **Participant 8**

3. Communal appraisal	*"No one has any negative objections to it. Yes, everyone uses it."* **Participant 3** *"it happened (before the app) that we had taken the wrong blood samples from patients with the wrong labels, but have not received any synergy cases on it after the app was used."* **Participant 4**

4. Reconfiguration	*"We haven't had any more follow-up, but it's something that we can have and examine how many people use it interestingly, really."* **Participant 4** *"Yes, we used it a lot in that onboarding (introduction phase) process, then we spent a lot. I took a lot of expressions to see if they actually used it when we had been there for training and kind of been there for an introduction."* **Participant 6** *"I don't think it's worth updating. Not that I can remember myself"* **Participant 8**

The participants were quite satisfied with the use of blood sample taking application as they mentioned several benefits of using the application and how this app has added comfort to their routine work (Individual and Communal Appraisal). The participants were not much aware of the formal appraisal reports regarding the use of application in the departments, but they mentioned that laboratory can be one useful source to some useful data. The participants revealed the satisfaction of employees regarding the use of application which is a kind of informal appraisal. They showed great interest in knowing some numbers and facts about the use of the app (Systematization and Reconfiguration). When laboratory was asked about the formal appraisal of the application, they could display us a graph that presented the percentage of total tests taken with the help of application (about 50%) against the percentage of total blood tests taken in 2021 and 2022. There was no clarity of how many samples were taken by which specific department or how many samples were taken by the laboratory or nurses. This could have been a useful information if one could see which department is most efficient regarding the use of application and which departments need improvement concerning implementation of the intervention. Similarly, there was no specific data available regarding the use of glass tubes (blood sample containers). If they could see the number of glass tubes used while taking samples with the help of application, they can estimate the error rate and check the effectiveness of the application. But they have a system for reporting errors that is called, "Synergy", if somebody takes a wrong sample, then a synergy case is registered against that employee. The participants agreed that synergy cases have been reduced up to a greater extent since the introduction of the blood sample taking application (Reflexive Monitoring).

4.7.2.2 Special issues, Challenges, Deviations and Recommendations

Some special issues gave been identified during the interviews and it seem appropriate to deal them separately so that proper attention be paid towards them.

4.7.2.2.1 Initial resistance towards delegation of blood sample taking.

Communal Specification (Coherence issues)	*"Yes, the attitude to it was well divided. Because we didn't get any more resources. It was an extra task we had to do."* **Participant 3** *"Patient contact. That's what a lot of people talk about, yes, liked it before."* *"Hmmm, we had face connections then in a way. Now we're just behind machines and like that. If you guys are in the hospital, they never see bioengineer at all"* **Participant 7** "*There was so much to sting that we had a chance otherwise"* **Participant 6**
Individual Specification (Coherence issues)	*"What I remember most was that there was a bit of a bad atmosphere between the lab and the ward that they felt that we were taking away their duties."* **Participant 8** *"There was opposition to it from the biomedical laboratory scientists and from those who work out on post because it is a three-year education to be able to take blood samples. So, there was a big job that had to be done to train a whole staff of employees who have never taken blood samples before. They hadn't dealt with what we call glass expertise, maintaining the right glass to the right test. and so, which is an important part of this here with blood sampling."* *"They're much less out now. They used to come with trolleys every day, right? And had such close contact with everyone, but now it's only when it's needed (etter stikk) then."* **Participant 1**

In the start, when decentralization decision was taken, some form of lack of coherence was seen especially from bioengineers' side. As blood sample taking is a certified competence and

not everyone is competent enough to take blood samples. There were a lot of doubts about quality issues and lose of patient contact those bioengineers had before.

4.7.2.2.2 Variation in implementation

Enrolment (cognitive participation)	*"The day shift does it. We are trying to introduce that night shifts can take blood samples from the patient we think is ready for discharge so that we have early results from the blood tests. Some day areas take blood samples, and the night shifts take blood samples so that it is ready until early in the morning. I know, but we don't have that as a routine."* **Participant 3** *"But that means it's perfectly fine that we can say 70% of employees do it and then 30% don't,"* *"True and those who don't work nights may use the app a lot less than others, so those who work only nights use yes. It is all the time. A bit of variety there. Surely some co-workers have never used it because they never take tests, because they have a weekend position... or yes.."* **Participant 4**
Legitimation (cognitive participation)	*"but we saw that there is a higher usage on the ward than in the emergency department, significantly, higher."* *"Then the nurses have to take the test themselves in all wards, except psychiatry and children."* *"there may have to be a lot of very difficult patients who are unable to take, then there are several bioengineers there and have to take a little samples then."* **Participant 6**
Skill set workability (collective action)	*"Yes, there are areas that are not decentralized. Yes, so were children. If it is not decentralized and in outpatient clinics it is not decentralized and not mental health care."* *"That's because they have so few patients being stung. The nurses there are not allowed because they do it too infrequently. They can't maintain their expertise."* **Participant 1**

4.7.2.2.3 Specific issues with emergency department

Communal Specification (Coherence)	*"The emergency department is hard to come by."* "*Yes because that emergency department has made Wearing something a little like shortcuts? And with this one, the app then force them into the correct path and it takes longer yes,"* **Participant 6**
Individual Specification (Coherence)	*"Then you go down to the emergency room and take a random person there, then you say you know it there we can't use, because it takes too long, whereas if you go to emergency geriatrics, you say we use it every day. It's 100% used to it's awesome, so it's kind of like how you've kind of implemented, I think and who's kind of implemented"* **Participant 1**
Enrolment (Cognitive Participation)	*"It's a job to do it here, but I'd like to say something like that about the history of the emergency department. Because it's also about the one there, i.e. implementation time. What is the right way to do things and how to reach everyone too? Acute geriatrics, which is perhaps a success story, is a department that has very clear leadership. They have succeeded in what they have done. The emergency room (Akkutmottaket) is on the opposite end. They have had some challenges in using Imatis. They have also had some performance challenges,"* **Participant 2**
Initiation (Cognitive Participation)	*"Yes, it's all about leadership. As I said, those in the emergency (Acute) geriatrics have clear leaders, and they use it the way they should. They love this system, so it's not been a problem, but we've got a job to do in the emergency room to get the managers on board. Because it must be the manager's responsibility to tell the employee that this is something we should use, and then it must be the manager who thinks it is important"* **Participant 1**
Interactional Workability (Collective Action)	*"That's how we reach another task to be performed on the phone. Then it settles on an already negative experience when using products and phones. So, we may not only blame the app as such for this. They probably haven't even given it a chance"* **Participant 2**

4.7.2.2.4 Infrastructure Issues

Contextual integration (collective action)	*"An employee who cannot log in using his ID card, and who must log in with a username and password. But he's not complaining. IT has tried to help, but they can't figure out why it's not working for him."* *"But it doesn't go as if manually entering, so that's a challenge for him then."* **Participant 3** *"After all, not many people are fond of change. It often takes some time for us to get them well incorporated into new routines then. We have also had some problems with some of the phones where it was not possible to scan."* **Participant 4** *"No, there have been some Wi-Fi issues lately, so it was very silly that when that people haven't used it, ……,so the hospital partner has been here and arranged with the access points to determine what was wrong then."* *"But we have also had some challenges with Wi-Fi at Sykehuset which in a way has made you have a bad relationship with the apps. It is negative that the app hangs up and takes so long"* *"They don't really have time to report either that they somehow complain about it, but at the same time they're sort of so pressed on with this that they don't report either, but it doesn't get better either, so it's not good news. Man can't bet that if you don't hear anything, everything works. It's not always like that."* **Participant 1** *"Those are some of the departments, there is a little worse coverage on, so there are some places it says that on the phone that you do not have any coverage, so then it is a bit worse. I've noticed now I've been out doing and so on."* **Participant 7** *"So it is under constant improvement and thus if they report, that it is wrong, then no action is taken pretty immediately. I simply lost my Wi-Fi, and then I reported it to my hospital partner, and then it was arranged the next day."* **Participant 2**

There is little variation of routinization between the departments and within the departments. The application is not used by paediatric and psychiatry departments, because blood samples are not taken very often there and it's all about finances. This requires considerable sources to train the staff. In the cardiac medicine department, according to one rough estimate given by one of the participants, about 70% healthcare staff use the app. In gastro surgery and gastro medicine departments, all the staff members use the app.

In the emergency department, some issues have been reported by the participants that the healthcare professionals do not use the app and the leadership there do not participate to encourage practicing the app (intervention). The emergency department employees have much to do, maybe they have to deal with around 150 patients each day. They are used to shortcuts (do not print labels etc.). But the usefulness of the app is irrefutable there as it can really help to prevent errors and mistakes and can assure quality. On the other side, the emergency geriatrics has very clear leadership and the app is fully routinized.

There were also some issues related to Wi-Fi coverage reported by some participants. Wi-Fi coverage was little poor in a few departments where app frequently hanged, so leaving the process little time-consuming instead of making it timesaving. the participants claimed that employees in those departments do not find enough time to complain against the poor internet coverage.

4.7.2.2.5 Patients' Perspective

Individual Specification	*"Then we can discuss whether it's time to wake patients up between 0 5.00 and 06.00 and this is not exactly as humanized, but that's what it takes for to work then."* *"yes, the idea of it doing so early that we should take it. We were supposed to get an answer early so that the doctor's visit can go early and discharge is also earlier."* **Participant 4** *"Yes, some react that it can be very early that we wake (them) at 5, 06, but we are going to be able to do what we're supposed to and the doctors can react if we don't have blood samples taken and so it's kind of like that. Yes, but it's not good to wake them too early,"* **Participant 5** *"maybe for older patients themselves, maybe it feels like we're coming with these phones all the time. We don't know what we're doing on that phone. Do you think we run and read news and Facebook? Or it's kind of like maybe you felt more seen as a patient because all these electronic things came with nurses in, and then you tap the screen there for that, and then there's the blood test app there and then right. There's a lot going on a screen."* **Participant 6**
Internalization (Coherence)	"*We had the case the other day where there were some parents who thought it was very uncomfortable that we were walking around with the phone that's going to scan and is going to take it on the kids, then we're going to scan the bracelet and film sort of that's it, it's a camera in a way. They found it a little uncomfortable to be around a camera to an inpatient child than if it was, but even though it's only used for scanning and not recording, or anything like that, I found it a little uncomfortable*." **Participant 7** *"Now it is finished, patients were stung enough through a hospital stay so we needed to stab them several times in a row sort of because of mistakes."* *"And I think we don't think much about it, so somebody thinks we've occasionally taken pictures of them then when we're going to scan them and stuff. We need to explain that we don't picture, we just scan QR codes and like that."* **Participant 8**

4.7.2.2.6 Recommendation

Reconfiguration (Appraisal)	*"I think we might not be able to change perhaps, but one might wish for an expanded use compared to the fact that now it is to blood tests, while there a lot of other different samples are taken here at the house, also that we could use it for several different sample materials. For example, they take samples from wounds or throats, or a lot of different things are taken. So, there's nothing maybe that we could get width into several different em try out different sampling then."* **Participant 6**

When participants were asked to evaluate the intervention (individual specification/appraisal) from patients' perspective, a sense of discomfort was explored while it came to use of mobile phones for scanning the arm bands (with QR codes) of patients. They mentioned that patients often asked if they were taking their pictures. Some patients felt like the staff was busy using mobiles instead of taking care of patients. On the other side, the use of app is positive for patients as the error rate has been reduced and they ae not pricked often because of errors. The blood samples are taken by night shifts so that the results can be presented to the doctors and the patients are ready for discharge from the hospital if test results are okay.

Some participants were so much positive about the app that they would like to have similar interventions for other tests as well besides blood sample tests. There are a lot of specimens that healthcare professional take from patients e.g., from throat or wounds. Therefore, such an intervention can be useful in the overall healthcare process (reconfiguration).

5. Discussion

The research findings give us enough details to answer the research questions. In this section, the research question would be discussed in detail.

5.1 Implementation and Routinization of the Intervention

This is clear that the implementation of the digitalized blood sample taking process follow the mechanism proposed by NPT (May et al., 2009). The employees have a shared sense of understanding of the intervention and the purpose of introducing the app (Coherence). The employees' teams have been reorganized to perform the blood sample taking and then using the application to improve the effectiveness of the process. All the employees and new commers are trained on both the blood sample taking and, on the app (Cognitive Participation). The employees work together and collaborate to make the intervention work effectively. There is sufficient management and laboratory support on working with the app and blood sample taking (Collective Actions). The appraisal mechanism of the app is not formalized yet. There is some form of informal appraisal about the satisfaction of nurses and healthcare professionals regarding the use of app (Reflexive Monitoring).

Through interviews, the background of the digitalization of blood sample taking (the intervention) process got clear. The process started in 2015 with decentralization of blood sample taking process when some laboratory workers were stuck with some of the blood tests (insufficient HR to meet the demand). Therefore, they initiated the process and blood sample taking task was delegated to the nurses in their respective departments. Initially, bioengineers were not positive towards the change as some of them thought they were losing patients contact and now they would have to sit behind the machines. On the nurses' side, the attitude towards decentralization was mixed (relational integration). The laboratory staff trained the nurses who must be recertified every two years to make sure they still maintain the competence.

But how digitalization of blood sample taking started, this is quite new technology-based intervention, introduced in 2021 in response to a greater rate of ID errors which means errors in blood sample taking. Laboratory reported many wrong blood tests taken on wrong patients. Other issues included traceability of time and the sample taker. Although the quality improvement in laboratory is mostly focused on analytic process improvement, the literature emphasizes equal consideration be given to the pre-analytical issues, and highlights the importance of interventions to reduce errors related to pre-analytical phase, thus improving

patients' safety (Da Rin, 2009).The blood sampling app has resolved many of these issues and is being practiced in several departments. All the healthcare employees who are trained on blood sample taking are trained on the app too therefore it is the legitimate part of their work. All the departments are practicing the app except paediatric and psychiatry departments because there is not much work related to blood sample taking and laboratory helps with this task as and when needed. There are some special challenges with practicing the application in the emergency department which are further elaborated next.

5.2 Outcomes of the Intervention and impacts on employees' work

The blood sample taking application has very positive consequences on the overall health logistics process. It has reduced the ID errors and therefore, the synergy cases. The employees can print the labels, then scan their ID cards to log in to the app, scan the patients' arm bands and check what tests are to be taken. Then, they scan the labels on glass tubes. In this way, they can take the correct samples from correct patients. This has a very positive impact on traceability as exact time and the name of the sample taker are registered on the app as soon as the blood sample is taken through the app. This is very significant outcome of the intervention as literature suggests that a crucial element of laboratory work is to ensure that specimens are taken from the right person into the right glass tube (container) and can be traced back to the right person every time (Da Rin, 2009).

Traceability is important as sometimes the test results are quite surprising and the laboratory wants to investigate about the patient from the sample taker e.g., if the sample was taken from some vein where a drip was induced or what the patient had in the meal before sample was taken. The app has been helpful in tracing the sample taker who can best explain the context. Traceability is also important regarding time, as some of the analyses are to be performed within a specific time window e.g., within thirty minutes. So, it is important that blood sample taking time should appear with the samples and the app has been quite effective in this regard. Sometimes, it is hard to prick the patients, e.g., some cancer patients or patients with severe illnesses whose vein are fragmented because of ailment. If nurses cannot manage to take blood samples of such patients, they might need assistance of laboratory staff. The application is quite useful in asking for assistance, there they can order "etterstikk" in the app. The application is quite time saving because the nurses save their time from moving back and forth to the workstation and the patient's room to print labels repeatedly in case of any mistake. This is

related to the decentralization of the blood sample taking process. The blood sample taking timing vary between departments. Most of the departments use night shift to take blood samples at around 5 or 6 am in the morning and this is fruitful for patients' logistics management e.g., if some patients can be discharged from the hospital the same day, this makes space for others. Moreover, if some patients have to undergo fasting tests, the tests are done early in the morning before the breakfast is served and they don't have to wait to eat till 10.00 am for example.

Despite the presence of the application, still there is a lot of manual work, they write notes for record keeping purpose. According to them, they cannot rely completely on technology, as the app can go down sometimes. Moreover, there are some departments where Wi-Fi coverage is worse than others. IT team has reported the issue, but it took some time to recover the network but still the problem persists. The employees do not report this problem.

5.3 Challenges, Variations and Patients' Perspective

Certain issues have been identified with the routinization and implementation of the intervention. One of these is concerning the Wi-Fi coverage that is poor in some departments. It may impact the smooth functioning of the application that may hang for a while due to insufficient coverage. Another issue is about lack of reporting about Wi-Fi issue from the healthcare employees' side. They do not have time to report the internet issue, rather they still prefer to manually record important stuff and carry notes with them.

The implementation of the intervention varies across different departments. The paediatric and psychiatry departments still take help from the laboratory staff for blood sample taking, but the app is used by bioengineers and laboratory staff who comes to take blood samples. The staff in these departments is not trained for blood sample taking as sample taking is not so often here and it requires considerable resources too. Nurses must be recertified every two years and what if some staff members go on maternity or sick leave, so it is not wise to train them for something which is not practiced very often in these departments. In gastroenterology and gastro surgery departments, the application is 100% in practice. Almost all the staff members use the application. In cardiac department, the application is not used by everyone. But they have allocated the blood sample taking task to some nurses and health professionals who take blood samples. They don't have some concrete statistics on the app usage, but according to one nurse, roughly 70% employees in the department use the app for blood sample taking. In the geriatric emergency department, all the staff members use the application, and this is perhaps the most interesting department with very clear leadership who have successfully implemented the blood

sample taking application. Whereas the emergency department, is at another end. Although the mistakes and errors there, can have drastic consequences, the employees are reluctant to practice the application (Richards et al., 2000). The leadership is very neutral/passive towards implementing the app. The observed resistance towards the use of app is just in line with the research findings of Nilsen et al., (2016) who observed various forms of resistance towards technology by healthcare employees for example, resistance because of insufficient or less supportive infrastructure and lack of management support who are reluctant to make necessary adjustments in the routine practices (Nilsen et al., 2016).

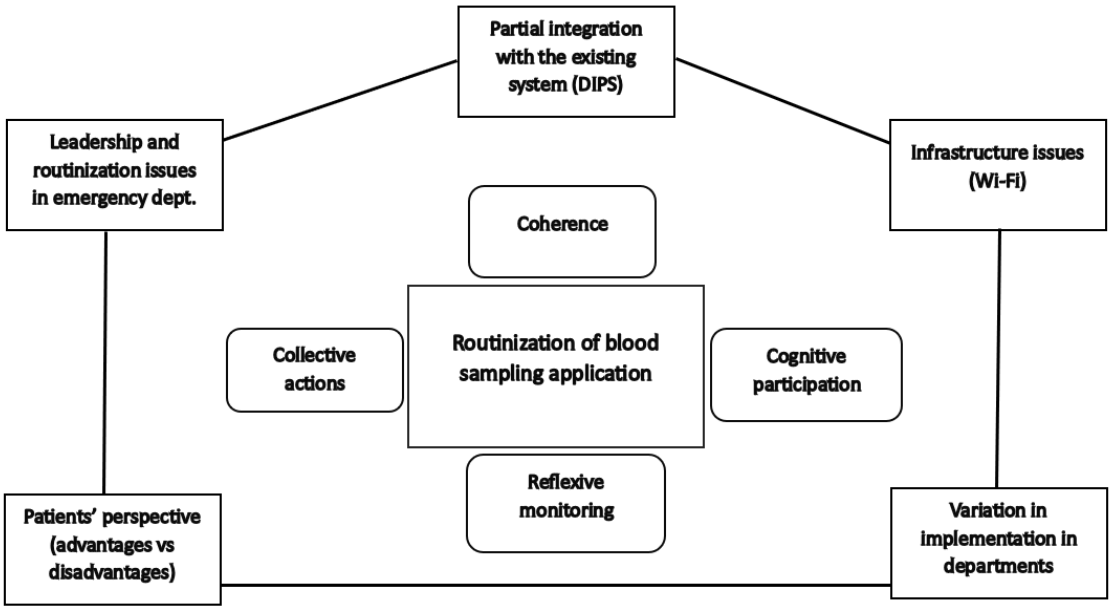


Fig 2: Framework for routinization of the blood sampling application based on the evaluation.

When the use of application and digital tools is concerned, this is important to discuss the findings from patients' perspective. As the ID error rate is reduced, the patients are not pricked often for sample taking. The rate has been significantly higher before. Participants shared their views that some patients were not very positive about the use of mobile phones and the application as they frequently asked them if they were taking their (patients') pictures while they were in fact scanning their (patients') arm bands. According to participants, some patients are very uncomfortable that healthcare employees are always carrying phones with them and

instead of taking care of the patients, they are perhaps using social media etc. The patients' attitude towards this technology based intervention is supported in literature where digital interventions may cause distractions between healthcare employees and the patients (Murray et al., 2011; Ross et al., 2016).

Another issue is related to the night shift that takes the blood samples early in the morning. Some employees think it is not humanized to wake up the patients so early to take blood samples. But at the other end, this is useful for the patients too as they can be discharged from the hospital the same day if everything turns out to be all right for them (test results).

There were also some integration issues (Ageron et al., 2020) between the new system (Imatis) and the old system (DIPS) as mentioned by the participants. There is partial integration between the two systems. Only one Icon is there that can lead to the DIPS window where they have to manually add the comments or test results.

Some participants were so positive about the app that they recommended to modify the app to make it feasible for other types of specimens taking too as specimen from throat or wounds.

In figure 2, a framework is given specifically about the implementation and routinization of the blood sampling app. The issues in the outer box need attention of the concerned people who would try to improve the intervention and the implementation process. The findings are in accordance to what theory suggests that new practices are routinized and made workable when multiple elements like the features of the intervention, components of the physical and social settings/environments and actions of people participating in the process interact together (Finch et al., 2012).

6. Research Implications

This research has important implications for the practitioners. Keeping in view the challenges associated with partial routinization of the app, the context should be given due consideration. Researchers argue that the implementation of an intervention should be planned before its development and the interests of the people who would be participating and working on it should be taken into consideration in order to make the intervention fit for the purpose (J. Ross et al., 2018). Interventions must consider different organizational challenges for effective implementation in different settings (Keyworth et al., 2018).

Research suggested that certain issues are in place when it comes to taking on new roles in an interprofessional settings. Nurses especially those working in acute sector are reluctant to

welcome some tasks delegated to them (Allen & Hughes, 1993; Richards et al., 2000). Therefore, the context should be evaluated before the introduction of an intervention and implementation issues should be considered and likely changes should be planned accordingly (Murray et al., 2010).

This study also provides useful insight to the researchers about how the constructs of NPT can be used in the evaluation process of some intervention and how to include various stakeholders for detailed analysis of the social roles, and contextual factors as challenges for successful implementation of some intervention in a social system.

7. Limitation

This study has some limitations. Emergency department is an important stakeholder in the healthcare where the errors and mistakes can lead to drastic results. Unfortunately, we could not reach out to them due to time constraint. Employees there are already saturated with the tasks, and they often have many patients on daily basis, so they are hard to find for any detailed discussion. The findings on emergency department are based on the data from the participants judgements who had general information about the overall routinization of the app in the hospital.

The credibility of the findings has not been validated by the participants themselves for on-site interviews as healthcare employees are hard to reach out once again due to limited time. Instead for credibility, the quotes with explicit meanings were considered through semantic coding and a lot of quotes with hidden meanings were not included through latent coding. The analysis was confirmed with one of the research fellows. The results and findings are not statistically verified due to limited time.

The research findings are context specific and cannot be generalized to all the organizations implementing the digitalized blood sample taking process. But still some parts of the findings can be used as guidelines in an attempt to improve the implementation process.

The findings have not been quantitatively verified. This study was planned to be a mixed method study and a questionnaire was also developed based on the study of (Finch et al., 2012), but due to time constraint, it could not be completed.

8. Recommendations for future research

The literature on NPT suggests the theory to be used in research projects using mixed method approaches so that the dynamics of and variations in the implementation process can be studied in detail (May et al., 2018). It is suggested that the research findings be quantitatively verified. For this purpose, a questionnaire has been attached in the appendices.

Ross et al. (2018) have suggested incorporating patient factors while implementing the digital health interventions. This study put emphasis on patient's perspective from employees' point of view, but it would be interesting to ask the patients about the possible effects of the application on their treatment during their hospital stay. It would be useful to incorporate several stakeholders in the study specifically the emergency department where the application can have fruitful impacts if implemented effectively.

Given the importance of contextual factors, the researchers can study the similar contexts and intervention implementation processes with the help of "General theory of implementation" that takes onto account both the dynamic elements of the context and expressions of agency. The implementation theory incorporates the NPT as one part of a bigger social system that describes just the contribution of agency (May, 2013). Moreover, various socio-technical challenges in the implementation process can also be evaluated in detail to suggest the possible improvements (May et al., 2016).

9. Conclusion

This study intends to explore the implementation and routinization process of a healthcare intervention and its outcomes and impacts on healthcare employees' routine work. The study also explored some challenges regarding the routinization of the intervention. This is originally an evaluative case study that involves the assessment of the intervention with the help of NPT that helped to explore several important phenomena of interest for practitioners who can use the findings to improve upon the implementation process. The study also present useful insight to the research concerning the use of NPT from various angles.

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Appendix 1: Interview Guide

Decentralization and Digitalization of a Healthcare Process:

An assessment of the healthcare intervention through normalization process theory

Your department:

Your role or position (Job title):

Q1: What is the background of the blood sampling application?

Q2: Who is responsible for introducing the application? Can you identify who initiated the process?

Q3: How does the blood sampling application impact your work routines?

Q4. How does the application impact the work routines of the overall department?

Q5. How has the application proved useful?

Q6: How have the teams been organized to work on the application?

Q7: Are all the nurses and healthcare staff trained to use the blood sampling application?

Q8: What is the attitude of the staff in the departments towards using the application?

Q9: How do you work with the app if you have some ambiguities or need assistance?

Q10: Are there any challenges associated with working with the app?

Q11: Does the app fit well in the existing system?

Q12: What will you say about management support and the availability of infrastructure regarding the app?

Q13: Do all the healthcare staff perform all the tasks or tasks are divided?

Q14: Do you have any idea how many employees use the application for blood sample taking?

Q15: Have you any statistics or reports regarding the use of app or about the improvement of the processes due to the app?

Q16: How do you feel about the app?

Q17: What is the general attitude of employees towards the app?

Q18: How the app can be improved? What will you recommend improving the application?

Q19: What is the attitude of the patients towards the app?

Appendix 2: Information Letter and Consent Form

Are you interested in taking part in the research project?

"Decentralization and Digitalization of a Healthcare Process:

An assessment of the healthcare intervention through normalization process theory"

This is an inquiry about participation in a research project where the main purpose is to explore the organizational effects of the digitalization of the intervention in healthcare process specifically on employees' work patterns and routines. In this letter, we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

This project is part of a master thesis and the purpose of this is to document the findings of the interview questions.

Today, healthcare organizations face the enduring challenge of improving the quality and efficiency of the healthcare system. The digitalization of the supply chains guarantees to improve several components of logistics by enabling real-time, autonomous, and decentralized management. The aim of this research is to study the effects of digital transformation of health logistics systems on employees in a healthcare setting. It will be an exploratory case study and data will be collected through semi-structured interviews with employees of a hospital. The study's findings will provide useful recommendations to the hospital's management for the successful integration of digital interventions in the healthcare system.

Research Questions

RQ1: How a complex intervention i.e., blood sample-taking application is implemented and routinized in a healthcare setting like a hospital? How do employees understand and describe this intervention?

RQ2: What are the effects of this intervention on healthcare employees' work routines and what are the possible outcomes of this intervention (digitalized blood sample taking) in the overall implementation process?

RQ3: What are the possible challenges in the implementation process?

Who is responsible for the research project?

University of South-Eastern Norway (Krona-Kongsberg) is the institution responsible for the project.

Why are you being asked to participate?

The sample is selected through non-probability sampling. As you are one of the employees at the hospital, therefore you are being asked to participate in this interview.

What does participation involve for you?

Data is going to be collected through semi-structured interviews. The interviews will be recorded electronically and will later be transcribed.

- « If you chose to take part in the project, this will involve an interview. It will take approx. 45 minutes. The interview includes questions about how your work routines are being affected by this newly digitalized and automated system. Your answers will be recorded electronically and notes will be taken.

Participation is voluntary
Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- Only the student, working on this project, and her immediate supervisor “Abdelkader Sibihi” will have access to data provided by you.
- I will replace your name and contact details with a code. The list of names, contact details, and respective codes will be stored separately from the rest of the collected data and no unauthorized person shall have access to the personal data provided by you.
- Only the name of the department and job title shall be included in the document.

What will happen to your personal data at the end of the research project?

The project is scheduled to end on 20.06.2023. all the data which could identify you will be deleted at the end of the project.

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.

Based on an agreement with USN, Data Protection Services has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?
If you have questions about the project, or want to exercise your rights, contact:

- USN via Abdelkader Sbihi. Contact # +4731009322, Email: Abdelkader.Sbihi@usn.no
- Data Protection Services, by email: (personverntjenester@sikt.no) or by telephone: +47 53 21 15 00.

Yours sincerely,

Project Leader

Student (if applicable)

(Researcher/supervisor)

Consent form

Consent can be given electronically through an email which should be explicitly demonstrating that you are ready to give information about the project through an interview.

Student: Adeesa Iram. Email: 237961@usn.no ; adeesagul@gmail.com
Supervisor: Abdelkader Sbihi. Email: Abdelkader.Sbihi@usn.no

I have received and understood information about the project "Decentralization and Digitalization of a Healthcare Process: An assessment of the healthcare intervention through normalization process theory"

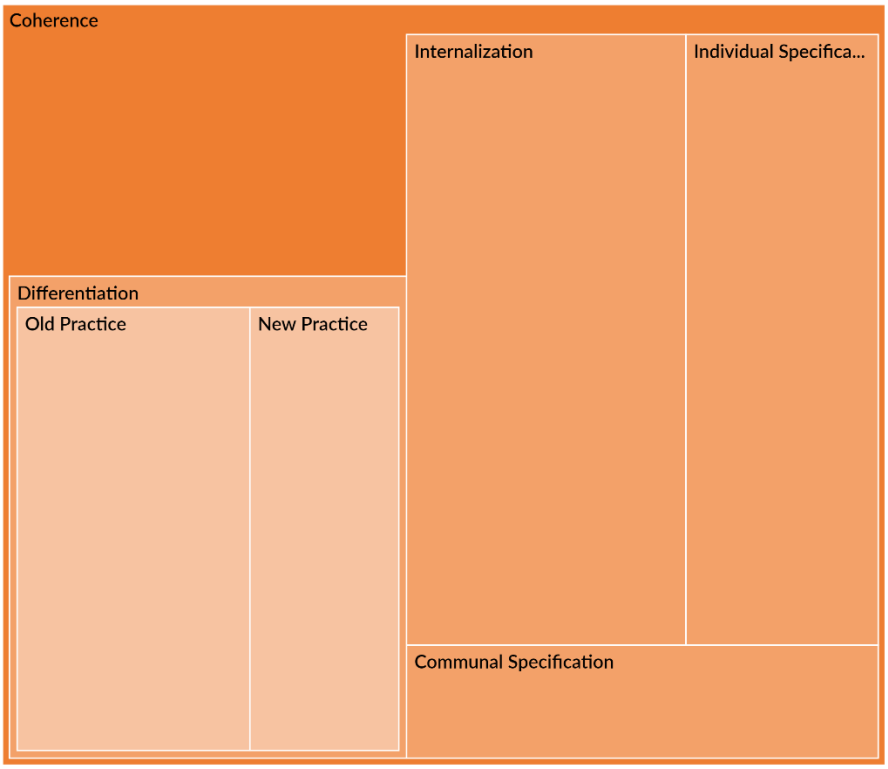
and have been given the opportunity to ask questions. I give consent:

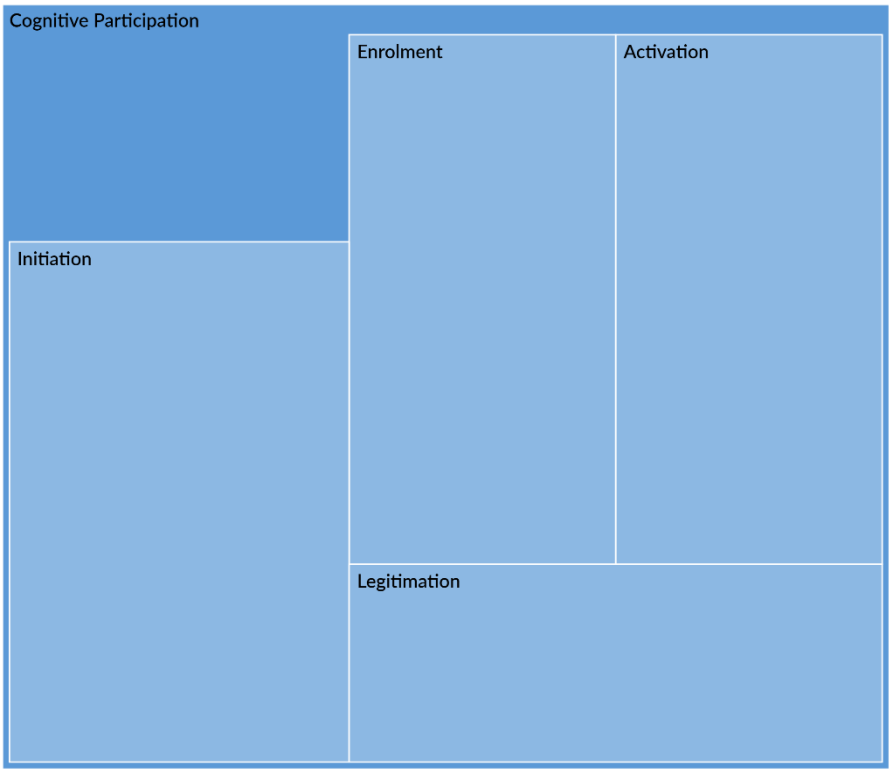
☐ to participate in an interview

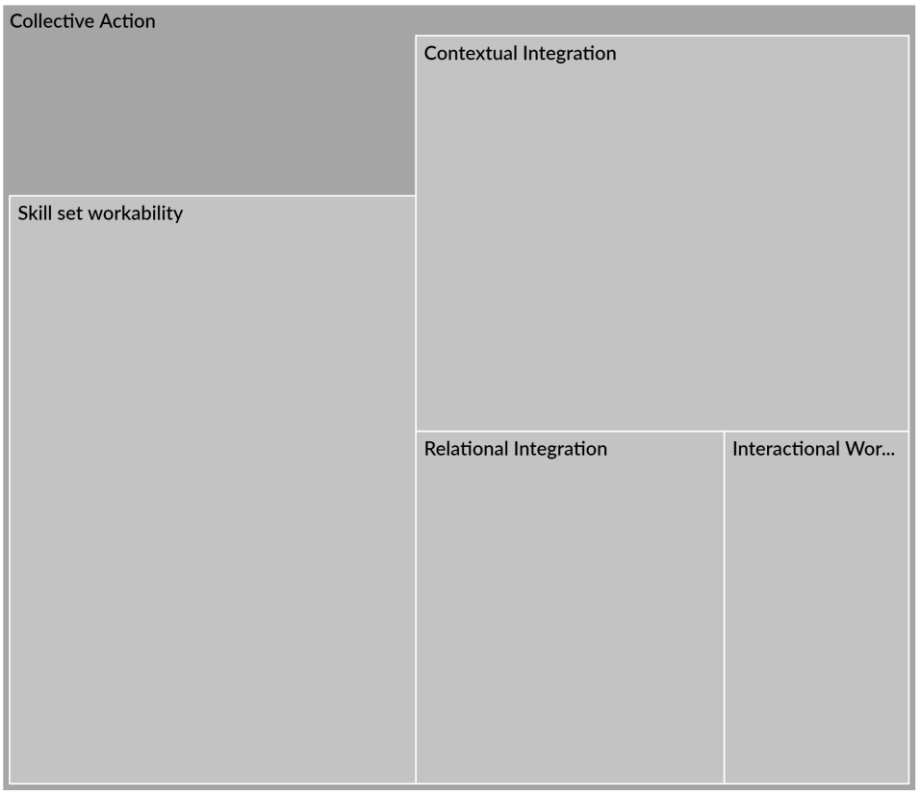
I give consent for my personal data to be processed until the end date of the project, approx. 20.06.2023.

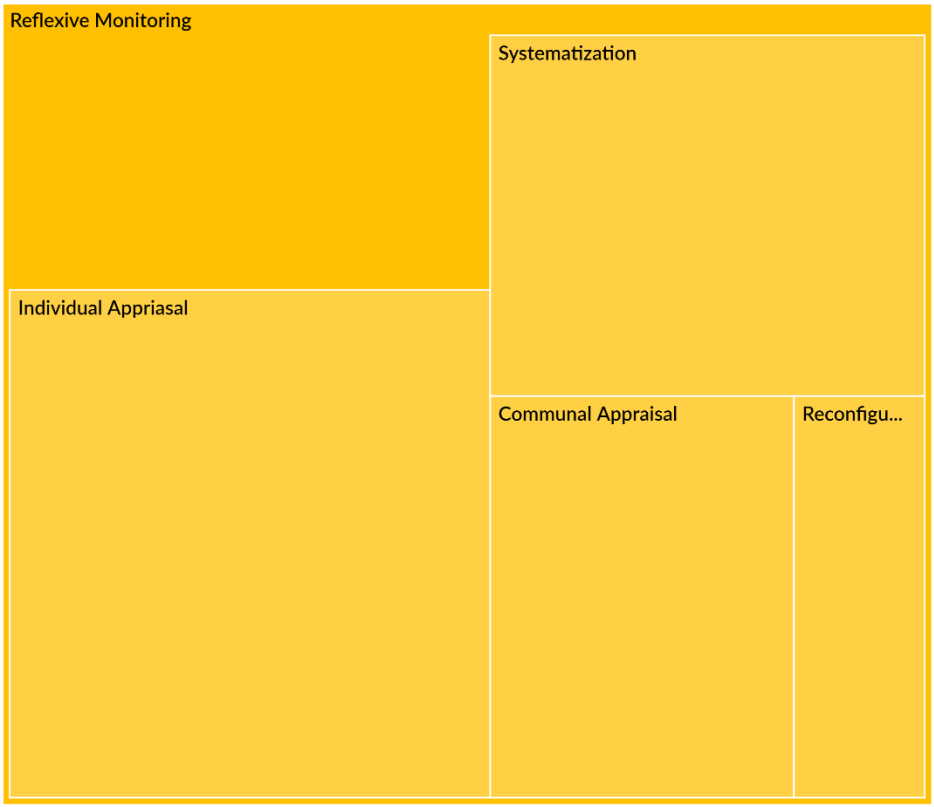
(Signed by participant, date)

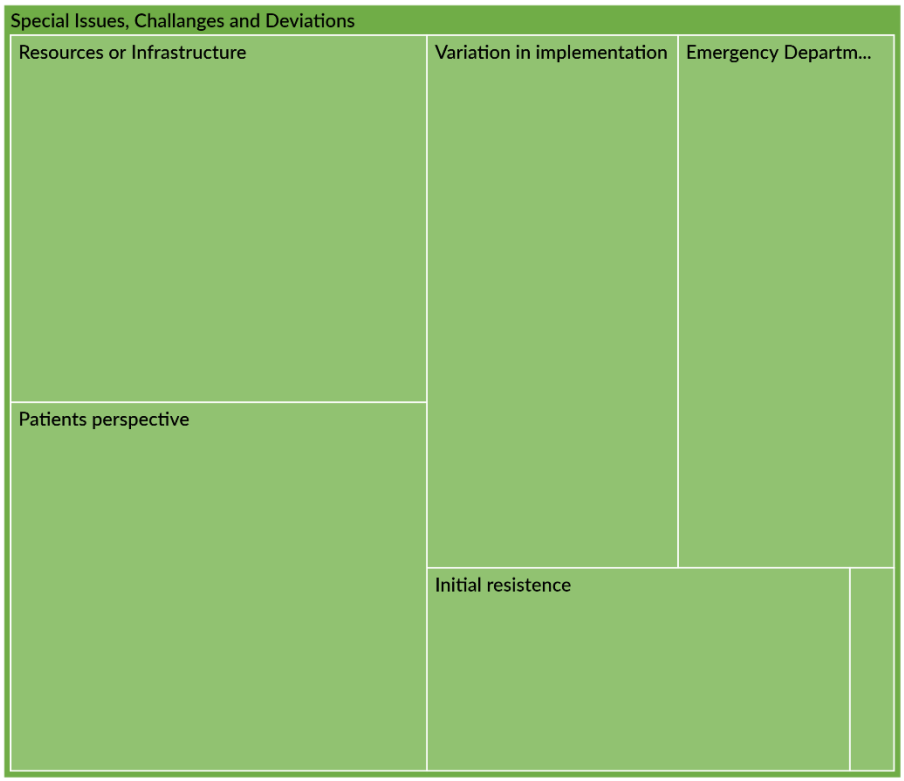
Appendix 3: Coding References for sub-constructs of NPT






Collective Action
Contextual Integration
Skill set workability
Relational Integration
Interactional Wor...


Reflexive Monitoring
Systematization
Individual Appriasal
Communal Appraisal
Reconfigu...


Special Issues, Challanges and Deviations
Resources or Infrastructure
Variation in implementation
Emergency Departm...
Patients perspective
Initial resistence