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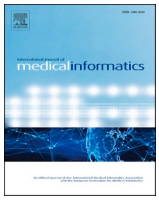

Unleashing innovation in first-line healthcare: The barriers to realizing platform openness

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ABSTRACT

Purpose: Digital platforms are essential for fostering innovation in first-line healthcare. These platforms require openness, allowing external parties to utilize, enhance, or profit from them. Yet, knowledge about barriers to realizing platform openness is lacking. This research investigates the barriers to realizing platform openness in first-line healthcare.
Method: This research employed a qualitative exploratory approach. We collected data through thirteen semi-structured interviews with platform experts, application developers, and healthcare practitioners. As a study setting, we focused on Dutch first-line healthcare. We then analyzed the data using thematic analysis.
Result: We identify barriers in three main categories that hinder platform openness: technology-related (e.g., redundancy in development work), business-related (e.g., profit-maximizing strategy), and healthcare-related (e.g., reluctance to change).
Scientific contribution: We contribute to the platform literature in medical informatics by being among the first to examine openness barriers that hinder platform-based innovation. We thus explain why platform implementations often do not result in substantial improvements in healthcare delivery despite their transformative impact in other industries.

1. Introduction

Platform-based innovation plays a crucial role in first-line healthcare. For example, platform-based innovation enables novel medical interventions [12,16,25], customized care for the specific needs of particular population groups [40], and healthcare delivery integration [27]. A digital platform is an extensible codebase of a software system that provides core functionality (Tiwana et al., 2010) and enables third-party providers (i.e., complementors) to offer complementary services [9], thereby allowing for integrating new functions beyond the core features [76]. To trigger innovation in digital platforms, platform openness is a central issue [17,55], which relates to enabling complementors to create platform-based services [20] or other platform providers to share platform resources such as patient data [45,68].

Related work in other domains shows that realizing platform openness is challenging (e.g., [54,73], and the medical domain likely brings in even more challenges. As platform-based innovation relies on platform openness, understanding the barriers that hinder platform openness is crucial to improving first-line healthcare. Much of the literature in medical informatics examines challenges related to user adoption on digital platforms [2,42,75,79]. Surprisingly, the literature seldom addresses the barriers to realizing openness that prevent platform-based innovation. There are a few exceptions that explore platform openness innovation barriers. For example, Adner and Kapoor [4] find that complementors struggle to adapt to platform complexities and evolution, thus hindering platform openness. Yet, these studies do not specifically focus on the health context.

This research investigates the barriers to realizing platform openness in first-line healthcare. We conduct a qualitative exploratory study by interviewing platform users (e.g., medical practitioners), IT providers, and domain experts. As a setting, we focus on the Dutch first-line healthcare sector, which includes all professional care accessible to patients without a hospital referral (e.g., general practitioners, dentists, physiotherapists). We focus on this setting because the Netherlands excels in digital health (e.g., data maturity) compared to other countries [53]. Therefore, the setting offers a relevant context to explore why realizing platform-based innovation remains challenging despite a favorable environment.

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This study establishes a foundation for researchers, practitioners, and policymakers. It provides researchers with an understanding of three overarching categories of platform openness barriers, facilitating follow-up explanatory (e.g., examining why these barriers occur) and design science research (e.g., designing solutions to overcome the barriers). Additionally, we identify specific platform openness barriers that have not previously been discussed in the medical informatics literature. For practitioners, it offers insights that guide solution development to enhance platform openness, thereby fostering innovation. For policymakers, it provides insights to develop policies aimed at removing these barriers and thus stimulating platform-based innovation.

The rest of the paper is structured as follows: Section 2 provides background on the study. Section 3 elaborates on the research method. Section 4 discusses the findings related to barriers to realizing platform openness. Section 5 presents the results, and Section 6 concludes the paper.

2. Background

2.1. Digital platform openness

Digital platforms have transformed various industries (e.g., [38,78], specifically by fostering innovation [77]. Digital platforms enable innovation by catalyzing business model transformations of their user groups [78]. Generally, digital platforms have three core characteristics: matching users, facilitating interactions, and maintaining modular architecture [30]. Firstly, platforms connect supply-side and demand-side users, utilizing relevant information to create mutually beneficial connections. Secondly, platforms facilitate user interactions by establishing rules that promote constructive exchanges and prevent negative ones. Platform sponsors and operators govern these user interactions. Platform sponsors are single or multiple firms that design platform components, own the property rights, and decide who may participate in platforms. Meanwhile, platform operators are commercial entities that operate platforms when running as businesses [23]. Lastly, platforms have a modular architecture [18], enabling third-party providers (i.e., complementors) to offer supplementary services [9]. This modularity makes platforms highly flexible, facilitating the addition of new functions [76].

The modularity characteristic of digital platforms relates to the concept of *platform openness*. In digital platform literature, platform openness is the degree to which external parties can use, expand, or monetize a platform [14]. In addition, platform openness can also happen between platforms [45]. The most common approach to achieve platform openness is by developing open interfaces within a modular architecture, primarily through boundary resources like application programming interfaces and software development kits [29]. Given the promising benefits of platform openness to foster platform-based innovation, governmental bodies like the European Union have introduced regulations encouraging openness in healthcare, such as the European Health Data Space.[1]

Yet, openness that triggers platform-based innovations can contribute to the digital divide (cf. [47], especially for healthcare providers and patients. Smaller healthcare organizations or those needing more resources may need help adapting to and keeping up with platform-based innovations, resulting in disparities in the provision of high-quality care [3]. Moreover, patients with limited digital literacy, often due to age-related disparities, may struggle to use healthcare platforms, potentially worsening health inequities [19]. In addition, platform-based innovation can contribute to overreliance on technology and reduced human interaction (e.g., [74]. Excessive reliance on technology may lead to depersonalized care. Patients may feel disconnected and less satisfied with their healthcare experiences if their interactions are predominantly with screens rather than healthcare professionals. In summary, while platform openness fuels innovation and offers significant benefits, it may also present unintended consequences that we must consider.

2.2. Barriers to realizing platform openness in healthcare

One key reason platform business models remain dominant in the market is that platform sponsors open up their core resources to complementors, fostering collaborative innovation between these two actors [50]. In other domains, for instance, gaming platform sponsors (e.g., Sony) provide game consoles that enable complementors (e.g., Electronic Arts) to create games [62]. Another example in another domain is that lighting platform sponsors (e.g., Philips Hue) that enable complementors (e.g., MusicHue) to synchronize light color with music rhythm [32]. In the healthcare domain, opening up digital platforms also leads to innovation. For instance, platforms transform medical procurement processes [6,72], care deliveries [70], patient communication strategies [5], and clinical trials [56].

Medical informatics literature often explores digital platform openness but does not primarily relate to innovation endeavors. Instead, the focus includes aspects like open science [10] and transparency in clinical trial data [34]. We only find a few studies that discuss platform openness barriers, such as poor design coordination between platform providers and third-party innovators [35] and lack of cross-disciplinary understanding between them [43]. Another known barrier includes the complexity of integrating new technologies into existing systems [21]. Given the state-of-the-art of literature, industry trends, and policy agendas, exploring platform openness barriers to enable platform-based innovation in healthcare is thus particularly timely and critical.

3. Method

We employed semi-structured interviews to explore the challenges that hinder innovation within digital health platforms in first-line healthcare.[2] These interviews followed a predetermined set of discussion topics, allowing for some flexibility in the sequence and depth of questions. This approach allowed the interview participants to express their views related to specific topics on their own terms. Moreover, this method is helpful because it allows for additional insights to emerge that the researcher did not foresee [36]. We chose semi-structured interviews for our data collection to facilitate a deeper, individualized exploration of participants' experiences, minimizing social dynamics and conformity biases often found in focus groups (cf. [71]. This method is crucial for studying sensitive issues like barriers to platform openness, where participants might hesitate to speak freely in a group setting. Semi-structured interviews helped create a private and secure environment, encouraging open and honest discussions.

3.1. Selection of respondents

The selection of the respondents is an essential step for the practical usage of semi-structured interviews because the insights depend on the respondents' knowledge. We adopted a purposive sampling approach, particularly judgment sampling, to choose our interviewees based on their expertise [69]. This method was suitable for exploring a relatively uncharted area, where only a select few possess the requisite knowledge [24],thus, we targeted those best positioned to provide vital insights.

We focused on three key roles: 1) developers of IT applications for

[1] https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en, accessed on 26 June 2024.

[2] The authors confirm compliance with ethical and legal standards according to the national jurisdiction where the data was collected. This data collection, part of a larger PhD project led by the first author, received approval from the Human Research Ethics Committee, number 2475.

the first-line healthcare domain, 2) platform experts, and 3) healthcare practitioners. The healthcare practitioners are further divided into three sub-groups: general practitioners, pharmacists, and pharmacy-holding general practitioners (i.e., GPs with their own small pharmacy due to the absence of nearby pharmacies). We selected developers with extensive experience in creating healthcare applications on platforms (e.g., patient communication or skin cancer detection apps). Platform experts were chosen based on their experience in developing and managing platforms in the first-line care domain. Healthcare practitioners were included if they demonstrated proficiency in using digital platforms. We confirmed the participants' expertise by reviewing their public professional profiles, such as those on LinkedIn. We also asked them to discuss their experiences with platform openness during the interviews. Finally, English proficiency was also a crucial selection criterion for all roles. Table 1 presents the overview of the interviewees.

The first author conducted the interviews between September and November 2022. The first author is a PhD candidate who specializes in digital platform research within the health domain and has extensive experience as a practitioner focused on platform openness. The first author is trained in qualitative research methodologies.

In total, we conducted sixteen interviews. Specifically, we interviewed three developers, three general practitioners, four pharmacists, three pharmacy-holding general practitioners, and three platform experts. The first author recruited participants from his own networks. No participants refused to participate or dropped out of the interviews. We reached saturation after these sixteen interviews. In qualitative research, the saturation principle refers to the point at which additional interviews no longer yield new or significant insights into the research topic [64].

Table 1
The overview of the interviewees.

ID	Role	Core relevant experience	Overall work experience
1	Platform expert 1	Information systems development in healthcare, specialized in the patient journey in first-line healthcare	>25 years
2	Platform expert 2	Information systems and platform development in healthcare and finance. Independent enterprise architect specialized in interoperability	>20 years
3	Complementor 1	Ecosystem expert and owner of several apps in the healthcare domain	>25 years
4	Platform expert 3	Independent consultant, project, and program manager in information systems development in healthcare	>25 years
5	Pharmacist 1	Director of an e-health company, expert of the pharmacy ecosystem	>15 years
6	Pharmacy holding GP 1	General practitioner, with a Pharmacy. Board member of various healthcare associations.	>35 years
7	Pharmacist 2	Owner of several pharmacies. An expert how to use digital health in practice	>20 years
8	General practitioner 1	General practitioner and board member of a healthcare user association	>25 years
9	Complementor 2	Director of several IT companies in the healthcare domain	>25 years
10	General practitioner 2	General practitioner and board member of a healthcare user association	>10 years
11	Pharmacist 3	Pharmacist and owner of a pharmacy	>15 years
12	Pharmacist 4	Pharmacist and member of a pharmacy association	>5 years
13	Pharmacy holding GP 2	General practitioners, witha pharmacy	>25 years
14	General practitioner 3	General practitioner and board member of a healthcare user association	>35 years
15	Pharmacy holding GP 2	General Practitioner, including a Pharmacy. Board member of a healthcare user association.	>20 years
16	Complementor 3	Ecosystem expert in healthcare and senior consultant in digital health	>30 years

3.2. Interview protocol

The respondents received an email explaining the scope and purpose of this research. This email also stated the goal of the semi-structured interviews a few days before the interview. The document explained that the interview would discuss barriers to platform openness that hinder innovation in Dutch first-line healthcare. The average duration of the interviews was about one hour. We conducted interviews either online using Microsoft Teams or in-person at the participant's office. For online interviews, we used the built-in recording feature of Microsoft Teams. For in-person interviews, we recorded using a mobile device. We then transcribed recordings. Afterward, we deleted the recordings and sent the revised slides to the interviewees for their feedback or approval of the changes. Participants gave explicit consent for the interviews and their recordings. The ethics board at TU Delft approved the consent form prior to data collection.

The interview protocol consists of two parts. In the first part, we presented barriers to platform openness that hinder the innovation generated from the ongoing discussion of the Dutch National General Practitioner's Association conference. In doing so, we did not reinvent the wheel. Appendix A presents these preliminary barriers. In the second part, we invited respondents to comment on these barriers and share any additional insights related to platform openness in first-line healthcare. The second part was flexible, allowing the interviewee to probe into insights that emerged during the discussion. Bias may occur if the interviewer inadvertently influences the type of responses given [69]. To deal with this, we maintained a consistent interview protocol across all interviews (e.g., presenting the information in Appendix A).

3.3. Analysis approach

We performed a thematic analysis (cf. [52]. To begin, we arranged our transcripts into organized cloud-based repository folders. Then, we thoroughly reviewed the interview transcript, noting potential codes based on the initial barriers outlined in Appendix A. Next, we generated initial codes. We used Microsoft Words to code our transcripts by annotating specific blocks of text. For example, Interviewee 6 mentioned: "It is often easy to stick to that 'what works' [in existing digital platforms]. A major change is mainly seen as a time-consuming process despite possible net time gain afterward." We coded this excerpt into *reluctance to change*. In many cases, participants identified additional explanations that were not part of the original categories, which prompted us to revise our discussion slides. Bias could arise in the interview analysis from misinterpreting or distorting responses [69]. To address the bias, the analysis was conducted jointly by the first and second authors. The first author coded certain statements, and the second author checked these until consistency was achieved. The result in Table 2 reflects the coding tree of our analysis, where specific barriers correspond to the first-order codes, and the categories are derived from these codes.

4. Results: Barriers to platform openness

The following section presents the barriers to platform openness in first-line healthcare. We find three overarching themes: technology-related, business-related, and healthcare-related barriers.

4.1. Technology-related barriers

Limited data interoperability, focusing on short-term issues, and redundancy in development work technically challenge platform openness.

The first technology-related barrier to platform openness is *limited data interoperability* (1, 2, 4, 7, 11, 12, 14, 16). Interviewee 11 illustrated:

Table 2
The finding summary (category – barrier – interviewee).

Categories	Barriers hindering platform-based innovations	Example	Interviewees
Technology-related barriers	Limited interoperability	Professionals prefer to stick with familiar and functional old connections, fearing that new interfaces might fail in the short term	1, 2, 4, 7, 11, 12, 14, 16
	Focus on short-term issues	Many IT parties tend to create individual point solutions instead of comprehensive and innovative total solutions	1, 3, 5, 7, 8, 9, 10, 14
	Redundancy in development work	Instead of working together and building shared components, each company prefers to develop its systems	2, 4, 7, 16
Business-related barriers	Profit-maximizing strategy	Some companies prioritize buying strategies over innovation to maximize profits for investment firms	2, 5, 7, 10, 11, 12, 16
	User lock-in	Long contracts to prevent customers from being able to leave	3, 4, 6, 7, 8, 12, 15
Healthcare-related barriers	Private-sensitive data	It raises anxiety among companies, leading to reluctance to work with private-sensitive data	1, 3, 5, 6, 14
	Existing old business models	Insurance companies do not encourage new initiatives	3, 6, 8, 9, 10,15
	Reluctance to change	The ingrained habit of sticking to traditional practices	13, 14, 15

"Current systems require external links with other supporting systems, which will not work." Some interviewees (2, 14) argued that since the existing healthcare systems work to a certain extent, there is resistance to adopting new standards and making necessary changes. Many professionals prefer to stick with familiar and functional old connections, fearing that new interfaces might fail in the short term. Hence, the need for external links with other systems is often interpreted as unreliability. This resistance hampers data interoperability.

In addition, Interviewee 06 mentioned: "You [platform providers] are not alone in making an openness decision: Pharmacies/GPs often have a link with *** [platforms] that they are familiar with. If one party would like to switch, that does not necessarily mean that the other party also wants to. It falls under limited interoperability to a certain extent, but even if you could seamlessly coordinate programs, you still see reluctance there." Interviewee 2 discussed the consequence: "This results in different versions of interoperability, with APIs, hard-coded linking systems, and export files being used instead of a unified real-time sync solution.".

Another significant factor affecting the advancement of healthcare technology is *the focus on short-term issues*. I-05 illustrated this point: "Many IT parties tend to create individual point solutions instead of comprehensive and innovative total solutions." Consequently, professionals need to become (or stay) familiar with multiple platform add-ons. Various interviewees (1, 3, 5, 7, 8, 9, 10, and 14) highlight the healthcare industry's immense pressures, such as staff shortages, drug shortages, administrative burdens, and government measures. These urgent matters need more time to implement long-term sustainable innovations. The limited availability of resources, including people and funding, further restricts technology development. The lack of training and interest among system users prevents them from fully utilizing the capabilities of their software packages. The need for more qualified professionals, including software developers and caregivers, further adds to the hurdles in advancing healthcare technology. Moreover, more funding for ICT in primary care is needed to acquire up-to-date equipment and technology, preventing practices from leading the way in innovation.

Redundancy in development work also hinders platform openness in healthcare. Interviewees (2, 4, 7, and 16) highlighted the need for more collaboration and the unwillingness to cooperate among different companies and organizations. Instead of working together and building shared components, each company prefers to develop its systems. Interviewees suggest that the government should be more active by building new shared services. This is mainly due to healthcare having multiple first-line systems. When laws change, all these companies have to fix these laws; a lot of development work is done multiple times instead of making one shared service that all others can use. Hence, the shared service approach would reduce redundant development work by commercial software companies, allowing them to focus more on innovation.

4.2. Business-related barriers

Business-related barriers impede platform openness in healthcare. These are *profit-maximizing strategies* and *user lock-in*.

Some interviewees (2, 5, 7, 10, 11, 12, 16) noted that the *profit-maximizing strategy* often leads to the adoption of closed systems to safeguard legacy operations and market share, thus resisting the opening of internal platforms. Moreover, platform openness is unfavorable, as complementors or healthcare providers opt for safer, less innovative paths. For instance, Interviewee 16 explained: "Some companies [healthcare providers] prioritize buying strategies over innovation to maximize profits for investment firms, impacting their commitment to advancing healthcare technology." In addition, existing platform operators have a severe profit strategy and do not want to lose customers. When asked whether they would open their platform to complementors, they acknowledged that this would strongly depend on what functionality the complementors would provide and whether it would compete with their existing platform features.

User lock-in poses another significant barrier to platform openness (3, 4, 6, 7, 8, 12,15). A user lock-in at existing platforms makes it challenging for new entrants to penetrate the market and establish a sustainable business model. Interviewee 4 said: "Start-ups face a lengthy process to earn back investments, and insurers' limited facilitation of innovative projects adds to the struggle." As a result, platform openness faces challenges due to the lack of new complementors and digital platforms emerging in the healthcare market.

4.3. Healthcare-related barriers

The advancement of healthcare technology faces various challenges related to *private-sensitive data*, *existing old business models*, and *reluctance to change within the industry*.

Private-sensitive data poses a significant concern for platform openness in healthcare. Interviewees (1, 3, 5, 6, and 14) expressed the need for more detailed specifications from the government on how to share private-sensitive data. In addition, the mention of privacy raises anxiety among companies, leading to reluctance to work with such data. Interviewee 1 stated, "If the word privacy pops up, it makes companies extra nervous and careful." Legislation, including the General Data Protection Regulation and Medical Device Regulation, adds complexity to opening up platforms.

The *existing old business model* in first-line healthcare, where providers are often paid by insurers per patient visit or registration, does not incentivize platform openness (3, 6, 8, 9, 10, and 15). Consider a scenario in which GPs receive a bonus or additional compensation for

exclusively conducting consultations via video streaming services provided by a digital platform. Currently, insurance companies do not encourage such initiatives. The saying "If you do what you did, you get what you got" describes this situation. Therefore, we must ensure that something else happens in funding so everybody is willing to go outside the box. I-1 commented: "Innovative projects [for platform openness] are often facilitated to a limited extent for a short period and then canceled again by the insurers".

Reluctance to change is also a significant obstacle to platform openness. This is mainly due to the ingrained habit of sticking to traditional practices and the resistance to change without a clear understanding of its needs. Interviewees (13, 14, and 15) noted the need for more intrinsic motivation to change and the misconception that the current methods are sufficient. Interviewee 13 illustrated: "Some healthcare professionals are reluctant to embrace IT [platform openness] and prefer to focus solely on caregiving." The desire to guarantee success before embracing change further slows down progress. Table 2 summarizes the findings.

5. Discussion

We find barriers to realizing platform openness in three primary categories: technology, business, and healthcare, which hinder platform-based innovation in first-line healthcare. In doing so, *we contribute to the platform literature in the medical domain by being among the first to examine platform openness to enable platform-based innovation.* We uncover specific, previously undiscussed barriers, including a focus on short-term issues, redundancy in development work, and resistance to change. These findings extend our understanding beyond known barriers like coordination [35,43] and integration issues [11,21]. This means we have a better understanding of why platform-based innovation often does not result in substantial improvements in healthcare delivery, even though platforms have shown such a driving role in other industries. Thus, we offer a descriptive understanding that lays the groundwork for explanatory works to explain further how and why specific barriers make platform openness difficult to realize. As these factors are specific to a particular geographic area, they also help further studies in examining the specific conditions under which these findings can hold. In addition, the identified barriers can also serve as requirements for studies employing design science research, which focuses on designing solutions to those openness barriers.

Interestingly, we also find some new specifications of certain barriers from platforms in general that apply to healthcare in a somewhat different way. One example is the technology-related barrier, interoperability. Limited interoperability generally can stem from coordination issues, too many variations of standards, and commercial interests [33]. Our findings show, instead, that low interoperability stems from the perceived unreliability of other systems. This is justifiable as, in healthcare, many systems are still dependent on outdated legacy technologies that are inflexible and challenging to update [15].

In terms of business-related barriers, the general literature on digital platforms suggests that restricting access to platforms can maximize profits by providing various benefits. Closing platforms prevent low-quality add-ons that could damage the platform's reputation [80] and destabilize it [81]. Additionally, controlling complementors can be expensive [80] and may provoke competition among them [23]. In extreme cases, openness could even lead to platform *forking* (e.g., Amazon Fire OS platform copied Android core) [37]. In the medical field, instead, our findings show that the main driver of profit-maximizing strategy is to prioritize procurement over fostering innovation. This tendency stems from high investment costs, risky investments, distribution challenges, and difficulties integrating with existing systems [31].

Another example of differing specifications occurs with the healthcare-related barrier of private-sensitive data. Generally, the nature of private-sensitive data hinders the openness of digital platforms across various domains, including the sharing economy (e.g., [61], social networks (e.g., [39], and energy (e.g., [44]. Platform users often resist sharing privacy-sensitive data due to issues like excessive targeted ads [28], unfair pricing [13], identity theft [8], and financial fraud [63]. Yet, in the medical domain, the sensitivity of data exacerbates privacy concerns to the extent that merely mentioning *privacy* can halt openness initiatives. Medical data breaches can have severe societal repercussions and harm self-image. For instance, HIV patients are less likely to consent to sharing their health information even with general practitioners [7], fearing negative judgments about themselves.

We recommend future research explore potential solutions for achieving platform openness. For instance, considering issues such as limited interoperability, redundant development efforts, and user lock-in, investigating the role of *meta-platforms* could be one solution. A *meta*-platform is built on top of two or more existing platforms, thereby connecting their respective ecosystems [82]. A *meta*-platform acts as a coordinator or an orchestrator for participating platform operators [51,67]. In some cases, *meta*-platforms are the *center of gravity*, which redirects the strategic direction of participating platforms [82]. This happens when a *meta*-platform acts as a keystone player (e.g., Alipay or WeChat pay). In this case, a *meta*-platform has a high influence and is even responsible for the growth of participating platforms. In doing so, *meta*-platforms create value by *standardizing*. Meta-platforms provide standardized infrastructure architecture, setting a consistent framework adopted by participating platforms [26,60]. An example is the plug-in architecture [57,58]. This architecture has a core system for general tasks, while plug-ins handle specific tasks. This setup enables new participating platform operators to build new platforms by leveraging the core *meta*-platform system and selecting relevant plug-ins [59]. This idea aligns with shared services, where *meta*-platforms provide core and minimal offerings, letting new participating platforms build new services. Additionally, *meta*-platform can offer *integration services* to pre-existing platforms (e.g., Lanza et al., 2016). By doing so, *meta*-platforms create common interfaces or protocols, facilitating platform-to-platform openness without necessitating significant changes to the internal components of participating platforms. This integration can be facilitated using software development kits and application programming interfaces (Ulrich & Alt, 2021). The standardizing offering from *meta*-platforms thus enables interoperability and avoids redundant development efforts, which in turn prevents user lock-in by allowing users to move from one platform to another.

Considering the private-sensitive data, we suggest exploring solutions that relate to the recent discourse of personal data sovereignty (i.e., self-determination and capability of data subjects to control their data) [41]. Among others, two central facets of data sovereignty are data ownership, which entails the *right* to set the terms of data sharing, and data control, which refers to the *ability* to technically enforce these predefined terms [1]. Data sovereignty has become a critical concern in recent policy-making agendas, such as the European Health Data Space. Data sovereignty appears to enhance trust and reduce perceived risks of end-users, thereby increasing their willingness to share personal data. This is a crucial element for achieving platform openness. Thus, potential solutions worth exploring to enhance data sovereignty include usage control [49], self-sovereign identity [48,66], privacy-enhancing technology [65], and smart contracts [46].

We also suggest further research based on the limitations of this study. Specifically, our study setting focuses on Dutch first-line healthcare. Therefore, we advise further research to test the generalizability of our findings in other contexts. For example, the German healthcare model benefits from sustainable financing [22], contrasting with the short-term approach often seen in the Netherlands, which may be limited in scope and duration.[3] This model in Germany may reveal insights, for example, that some barriers may function differently.

[3] https://duitslandnieuws.nl/blog/2023/03/20/groeiende-zorgsector-duitsland-interessant-voor-scale-ups/, accessed on 23 May 2024.

Although we achieved implicit triangulation by comparing findings among participants, we did not use other data collection methods, such as group discussions or workshops. Given the nature of our study, nevertheless, this choice was justified as we aimed for rich data exploration rather than validation through multiple methods. Yet, we acknowledge the benefits of methodological triangulation for strengthening the rigor of our research outcomes. Thus, we invite future studies to include such additional methods to validate and enrich our findings.

6. Conclusion

This study explores the barriers to realizing platform openness, hindering platform-based innovation in first-line healthcare. We do so because of a limited understanding of platform openness despite its critical role in fostering platform-based innovation. We identify barriers in three main categories that hinder platform openness: technology, business, and healthcare. Technological barriers include limited interoperability, a focus on short-term issues, and redundancy in development work. Business barriers comprise profit-maximizing strategies and user lock-in. Healthcare barriers involve privacy-sensitive data, existing old business models, and resistance to change.

In all, this study lays the groundwork for researchers, practitioners, and policymakers. It provides a descriptive understanding for researchers, facilitating further 1) follow-up explanatory studies to examine in detail why these barriers occur and 2) design science research to create solutions to overcome the barriers). For practitioners, including platform sponsors, it offers insights that enable more informed decisions in developing solutions for openness.

Practitioners can refer to our identified barriers and assess how well their digital platforms address these gaps. In other words, the identified barriers can serve as requirements for platform owners developing digital platforms that rely on openness. These requirements should be analyzed (e.g., compared between stakeholders) to identify potential conflicts. For instance, platform sponsors may choose a profit-maximizing strategy that conflicts with the interests of platform users. Thus, the identified barriers can provide an early indication of where such tensions may arise. Once these requirements are elaborated, platform sponsors can develop modules that inform the overall platform architecture. This approach enables digital platform sponsors to create an architecture that addresses not only technological aspects but also the business and specific needs of the healthcare domain.

Policymakers can address the barriers such that they stimulate platform-based innovation. Policy instruments must be developed beyond existing measures like GDPR, which handles sensitive data and data portability to prevent vendor lock-in. Special attention should be given to the unique barriers we identified: short-term issues, redundancy in development work, and resistance to change. Taken together, successfully overcoming these barriers contributes to platform-based innovation, which in turn enhances patient care in the first-line healthcare sector.

Summary Table.

- What is already known on topics:
  - o Platform openness is crucial to trigger platform-based innovation but often difficult to realize
  - o Literature in medical informatics examines barriers to digital platforms from the perspective of user adoption.
- What this study adds to knowledge:
  - o Three overarching categories of factors hindering platform openness for healthcare specifically: technology-related, business-related, and healthcare-related.
  - o Specific challenges within each category, for example, focus on short-term issues, user lock-in, and existing old business models.

CRediT authorship contribution statement

Gijs van der Wielen: Writing – review & editing, Writing – original draft. **Antragama Ewa Abbas:** Writing – review & editing. **Mark de Reuver:** Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. – Discussion slide

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