

# Challenges and conditions for successfully implementing and adopting the telematics infrastructure in German outpatient healthcare: A qualitative study applying the NASSS framework

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## Abstract

**Background:** Germany's healthcare system provides high-quality, universal health coverage to almost all residents. However, a major challenge lies in the strong separation of healthcare structures, which hinders efficient interprofessional and intersectoral communication and collaboration. The mandatory nationwide implementation of the telematics infrastructure may offer a solution to enhance healthcare professionals' communication and collaboration.

**Objective:** Our study aims to elicit participants' perceptions of and attitudes towards the implementation and usage of the telematics infrastructure in fostering interprofessional communication and collaboration between home-care nursing services and general practitioner practices.

**Methods:** We conducted interviews with seven members of general practitioner practices and 10 in home-care nursing services. Using thematic content analysis, we identified five themes, of which four along with 10 subthemes were integrated into Greenhalgh et al.'s 'nonadoption, abandonment, scale-up, spread and sustainability' framework.

**Results:** Participants recognised the potential of digital technology to enhance interprofessional communication and collaboration. However, this potential largely depended on individual healthcare actors' willingness to seek information, invest and adapt. Attitudes towards the telematics infrastructure varied widely from hopeful confidence to outright rejection. Home-care nursing services generally viewed the telematics infrastructure with optimism, while general practitioners expressed reservations, particularly due to technological disruptions, lack of user-friendliness, and organisational structures.

**Conclusion:** Our findings highlight the potential of digital technology to enhance interprofessional communication. Successful implementation of technological innovations, however, goes beyond technological aspects and involves social, political and organisational processes. Future implementation strategies for such innovations in healthcare should involve users early and ensure clear communication.

## Keywords

Nurses, general practitioner, communication, collaboration, ambulant care, health telematics, eHealth strategy

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## Background

Introducing technological solutions in the healthcare sector is often accompanied by challenges and frictions, sometimes even resulting in failure. The interaction and relationships among the involved stakeholders play a critical role.<sup>1</sup> This applies in particular to national eHealth systems and

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health data infrastructures.<sup>2</sup> Globally, countries like Israel, Denmark, and Estonia, are adopting such nationally mandated digital health infrastructure to enhance the efficiency of their health systems.<sup>3</sup> While some countries have made significant strides in digitalisation, others lag behind – facing challenges including resistance from the public and healthcare providers, high costs and difficulties in implementation, particularly when using a top-down approach.<sup>3,4</sup> Success factors are amongst others modularisation and a gradual approach to implementation (e.g., as seen in Austria) and a sustained political commitment.<sup>3</sup> These challenges extend beyond the adoption of nationally mandated digital tools, and have been described by Greenhalgh et al. (2017) in their ‘nonadoption, abandonment, scale-up, spread and sustainability’ (NASSS) framework, aiming at explaining the failure or success of a technological intervention in the healthcare setting.<sup>5</sup> Digital tools are frequently expected to enhance collaboration among healthcare providers, a success that depends on the technology’s ability to support social relationships within its implementation context.<sup>6</sup>

Currently, Germany is implementing such a nationally mandated system, which is called ‘telematics infrastructure’ (TI).<sup>7</sup> The German health system, extending universal health coverage to more than 98% of the population through statutory and private health insurances, offers a high-quality care with minimal cost-sharing obligations and free choice of provider.<sup>8,9</sup> However, a major challenge within the German healthcare system is the strong separation of healthcare structures, which impedes collaboration between health actors and settings, thereby negatively impacting the continuity of patient treatment.<sup>7,8,10</sup> The TI shall counteract the challenge and simultaneously lower the costs of the German health system by linking healthcare actors, such as hospitals, pharmacies and practices, via a secure platform, enabling rapid and seamless data exchange.<sup>11–13</sup> Coordinated by ‘gematik GmbH’, the system has been under development since 2005<sup>10,13</sup> and consists of different components such as secure email for healthcare providers (‘Kommunikation im Medizinwesen’ – KIM), the electronic certificate of incapacity to work (‘Elektronische Arbeitsunfähigkeitsbescheinigung’ – eAU) and electronic patient records (‘Elektronische Patientenakte’ – ePA), which have been successively introduced since 2018.<sup>7,14</sup> A secure connection to a virtual private network (VPN) is established at the point of access, for example, a general practitioner (GP) practice, in order to share information. Professionals and institutions need to identify themselves with an electronic card to gain access to documents and services such as KIM in order to comply with data protection laws.<sup>11</sup>

Outpatient practices were required to implement the TI at their institution by 2020 and hospitals by 2021.<sup>15,16</sup> Despite this, only 89% of outpatient practices were connected at the end of 2021,<sup>7</sup> even if being in favour of a unified communication channel.<sup>17</sup> The main obstacles to implementing and using the TI are a lack of usability,

susceptibility to technical errors, and an unfavourable cost–benefit ratio.<sup>17</sup> While implementation of the TI is compulsory for GP practices, home-care nursing services have had the option of connecting voluntarily since 2021. Their mandatory connection was initially scheduled for January 2024. However, the Care Support and Relief Act (Pflegerunterstützungs- und Entlastungsgesetz [PUEG]) has deferred the deadline for home-care nursing services providing care under the German Social Code Book XI (Sozialgesetzbuch [SGB] XI) to July 2025.<sup>18</sup> The integration of the TI in home-care nursing services is expected to enhance collaboration, as presently fax machines, telephone and personal contact are the primary communication methods between home-care nursing services and GP practices, leading to time-consuming and error-prone processes.<sup>19,20</sup>

## Aims

Against this background, this qualitative study aimed to provide an in-depth insight into nurses’ and GPs’ use of (digital) communication tools, and, in particular, their perceptions of and attitudes towards the (planned) implementation and usage of the TI to elucidate its use to foster interprofessional communication and collaboration between home-care nursing services and GP practices. With the TI already being implemented at GP practices and not yet in home-care nursing services, this study’s focus on the transition phase of the implementation of a nationally mandated digital system is an innovative perspective adding value to previous studies. In this study, we determined the current use of digital tools for communication and collaboration together with participants’ knowledge about, opinion of expectations (in terms of value propositions) and experiences with the TI.

## Methods

This study’s dataset consists of 15 individual interviews and one interview with two participants, lasting on average of 35 min (17–72 min). Data were collected from April to July 2023 in a region in southern Germany, and the Consolidated Criteria for Reporting Qualitative Research were applied in reporting the outcome (see Supplementary Appendix 1).<sup>21</sup>

## Setting

The German outpatient care setting is characterised by high fragmentation with a multitude of different actors independently providing healthcare services. Their services are usually paid for on a predetermined fee-for-service basis by statutory and private health insurance funds.<sup>8</sup> GPs are predominantly self-employed, operating in small practices, that qualify as micro-enterprises by the definition of the European Commission. In contrast, home-care nursing services range from small, family-run services (also considered

micro-enterprises with a turnover up to 2 Mio. € annually), to big companies with branches in different cities and a turnover exceeding that of micro-enterprises by far.<sup>22</sup>

### Participants and recruitment

We targeted adult healthcare providers in one of the following groups: GPs, medical assistants, nursing care managers, nurses and trained nursing assistants who were working at a GP practice or in a home-care nursing facility in the target region at the time of the interview. Recruitment flyers were sent via post to all 55 GP practices and 32 home-care nursing services in the target region in early March, followed by an email invitation 3 weeks later. Due to a low GP participation rate of 5%, we expanded the target region for healthcare providers working in GP practices to adjacent districts and invited them via emails in June 2023.

All participants provided informed written consent before the interview and were advised of their right to withdraw their consent at any time during or after the interview. No participant withdrew consent. The study, including its consent forms, was approved by the Joint Ethics Committee of the Bavarian Universities of Applied Sciences ('Gemeinsame Ethikkommission der Hochschulen Bayerns') under the number GEHBa-202211-V-084.

### Data collection

All semi-structured interviews followed an interview guide that was systematically developed and tested with two nurses and a GP, and expanded throughout the interviews, followed by some verbal questions regarding the participants' socio-demographic background (see Supplementary Appendices 1 and 2). The original guide was devised along the themes: current communication patterns between GP and home-care nursing service and use of digital technology for communication, such as the TI. Five researchers (two male and three female) with a background in qualitative research led the interviews (KN, MCR, SS, MS, FF, PML), with most being conducted by two researchers (one moderator and one note-taker). The interviews were conducted with all the healthcare providers willing to participate at either the participants' workplace, the researchers' office or via an online conferencing tool – according to the participant's choice. During the interview, only the participant and the researcher(s) were present. Participants did not receive any compensation for their participation, transcripts were not returned to participants for comments or corrections and no repeat interviews were carried out. Towards the last interviews, no new themes emerged, leading us to determine that data saturation was achieved.

### Data analysis

Interviews were tape-recorded and transcribed verbatim, then pseudonymised, with quotes translated from German

into English for the purpose of this publication. Using Braun and Clarke's six-phase framework,<sup>23</sup> we conducted thematic analysis based on a positivist epistemological approach to systematically elicit participants' perceptions of and attitudes towards the TI. First, we familiarised ourselves with the data and then inductively developed an initial coding framework by two researchers each coding one interview independently (KN and MS a GP interview; FF and MCR an interview of a nursing care manager) and jointly discussing the initial coding. KN then coded the remaining interviews using MAXQDA version 2022. MCR reviewed the coding, and differences were settled. After coding, KN collated the codes into potential themes on a semantic level and reviewed the themes across the coded extracts and the dataset. KN then defined, named and subsumed the themes into Greenhalgh et al.'s NASSS framework,<sup>5</sup> using some of the framework's dimensions – technology, value proposition, adopter system and organisation(s) – as headings, with an additional theme of 'current use of (digital) communication tools'.

## Results

### Participant demographics

Interviews were conducted with members of seven GP practices (six GPs and one medical assistant) and eight home-care nursing services (nine (deputy) nursing care managers and one nurse). Table 1 shows the socio-demographic characteristics of GPs and (deputy) heads of nursing care in comparison to the German distribution. The mean age of all participants was 44 ( $\pm 11$ ) years, and 53% of the participants were female. Both, the study participants from GP practices and those from home-care nursing services had worked on average 7 ( $\pm 5$ ) years at their current workplace. In our sample, GPs treated on average 1343 ( $\pm 322$ ) patients, of whom approximately 17% received home-care nursing services.

### Thematic analysis

Thematic analysis revealed 12 themes, summarised under four headings taken from the NASSS framework (technology, value proposition, adopter system and organisation; Figure 1) and one additional heading named 'current use of (digital) communication tools'. Quotes under each theme can be found in Supplementary Appendix 4.

**Current use of (digital) communication tools.** All GP practices used multiple non-interoperable software to support their work, such as online tools for making appointments, receiving laboratory results or internal communication. Similarly, all home-care nursing services were either already utilising or in the process of adopting software for internal purposes, with the aim of improving efficiency by

**Table 1.** Sociodemographic characteristics of GPs and (deputy) heads of nursing care of the sample in comparison to the German distribution.

	GPs ( <i>n</i> = 6)	German comparison <sup>20</sup>	(Deputy) Nursing care manager ( <i>n</i> = 9)	German comparison <sup>20,21</sup>	
Mean age ( $\pm$ SD)	42 $\pm$ 8	55	43 $\pm$ 12	40–50	
Gender	Female	2 (33%)	50%	5 (56%)	83%
	Male	4 (67%)	50%	4 (44%)	17%
Average number of patients/clients ( $\pm$ SD)	1343 $\pm$ 322	853	152 $\pm$ 138	68	
Individual practice	4 (67%)	54%	NA	NA	

GPs: general practitioners; SD: standard deviation; NA: not applicable.

streamlining tour planning, facilitating quick team communication and enhancing documentation processes, amongst other things. While digital systems generally worked well and improved the facilities' workflows, one home-care nursing service encountered compatibility issues with the technology on Android devices.

Communication between home-care nursing services and GPs predominantly took place via fax machines and telephone. In rural areas, personal visits by home-care nurses to GP practices were more common, while in urban areas such visits were usually reserved for urgent cases. One GP valued fax machines as an asynchronous method of communication, allowing responses at their convenience, whereas some GPs highlighted disadvantages of the fax machine, as emphasised by this GP:

There is certainly room for improvement, because the fax simply has its limits. Be it from the image resolution, be it from the colour reproduction, yes, and be it especially from the feedback. (GP, M, 43)

Despite these issues, most GPs continued to rely on fax machines, considering them more compliant with data protection laws than emails, which were infrequently used. Similarly, GPs were reluctant to use photos in their communication for fear of breaching data privacy, whereas some nurses regarded photos of, for instance, wounds as an alternative to lengthy descriptions. Some nurses reported communicating with other health system actors via digital tools such as email and portals. For example, one nurse described receiving updates on a patient's wound status from a wound expert via a downloadable link.

**Technology.** Some GPs desired greater collaboration between the various actors in the development of the TI, as they felt omitted from the process of developing the nationally mandated systems that they were expected to use. GPs, in particular, criticised the technological

realisation of the TI, judging it to be outdated and not keeping up with the current state of the art.

It's a bit tragic that in principle they don't manage to introduce a really innovative system that is really up to date, but somehow stumble from hurdle to hurdle to improve something that is actually already outdated. (GP, F, 38)

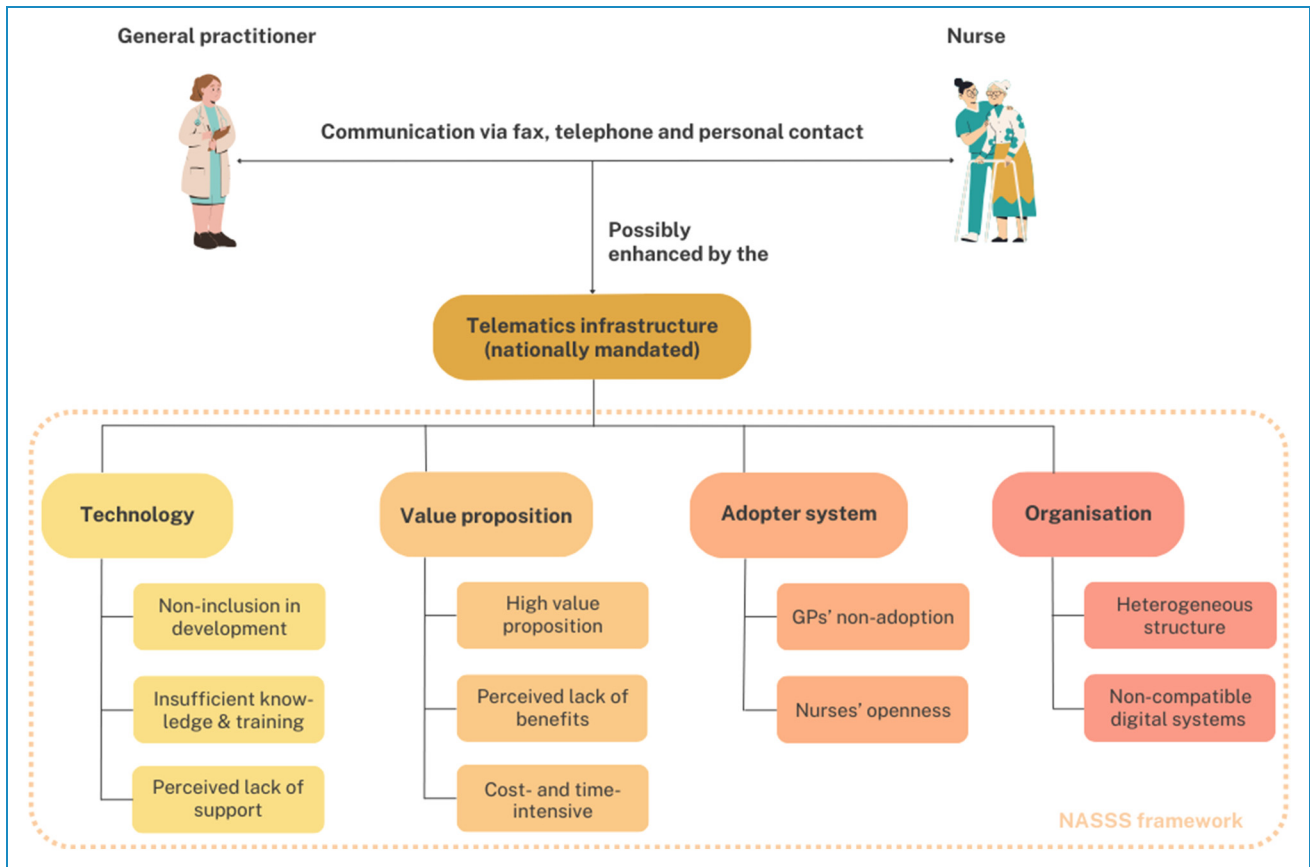
GPs and nurses alike perceived the nationally mandated TI as underdeveloped and misaligned with their needs, inhibiting uptake and continued use:

We are not yet connected to the digital infrastructure. Because everyone knows that it would be nonsense to set up a stationary device at an outpatient service, where I then have to scan the insurance card. (NM, M, 47)

Most GPs were well informed about the functions of the TI that were yet to be implemented, such as electronic patient files. However, the specifics regarding the organisation and workflow of these remained unclear to them. In contrast, nurses generally had limited knowledge about the TI, except for one nursing care manager who was actively involved in voluntarily implementing the TI in the home-care nursing service. Nurses had received minimal practical training on the TI, and many nurses felt that communication should be improved regarding the process of implementation, the TI's use and its benefits.

We simply need more knowledge about telematics. [...] Everyone has half-knowledge, and we first have to put ourselves in a state that enables us to somehow judge this in a competent way to some extent, so that we can then also use it properly. (NM, W, 29)

Many GPs recounted challenges in implementing the TI, such as frequent system shutdowns despite being well



**Figure 1.** Themes and subthemes of 16 interviews conducted with members of GP practices and home-care nursing services in a southern German region, grouped by dimensions of the NASSS framework (nonadoption, abandonment, scale-up, spread, sustainability framework).<sup>5</sup>

supported by their software provider. Regarding the mandatory introduction of the TI in home-care nursing services, one GP noted that these services seemed to receive less support with the process than GPs. While most home-care nursing services acknowledged that challenges might arise during the integration phase that would require considerable effort to address, they remained confident about overcoming these issues:

Of course, the first phase will be difficult, introduction etc., something new. But I think it would help in the long run. (NM, M, 30)

However, at the time of the interviews, home-care nursing services were sceptical about the feasibility of implementing the TI by 2024, and judged 2025 to represent a more realistic timeline.

**Value proposition.** Nurses and GPs alike wished for user-friendly, clear and concise, structured and unified communication through the TI that would lead to fewer errors and quicker interaction between health actors. Both groups recognised the potential of the TI to enhance workflow and bolster communication and collaboration with other

professionals. Some GPs specifically noted the TI's potential in acute care situations, enabling quick access to patient data, accelerating treatment and potentially saving lives. Concerning collaboration with nursing facilities, most GPs valued the prospect of the TI's secure emails ('Kommunikation im Medizinwesen' – KIM) and direct contact with home-care nursing services. One GP emphasised that the choice between asynchronous or synchronous communication and its frequency should be tailored to the physician's needs. For urgent matters, telephone contact with the home-care nursing service would remain preferable, as one GP explains:

If it's about any questions that you have, for example, that the nursing service has for me, if we do it through any encrypted KIM services or emails or anything like that, I can answer that in peace. If there are any acute things, then it is certainly still the case that they get in touch or I get in touch by phone and ask what is going on or if the patient is unwell. I don't think that works via the telematics infrastructure somehow, but remains one-to-one contact. (GP, M, 40)

Most nurses hoped that the TI would provide them with better insight into patients' conditions and diagnoses, enabling them to provide improved patient care without depending on information from the GP. One nurse expressed interest in automatic notifications about changes in patients' medical plans. Other nurses valued, above all, the secure and prompt exchange of information in a manner compliant with data protection laws and hoped that the TI would contribute to enhanced intra- and intersectoral communication, particularly between home-care nursing services and GP practices.

In itself, I think it's good, because if I had access now, for example, I wouldn't have to ask the doctor now what diagnoses does the patient have? [...] And I could also communicate with the doctor in a completely different way, because I would know exactly what the patient has. (NM, M, 30)

While participants recognised the potential of the TI, they lamented a lack of functions. For example, some GPs desired greater integration of data from home-care nursing services, such as patients' vital parameters. Similarly, some nurses wished for features to streamline their workflow, for example, concerning prescription management. Despite these wishes, nurses recognised the limits of the TI, as one nurse pointed out: 'digitalization can help us, but it can't perform miracles' (NM, M, 47). GPs perceived the benefits of the TI for patients as minimal, especially concerning elderly patients not experienced in digital technologies. One GP noted further that some patients might doubt the security of their data stored on a chip. According to some GPs, the main beneficiaries of the TI were insurance companies and corporations gaining easy access to data.

Most nurses and GPs shared concerns about the time required to implement the TI and operate it efficiently. Nurses were apprehensive of and GPs were already experiencing challenges in its implementation and use, similar to previous digital endeavours. These challenges were time-consuming and interfered with their already tight schedules. Some GPs recounted issues with the TI's hardware in their daily operations and criticised poorly designed workflows that added to their workload.

We already have a problem every week somehow, whether it's that somehow the connector or something else doesn't work. (GP, M, 40)

Furthermore, nurses and GPs alike were concerned about the financial implications of the TI. Some GPs explained that while they had been paying a monthly fee for the TI for several years, they were unable to fully use it, as it was not ready for implementation. This led to a loss of trust in the TI and frustration. Additionally, GPs faced

additional expenses due to the mandatory updating of hardware components in order to continue using the TI, thus further increasing costs and frustration.

*Adopters.* Most nurses predicted a resistance from GPs to engage with the TI, citing reasons such as time constraints and an unfavourable cost-benefit ratio, particularly for older GPs nearing retirement who were unsure about finding successors.

That there will be practices that say: 'No, I won't do it, I'm too old, I don't feel like it,' or 'I'll retire in two years, it's not worth it for me anymore'. (NM, W, 42)

Nearly all GPs expressed reservations towards the TI. Most GPs preferred their own customised solutions, which cannot be integrated into the nationally mandated TI, leading to a perceived loss of control and increased error rate. Some GPs voiced concerns about an increase in information channels due to the TI. Other concerns raised by GPs included legal responsibilities and increased obligation to complete documentation. One GP emphasised that doctors would naturally adopt any system that reduced their workload, implying that this was not the case with the TI. GPs believed that only an obligation to integrate the IT would lead to widespread adoption.

Until it [the telematics infrastructure] becomes obligatory, and hopefully works, no one will bother with it. (GP, M, 40)

Conversely, most nurses were more receptive to digitalisation and implementing the TI. They hoped for an enhanced workflow and advances in communication and collaboration. The mandatory introduction was perceived positively, as a means to ensure universal participation, leading to uniformisation across the healthcare sector.

*Organisation(s).* GP practices were fairly homogeneous in their structure, with GPs predominantly owning individual practices and being responsible for the implementation of the TI. These small practices typically employed several part-time medical assistants. In contrast, home-care nursing services varied greatly in their structure, ranging from small familiar services with few employees to large corporations with branches throughout Germany. In smaller services, the manager oversaw TI integration, while bigger home-care nursing services had a dedicated IT department to manage the implementation of the TI and other digital solutions.

This telematics infrastructure is a current topic for us. It was now communicated that some things have to be changed in our company. But at the moment, this is more an area that IT is covering. And we are not quite involved at the moment. (NM, W, 60)

Nurses expressed uncertainty about integrating their digital tools with the TI. Similarly, most GPs lamented incompatibility of the digital tools used in their practice with the TI, or uncertainties about their compatibility.

I think that has to run in parallel to some extent. Because, for example, the online appointment calendar, that's in the cloud, that has nothing to do with the TI [telematics infrastructure]. (GP, M, 43)

## Discussion

We explored the perceptions and attitudes of nurses and GPs in home care regarding the implementation of a nationally mandated, digital tool to support the interprofessional communication between these two professional groups. Based on the underlying domains of the NASSS framework, we identified and categorised various influencing factors in this process of change.<sup>5</sup> Our key findings include:

1. **Technology:** The TI should be enhanced and tailored to meet participants' requirements, supported by increased assistance in implementation and use, along with more information about upcoming functionalities.
2. **Value proposition:** Participants recognised the potential of a digital technology for interprofessional communication and collaboration, albeit acknowledging concerns about the associated monetary and time investments.
3. **Adopters:** Perceptions of the TI varied widely, ranging from hopeful confidence and cautious restraint to outright rejection.
4. **Organisation(s):** The implementation of technological innovations encompasses social, political and organisational dimensions. Its success thus depends on more than just the technology itself; in organisations it needs structures promoting and supporting innovation.

## Comparison with existing literature

One factor that influences the use of technology for interprofessional communication and collaboration between GPs and home-care nursing services is the varied knowledge of home-care nursing services about the TI. This variation depended partly on the motivation to acquire information, the timeline of the implementation and on organisational structures. For instance, employees of larger home-care nursing services with specialised IT departments were not directly involved in the introduction of the TI and were thus generally less informed about it. Following an explanation about the TI and its components during the interviews, many home-care nursing services displayed a great openness towards its implementation. They particularly hoped for enhanced interprofessional communication, especially given their current challenges

with the lack of information exchange and the time-consuming and cumbersome process of existing methods via fax and telephone. Similarly, in a study on the introduction of the Austrian electronic health record in nursing homes, nursing care managers hoped for an improved information flow and exchange of patient-related data to ensure complete and up-to-date patient data.<sup>24</sup> Optimising intersectoral TI applications to provide improved access to information and better communication channels leads to enhanced patient care and safety.<sup>25,26</sup> This aligns with our findings that home-care nursing services anticipated that the TI would provide better insight into the condition of patients, up-to-date medication plans and enhanced communication with GPs. However, they also recognised that some communication with other healthcare providers would still occur outside the TI. Coinciding with our results, GPs valued digital applications such as access to patient information in acute care situations and the possibility of improved communication with other healthcare actors.<sup>17,27</sup> However, while the German electronic health record ('Elektronische Patientenakte' – ePA) provides insight into a patient's condition and medication, low usage – at <1% of insured persons – impedes the realisation of those benefits.<sup>28</sup> The lack of functionality and the overly complex application and registration procedures are a main barrier for ePA uptake, as insured persons are required to activate the ePA (opt-in) and assign authorisations allowing healthcare service providers to access the ePA.<sup>29</sup> When using an opt-in model for their electronic health record, the Netherlands as well as Australia encountered low adoption rates. In response, Australia opted to transition their electronic health record 'My Health Record' to an opt-out system to bolster adoption rates.<sup>3</sup> Similarly, Germany will transition to an opt-out system in January 2025.<sup>30</sup>

Home-care nursing services were significantly more positive about the introduction of the TI than GPs. Not yet connected to the TI and largely unaware of the requirements for a successful connection, negative experiences with the TI were uncommon amongst home-care nursing services. In contrast, GPs in the study highlighted their negative experiences with the TI's mandatory introduction during the past few years. Gagnon et al. (2012) found that user-friendliness, facilitation of work processes and a clear understanding of the added user value are some of the most important factors for the successful introduction of technologies, such as the TI, in the healthcare sector.<sup>31</sup> However, despite 89% of GPs being connected to the TI, its integration into everyday practice has been minimal, above all due to the TI's susceptibility to technical errors.<sup>17</sup> A study by the National Association of Statutory Health Insurance Physicians revealed that 80% of practitioners experienced organisational disruptions due to TI problems.<sup>17</sup> Similarly, respondents from home-care nursing services feared technical challenges, incompatibility with current systems and increased workload in an already time-constrained work environment. Gagnon et al. showed

that technical concerns were one of the most frequently cited barriers to the adoption of technological tools for communication in healthcare.<sup>31</sup> Other barriers stated by GPs were the lack of user-friendliness, high implementation costs, increased workload and the need to update seldomly used hardware such as the medical identification card required to use the TI.<sup>7,17,32</sup> This is in line with the factors cited by the GPs in our own study. Additionally, in Germany, particularly within the healthcare sector, there are significant concerns about data security and privacy, which impedes innovation and rapid implementation.<sup>25</sup>

The demographic and organisational structure of GPs in Germany is a further factor to consider in the adoption of technological tools. Some 70% of GPs are over 50 years of age, with more than 35% of all GPs being over 60, indicating that many are nearing retirement.<sup>27</sup> They might hesitate to invest time and money in the TI infrastructure, as they are uncertain about finding successors for their practices. In contrast, the GPs in our sample were younger than the German average, potentially being more engaged and willing to adopt the TI. Yet, a higher proportion of GPs in our sample were self-employed compared to the German average. They also tended to work in practices with higher patient loads than average, which probably reflects the rural setting of the study site. Negative experiences, technical challenges and organisational structure may have contributed to the GPs' negative attitude towards the TI, and are probably partly responsible for the slow introduction and adoption of the TI nationwide. This aligns with studies emphasising that technological adoption processes extend beyond the technology and are social, political and organisational in nature – resulting in such technologies being commonly referred to as sociotechnical innovations.<sup>5,33,34</sup>

### Methodological considerations

Although the NASSS framework consists of seven domains, we grouped the subthemes around just four. Domain 1 ('the condition') was not relevant, as the TI spans the entire health system. We integrated relevant aspects of domain 6 ('the wider system') and domain 7 ('embedding and adaptation over time') into other domains, as their content was intrinsically linked. It is crucial to understand that, although the domains are isolated entities, they are partly interdependent without any one dimension being superior to another. Previous experiences with other technologies might further impact the adoption of new technologies, as providers' openness to new technologies might depend on past interactions with other technologies. Recognising user experiences and accounting for the various domains of the NASSS framework prior to the introduction of any new technology is vital to generating a positive narrative that empowers users to actively engage with the technology, as compared to a passive 'wait and see' approach.

### Recommendations for the future development and implementation of (nationally mandated) sociotechnical innovations

*Involve future users in the design process.* Various studies demonstrate the benefits of early user involvement in the development of digital technologies.<sup>35,36</sup> This study reveals that GPs and home-care nursing services felt overlooked in the design process for the TI, leading to a technological solution that does not adequately address their needs. An enhanced focus on user-centred design, which prioritises user needs and consults future users during the design process might be beneficial.<sup>36</sup> An even better option to anticipate problems leading to nonadoption, could be participatory design, where future users are active collaborators in the design and development process in order to ensure that the product meets their needs and is functional.<sup>35</sup>

In 2023, the German Federal Ministry of Health incorporated participatory design into devising its current digitalisation strategy. Prior to March 2023, Germany lacked a comprehensive eHealth strategy with clearly defined objectives, strategic fields of action, and implementation plans detailing stakeholders and their responsibilities, resource allocation and funding, and evaluation metrics. A study of 17 countries' digitisation strategies concluded that a comprehensive digital health strategy effectively aligns stakeholder and technology developer efforts with national objectives.<sup>3</sup> In developing Germany's strategy, the Federal Ministry of Health conducted interviews with experts from healthcare, politics, science and business, along with patient representatives. Simultaneously, stakeholders from healthcare and nursing were invited to contribute their perspectives and expertise via a public online survey.<sup>37</sup>

*Communicate clearly and transparently.* In the context of implementing digital tools in the healthcare sector, clear and succinct communication with all stakeholders is paramount. Healthcare actors need to be thoroughly informed about the implementation trajectory, costs involved and anticipated changes in their working routine. Providing comprehensive pre-implementation training equips healthcare actors with the skills required to use the technology. Additionally, ensuring accessible support during and after the role-out phase is critical in order to minimise disruptions in workflows.<sup>38</sup> Adopting a phased approach to implementation may avoid larger-scale technological complications. Clear and transparent communication of the common challenges besetting implementation may facilitate rapid solutions among different technology suppliers and stakeholders.<sup>17</sup> Such open dialogue may bolster trust in technological tools, thus reducing the likelihood of nonadoption.

### Limitations

This study has several limitations that warrant consideration. Firstly, the GPs in our sample were younger than



the German average, potentially making them more inclined towards digitalisation and adoption of the TI. Secondly, the lack of reimbursement may have led to greater participation by those individuals already interested in the topic. Thirdly, as highlighted in the discussion, home-care nursing services were not connected to the TI. Their narratives are therefore only conditionally comparable to those of GPs who had already implemented the TI. Fourthly, we acknowledge the potential of a sampling bias as we (i) limited the sampling to one rural region in Germany and (ii) encountered a high rate of non-responders among the GP practices. Further research is needed to compare different regions with varying demographic and structural backgrounds in order to gain a comprehensive understanding of the current situation in Germany.

## Conclusion

This study assessed the challenges and conditions for successfully integrating and adopting a nationally mandated digital health infrastructure as a means of promoting interprofessional communication and collaboration between home-care nursing services and GP practices in southern Germany. Our findings underscored the potential of digital technology to enhance interprofessional communication, albeit reliant upon individual healthcare actors' initiative to invest and adapt. Home-care nursing services expressed hope, while GPs were more reticent towards the TI, particularly due to the challenges presented by technological disruptions, lack of user-friendliness and prevailing organisational structures. Recommendations for future development and implementation of sociotechnical innovations in healthcare highlight the importance of early user involvement, at best in the form of participatory design, and clear communication, while acknowledging their social, political and organisational nature. The insights gained from our study contribute to a broader understanding of the complex dynamics surrounding digital transformation in the healthcare sector, which needs a holistic approach encompassing technological, social, political and organisational dimensions.

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