The Darker Qualities of Repair

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Abstract

This article investigates the darker dimensions of repair, departing from STS scholarship that portrays repair as a productive force of learning and renewal. It focuses on moments when repair fails to generate insight or restore stability, examining the aftermath of the Apotti data management platform's implementation in Finland. Drawing on documents outlining the platform's aims and discussions with medical doctors, the analysis traces persistent disruptions and misalignments in clinical workflows. The study identifies three forms of darker repair: corrective clicks, workflow fixes, and cosmetic repair. These manifestations reveal how efforts to upgrade and renew technology can deepen and mask organisational tensions. Central to the analysis is the recognition that multiple, qualitatively different repair processes are simultaneously at play. Research into the darker qualities of repair provides an evaluative lens to identify and anticipate the breakages and dissatisfaction accompanying data-driven reforms, suggesting that such issues can be detected before they become permanently irreparable.

Keywords: Datafication of Health, Qualities of Repair, Data Management Platform, Epic, Apotti, Workflows

Introduction

In April 2016, a collaboration agreement was signed between the Apotti company – jointly owned by the HUS hospital district, the City of Helsinki, and several municipalities in Southern Finland – and the US-based corporation Epic Systems to build a new data management system. Epic is a provider of electronic health record software used by hospitals and healthcare organisations to manage patient data, clinical workflows, and administrative processes. The plan was that while Epic delivers the underlying electronic health record and enterprise platform, the Apotti company integrates this platform with Finnish social and healthcare services, legal requirements, and language interfaces through customisation by the regional consortium that manages the system.

The planned Apotti platform set an ambitious goal: to renew healthcare by creating the world's first integrated system for both healthcare and social services. It was intended to replace earlier information systems that were considered obsolete and inefficient in handling information flows. According to company materials (see www.apotti.fi), Apotti promised to renew organisations by promoting data gathering on work processes and guiding professionals' actions by making them traceable and comparable.

The platform was officially launched at Peijas Hospital in November 2018. Prior to this, hundreds of healthcare professionals participated in the preparatory phases of the platform's 'user-driven adaptation'. Usability was prioritised during the procurement phase by setting user-centred design requirements, ensuring the selection of the system with the highest usability potential (Raatikainen et al., 2021: 7). Throughout the project, professionals contributed to design workshops, and numerous assessments were conducted to maintain a focus on their needs.

Despite the emphasis on usability, critical issues became apparent after the data management platform was rolled out (Raatikainen et al., 2021; Tyllinen et al., 2021) and progressively introduced across regional hospitals and public health stations. Physicians voiced their dissatisfaction with Apotti's features, citing complicated workflows, cumbersome pharmaceutical dispensing, difficulty in finding timely and relevant patient information, incomprehensible language due to business jargon, poor machine translation, and an unwieldy vocabulary that attempted to address both social and healthcare workers (Hertzum et al., 2022).

In October 2020, the Managing Director of the Apotti company responded to the critique by explaining that implementation and related operational changes take time, arguing that the benefits of the system might only become visible after years of use (see Grön, 2021: 8). The promises of future efficiency framed an everyday hospital reality in which the struggles and misalignments that medical doctors faced with Apotti were repeatedly ignored, as they were characterised as temporary issues that would be resolved once the platform was fully operational.

When physicians in the Helsinki-Uusimaa region were surveyed in 2021 about their experiences (see Hertzum et al., 2022), the percentage of those who agreed with the claim that information systems help improve the quality of care had dropped from 44 percent before Apotti to less than 10 percent after its implementation. All information systems have flaws that must be tolerated and worked through. With Apotti, however, the professional stakes were higher for physicians, due to concerns surrounding the quality of care, patient safety and inefficient uses of public healthcare resources.

This article mobilises the notion of 'repair' (Denis and Pontille, 2023; Jackson, 2014) to examine how Apotti's efforts to reform healthcare organisations disrupted existing workflows, thereby necessitating further repair. A growing body of research explores the specificities of repair in relation to data management and algorithmic systems, paying attention to how the repair work undertaken by those who use the system facilitates its operations (Conrad, 2019; Kaun and Liminga, 2023; Schwennesen, 2019, 2021). My analysis departs from the disruption caused by the data-driven initiative, which is itself an effort to repair and reorganise organisational workflows to generate the data required to gradually improve healthcare. The main focus, however, is on the consequences that this disruption had for physicians.

The renewal promised by Apotti aligns with the broader trend of 'the datafication of health', which promotes healthcare reforms by means of data sourcing, circulation, and the utilisation of patient and healthcare data, making it available for multiple purposes (Helén and Tarkkala, 2024; Hoeyer, 2023; Hogle, 2016; Ruckenstein and Schüll, 2017; Salovaara, 2024). The aim is to speed communication, introduce novel organisational and professional practices, utilise data-enabled guidance, and replace existing methods with preset standard tasks (Grön, 2019).

The introduction of datafied workflows is not repair in a 'getting back on track' or 'back to order' manner (see Denis and Pontille, 2023); rather, it is transformative (Sims and Henke, 2012), or even disruptive, repair. Sims and Henke (2012: 327) define transformation as "a repair strategy that seeks more radical change in existing structures and practices in order to maintain what actors see as core elements of a system". Transformative repair upgrades existing practical and institutional structures while balancing between stability and change. It is a process that can lead to learning and improvisation (Pink et al., 2018; Tanweer et al., 2016). Gradual adaptation functions as "a feedback loop of experimentation which, through many small increments in practical knowledge,

can produce large changes" (Graham and Thrift, 2007: 5).

However, to emphasise the disruption that Apotti generated and the associated discontent of medical doctors, this article departs from the productive notions of repair and highlights its darker qualities (Ribes, 2017). The focus on darker qualities introduces repair as an evaluative lens. It recalls Star's (1990: 43) proposition: "Cui bono?" With the question of who benefits, Star urges researchers to examine whose interests are served by a system, classification, or infrastructure. Aligning with Star's proposition, the repair lens can expose the social and political dimensions hidden in seemingly neutral technical arrangements (Velkova and Kaun, 2021). It can highlight how technologies and standards never serve everyone equally.

In March 2023, an interdisciplinary project that I lead arranged four workshops for medical doctors to assess whether the post-implementation phase of Apotti had settled into a more satisfactory situation. The goal was to explore what had changed with Apotti and how any resulting disruptions at work had been or could be addressed and repaired. What became apparent in these workshops were the darker aspects of repair processes, described by Hoeyer and Wadmann (2020) as 'meaningless work'. Drawing on the workshop discussions that detail how repair efforts may fail to improve the overall situation, I describe responses to disruptions within the workflows. In addition to the workshop materials, my analysis has benefited from publicly available reports and blog posts, news about the Apotti implementation, and discussions at seminars and conferences with researchers studying Epic-based systems. Apotti's building process, reconstructed using publicly available materials, provides crucial context for understanding physicians' perspective. Central to the analysis is the recognition that various repair processes are simultaneously at play and that they differ qualitatively.

In what follows, I treat as darker qualities of repair those instances when the physicians' practices feel pointless and frustrating and do not lead to meaningful improvement. I first explain how I develop the notion of repair to discuss the aftermath of Apotti's implementation. I then introduce Apotti's building process to explain the breakages that demand a response from physicians. These breakages range from medical records that have become fragmented and contain unnecessary information to the Apotti system's constant demands on attention. By analysing how medical doctors express discomfort with what Hoeyer and Wadmann (2020: 439) describe as "a sense of digression from the goal of helping the patient", we gain a sense of what troubles them in datafied workflows. By specifying what kind of repair is at stake, we can begin to observe who or what transforms existing workflows and who repairs them. This allows the various qualities of repair to be contrasted with what desirable repair *should* or *could* be.

Conceptual coordinates

The different qualities of repair

Discussions of repair often begin with Heidegger's notion that being in the world involves practices and tools used in 'handy' and 'invisible' ways (Verbeek, 2005; Graham and Thrift, 2007). Typically, people do not focus on tools or equipment when they engage in tasks; rather, their attention is directed towards the activities themselves. A hammer or a computer only becomes an object of attention when it cracks or becomes inoperable. For instance, if a laptop freezes and cannot be used for writing or scrolling, it necessitates repair. This type of repair is situated in a relatively stable world, where tool handlers have coherent interactions with their surroundings and can easily identify when tools break or stop functioning. Repair practices serve to restore the stability that brokenness disrupts, allowing tool handlers to resume their regular activities. However, it is not always clear what 'stability' means or how it should be restored. Transformative and disruptive repair can explicitly aim to interrupt the current status quo and, as a result, things may never return to their previous state. Despite efforts to restore stability, they can continue to feel broken and out of rhythm.

Ongoing testing and experimentation with digital tools and services, along with their updates and evolving nature, create a terrain where repair needs are constantly emerging. Repair positions

algorithmic technologies as negotiable and unfinished, and needing further work (Jackson, 2014; Schwennesen, 2021). To build and maintain connections that enable productive relations between the system and its users, an algorithmic system might have to be adjusted and creatively repaired (Schwennesen, 2019). Yet if the algorithmic system conflicts with publicly cherished values, such as privacy, autonomy or equity, it might also be seen to be beyond repair, and in need of shutting down or rethinking (Ratner and Schrøder, 2024; Ruckenstein and Trifuljesko, 2022).

Usefully for this discussion, Houston (2017) argues that the very notion of repair tends to convey a linear sense of time along which people move 'back' through repair work. Thinking about repair in this way obscures "the complex forms of change and their temporal unfolding – that both lead to breakdown and are enacted through repair work" (Houston, 2017: 38). Acknowledging the complexity of change suggests that repair should be understood in terms of differentiation rather than mere restoration (Houston, 2017; see also Denis and Pontille, 2023).

The implementation of any new data platform can be seen as "a disturbance coming from the outside", as Conrad (2019: 316) phrases it, because "it stirs up the existing information infrastructure consisting of well-established and well-known tools and their entanglement with the ways of doing things". Consequently, the implementation phase can be a messy and disorganised process wherein nobody knows exactly what the system is or when it will be completed. The success of the implementation process typically varies depending on who is evaluating it. The data management reform might meet the needs of managers and administrators, while physicians find themselves in a situation where implemented changes disrupt their usual practices and call for repair. This scenario, which is by no means limited to Apotti, exemplifies the complex nature of repair.

Furthermore, platforms like Apotti, built on data and algorithmic techniques, are open to very different kinds of use. The Apotti platform includes data-driven management tools, research tools, public health applications, and a customer portal. It contains different versions for different healthcare units and professionals. This adds to the difficulty of talking about 'a system' or 'a platform', as adaptation and related repair are likely to produce varying outcomes within the same platform. In practice, this means that the platform engages people differently. When things do not work as planned, they can be repaired through careful customisation, allowing Apotti's features to be tailored to specific workflows. Physicians can also personalise Apotti to meet their needs. Health professionals may find Apotti effective and helpful, but they might also perceive it as permanently flawed and laborious—an experience that was prominent in the workshop materials.

The modifiable and constantly updated features make it apparent that it is increasingly difficult to pin down exactly what constitutes repair in an evolving system. Does it involve maintaining and developing hardware, software, and workflows, or the divisions of labour and knowledge formation that the system promotes? What about the repair efforts of the broader operational environment that the system both disrupts and enhances? To emphasise the disruptive aspects of repair might appear counterintuitive: is it still considered repair if the aim is to disrupt? Undoubtably, in this context, repair raises the question of how far we can stretch the notion.

Questioning the limits of repair suggests that it is more productively employed as a situated lens rather than as a fixed definition. The lens of repair invites us to consider how external disruption might break existing practices and what consequences this has for professionals and organisations. Depending on the context and aims of the analysis, repair can be defined as anticipatory, disruptive, transformative, emancipatory or reflexive (Conrad, 2019; Henke and Sims, 2020; Sims, 2017; Velkova and Kaun, 2021). These different qualities can be thought of as an analytical toolkit that effectively reveals underlying or projected system features and their flaws. It is with this aim in mind that I attend to the darker qualities of repair.

Repair as a burden

In considering what might be 'dark' in the repair efforts of medical doctors, I emphasise the need "to broaden the meaning of repair to include

affect and care" (Ribes, 2017: 56). In what follows, I discuss the repair work carried out by physicians in the aftermath of Apotti as a collective experience that is not only frustrating but raises concerns about the quality of care. Ribes (2017: 56) emphasises the finite nature of maintenance and repair resources, suggesting that repair activities bring into focus what should be cared for and restored. Like all investments, repair and maintenance need to be allocated thoughtfully: "they cannot be distributed equally to all things that may need them" (Ribes, 2017: 56). Ribes urges scholars to adopt a less romanticised view of the productive qualities of repair, asking "at whose expense" the repair is conducted. As I demonstrate, this is a matter that should not be overlooked. The physicians who participated in the workshops shared the concern that attending to Apotti takes time away from patient care, which remains their unquestioned priority.

Disruptive repair challenges existing organisational practices and forces people to adjust and 'work things out' (Strauss, 1988). Working things out includes modifying workflows to accommodate the interdependencies between the new system and the various human tasks and roles. These practices have been studied as 'articulation work' (Strauss, 1988), which is often invisible and underappreciated yet crucial for the functioning of organisations, especially in environments like healthcare, where tasks are interdependent and require coordination across different teams and units.

I could discuss physicians' responses to the disruption caused by Apotti as articulation work, but my aim is to demonstrate that this approach would not adequately address the darker qualities of repair and related forms of invisible labour. The breakages in physicians' workflows trigger responses that extend beyond mere articulation work, adding repetitive repair tasks on top of the invisible labour that is already well-documented in the healthcare field (Oudshoorn, 2008; Schwennesen, 2021). The darker aspects highlight how disruptive repair becomes a burden that derails workflows rather than aids in getting back on track. It leads to dissatisfaction rather than renewal or hope. What is crucial, then, is to make visible the difficulty or even impossibility of adapting to the new situation.

Modes of inquiry

Contextualising a collective experience

Before discussing the workshop materials, I offer selective background information to contextualise physicians' experiences. The aim is to set up the analysis, not to provide a comprehensive or evaluative review, which would be beyond the scope of this study. Epic is currently the dominant vendor of data management platforms for healthcare globally and has recently secured new contracts in several European countries, including Denmark, Norway, and Finland (Grön, 2021; Hoeyer, 2019). Notably, these Nordic countries are welfare states in the Scandinavian tradition, with tax-based, universal healthcare systems, which fundamentally distinguish them from the US model that Epic has primarily served (Raatikainen et al., 2021: 8).

The Apotti platform is based on Epic's software packages, which have been locally implemented with the assistance of health and social care personnel. Customisation of generic software packages is laborious and time-consuming (Conrad, 2019), and, as in Denmark, physicians in Helsinki recognised the complexity of the overall process (Bansler, 2019). Epic offers construction materials, but the final results depend on how those materials are utilised. To illustrate this concept, one might think of Epic providing a Lego set that allows the buyer to build whatever they choose according to their needs and desires.

In Denmark, the configuration work of Epic's generic software was carried out at the hospital level by so-called 'physician builders' who have attended Epic's classes to learn how to code and work with the tools, templates and reports (*builds* as they are called in Epic's jargon) in ways that would support the workflows of a specific hospital department or medical specialty (Bansler, 2021). In Finland, physician builders have been affiliated with hospital departments, promoting localisation efforts. In addition, healthcare professionals have worked in various supporting roles, spending between ten and fifty percent of their time with Apotti-related tasks.

Bansler (2021: 6) identifies tensions in the Danish implementation process between standardisation and local variation, and centralised

control and local autonomy, and argues for balancing top-down and bottom-up approaches. Developers in Finland acknowledge that Apotti increasingly participates in care activities performed by professionals, guiding them towards a predefined operating model. As one director puts it, "this sort of guidance is relatively new, and it feels foreign and unpleasant" (Raatikainen et al., 2021: 8). One of the medical specialists confirms this experience, referring to Apotti as a *jötkäle*, a Finnish term used by fishers to describe a fish of massive size. For him, Apotti feels remote: an unwieldy obstacle, too slow and cumbersome to adapt and change. Despite using Apotti daily, he positions the platform outside the interactional realm, as if it were 'a thing' he observes from the outside but cannot relate to.

When healthcare professionals collaborate closely with IT specialists during an implementation process, they act as mediators and brokers between technical questions and local applications, often facing criticism when things do not go as planned. As a result of local adaptations, the platform can evolve into a patchwork of 'builds' and related repair efforts. The varying amounts of resources and effort invested in implementation shape its outcomes in different units and specialties. Naturally, this also raises questions about what is seen as worth investing in during the building process.

By following physicians' attempts to restore breakages caused by the data management platform, we can trace the discrepancies and misalignments between Apotti's operational routines and clinical work. Markham's (2021: 388–389) observations are helpful here, as they highlight the need for workable pathways when engaging with digital platforms. Pathways are sequences of actions or procedures established through initial usage, which, over time, become habitual practices for accomplishing a task. The pathway, Markham explains (2021: 389), steers the action and its direction. Over time, pathways become ingrained in workflows, causing both the pathway itself and the underlying process to fade away from conscious awareness. Guidance is no longer needed, as actions occur in a routine manner without conscious effort. In the case of Apotti, such pathways might not be where they are needed, leading to breakages and persistent repairs. Their absence becomes observable in the efforts of medical doctors to repair their daily workflows.

Workshop materials

The recruitment of physicians for the workshops that provided the empirical foundation for this article was conducted in collaboration with the Finnish Medical Society, Duodecim, which published an open invitation in its magazine and on the website. The workshops took place in Helsinki at the society's premises, with a total of 25 physicians: the first workshop had nine participants, the second six, the third seven, and the fourth four. One of the medical doctors participated in two sessions, as we offered the option. At the time of registration, the participants filled out a background questionnaire but, due to a technical glitch, data from one participant was not stored. Therefore, the description of the participants is based on information provided by 24 individuals. Among them, 19 were specialist doctors, three were specialising doctors, and two were non-specialised doctors. Many of them worked in several different units. Ten reported working in primary healthcare, 21 in conservative specialties, and four in surgical specialties. Their experience as medical doctors ranged from two to thirty-five years. Most (21) had been using Apotti for over a year, while the remainder had been using it for three to twelve months. Except for one participant, all used Apotti daily.

The participants included medical doctors with advanced degrees in computer science; others had taken IT courses or simply enjoyed experimenting with information systems and software. Many had also worked as Apotti support, and those less experienced benefited greatly from their assistance. As one doctor wrote on a post-it, "A doctor is the best IT support." This reflects a shared understanding of patient care and explains why doctors turn to fellow professionals for help with Apotti and daily workflows.

Aware of the critique surrounding Apotti, we inquired about the participants' current attitudes toward the platform in advance, which were negative (18), neutral (5) or positive (1). In light of this negative predisposition, we actively sought to

recruit physicians who had spoken about Apotti in positive terms in the media or in marketing materials, or who were Apotti experts that had contributed to the building of the system. Many promised to participate but ultimately did not attend. Afterwards, one of them explained that those who think positively about Apotti are tired of being hectored about the shortcomings of the platform. The atmosphere surrounding the Apotti assessment continues to be tense and polarised.

The workshop discussions were conducted in small groups of three to five participants, with trained facilitators managing their progress. Participants were encouraged to use their own observations as examples and describe their Apotti experiences as concretely as possible on post-it notes, which were then displayed for all participants to review. In addition to the facilitators and participants, researchers (2–4 per workshop) were present to observe, record proceedings and provide their insights at the end of each workshop. All discussions were recorded and later transcribed.

As a method, a series of workshops enables iterative approaches whereby insights from earlier sessions can be integrated into future ones (Ørngreen and Levinsen, 2017; Ruckenstein and Trifuljesko, 2022); striking in Apotti workshops was the uniformity of medical doctors' responses. Unlike the format more generally, where experiential divides can soon develop, Apotti experiences were shared, and hardly any tension or disagreement emerged. Considering the hierarchical nature of the medical profession, where surgical specialties are ranked higher than general practitioners, this was even more conspicuous.

At the conclusion of the first workshop, I revisited a concern raised by one of the workshop participants about the representativeness of the research material, collected with the aid of self-selected participants, most of whom held negative views about Apotti. Physicians value data-driven forms of reasoning, and it is difficult for many of them to appreciate that a collectively shared experience, with each participant building upon the details provided by the previous speaker, counts as evidence. What we heard in the workshop discussions did not address Apotti in its entirety, but it did reveal a consistent view of workflow disruptions attributed to the healthcare reform. This specific view anchors my analysis of the darker qualities of repair.

Reduced visibility

Due to the uniformity of Apotti experiences, it was possible to develop hypotheses concerning what had changed with the new data management platform only after two workshops. These hypotheses were based on recurring themes of the workshop discussions. The first hypothesis, which provided the trigger for the analysis presented in this article, states, "The visibility of the patient's situation has decreased." In the latter two workshops, the doctors (referred to by a participant number 1–25) were asked to respond to this hypothesis. They collectively confirmed that visibility of the patient's situation had indeed diminished.

> P25: Well, I don't really have much else to say except, yes, finding relevant information is more difficult.
> P24: Well, I definitely endorse that hypothesis completely…the medical record is totally fragmented, it's really difficult to fish out information, and it contains unnecessary data which takes an unreasonable amount of time to click open.
> P23: Yes, I agree…to the extent that I feel that no matter what I do, I cannot fix it myself, even if I spent a lot of time on something that doesn't exist, that's not available. It's not just that this issue is a bit unclear and messy, it has been completely blown apart, the whole material I need for doing my job.

Visibility into a patient's situation is essential for physicians to perform their work, as it forms the basis of patient care. The doctors described how they piece together information by digging into "tiny text boxes" or using "a crochet hook", referring to the meticulous process of information collection by comparing it to how a crochet hook connects strands of yarn into a unified fabric.

In analysing the workshop data, I traced how the physicians talked about the mending and fixing necessitated by the breakages within workflows. I used the emotionally charged relationship between Apotti and the healthcare professionals

as an entry point to explore workflow breakages and consequent repair work. Methodologically, investigating the 'feel' of technology relations provides an opportunity to unpack experiences with evolving systems (Choroszewicz, 2022; Ruckenstein, 2023). Workshop participants were aware that their dissatisfaction could be dismissed as resistance to change stemming from a general reluctance to adopt new work practices (Raatikainen et al., 2021: 8). Their non-compliance might be interpreted as a reason for Apotti's failures, causing 'cumulative mess', where "patience grows thin, frustration mounts, and ideologies clash" (Strauss, 1988: 171), and each new misalignment in tasks adds to the complexity and difficulty of change. To counter this claim, many of the physicians explicitly stated that they had not resisted the change or advanced technology. They had looked forward to the improvements that Apotti promised, contributed to the user-driven development workshops and spent countless hours studying the data management platform. As if to confirm this, the workshop discussions spontaneously descended into repair sessions, with participants explaining how they strengthen incomplete and missing pathways in workflows. They recounted how they improvise and manage their daily tasks: copying and pasting their texts with Word or creating their own shortcuts, 'smart phrases' that trigger an automatic insertion of longer text.

I grouped the different ways of talking about repair and found that it can be discussed as a fairly neutral, everyday activity. At times, however, the discussion shifted into a heavier register, in which the darker qualities of repair were detectable. While there is no uniform 'dark zone' to capture, these darker aspects emerge in the difficulties of piecing together information about a patient's situation. Another recurring theme was the resources wasted on Apotti-related tasks. It appeared that, whereas an integrated system assumes shared information needs, different professionals dealing with the same patient may require very different information. As a result, healthcare professionals who complain about the system receive too much or too little information, or information structured in the wrong way (Tanninen et al., 2025).

In the analysis of darker qualities, I focused on the repetitive attempts to repair Apotti engagements using the means available to the physicians. These engagements highlight how repair may not lead to meaningful improvement – it is repair that fails to repair. Below, I present evidence from workshop materials that illustrates a persistent state of repair. Corrective clicks and workflow fixes exemplify the work physicians do to repair visibility into patients' situations and the misalignments in workflows. I also describe how physicians write detailed service tickets to IT support to report problems and suggest improvements. However, these efforts often encounter long delays and responses indicating that certain issues cannot be fixed. The notion of cosmetic repair underscores the possibility that repair fails to achieve its projected aim. The darker qualities of repair speak to attempts at renewal that fall short of their intended purpose, confronting the losses that accompany data-driven reforms.

Forms of repair work

Corrective clicks

Originally developed for the US healthcare system, Epic's software packages have served a specific model of insurance-based healthcare and associated documentation. This means that the clicks and workflows they suggest may be irrelevant in the Nordic context, yet they are so deeply embedded in the software that they cannot be easily reconfigured (Hertzum et al., 2022). The countless clicks required by the platform are a way to talk about increasing requirements of data production. When data is needed to make the organisation and workflows legible, it drives a 'logic of escalation' in data work (see Hoeyer and Wadmann, 2020: 443). In terms of repair, however, the talk about clicking serves as a means to address the lack of visibility regarding the patient's situation. In pursuit of relevant information about the patient's history, overall situation and medication, the physician must work to restore fragmented information, one click at a time.

> P24: The medical records have been fragmented into such small references. And then you never know from those references where there is something essential and where there is something

> like changing a diaper. You have to click there like, aha, the nurse has changed the diaper there, there a lab test has been taken, okay, and then you click them one by one as you try to find something important, like where the cardiologist has given instructions on how the patient should be treated.

The quoted physician describes how the clicking and scrolling through text boxes is part of the search for clues about the patient's condition. As part of their repair work, the physicians engage in filling knowledge gaps to ensure patient safety. "The diaper change" serves as a typical example highlighting that Apotti cannot distinguish between relevant and irrelevant information. It is an annoying detail displayed alongside medical procedures, which symbolises information that doctors would prefer to ignore.

Physicians confirm critical details regarding treatments. Still, some of them believe that patient safety has been compromised, or they suspect that this is the case: "I can't, or dare not say for certain that this is definitely the case, but I have a strong suspicion it's been compromised in some situations", as one of them (P23) put it. Another doctor (P24) is more confident, referring to difficulties with prescribing medications and asserting, "I feel that patient safety has often been compromised with this information system."

The potential loss of critical details triggers a new kind of uncertainty. To avoid "ethical stress" physicians meticulously search for information that may have been overlooked. Piecing together the patient's situation is slow and requires careful attention. The repair of knowledge gaps takes its toll, producing breakages that are felt in the body – after a day at work, the wrist hurts. Here, the darker qualities of repair become manifest as bodily discomfort. Alongside concerns about bodily ergonomics, physicians worry about their cognitive ergonomics. The inability to concentrate arises from the laborous clicking through the data management platform while hunting for bits of information. As one of the medical doctors (P5) explains:

> You have to click yourself to so many places, [without forgetting] what that place even was… where did I need to go? In that time, the other things that I should keep in mind have been forgotten. And then you end up forgetting to do the thing you were going to do.

The need to think about what to click and where to go next is concrete proof of the lack of pathways that calls for repair. If the interaction between the physician and the platform were sufficiently aligned, the interaction would appear 'automatic' (Markham, 2021: 388); however, the clicking has not sunk into an inconspicuous part of workflows. If it had, the clicks would no longer bother the physicians, having become an imperceptible routine. The awareness of clicks, along with the experience of them as cumbersome and pointless, speaks to the darker aspects of repair. Clicks fit into the data-driven logic, which defines what each click means. The resulting click-based approach to handling information leads to workflow fixes that compensate for the limits of standardisation, a theme that I turn to next.

Workflow fixes

In primary healthcare, which is typically the first point of contact within the healthcare system, the breakages caused by Apotti underscore how difficult it is to fit the diverse requirements of both doctors and patients into standardised workflows. The accomplishment of tasks requires the alignment of workers and workflows (Strauss, 1988: 168). One of the doctors (P23) voiced frustration over the developers' inability to grasp the everyday realities of their work environment.

> If they think my job is just about having somebody come in every three months for a 45-minute blood pressure check, and then I just order a certain routine lab set, and it keeps going like that forever, well, no, our job is definitely not like that. We get people randomly from here and there, and they have all kinds of issues and concerns. There's just this huge lack of understanding here. If they don't understand what people do in different workplaces, then this can never turn out well.

The quoted doctor is referring to developers, but the problem might as well be that required standards need to be comparable across contexts. When tasks are standardised, they become defined by general rather than specific needs assessments (Star and Ruhleder, 1994). Despite

decades of research demonstrating that all work tasks, regardless of their simplicity, must be understood within the specificity of their human and organisational context, implementation processes continue to overlook this fact (Berg, 2001). While introduced as user-driven, the implementation of Apotti was described by physicians as top-down. They expressed dissatisfaction that neither the Apotti organisation nor HUS management had shown much interest in the aftermath of the implementation process in their unit. Experiences of having to handle the consequences of the change process independently resonated with those described in earlier studies, with care workers feeling they are left to their own devices when adopting new technologies (Schwennesen, 2021).

The misalignments in workflows lead to repair tasks that maintain additional interaction with the platform, while actively dealing with its gaps and flaws. For instance, the repair work can focus on simplifying and 'hiding' unnecessary features of Apotti to streamline the data management platform, ensuring that work tasks are interrupted as little as possible:

> P21: When we get a new employee, I redo the pages, I hide that, and all that is in forms.
> P19: And you hope that the update will not delete them later.
> P21: Yes, yes. But that probably needs to be done separately for everybody.
> P19: Yes, I do that as Apotti support; I hide things because twenty tabs are visible and we use these four.
> P20: In my opinion, this emphasises how we doctors, together, are trying to find ways to cope with Apotti.

Doctors' collective coping consists of working things out. However, through the evaluative lens of repair, it should not be seen merely as articulation work. By focusing on the ongoing efforts to mend breakages, we can recognise more serious misalignments that, as Ribes (2017: 56) suggests, occur at the expense of the physicians. The doctor who redoes the Apotti pages for an incoming employee aims to ensure that the guiding pathways are available when the shift begins. The systematic flaw is that these pathways have to be secured repeatedly.

If doctors worked in standardised ways, with predefined work tasks, Apotti might provide ample guidance. Ideally, the doctor should remain stationary in front of a personalised screen. However, the reality of a big hospital is that new employees must quickly adapt to the data management platform. People also work in different units, which means that customised and personalised workflows might not be at all what is needed. As one of the doctors (P19) explains,

> In Apotti, you should create a view for every single user, so it would be relevant in that sandbox, which is not the reality, because it doesn't correspond to our treatment system and the fact that we move from one place to another.

The doctor describes how Apotti's data management logic treats work at the hospital with an atomistic framing: one person for one screen. This sandbox reality clashes with the hospital reality, which is characterised by a flow of interactions among patients and colleagues in different units. Rather than accessing their own personalised screens in isolation, doctors might prefer to share their screens with nurses. If each screen is different, sharing becomes demanding. Here, the fixing of workflows might mean "leg work" or talking about what is not on the screen.

The extra work associated with the workflow fixes explains why the workshop participants longed for more stable and consistent information systems, frequently mentioning alternatives (Pegasus, Miranda/Uranus, Finstar, Navitas) that, while clumsy and far from perfect, were easier to work with. Although these earlier systems may have disrupted daily workflows, the doctors had figured them out. This longing for earlier systems should not be interpreted as a desire to move back in time. Medical professionals are not against change, but they would like to see transformation that provides stability and does not call for repetitive repair.

Cosmetic repair

Physicians tell how they try to influence the repair of workflows and other misalignments in the Apotti system by writing service "tickets" (*tiketti*) to IT support, detailing the problems they have

encountered. These tickets were discussed in the workshops in an ambivalent, frustrated and disappointed manner. Some had written tickets, or should have written them but ended up not doing so because they had been informed that there were already too many tickets in the backlog. Others had written tickets, but had waited for a response for weeks, months or even over a year, as explained by one workshop participant (P7) when talking about "extremely sluggish" development work:

> When I make a development request to Apotti, it might take a year before they respond, and then they ask questions about things that were clearly stated in [my] request. It's like they didn't understand the question at all, or where the issue originated.

Suggestions are typically small, but much needed in daily work (P14):

> So, two years ago we made a bunch of proposals which were really important to us and, as of last week, I would have said that none of them had led to anything, but now one has. On the death certificate, there's this location code that needs to be entered, which has maybe 15 numbers, but we always have the same code. Since it's always the same for all of us, now it gets entered there automatically.

One of the physicians (P19) has written dozens of tickets: "It is always the fault of the user", he says, referring to the notion that if the data management platform fails to work as planned, the human is the weaker link, not the system. The local developers confirm this notion by stating that users 'blame the system for something that in fact isn't even the system's fault' (Raatikainen et al., 2021: 9). The physician continues to describe a structural problem: Apotti platform is adapted to local conditions, but the adaptation is constrained by Epic's software packages. He thinks that the Apotti company is merely a *bulvaani* – a Finnish word for 'a front' – acting on behalf of Epic, disguising the true control of software assets. The Apotti company has no ability to repair the data management platform because it is assembled from parts owned by Epic, which cannot be changed.

Without a clear understanding of how to turn the vision into reality, "disruptive problems will haunt the entire project", Strauss (1988, 53) predicts, echoing the experience of the workshop participant (P19), noting that Apotti support often replies, "We can't fix this," because the issue is a feature of Epic's system and outside their remit. "And this leads to the situation where all this development work is just tinkering because they don't actually change Epic's stuff, nor do they have the rights to change it."

The Apotti critique recalls the widespread experience of muteness and inaccessibility associated with big tech platforms, emphasising the informational asymmetry and unequal power relations in which no actual dialogue occurs (Ruckenstein, 2023). People send queries and requests to companies in an attempt to understand why the platform and its algorithmic functions operate as they do. In return, they receive automated responses or answers that feel unjustified or unfair. At times, they get no response at all. In the Apotti case, doctors perceive the lack of communication as a systemic failure, alternatively attributing it to Epic or the Apotti company.

Using the analogy of a mouldy house, one of the doctors (P20) explains how the repairs are merely cosmetic, as the underlying issues, related to Epic's software packages and the outcomes of local implementation processes, are not properly addressed.

> I don't have the energy to make out tickets for Apotti because they just get deleted when they don't have the time to respond to them; it feels like it's the same kind of thing as if mould were found in a building and it were just scraped off and painted over to make it look good – so it doesn't look like there's mould anymore.

The "making it look good" speaks to the idea of surface-level fixes that mask structural problems. Workflows are patched, templates tweaked, and interfaces adjusted, yet the fundamental mismatches between clinical practice and the platform's design persist.

Confronting the losses

By writing up their tickets, healthcare professionals are trying to inform 'someone' who might care, although they are unsure who is ultimately in charge of the process or whether the overall system can ever be modified to support their work. The post-its written during the workshops reflect this notion:

> P7: Then I wrote here, can Apotti be fixed, or is its foundation so flawed that it can't be modified anymore? Is it fundamentally such that we can't build the things we need? I don't know how to answer that.
> P6: I've written that the development doesn't seem to focus on the core structure, meaning the user interface, but rather on minor details. On the other hand, developing those minor details is important too, but it doesn't change the fact that the underlying system is bad.

The medical doctors spoke of "some pretty fundamental changes" (P18) needed for Apotti to assist them, even though they remain unsure about what belongs to 'the system' and what is possible. Some physicians reported losing faith in the implementation process. They did not think that management knew what it was doing. Given the current misalignments, physicians continue to improvise and tinker, trying to make the best of the platform. In the face of economic pressures, however, the workshop participants are increasingly aware that such efforts are not without cost. The darker aspects of repair manifest in various kinds of losses, including time and promised efficiency. As suggested by one (P18): "What concerns everyone the most now is our poorly utilised work resources. Everything costs quite a lot, in terms of indirect costs. You can't directly calculate how much this has cost".

To illustrate the loss of resources, the physicians engage in number-based reasoning, comparing the time before Apotti and after, observing, for instance, that they treated nine patients in a day in the past and now only seven. Yet they have no official data to back up their claims.

Rethinking from here

The darker range of repair

I have suggested that the lens of repair invites us to think about the different qualities of repair. Depending on the context and evaluative stance, repair can be defined as anticipatory, disruptive, transformative, emancipatory or reflexive. Disruptive repair presents an opportunity for renewal, but it can also derail workflows and lead to repetitive repair tasks. To make such tedious tasks visible, I focused on the darker qualities of repair, suggesting that their analytical power lies in identifying moments when repair becomes a burden. These darker qualities bring to the fore attempts at restoration that fall short of their intended purpose. Even if repair is ongoing, it may feel pointless when it fails to improve the overall situation.

In the case of Apotti, these darker qualities reveal how data-driven improvements, and their underlying database logic can unsettle organisational flows, with taxing consequences. Medical doctors' efforts to regain visibility of the patient's situation, lost through the data-driven reform, make clear that this work is carried out at their expense. They must engage in daily click work and workflow fixes to operate the data management platform.

While such repetitive tasks divert attention away from patient care, medical doctors are effectively maintaining a platform whose gaps and flaws appear systemic rather than isolated. The notion of cosmetic repair, used to characterise the shortcomings of efforts to fix Apotti, is telling. Successful repair requests may add a button, a line of code, or a new feature, yet still fail to improve the overall system. Physicians' discontent appears as a longing for simpler information systems with predictable and shared workflows. Such systems do not feel as overwhelming, uneven, or distracting.

Repair requests can culminate in an impasse: the platform is built to support purposes that differ from the practices and expectations of professionals. "I am a doctor, not an IT nerd," one doctor concluded, referring to the constant need to think about the data management platform. This doctor was contemplating abandoning their medical specialty to work as a general practitioner

in the private sector, thereby avoiding interactions with Apotti. If there is little scope for repair that would improve what most needs improvement, it might be time to let go. The cost of such a decision is personal, but in this instance, it is also societal, with the public healthcare system suffering the consequences.

Towards reflexive repair

The problems associated with Epic-based platform implementations in the Nordic countries are by now well-known, yet it remains unclear what will be learned about the failed promises and lost resources. Differentiating between forms of repair offers new entry points for this discussion. The qualities of repair are useful for distinguishing between those forms that compel people to adapt and adjust, even in the absence of improvement, and those that are emancipatory, creating opportunities to rethink and renew infrastructural relations and information flows.

The workshops held in Helsinki stand as a testament to the sheer magnitude of work invested in repairing workflows and securing pathways. As with any emerging system, the healthcare professionals' engagements with Apotti develop over time; what they thought about the system a year ago may have already shifted. Expectations and priorities continue to evolve, and the processual nature of repair means that practices of repair do so as well. Even as people gradually adapt in the wake of disruptive changes, the darker aspects should not be disregarded, as they can offer valuable lessons about whose aims and interests are served.

In the midst of data-driven reforms, listening to what people feel or think needs repair, and observing how they engage in repair practices, offers a corrective. Medical doctors are accustomed to being valued, yet in this instance, they have been downgraded to click workers and workflow fixers, which explains their frustration. Their privileged position makes them more vocal about their situation than many others, drawing attention to the need to attend to the darker qualities of repair among those who are heard even less. To understand the limits of repair and its qualities, it is crucial to examine not only what is seen as broken but also how the act of repair might illuminate breakages. This invites us to consider the potential for repair to fail in its intended purpose and to ask at whose expense the repair work is conducted.

In future work, the notion of reflexive repair (Henke and Sims, 2020) can be mobilised to encourage a more critical and transformative stance on the darker qualities of repair. Reflexive repair suggests stepping back and rethinking how we undertake repair. Instead of simply fixing problems as they arise, it asks us to consider the wider consequences of large, interconnected infrastructures, including how power, scale, and time shape what is built, who benefits, and who bears the costs. In this light, reflexive repair poses a simple but demanding question: how can we repair or renew information systems so that they do not create new burdens or lock in unsustainable practices?

Reflexive repair encourages a two-way approach: tracing the broader political and economic implications of the datafication of health, while also attending to bottom-up realities of data management systems, such as how repair shapes clinicians' work, their ability to care for patients, and the quality of their professional lives. Connecting the qualities of repair to care and affect brings unacknowledged practices into view and offers insight into ongoing processes of change. Rather than merely exploring and describing the darker range, a focus on the qualities of repair allows processes to be unpacked and treated as material for rethinking data-driven developments.

Research into the darker qualities of repair provides a productive lens for identifying and anticipating the breakages and dissatisfaction that accompany data-driven reforms, helping ensure that these issues are acknowledged before they become permanently irreparable.

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References

Bansler JP (2019) Adaptation of Clinical Information Infrastructures by and for Users. *Infrahealth 2019 - Proceedings of the 7th International Conference on Infrastructures in Healthcare 2019*. European Society for Socially Embedded Technologies (EUSSET). Vienna, Austria, 30-31 May 2019. https://doi.org/10.18420/ihc2019_001.

Bansler JP (2021) Challenges in user-driven optimization of EHR: A case study of a large Epic implementation in Denmark. *International Journal of Medical Informatics* 148: 104394.

Berg M (2001) Implementing information systems in health care organizations: myths and challenges. *International Journal of Medical Informatics* 64(2-3): 143-156.

Choroszewicz M (2022) Emotional labour in the collaborative data practices of repurposing healthcare data and building data technologies. *Big Data & Society* 9(1): 20539517221098413.

Conrad L (2019) The organization is a repair shop. *Ephemera: Theory & Politics in Organization* 19(2): 303–324.

Denis J and Pontille D (2023) Before Breakdown, After Repair: The Art of Maintenance. In: Mica A, Pawlak M, Horolets A and Kubicki P (eds) *Routledge International Handbook of Failure*. London: Routledge, pp. 209–222.

Graham S and Thrift N (2007) Out of order: Understanding repair and maintenance. *Theory, Culture & Society* 24(3): 1–25.

Grön K (2019) *Apotti-hanke ja sosiaali- ja terveydenhuollon tulevaisuuden odotukset*. Master's Thesis, Faculty of Social Sciences, University of Helsinki.

Grön, K (2021) Common good in the era of data-intensive healthcare. *Humanities and Social Sciences Communications* 8:230. https://www.nature.com/articles/s41599-021-00911-w.

Helén I and Tarkkala H (2024) Adjusting expectations actionable: Personalised treatment plan in anticipation of data-driven healthcare. *Big Data & Society* 11(4): 20539517241285384.

Henke CR and Sims B (2020) *Repairing infrastructures: The maintenance of materiality and power*. Cambridge: MIT Press.

Hertzum M, Ellingsen G and Cajander Å (2022) Implementing large-scale electronic health records: experiences from implementations of Epic in Denmark and Finland. *International Journal of Medical Informatics* 167: 104868.

Hoeyer K (2019) Data as promise: reconfiguring Danish public health through personalized medicine. *Social Studies of Science* 49(4): 531–555. https://doi.org/10.1177/.

Hoeyer K (2023) *Data Paradoxes: The Politics of Intensified Data Sourcing in Contemporary Healthcare*. Cambridge: MIT Press.

Hoeyer K and Wadmann S (2020) 'Meaningless work': How the datafication of health reconfigures knowledge about work and erodes professional judgement. *Economy and Society* 49(3): 433–454.

Hogle LF (2016) Data-intensive resourcing in healthcare. *BioSocieties* 11(3): 372–393. https://doi.org/10.1057/s41292-016-0004-5.

Houston L (2017) The timeliness of repair. *Continent* 6(1): 51– 55.

Jackson S (2014) Rethinking repair. In: Gillespie T, Boczkowski PJ and Foot KA (eds) *Media Technologies: Essays on Communication, Materiality, and Society*. Cambridge : MIT Press, pp. 221–239.

Kaun A and Liminga A (2023) Welfare service centers: Maintenance, repair, and care at the analog interfaces of the digital welfare state. *New Media & Society 27*(5): 3039-3054. https://doi.org/10.1177/14614448231220362.

Markham A (2021) The limits of the imaginary: Challenges to intervening in future speculations of memory, data, and algorithms. *New Media & Society* 23(2): 382–405. https://doi.org/10.1177/1461444820929322.

Ørngreen R and Levinsen KT (2017) Workshops as a research methodology. *Electronic Journal of E-learning* 15(1): 70–81.

Oudshoorn N (2008) Diagnosis at a distance: The invisible work of patients and healthcare professionals in cardiac telemonitoring technology. *Sociology of health & illness* 30(2): 272–288. https://doi.org/10.1111/j.1467-9566.2007.01032.x.

Pink S, Ruckenstein M, Willim R and Duque M (2018) Broken data: Conceptualising data in an emerging world. *Big Data & Society 5*(1): 2053951717753228. https://doi.org/10.1177/2053951717753228.

Raatikainen P, Pekkola S, Nurminen M and Mäkelä M (2021) Masterplots in information systems implementation. ECIS 2021 Research Papers, 136.

Ratner HF and Schrøder I (2024) Ethical plateaus in Danish child protection services: The rise and demise of algorithmic models. *Science and Technology Studies* 37(3): 44–61.

Ribes D (2017) The rub and chafe of maintenance and repair. *Continent* 6(1): 71-76.

Ruckenstein M (2023) *The Feel of Algorithms*. Berkeley: University of California Press.

Ruckenstein M and Schüll ND (2017) The datafication of health. *Annual Review of Anthropology 46*: 261-278.

Ruckenstein M and Trifuljesko S (2022) Algorithmic futures and the unsettled sense of care. In: Lanzeni D, Waltorp K, Pink S and Smith RC (eds) *An Anthropology of Futures and Technologies*. London: Routledge, pp. 79–92.

Salovaara S (2024) *Tietojärjestelmät osana sosiaalityön tiedonmuodostusta*. PhD thesis, University of Lapland.

Schwennesen N (2019) Algorithmic assemblages of care: Imaginaries, epistemologies and repair work. *Sociology of Health & Illness* 41: 176–192.

Schwennesen N (2021) Between repair and bricolage. In: Peine A, Marshall B, Martin W and Neven L (eds) *Socio-Gerontechnology: Interdisciplinary Critical Studies of Ageing and Technology.* London: Routledge, pp.175–188. https://doi.org/10.4324/9780429278266

Sims B and Henke CR (2012) Repairing credibility: Repositioning nuclear weapons knowledge after the Cold War. *Social Studies of Science* 42(3): 324–347.

Star SL (1990) Power, technology and the phenomenology of conventions: on being allergic to onions. *The Sociological Review* 38: 26–56.

Star SL and Ruhleder K (1994) Steps towards an ecology of infrastructure: complex problems in design and access for large-scale collaborative systems. In: *Proceedings of the ACM conference on Computer supported cooperative work,* pp. 253-264.

Strauss A (1988) The articulation of project work: An organizational process. *Sociological Quarterly* 29(2): 163–178.

Tanninen M, Helén I and Ruckenstein M (2025) Epic disappointment: Physicians' experiences of steerability in data-driven healthcare. *SSM - Qualitative Research in Health*. https://doi.org/10.1016/j.ssmqr.2025.100667.

Tanweer A, Fiore-Gartland B and Aragon C (2016) Impediment to insight to innovation: Understanding data assemblages through the breakdown-repair process. *Information, Communication & Society* 19(6): 736–752.

Tyllinen M, Kaipio J and Lääveri T (2019) Usability analysis of contending electronic health record systems. In: Francis L, Bartle-Clar JA, Bliss G, Borycki EM et al (eds) *Improving Usability, Safety and Patient Outcomes with Health Information Technology*. Amsterdam: IOS Press, pp. 430–435.

Velkova J and Kaun A (2021) Algorithmic resistance: Media practices and the politics of repair. *Information, Communication & Society* 24(4): 523–540.

Verbeek PP (2005) *What things do: Philosophical reflections on technology, agency, and design*. University Park: Pennsylvania State University Press.