Evaluating Healthcare Automation: A Multi-Case Study on the Utilization of Automation Initiatives in Healthcare Operations

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Abstract: Automation technologies such as robotic process automation (RPA) and intelligent automation (IA) are essential for managing rising healthcare costs and ensuring sustainable health services. Although these solutions have been implemented in several Finnish healthcare organizations, their overall impact has not been systematically evaluated. This research investigates the impact and evaluation of healthcare automation through a multi-case study conducted in two Finnish healthcare organizations. While automation has improved resource utilization, process efficiency, and standardization across units, the findings highlight the need for a more comprehensive evaluation and continuous monitoring of automation benefits. Future research should focus on developing a specific evaluation framework tailored to healthcare automation technologies. The adoption of holistic evaluation methods could allow healthcare organizations to better understand the impact of automation and further enhance operational efficiency and patient care.

1 INTRODUCTION

Mestres (2017) posits that healthcare faces three key challenges: rising costs, a decrease in available physicians, and an increase in patients. Similar trends are noted in Finland, with increasing healthcare costs and declining availability of personnel (Kirkonpelto, Mäntyranta, et al., 2023). Digitalization offers solutions by improving productivity, transforming care delivery, and simplifying administration (Sony, Antony & Tortorella, 2023). Although digitalization can help healthcare organizations meet their objectives, the outcomes of digital interventions often take time to materialize and can be challenging to measure (Cresswell, 2023).

This paper focuses on one specific avenue of digitalization in healthcare – the impact of automating digital workflows. Automation initiatives can deliver a wide range of benefits to healthcare organizations through cost savings, standardized and always-available processes, and freeing employees from repetitive manual tasks (Kedziora and Smolander, 2022; Ratia et al., 2021; Kedziora and Kiviranta, 2018).

Although automation solutions are recognized for their potential, it remains unclear how these back-office solutions generate value in the public healthcare sector (Ratia et al., 2021). In particular, there is a lack of relevant research on the impact assessment of automation (Meironke and Kuehnel, 2022), with discussions being "ad-hoc and scattered, with minimal empirical and theoretical support" (Denagama Vitharanage et al., 2020). The research on automation solutions often focuses on the technical dimensions, giving less emphasis on the benefits and value creation (Ratia et al., 2021). Various patient-centric attempts have been made to create an overall impact assessment framework for digitalization efforts (e.g. WHO, 2016; Lillrank et al., 2019; Parviainen et al., 2017; Karunasena & Deng, 2012). However, research on automated back-office solutions that do not directly affect patient outcomes has been more limited. Especially in the Finnish public sector, systematic evaluations of automation technologies are limited (Kääriäinen et al., 2018).

This research aims to examine the outcomes of automation solutions in healthcare and provide information on how their impact can be measured. The study focuses on two methods: *robotic process automation* (RPA) and *intelligent automation* (IA), applied within two Finnish public healthcare districts: The Wellbeing Services County of Pirkanmaa

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(PIRHA) and the Helsinki and Uusimaa Hospital District (HUS). Although both healthcare organizations had implemented various automation tools, they had not fully assessed the overall impact of these solutions. The objective of this paper is two-fold: to identify key automation benefits and potential risks and to provide information on what should be considered when evaluating automation outcomes. The research questions are the following:

RQ1. *What are the benefits and risks of utilizing automation solutions in healthcare?*

RQ2. *What should be considered when evaluating automation in healthcare?*

2 BACKGROUND LITERATURE

2.1 Utilizing Automation to Enhance Healthcare Operational Processes

Workflow automation, which involves identifying sequences of tasks that can be streamlined with digital tools, provides opportunities to address process inefficiencies in healthcare (Zayas-Cabán, Okubo, & Posnack, 2023). Automating simple workflows is needed in healthcare, where professionals are burdened by repetitive administrative duties like data entry, documentation, and scheduling – tasks that often distract from patient care. Automation technologies can take over these routine tasks, allowing healthcare providers to dedicate more time to meaningful patient interactions. (Mohamed & Frank, 2022.)

Often automating business processes require the use of application programming interfaces (API) to connect with legacy systems (Herm et al., 2023; Syed et al., 2020). However, such solutions are not always feasible in healthcare due to technical constraints, legacy systems, or vendor limitations. In these cases, lightweight and non-invasive automation solutions, such as RPA and IA, can present an opportunity to improve operational processes across care delivery and administration (Ferris, Ackers & Borhani, 2022; Zayas-Caban, Okubo & Posnack, 2023).

RPA automates repetitive digital tasks typically performed by humans (Ivančić, Suša Vugec, and Bosilj Vukšić, 2019; Kääriäinen et al., 2018; Willcocks, Lacity, and Craig, 2015; Ratia et al., 2021). These robots mimic human actions on system interfaces (Herm et al., 2023). Due to its low cost, quick implementation, and minimal system changes, RPA is attractive for healthcare providers struggling with system integration (Ratia et al., 2021; Osmundsen et al., 2019; Kedziora & Kiviranta, 2018).

RPA is effective in automating routine processes, such as physician credentialing, patient scheduling, and billing (Jain and Bhatnagar, 2019). For example, during COVID-19, RPA accelerated diagnoses, distributed targeted health information, and updated quarantine data (Doğuç, 2021). In Finland, RPA was used to process up to 2,000 COVID-19 vaccinations daily, a task previously done by 10-15 employees (Adolfsson, 2021). Similarly, in HUS, RPA saved over 13,000 workdays in 2021, equivalent to the work of 65 full-time employees (HUS, 2021).

While RPA is a powerful tool, its applications are primarily limited to tasks that are highly rule-based, structured, standardized, and supported by well-documented decision logic (Ng, 2021). IA enhances RPA with AI features such as machine learning and natural language processing to replicate human cognitive skills (Kedziora and Hyrynsalmi, 2023; Coombs et al., 2020). With these capabilities, IA can handle unstructured data, make real-time decisions, and perform content-aware computing, overcoming many limitations of RPA (Ng et al., 2021).

IA can assist in complex scheduling, capacity management, and process optimization in operating rooms and emergency departments by managing patient movement between diagnostics and wards (Garcia et al., 2020). Additionally, IA can coordinate patient information, issue health risk alerts, predict health outcomes, and optimize logistics processes (Secinaro et al., 2021). However, IA research is still in its early stages with challenges and potential applications yet to be fully explored (Ng, 2021).

2.2 Impact Evaluation of Automation Initiatives

Porter (2013) defines healthcare value as "maximizing value for patients," meaning achieving the best outcomes at the lowest cost. In other words, *healthcare value = patient outcomes / total costs*. Specifically, Porter (2014) argues that while process measurement and improvements are valuable tactics, they cannot replace the importance of measuring the results of care. Thus, healthcare value is the result of care, not the volume of services delivered. What is then the impact of back-office automation solutions that do not directly affect patient outcomes?

To measure the overall healthcare outcomes, the primary metric used is *effectiveness*, which refers to the impact of treatment on the health conditions of a population under routine conditions (Ikonen, 2019; Pitkänen et al., 2018). From effectiveness, several

other important metrics are derived, such as *cost-effectiveness*, which evaluates the ratio of effectiveness to costs, and *productivity*, which is the ratio of output (the result of an operation) to input (the resources or costs used to achieve that output) (Sintonen et al., 2021). Productivity can be enhanced by either reducing costs while keeping the output constant or by increasing output while maintaining the same costs. Consequently, improving productivity also enhances the cost-effectiveness of healthcare processes (Sintonen et al., 2021).

Automation is often implemented to improve cost-effectiveness by enhancing productivity. Automation benefits can be tangible, like reduced costs and faster processing, or intangible, such as better customer satisfaction and employee motivation. Evaluating both types separately is crucial since not all benefits, like financial gains, are easily measurable (Axmann and Harmoko, 2021).

While the automation benefits are recognized, their impact assessment is still lacking (Meironke & Kuehnel, 2022; Kääriäinen et al., 2018). According to Kääriäinen et al. (2018), organizations tend to assess automation mainly using a narrow set of criteria, with a focus on internal savings. Many of the assessment frameworks focus on the requirements, feasibility, and readiness of a company to implement new technology, such as the 5D digital technology assessment (Axmann and Harmoko, 2021), RPA selection indicators by Kim (2023), or the method for RPA process selection proposed by Wanner et al. (2019). However, they do not consider how to conduct continuous monitoring and evaluate the impact after the implementation.

Moreover, Meironke and Kuehnel (2022) identified 62 unique metrics in the literature to evaluate the benefits of automation. Most of these metrics focus on efficiency and costs, emphasizing the number of transactions, work hours saved, and process time. Accuracy or error rates are also commonly used to measure quality and compliance benefits. On the other hand, metrics related to implementation effort, employee and customer satisfaction, availability, and interoperability are less commonly found. Thus, the authors conclude that the assessment of automation benefits "shows a tendency" to prioritize quantifiable economic metrics over qualitative and non-economic ones. (Meironke and Kuehnel, 2022.)

3 METHODOLOGY

This research aims to provide insights into evaluating automation outcomes. To address the research questions, the study has focused on the benefits, risks, and evaluation challenges of automation in two Finnish healthcare districts: PIRHA and HUS.

The research was conducted as a multi-case qualitative study. This study employed a qualitative design to explore a relatively novel topic, which is ideal for gaining an in-depth understanding of phenomena within specific contexts when little is known about a topic (Saunders et al., 2019; Antwi & Hamza, 2015). Moreover, the research employed an embedded multi-case study design; it contained more than one sub-unit of analysis to conduct an in-depth examination of a current phenomenon (the 'case') within its real-life setting (Yin, 2018). The method allowed to investigate stakeholders' experiences with various automation implementations across multiple units. The two case organizations were ideal for the study due to their size and previous experience with multiple automation projects. Furthermore, while both healthcare organizations had implemented various automation solutions, they had not fully assessed their overall impact.

3.1 Data Collection

The empirical data was gathered through 32 semi-structured interviews with employees, administrative staff, and stakeholders in PIRHA and HUS experienced with RPA and IA. Participants included department secretaries, nurses, doctors, pharmacists, digitalization experts, and head physicians. External IT companies providing automation solutions were also interviewed to capture their perspectives. Table 1 lists all participants.

The interview data was gathered in two phases: from PIRHA in Spring 2023 and HUS in Autumn 2023. PIRHA interviews focused on RPA solutions, while HUS interviews covered IA processes. Purposive sampling was used, meaning the participants were selected based on characteristics that matched the research objectives (Andrade, 2021; Etikan et al., 2016). Specifically, participants had prior experience with automation and represented a diverse set of roles. The research team provided preferences for roles and units but had limited control over participant selection. Due to the policies of both organizations, the final participant selection was made within a tight timeframe by a designated contact person. Consequently, convenience and availability also played a significant role in recruitment.

All interviews followed a similar structure and were conducted remotely via Microsoft Teams. Participants discussed automation benefits and risks from the perspectives of employees, patients, costs, and processes and shared their views on impact assessment. The interviews were recorded, transcribed, and pseudonymized with participants' permission before analysis.

While the interviewees discussed several automated processes, the primary focus was on two processes: referral handling and medical dosage building. Both organizations had implemented a *referral sorter* to shift manual work from nurses and department secretaries. "*Before automation or the electronic patient record system's XDS archive, the paper referrals arriving at the unit were placed on the doctor's desk,"* as one secretary from HUS describes it (Ahlskog, 2022). Now, the robot continuously processes new doctors' referral texts in a virtual referral center. It categorizes them into the correct queues, where doctors can access and review the referrals for further evaluation. In PIRHA, the RPA-based solution uses predefined logic to automate repetitive referral handling. However, if the robot misplaces a referral, an employee must correct it. Moreover, HUS has enhanced the referral sorter with AI, using machine learning to interpret symptoms and diagnoses from referral texts.

HUS has also an automation solution for filling patients' dosage information in the electronic health record system, Apotti. This *medical dosage builder*, used by nurses and pharmacists, transforms free-text medication info into the required structured format. It provides code suggestions, reducing the need for manual entry of the patient's medication list. The structured medical information is standardized data that is used to generate dosage instructions with a similar structure for all patients, reducing the need for manual input and minimizing errors.

3.2 Data Analysis

Data analysis was conducted using qualitative content analysis with the QDA software ATLAS.ti. The study followed a directed content analysis approach presented by Hsieh and Shannon (2005), starting with relevant research findings and preliminary theory-based categories for automation benefits and risks. The empirical data consisted of two datasets, one for each case, with data collection divided among the researchers. Consequently, none of the researchers participated in all interviews, resulting in a final dataset that was a mix of primary and secondary data for all researchers.

Given the mix of primary and secondary data, the study employed tactics for an abductive content analysis as outlined by Vila-Henninger et al. (2024). Firstly, a deductive theory-based codebook was created and expanded with inductive codes. For instance, in this step, the benefit dimensions provided by Meironke and Kuehnel (2022) were utilized to categorize the benefits. The "AI coding" feature of ATLAS.ti was also used for exploratory coding. Secondly, to reduce data volume, codes were combined into broader categories. Here, the 'Query Tool' was used to sort codes based on the four perspectives that were investigated. Finally, a detailed manual qualitative analysis was performed to identify emerging themes and compare differences between the two cases.

Table 1: Participant list from PIRHA and HUS.

Region	Role	Number of participants
PIRHA	Department Secretary	5
	Nurse	2
	Chief Physician / Director	2
	Medical Doctor	2
	Digitalization Specialist	2
	Head / Deputy Head Nurse	2
	Product Owner (External)	1
	Midwife	1
	Service Provider (External)	1
HUS	Pharmacist / Senior Pharmacist	5
	Digitalization Specialist	2
	Department Secretary	2
	Nurse	1
	Product Owner	1
	Deputy Chief Physician	1
	Product Owner (External)	1
	Data Scientist (External)	1
Total		**32**

4 FINDINGS

4.1 Perceived Benefits

The thematic interviews in both healthcare counties expressed that the overall perception of automation has been positive. The most mentioned direct benefits were related to process efficiency, improved resource utilization, and availability of services.

In HUS, one external expert describes that the referral processing time has decreased significantly, from 32-35 hours to approximately 3-4 hours. However, while quicker referral handling provides information to patients faster, it doesn't necessarily lead to faster treatment. More precisely, participants describe that the referral sorter has merely moved the bottleneck from the referral handling to the next step of the patient journey. Thus, speeding up one part of the process does not necessarily reduce overall treatment time. However, faster referral handling can be impactful for urgent patients. Participants describe how automation robots process urgent cases faster and thus increase the accessibility to treatment: *"For urgent referrals that take 1-7 days, it makes a significant difference if they can be processed in 2-4 hours instead of five working days."*

While interviewees often mention time savings, they struggle to pinpoint where the extra time goes. Nurses and pharmacists note a slight increase in patient care time, which enhances the overall quality of the patient experience. However, these time savings per patient inquiry are deemed small and hard to measure. In HUS, doctors have faced additional workload from the referral sorter, as incorrect referrals have been directed to them. On the contrary, in PIRHA, the effect has been more moderate. For secretaries, the possible benefits seem most direct, as they have more time for more challenging administrative tasks, such as appointment scheduling and other phone-related work.

Moreover, participants in HUS described that IA solutions has created standardization across the organization. Before automation, there were large variations in how medication lists were written. As automation requires rule-based inputs, it has standardized the medical information, leading to consistent interpretations across the organization. *"The fact that information is the same for all users. Perhaps that's the best benefit here. It also guides us in standardizing practices across different areas of healthcare,"* describes one pharmacist. *"This is a massive organization, and with automation, we have achieved greater unity across specialties,"* summarizes another participant.

Other process-related benefits were related to compliance and interoperability. The solutions have helped to meet reporting requirements and facilitated data and system linkage. *"The smoother we can make reporting, the better,"* describes one participant. "*From the perspective of organizational development, it supports knowledge management,"* continues another interviewee. Moreover, while automation robots act fast, they also handle information without biases, positively impacting equal access to treatment. *"It's not affected by whether someone is in a bad mood, had a rough morning, or is running late for work. Automation is consistent; it doesn't get tired or have biases."*

Automation solutions have also created indirect benefits in both organizations, such as enhanced employee and patient experience. The participants describe that automation can help "find meaningful job roles" and provide time for "brain-intensive work that professionals are trained for."

While cost savings are discussed, the perception of it varies across units and roles. The digitalization experts highlight the fast payback time and scalability of automation solutions. *"The time savings accumulate when creating such easily scalable processes. There are no additional costs with expansion,"* describes one digitalization expert. On the contrary, nurses and secretaries find it hard to evaluate cost savings, one reason being that some of the potential saved time goes to monitoring and correcting the results: *"Any freed-up time currently goes into fixing and monitoring the results. However, in the long term, when hopefully everything is running smoothly, I would see cost savings occurring,"*

Lastly, participants note that patients likely don't notice automation since it works in the background. However, automation has positively impacted patients in various ways, such as delivering treatment information faster and allowing doctors more time for patient care.

4.2 Recognized Risks

In both cases, the two main recognized potential risks of automation were additional work created by technical errors and decreased process quality. The risk of additional work appears to be significantly higher during what participants describe as the "infancy stage," meaning the early stages of development. PIRHA reported significantly more issues with its early-stage RPA solutions than HUS, which had both more experience and more advanced automation solutions implemented.

Table 2: An overview of the perceived main benefits and risks in HUS and PIRHA.

Direct benefits	**Description**
Process efficiency	Increase in volumes and decrease in throughput times and delays.
24/7 availability	The robots are always available to work.
Increased resource utilization	Time savings enable employees to complete more complex tasks.
Standardization	Automation provides similar outputs across units.
Faster access to treatment (urgent cases)	Automation can prioritize urgent cases.
Compliance	Helps to meet reporting requirements.
Interoperability	Easier data and system linkage.
Scalability	The solutions are fast and cheap to scale across units.
Equal access to treatment	Robots handle information without biases.
Indirect benefits	
Increased employee experience	Increased job satisfaction and meaningfulness of work.
Increased patient experience	Provides information faster to the patient and can speed up treatment visits.
Cost-effectiveness	Increase in the value of time gains (difference in cost of process by a human vs automation)
Potential risks	
Additional work	Automation solutions are not error-free. The risk of additional work is higher during the "infancy stage."
Decrease in quality	Humans perform tasks more accurately than robots.
Risks in patient safety	Automation faces challenges in interpreting complex data. Outputs involving critical patient information still need to be reviewed by a professional.

While additional work is a risk, it also matters to whom and how much of it is created. In PIRHA, most of the additional work was targeted to secretaries and nurses, some of whom felt that "it has consumed work hours and taken away time from patient care." The participants in PIRHA describe that the RPA robot should be able to handle 50 percent of the referrals to be beneficial. For example, one participant noted a success rate of only 27 percent during a two-week test period. Some other interviewed secretaries and nurses share similar experiences of automation feeling like an "additional burden." *"There is still a substantial amount of manual checking required. In the last report, more than 3/4 of cases had errors,"* describes, for example, another participant. In HUS, while the intelligent referral sorter appears to be more effective than the regular RPA solution in PIRHA, it has also created some extra work for the doctors. However, on the organizational level, the overall effect has been positive: *"The doctors don't see the advantage yet in the referral handling work. However, when I try to consider it from the perspective of the clinic's operation, I see that it creates a positive impact"*, describes one participant in HUS.

While automation increases quantity, it does not necessarily increase quality. Participants underline that humans still perform tasks with higher accuracy than robots. Thus, there appears to be a trade-off between quality and efficiency: *"I don't believe it has improved quality. But it has shifted mechanical work away from humans,"* concludes one doctor. *"The process is less precise; errors occur more frequently than with a human. However, the robot performs faster and around the clock. That's the trade-off,"* continues one external expert.

Lastly, interpreting data with changing inputs appears to be challenging. Several participants described that the dosage builder struggles with situations where the medication dosage changes within a time period. *"Often if there is a variable dosage, like one tablet in the morning and two in the evening… It cannot handle such situations properly, so it just makes a guess,"* describes one pharmacist. Thus, to maintain patient safety, the outputs need to be verified carefully by a professional. Moreover, the referral sorter in both case organizations has had issues interpreting complex data, for instance, sending the patient to a clinic outside their regular municipality.

4.3 Challenges Measuring the Impact of Automation

Measuring the impact of automation initiatives is perceived hard in both case organizations. The main assessment challenges relate to a lack of holistic data, baseline measurements, targets, and a regular evaluation process.

Active evaluation and monitoring have been missing from many implementations in both organizations. *"Not in any way, at least not in our unit,"* is how one participant describes the current state. *"I don't know if there's any monitoring at the*

PIRHA level, but at the unit level, there isn't," continues another employee.

The assessment has mainly focused on whether the technology works as intended, not on how people interact with it or how it improves outcomes: *"We have tried to gather genuine user feedback, but it has not been very successful. Essentially, what we document is the result of encountering bugs."* Evaluating the impact of automation is also challenging because it's "just a small part of it all," making it unclear which outcomes are directly caused by automation. Feedback has mostly been technical error reports: *"We get these cold reports that tell us how many times the robot has run and how many cases there are per month or week."*

Interviewees in both organizations note that evaluating progress is difficult without a baseline for comparison. *"We didn't do measurements before the start of this referral processing, such as how much time we spend now and how much we used to spend. Therefore, it's a bit challenging to assess time savings,"* describes one secretary. In some cases, potential benefits have been calculated in advance without collecting data afterward. *We haven't had any active monitoring. It's been more like we've calculated in advance the potential benefit and how quickly the process would pay for itself,"* summarizes one digitalization expert.

While participants acknowledge the time savings, it seems unclear how the saved time is utilized. *"What would interest me is somehow measuring how the saved work time is being used. Whether it means being able to serve one more patient or making more phone calls,"* describes one digitalization expert. Measuring time savings appears challenging because automation replaces only small specific tasks, not entire workflows. "*Measuring how much time various small tasks take is always challenging,"* as one digitalization expert describes. Secondly, assessment efforts would require an additional layer of monitoring, which would be difficult both technically and due to possible resistance: *"Adding extra monitoring to the busy daily work might not be the most effective solution."*

In some units, monitoring is seen as a sensitive issue. The work culture in these units seems to affect how openly the benefits of automation are discussed: *"If you have a difficult work atmosphere, you don't go tell your boss you have more bandwidth. You enjoy the fact that you have more space to do things. You don't report that you saved another 5 hours of work time this week,"* as one participant describes. However, collecting impact data could help in motivating employees to use the solutions: *It would likely turn even sceptical individuals towards a more positive outlook.*

4.4 Evaluation Metrics

Process metrics like time savings, throughput volumes, and error rates are frequently mentioned, especially those affecting treatment delivery, such as handled referrals for urgent patients. At HUS, greater emphasis is placed on qualitative metrics like worker wellbeing and satisfaction, reflecting their more mature solutions. In contrast, PIRHA focuses more on technical aspects, as their solutions are in earlier stages of development.

Back-office automation benefits patients indirectly, such as faster referral processing or clearer prescription instructions. Key metrics from the patient's perspective include patient safety, satisfaction, treatment efficiency, and service accessibility. Pharmacists and nurses using the medical dosage builder particularly emphasize patient safety as a crucial metric. Regarding the referral sorter, the main patient risk is treatment delays due to incorrect classification: *"The biggest risk we've identified is a delay in treatment due to incorrect classification. However, the risk is very low, and the consequences should not be significant."*

Measuring cost efficiency appears challenging, particularly due to difficulties in quantifying time savings. Cost savings may differ across units depending on whose tasks are automated. For instance, automating a doctor's tasks is more valuable than a secretary's. However, organizations can estimate time gains by "converting the saved time into work hours and the hourly rate," as one participant summarizes. Additionally, automation enhances organizational capabilities by increasing standardization and simplifying scalability. This organizational impact could be measured by metrics like the number of standardized processes, speed of implementation, and the number of employees trained in automation.

5 DISCUSSION

The results emphasize the need for an impact assessment model, as no proper "template or tool" exists. Despite some used metrics, employees found the value of implemented solutions unclear: *"The robot works well, but very few feel it's needed in their process."* In some cases, not seeing the benefits has also caused resistance to adoption: *"Some employees*

feel that they don't want to adopt automation because they perceive it as an additional burden."

Based on both PIRHA and HUS interviews, evaluation has been inadequate because a process has not been built around it. Essentially, assessing digital transformation should answer two questions: *is the project doing things right* and *is the project doing the right things* (Pritchett et al., 2013)

More concretely, impact assessment includes two steps: monitoring implementation activities and evaluating the monitored outcomes. *Monitoring*, which refers to routine data collection, review, and analysis, is the most time-consuming part of the process (WHO, 2016). *Evaluation*, the systematic and objective assessment of the implemented solutions, is only the final step in determining whether objectives have been met and the impact has been achieved (WHO, 2016). In other words, evaluation aims to determine whether changes in the monitored metrics are the result of the digital intervention.

The findings from the two case organizations emphasize six key steps in impact assessment: 1) defining clear objectives, 2) choosing suitable metrics, 3) setting baselines and targets, 4) implementing monitoring mechanisms, 5) gathering feedback, and 6) conducting regular evaluations.

Firstly, when setting goals, it is essential to consider both the potential direct and indirect benefits of automation. In HUS and PIRHA, the primary advantages include operational efficiencies such as time savings and productivity boosts, while indirect benefits include reduced costs, improved transparency, and enhanced experiences for patients and employees. Automation outcomes that improve the health system's effectiveness are mostly indirect second-order effects, such as freeing up time for patient interaction or more complex administrative work.

The maturity of the solution should also be considered for in the evaluation (WHO, 2016). In other words, consider if the automation solution is developed and evaluated for the first time or if it is undergoing scale-up. For instance, PIRHA's newer RPA solutions had more errors than HUS's mature systems, which requires evaluating them differently depending on their development stage.

Moreover, not all metrics are relevant to every context. More specifically, the impact can vary based on the context in which they are implemented. Thus, a full acknowledgment of the different perspectives and boundaries is necessary (Williams 2015). More precisely, organizations must broadly consider their specific stakeholders' perspectives: what goals are relevant for whom and what is needed to measure. Automation goals may not be achieved if stakeholders are not engaged in setting the objectives (Zayas-Caban et al., 2021).

Baseline measurements are essential for setting realistic targets. Both PIRHA and HUS faced challenges due to a lack of baseline data, as no initial measurements were taken before implementation. Inconsistent monitoring was also a major obstacle. While technical data was collected, qualitative insights have been lacking. Employees stressed the need for gathering feedback to fully understand automation's impact. Collecting feedback is important, as unanswered quality or safety concerns can undermine the long-term success of automation initiatives (Zayas-Caban et al., 2021).

Lastly, evaluation should occur regularly and be based on evidence collected at across multiple time points (WHO, 2016). While interviews identified cost efficiency and resource utilization as key factors for evaluation, both organizations would benefit from considering other dimensions. Similarly, Axmann and Harmoko (2024) argue that traditional cost-benefit analysis overlooks many automation benefits, possibly leading to poor decisions. They propose a balanced scorecard (BSC) framework to evaluate RPA projects, categorizing benefits into four areas: financial, process improvement, customer satisfaction, and learning. With adjustments, the model could potentially be applied to healthcare. The BSC, originally developed by Kaplan and Norton (1992), has already been used in healthcare, both with original and modified perspectives (Amer et al., 2022; Betto et al., 2022). Further research is needed to determine whether BSC framework could effectively evaluate healthcare automation outcomes.

6 CONCLUSIONS

This research explored the impact of automation solutions in two Finnish healthcare districts, providing insights into the benefits, risks, and evaluation of automation initiatives in healthcare. However, several limitations must be acknowledged. Firstly, this study focused only on two regions with varying levels of automation maturity, which may limit the generalizability of the findings to other healthcare environments. Additionally, the research primarily gathered insights from employees familiar with automation without including patients. Although participants were asked to reflect on the impact of automation on patients, no direct feedback was collected from patients themselves.

The findings contribute to future research on developing an impact assessment framework that could help healthcare organizations better understand and enhance the use of automation. Future research should explore whether successful evaluation frameworks from other industries can be adapted for the healthcare sector.

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