

Digital interventions for adolescents with type 1 diabetes to promote health literacy? A qualitative study on physicians' perspective in Germany

Aurélia Naoko Naef ¹, Nadine Fischbock,¹ Hürrem Tezcan-Güntekin,^{2,3} Volker Eric Amelung¹

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¹Institute for Epidemiology, Social Medicine and Health Systems Research, Hannover Medical School, Hannover, Germany

²Department of Health and Education, Alice Salomon Hochschule Berlin, Berlin, Germany

³Berlin School of Public Health, Charité Universitätsmedizin Berlin, Berlin, Germany

Correspondence to
Aurélia Naoko Naef;
naef.aurelianaoko@mh-hannover.de

ABSTRACT

Introduction Adolescents with type 1 diabetes mellitus (T1D) require a high level of health literacy (HL) to prevent complications. It remains unclear what potential digital interventions have for promoting HL among adolescents with T1D, as viewed by physicians working with this target group. Additionally, it is unclear how the institutions (inpatient care and outpatient care) can support and facilitate the use of digital interventions to promote HL.

Research design and methods An exploratory study was conducted using semistructured interviews with physicians (n=12) in Germany. The interview questions are based on a previous systematic review. The coding was conducted deductively and inductively using MAXQDA software. Subsequently, the interviews were analysed systematically through an iterative process of content analyses in line with Kuckartz *et al*.

Results It was reported by the physicians that digital interventions are underused due to technical resources, lack of structural conditions, information and legal constraints. The utilisation of digital interventions to promote HL was heterogeneous and depended primarily on the willingness of the physicians. Communication strategy techniques were widely employed to motivate patients, an activity occurring mainly in-person, thus limiting the opportunity for the deployment of digital interventions.

Conclusions To increase the use of digital interventions and improve HL, support for digital literacy skills could be implemented. Capacity building through patient-centred, interdisciplinary and participatory culture should be considered. The findings of this study can provide valuable insights for practice, research and policy.

INTRODUCTION

The rapid growth of digital interventions has revolutionised healthcare over the last decade. In Germany, 89% of young people between 12 and 19 years old are online every day for an average of 4.3 hours,¹ providing great potential for digital interventions in adolescents with chronic diseases such as type 1 diabetes mellitus (T1D) that commonly affect individuals in childhood, adolescence

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The scientific knowledge shows that adolescents with type 1 diabetes mellitus (T1D) face unique challenges in managing their disease. Health literacy (HL) is essential to prevent and avoid debilitating complications. Digitalisation in healthcare offers enormous potential but is currently underused.

WHAT THIS STUDY ADDS

⇒ This study provides physicians' perspectives and opinions on the utilisation of digital interventions to promote HL for young adolescents with T1D. This study also contributes an analysis of the challenges associated with the utilisation of digital interventions to promote HL, as perceived by physicians.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The implications of this study are the following: promoting the utilisation of digital interventions by incorporating digital literacy skills for patients and physicians; emphasising capacity building through patient-centred, interdisciplinary and participatory approaches; recognising the needs, experiences and perspectives of patients in future research and implementation efforts and adapting the necessary general conditions (such as financial and resource considerations) for effective implementation of digital interventions.

and young adulthood. This metabolic disease affected approximately 1.52 million individuals younger than 20 years old worldwide in 2022, with 201 000 new cases diagnosed within that age group during the same year.² The prevalence and incidence of T1D are also on the rise in Germany, with estimates that over 37 000 individuals under the age of 20 are currently affected, marking a twofold increase in prevalence over the past two decades.³ Digital interventions, such as telehealth, mobile health, messaging systems, mobile applications, game-based support,

social platforms and patient portals,⁴ could promote health literacy (HL),⁵ which is crucial to prevent complications, increase quality of life and significantly impact clinical outcomes.⁶⁻⁹ The authors refer to the study of Bröder *et al*,¹⁰ who identify 14 dimensions of HL that have been developed for children and adolescents, clustered in three core categories, namely (a) cognitive attributes, which correspond to the ability to think, learn and process information, (b) behavioural or operational attribute and (c) affective and conative attribute. HL is essential for adolescents diagnosed with T1D to face the complex challenges in managing their disease, like the demands of monitoring blood glucose levels, estimating nutritional intake and administering multiple daily doses of insulin or managing technologies, namely a continuous glucose monitoring sensor, an insulin pump or closed-loop system. Adolescents with T1D also contend with psychosocial issues such as stigma, stress, burn-out, peer relationships and diabetes-related family conflicts⁶; all in addition to simultaneously navigating a vulnerable developmental stage in life.¹¹

Physicians play an important role in the promotion of HL for adolescents with T1D, especially in the development of an individual treatment plan together with the adolescents, in regular medical check-ups and in the structured review of medication. Various physicians specialising in different areas are involved and it is coordinated by a diabetologist.¹² Physicians also play a role in education and can provide emotional support.^{13 14} The role of physicians in the management of T1D in adolescents in Germany, therefore, includes diagnosis, education, prescription of medication, regular follow-up, prevention of complications, interprofessional collaboration and overall support to ensure comprehensive, personalised management of the disease. Therefore, professional HL is essential to improve patients' HL.^{15 16}

The purpose of this study is to analyse the physicians' perspective working with adolescents with T1D on digital interventions to promote HL. The study aims to answer the following research questions:

- ▶ How are digital interventions commonly used for young adolescents with type 1 diabetes?
- ▶ What are physicians' perspectives and opinions on the utilisation of digital interventions to promote HL?
- ▶ How do physicians perceive the challenges associated with the utilisation of digital interventions to promote HL?

METHODS

This study used a qualitative approach, specifically content analysis based on Kuckartz and Rädiker¹⁷ and conducted semistructured interviews¹² with physicians to explore their perspectives on digital interventions for promoting HL among adolescents between 13 and 18 years old with T1D. The authors choose an in-depth understanding of the selected cases focused on the exploration and interpretation of meaning. The goal was

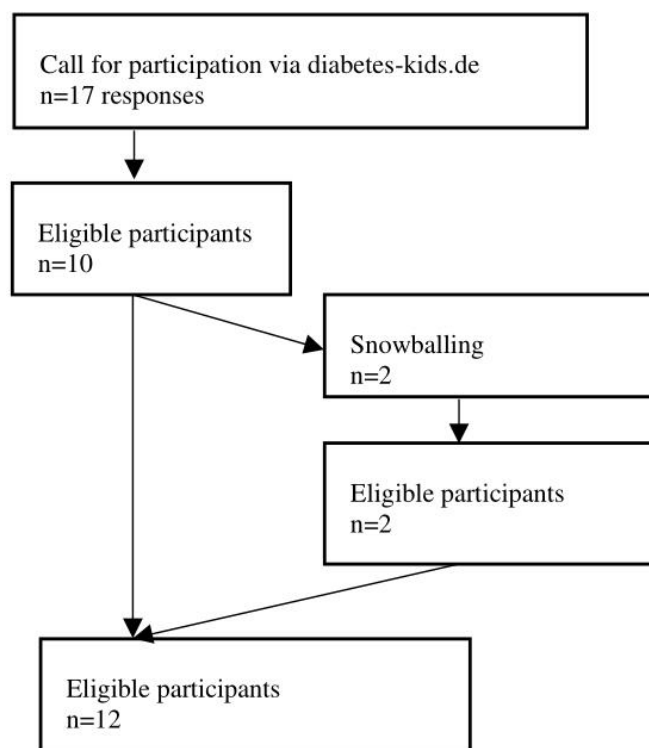


Figure 1 Flow chart of recruiting process.

to gain a more profound comprehension of the experiences of the participants, including how these experiences are perceived, interpreted and communicated by the participants, and how they are given meaning.¹⁸ The authors used the Consolidated Criteria for Reporting Qualitative Research checklist developed by Tong *et al*¹⁹ to report the study in a transparent way. The checklist can be obtained directly from the corresponding author of this study (ANN).

Inclusion criteria and recruitment

The population of interest for this study was physicians working with adolescents with T1D in Germany. An additional inclusion criterion was that they worked in a hospital setting, either inpatient, outpatient or both. Recruitment was carried out using purposive, criterion-based sampling (10 participants), as well as snowball sampling by asking participants to share the invitation with their colleagues (2 participants). Participants were recruited from various locations across Germany via the diabetes-kids.de²⁰ website, which serves as a forum for the largest virtual community for German-speaking children and adolescents with T1D. A total of 70 clinics were contacted either through a collective mailbox email or directly to physician's email addresses. Out of 137 emails sent, 17 responses were received, and 12 interviews were conducted. Five participants withdrew due to lack of time (see figure 1). The individual semi-structured interviews took place between October 2022 and January 2023.

Table 1 Sample (n=12)

	n
Age (average age (min.–max.))	47,9 (33–58)
Sex	
Female	8
Male	4
Work setting	
Only Inpatient care	2
Only outpatient care	0
Inpatient and outpatient care	10
Experience (average year (min.–max.))	15–25 (2–26)
Max, maximum; Min, minimum.	

Sample

A total of 12 physicians working with adolescents with T1D were interviewed, representing 9 different hospitals in Germany. Of these physicians, eight were female and four were male, with ages ranging from 33 to 58 years and a mean age of 47.9 years. All physicians had a minimum of 2 years of specialised experience in paediatric endocrinology, with an average experience of 15.25 years. Among the participants, 10 were employed in a specialised hospital setting that offered both inpatient and outpatient care, while the remaining 2 were exclusively inpatient physicians (see [table 1](#)).

Data analysis

The duration of the interviews ranged from 16 to 30 min, with a mean duration of 24 min. The authors discussed and determined that sampling saturation had been reached.²¹ Indeed, content saturation was achieved, with no significant new information emerging compared with the earlier interviews.²¹ The individual interviews were conducted in person (ANN, a female doctoral candidate experienced in qualitative interviews), by telephone or by video conference. The researcher had no familial or acquaintance connections to any of the 12 participants prior to data collection. The authors have provided a guideline for the interview questions, consisting of open-ended questions to ensure flexibility and adaptability for each interview. However, the guide was not made available to the interviewees. It comprises seven sections and is available in online supplemental material 1—interview guide. Prior to conducting the study, a pilot test was carried out with two physicians. The two interviews were conducted to improve the interview guidelines and were, therefore, not included in the current study. The thematic coding analysis was conducted iteratively using MAXQDA software. The analysis was then refined through an iterative process that involved comparing and analysing themes across cases. Two authors (ANN and NF) independently coded all the coding material

and achieved a level of intercoder reliability of 80% to ensure data quality, consistency, validity and reliability of the results.¹⁷

Patient and public involvement

There was no patient or public involvement in the design of the study.

Informed consent and confidentiality, ethics approval

Participation in the study was voluntary. Prior to the interviews, the participants were informed verbally and in writing of the study's objectives, the use of data and their rights as study participants. After being informed, the participants gave their consent to participate in the study. The study design and the interview guide had been submitted to the ethics committee of Medical School Hannover and were accepted on 18 October 2022. The interviews were audiorecorded and transcribed, and the recordings were subsequently erased. To ensure anonymity, any information that could potentially identify the participants was removed from the transcripts.

RESULTS

The code system consists of 9 main categories and 18 subcategories (see online supplemental material 2—category system). To answer the research question, three main themes were analysed in detail. The first theme focuses on the utilisation of digital intervention to promote peer education and peer-to-peer support. The second theme explores the utilisation of digital interventions for communication and interaction during consultations, outside of consultations and hospital settings. The third theme analyses the motivation and interest in digital interventions. The cited sources have been translated from German to English (ANN and NF).

Peer support and acceptance of illness

All physicians agree that the connection with other individuals of the same age group who are affected by the same illness ('peer-to-peer support') offers a significant benefit on multiple levels, although it is unlikely to occur by chance. First, peer-to-peer support can provide useful information that the physicians may not be able to explain due to lack of time and resources.

My experience is that affected patients, families, and caregivers benefit greatly from online peer groups, simply because there is so much to learn and know about a condition like diabetes. As health care professionals, we cannot possibly convey and accompany all of the information, so peer groups serve as a very valuable complement. (E11:58)

Additionally, advice or messages delivered by peers are more likely to be heard and integrated compared with those from non-illness-afflicted adult physicians. Second to facilitating the transmission of information about the illness, other themes such as belonging to a group and/or psychological support through a sense of camaraderie are beneficial. Moreover, certain emotional or personal

topics that may be challenging to address with adults can be more easily addressed between peers. However, physicians' opinions regarding the adoption of such exchanges or peer groups are contradictory. Some physicians claim that young individuals do not want to or are not motivated to meet and connect with other patients, while others argue that it is requested by patients and well received.

The main debate revolves around the utilisation of digital interventions used for communication and connection among peers. In general, digital interventions for peer-to-peer exchanges are still promoted at a low threshold. From the physicians' perspective, contacts with other young individuals would be beneficial but would mainly occur during analogue meetings, educational groups or in rehabilitation measures. In these groups, a certain dynamic can be established more easily and can lead to interesting discussions, sharing of experiences or exchange of contact information. The COVID-19 pandemic had a negative impact in this regard, as the formation of such groups was no longer possible.

This is truly different, and we are not there when they can exchange information peacefully and independently from us. We actively strive to achieve this peer-to-peer support. (E8:38)

Few physicians highlight online platforms or support group websites (deemed inappropriate for this age group) as a means to connect with other peers but acknowledge digital interventions such as social media for maintaining contact among peers, but for contacts that are initially established in person. Conversely, some argue that it is easier to connect with other young people through an internet platform. Two significant challenges, as identified by physicians, relate to the use of digital interventions in peer platforms: (a) a lack of awareness of existing options, which often prevents physicians from recommending specific websites to their patients:

I am not aware of any really good online forums. The largest one is diabeteskids.de, which is semi-moderated. However, primarily parents participate there, not adolescents, and it focuses on personal and established groups. Of course, such forums exist, but it is difficult to make recommendations because they are open and lack specific recommendations. (E7:52)

(b) a critical view of free platforms due to the lack of control over the accuracy of information shared on these sites. Given that anyone can register on a free site and disseminate false information or create misleading profiles for malicious purposes.

The downside, of course, is that you never know who may be present in such online platforms. Just like anywhere else in the world, there are always individuals who spread misinformation or false facts, and as medical professionals, we have to counteract those initially. A classic example is the rumor that has been circulating in online communities for the past four years, although I cannot pinpoint its origin, that high-dose vitamin D can cure type 1 diabetes. This is,

of course, nonsense. However, when vulnerable families who struggle with accepting the illness and the fact that their child has to inject and be pricked multiple times a day come across such information and seek help and refuge there, it can be dangerous. Firstly, because insulin may be omitted, and secondly, because excessive intake of vitamin D can be harmful. (E11:58)

This topic is currently being discussed in some hospitals to prevent the negative effects mentioned above and better organise online support communities through analysing the existing platforms instead of build something new.

There are already several platforms [...] It's more about connecting these resources together [...]. The question arises: shouldn't we do more research in that direction? Ultimately, it will go in that direction, utilizing what already exists. (E1:46)

Another proposed solution is to better educate and engage with young individuals to understand their online behaviour. This involves empowering them with the necessary skills to discern and select reliable websites or platforms.

We already emphasize in our trainings that not everything related to diabetes found digitally is true, accurate, or recommended. For example, when considering the vast market of health apps related to diabetes, there is a significant and, in my opinion, relatively unregulated market. The issue is also that it is highly dynamic, and we may not be able to fully keep track of it in its entirety. (E5:36)

Communication and interaction

Communication and interaction during consultation: face to face versus digital

In most cases of adolescent with T1D, consultations are currently conducted in-person, but some hospitals have started offering video consultations during the COVID-19 pandemic. However, for billing purposes, an in-person consultation at least once per quarter is mandated. With the pandemic regulations no longer in effect, video consultations have significantly decreased with availability relying on the willingness of physicians. Some argue that patients are more disposed to come directly in person:

Interestingly, patients actually prefer to come in person. But this option does exist. (E2:38)

While others see significant benefits for patients in being able to have remote consultations, particularly for families who live far away and for whom coming to the hospital requires significant organisation.

We offer video consultations at our facility, especially for adolescents, including evening hours, which better accommodate their schedules with longer school days or vocational training or studies. (E8:30)

One of the disadvantages mentioned is the technical difficulties associated with remote consultations, which can result in time loss. Other physicians expressed a lack of familiarity with digital interventions as a challenge.

An advantage of video conference consultations reported by physicians is the ability to see the environment in which the patient lives, which can provide insight into the patient's background and context. The fact that physicians obtain an overview of the patient's living environment through an online setting without having been given consent to do so and perceive this as a positive is ethically problematic.

The disadvantages are clearly related to the technology. A lot of time is wasted. [...] But then again, this can also be an advantage. I think when you ask, 'How is it at your home? What does it look like at your place?' you get a little more insight, whether it's a completely chaotic family or not. So, I see it as an advantage to have a glimpse behind the scenes, into the parents' home environment. (E3:34)

Communication and interaction during outpatient care follow-up

In outpatient care settings, communication between physicians and the patient primarily occurs through email or telephone. Some physicians say that phone contacts are effective, while some consider them to be less efficient:

The official procedure would be for them to contact us at our phone number at the Specialized Pediatric Center (SPC), leave a message on the voicemail. Then the nursing staff listens to the message and leaves me a note in my compartment. But sometimes I only see it days later. (E10:34)

Some physicians concur that email communication for appointment scheduling and inquiries is effective, as it allows for direct access through smartphones, which are ubiquitous among young individuals. However, some physicians hold the view that not all adolescents use email for communication, or that emails may go unread due to various reasons:

A patient sending me an email? That doesn't happen. Maybe when they're 17 or 18. That they would contact me and make a request. Otherwise, I do communicate with parents via email as well. (E9:54)

Some physicians argue that it may be necessary to communicate with patients in a different manner, using other digital platforms that would be more appropriate, such as a messenger service.

Preferably, something like WhatsApp would be ideal. However, we are not using it. There must be a data-secure platform that we (...) that we use in the clinic. (E1:32)

Some physicians use their personal mobile phones to communicate with patients via WhatsApp, but this is limited to specific and occasional situations, and it is not the official channel. Most of the barriers encountered by physicians revolve around data protection issues. One interviewee mentioned the creation of a patient portal where communication between physicians and patients would be possible, along with other interactive features such as information transmission and link sharing. The

project is currently being evaluated in terms of data protection measures.

A patient portal on a medical basis, similar to a Moodle platform or something similar, where I can upload data, download information, view resources, find links, but also communicate and receive push notifications or similar features. (E4:50)

Another mobile application project is underway in the transition programme to maintain contact between the patient and the case management. The idea behind the mobile application is to explore better ways of reaching out to young patients. However, technical issues arise regularly and require frequent updates, resulting in it not functioning as well as desired.

Motivation and interest

A challenge mentioned by physicians is the difficulty in motivating young adolescents with T1D with digital interventions. Physicians instead use various communication techniques such as positive language or motivational interviewing to promote a trusting relationship. Empathy is a term frequently used in interviews and involves attentive listening from the physicians and direct communication addressed to the young patients. This also entails communication on an equal footing, aiming to establish a physician-patient rapport where the patient feels comfortable and able to open up to the physician, particularly regarding topics they may not necessarily want to discuss with their parents. It is important to strike the right balance here to avoid a friendly relationship or the use of 'youth language'. While the topics discussed during a consultation mainly revolve around medical questions, physicians take the time to show interest in the patient's personal life and address other topics beyond the illness, such as school. Other motivation techniques are used by some physicians, such as using 'superdays' where the consultation starts by discussing the 'good days' before addressing less successful aspects. Shared decision-making plays a predominant role in the conduct of consultations and helps to prevent an 'abuse of power'.

Instead of talking about therapy failures or missed goals or poor control or derailment, we try to name what is happening in more neutral but also scientific terms. Yes, I think word choice plays an important role in communication and it also affects how much motivation someone develops to carry out daily management. (E10:30)

Another concept mentioned in the interviews is the 'Language Matters Movement', which involves communicating without stigmatisation, recognising through language that living with T1D is complex and exhausting, and assigned the responsibility to physicians to convey this recognition.

Another approach to fostering this trust-based environment, as suggested by some physicians, is through maintaining consistent physician-patient relationships. In other words, ensuring that each patient consistently sees the same physician(s) and does not have to switch

physicians for each consultation. In some cases, poor clinical outcomes may be attributed to psychological factors, such as stress, which can be better understood when the patient opens up during a patient-centred healthcare encounter and shares their current struggles in their personal life, family or school. The patient may feel more comfortable disclosing these sometimes very intimate difficulties only when a foundation of trust has been established, a trust nurtured only when the same person is consistently present during the encounters. However, logistical and organisational constraints often make it impractical to maintain consistent physician–patient relationships in most hospitals.

The use of direct and in-person communication techniques, as mentioned above, has been highlighted to increase motivation among young patients. According to physicians, digital interventions do not play a significant role in this context and cannot replace the trust-based relationship established through direct and in-person interactions.

CONCLUSION

Based on the existing research on HL among adolescents with T1D,^{5 10} this study reveals that three themes hold particular significance: peer-to-peer support, communication and interaction, and motivation and engagement.

The present study shows that few digital interventions are used to promote HL in the three themes. In the first two themes, the physicians expressed different opinions regarding the use of digital tools to promote HL. In the third theme, it was shown that digital tools do not play a significant role. As in the first part of the finding, the physicians noted a lack of familiarity with existing platforms for peer-to-peer support, which limits their ability to provide informed guidance to patients and peer-to-peer exchanges were mainly promoted in analogue form. The guidelines from ISPAD (International Society for Pediatric and Adolescent Diabetes)—Diabetes in Adolescence²² underline the importance of peer support through online social media platforms: ‘peer support through online social media is an increasingly important source of advice’. In order to use digital interventions, it is essential to have access to or knowledge of existing digital interventions to provide informed guidance to patients. It is necessary to promote the use of digital interventions by incorporating digital literacy skills for both patients and physicians, as emphasised in professional HL studies.^{15 16} As mentioned in the BMG (German Federal Ministry of Health),²³ digitalisation offers enormous potential but is currently underused.

The current study also highlighted the importance of the need for a stronger patient-centredness, with particular emphasis on capacity building through interdisciplinary and participatory approaches. As seen in the results, the perspectives regarding the potential of digital interventions are heterogeneous among physicians and are independent of the interviewees’ years of experience,

gender or age. Therefore, its usage is dependent on the physician. As in the first part of the findings, the lack of credibility and the prevalence of misinformation in online platforms are identified as negative factors. Also, in the second part of the findings, the results demonstrate that in-person consultations are preferred by physicians after the lifting of COVID-19 pandemic-related restrictions, but some have adopted new technologies implemented during the pandemic to maintain communication. The ISPAD guidelines ‘Diabetes Education in Children and Adolescents’²⁴ underline that ‘Telemedicine, which encompasses the use of video or phone appointments, between a person seeking care and the healthcare professional, offers an important alternative to in-person diabetes review for people who live in remote areas without access to professional counselling and diabetes education resources locally, as well as for routine diabetes care’. In this research, the physician’s perspective has shown that the utilisation of telemedicine is still being debated and has not yet been widely implemented in-hospital settings, notably due to technical issues. Regarding the utilisation of digital intervention for the communication outside of healthcare, such as obtaining information or exchanging messages with physicians, phone calls and emails are commonly used, although physician opinions on this matter diverge. Some physicians believe that these methods are well suited for adolescents, while others hold a contrary view.

Also, as in the third part of the results, we show that the utilisation of digital intervention is limited in fostering motivation, according to physician’s perspectives. Many face-to-face setting communication techniques are considered motivators for adolescents. The results show that the patient-centred approach must be stronger to better target the needs of the patient, regarding the use of digital intervention to promote HL.^{25–28}

Finally, the challenges associated with implementing digital interventions to promote HL include a lack of structured implementation frameworks and legal constraints; for example, concerning the protection of personal data when outsourcing data processing to third-party services (EU General Data Protection Regulation).²⁹ For example, as shown in the results, some physicians use their personal cell phones to communicate with patients via WhatsApp even when it is not the official channel (and not secure under data protection law), to facilitate communication with patients. Frameworks could slow down the use of digital interventions to promote HL. To address the absence of structured implementation frameworks, organisations should adopt necessary frameworks, including financial and resource considerations, for effective implementation of digital interventions to promote HL. Tools need to be used to strengthen organisational HL.^{30–33}

Limitations

The strength of this study lies in its in-depth understanding of the physicians and their perceptions

through semistructured interviews that explored inductive themes. However, there are limitations that should be considered. First, only physicians were included in the study, while it would have been desirable to include other professionals such as diabetologists, social workers, psychologists, nurses, etc, who work with adolescents with T1D. Additionally, the sampling of physicians was random across Germany, but some regions were not included, which may introduce bias to the results. The size of hospitals and the distinction between outpatient and inpatient settings were not considered, which may also influence the results. The participants' responses may have been influenced by socially acceptable expectations of the interviewer. It is possible that the recruitment method used in this study, based on a snowball effect with a sample of only two participants where a chief physician solicited the participation of two of their employees, may have introduced sampling bias. The responses of the participants may have been influenced by their hierarchical relationship with their superior, potentially biasing the results. In conclusion, it is essential to thoroughly examine the experiences and perspectives of physicians on the use of digital interventions in HL, considering structural constraints and comparing the experiences of young adolescents with T1D for a comprehensive understanding of the issue.

CONCLUSION FOR PRACTICE AND RESEARCH

- ▶ Promoting the utilisation of digital interventions by incorporating digital literacy skills for patients and physicians.
- ▶ Emphasising capacity building through patient-centred, interdisciplinary and participatory approaches.
- ▶ Adapting the necessary general conditions (such as financial and resource considerations) for effective implementation of digital interventions.
- ▶ Recognising the needs, experiences and perspectives of patients in future research and implementation efforts.

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Contributors Conceptualisation, ANN; methodology, ANN; conducting interviews, ANN; validation, ANN and NF; formal analysis, ANN; writing—original draft preparation, ANN; writing—review and editing, ANN, NF, HT-G and VEA. All authors have read and agreed to the published version of the manuscript.

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Provenance and peer review Not commissioned; externally peer reviewed.

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ORCID iD

Aurélia Naoko Naef <http://orcid.org/0009-0008-8727-4560>

REFERENCES

- 1 MPFS - Medienpädagogischer Forschungsverbund Südwest (MPFS). JIM- studie. Jugend, information, medien. Basisuntersuchung zum medienum- gang 12- bis 16-Jähriger. 2020. Available: https://www.mpfs.de/fileadmin/files/Studi en/JIM/2020/JIM-Studie-2020_Web_final.pdf [accessed 08 Mar 2023]
- 2 International Diabetes Federation. *IDF diabetes atlas*, 10th ed. Brussels, Belgium, 2022. Available: <https://diabetesatlas.org/idfawp/resource-files/2022/12/IDF-T1D-Index-Report.pdf> [accessed 27 Mar 2023].
- 3 Deutsche Diabetes Gesellschaft (DDG) und diabetesDE. Gesundheitsbericht diabetes. 2023. Available: <https://www.ddg.info/politik/veroeffentlichungen/gesundheitsbericht> [Accessed 27 Mar 2023].
- 4 Duke DC, Barry S, Wagner DV, *et al*. Distal technologies and type 1 diabetes management. *Lancet Diabetes Endocrinol* 2018;6:143–56.
- 5 Naef AN, Wilhelm C, Tezcan-Güntekin H, *et al*. Impact of digital health interventions for adolescents with type 1 diabetes mellitus on health literacy: a systematic review. *BMC Endocr Disord* 2023;23:70.
- 6 Ho Y-X, O'Connor BH, Mulvaney SA. Features of online health communities for adolescents with type 1 diabetes. *West J Nurs Res* 2014;36:1183–98.
- 7 Shan R, Sarkar S, Martin SS. Digital health technology and mobile devices for the management of diabetes mellitus: state of the art. *Diabetologia* 2019;62:877–87.
- 8 Caburnay CA, Graff K, Harris JK, *et al*. Evaluating diabetes mobile applications for health literate designs and functionality, 2014. *Prev Chronic Dis* 2015;12:E61.
- 9 Bakhach M, Reid MW, Pyatak EA, *et al*. Home telemedicine (CoYoT1 clinic): a novel approach to improve psychosocial outcomes in young adults with diabetes. *Diabetes Educ* 2019;45:420–30.
- 10 Bröder J, Okan O, Bauer U, *et al*. Health literacy in childhood and youth: a systematic review of definitions and models. *BMC Public Health* 2017;17:361.
- 11 Rewolinski JA, Kelemen A, Liang Y. Type I diabetes self-management with game-based interventions for pediatric and adolescent patients. *Comput Inform Nurs* 2021;39:78–88.
- 12 Institute for Quality and Efficiency in Health Care (IQWiG). Disease management program for type 1 diabetes in Germany. In: *InformedHealth.org*. 2017. Available: <https://www.ncbi.nlm.nih.gov/books/NBK458293> [accessed 30 Jan 2024].
- 13 Małachowska M, Gosińska Z, Rusak E, *et al*. The role and need for psychological support in the treatment of adolescents and young people suffering from type 1 diabetes. *Front Psychol* 2022;13:945042.
- 14 American Diabetes Association. 12. Children and adolescents: standards of medical care in diabetes—2018. *Diabetes care* 2017;41:S126–36.
- 15 De Gani S, Schaeffer D, Griebler R, *et al*. Professional health literacy – first results of a pilot study in Austria, Germany, and Switzerland. *Popul Med* 2023;5:Supplement.
- 16 Schaeffer D, Haarmann A, Griese L. Professionelle Gesundheitskompetenz ausgewählter Gesundheitsprofessionen in

- Deutschland. Available: https://www.stiftung-gesundheitswissen.de/sites/default/files/brochure/pdf/2023_06_20_Ergebnisbericht_Studie_professionelle_Gesundheitskompetenz.pdf [Accessed 30 Jan 2024].
- 17 Kuckartz U, Rädiker S. *Qualitative inhaltsanalyse. Methoden, praxis, computerunterstützung: grundlagentexte methoden*, 5. auflage. Weinheim, Basel: Beltz Juventa, 2022.
 - 18 Willig C. Perspectives on the epistemological bases for qualitative research. In: Cooper H, Camic PM, Long DL, et al, eds. *APA handbook of research methods in psychology: foundations, planning, measures, and psychometrics*, Vol 1. American Psychological Association, 2012: 5–21. Available: <https://doi.org/10.1037/13619-002>
 - 19 Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007;19:349–57.
 - 20 Diabetes-Kids.de. Available: <https://www.diabetes-kids.de/> [Accessed 03 Jan 2023].
 - 21 Saunders B, Sim J, Kingstone T, et al. Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual Quant* 2018;52:1893–907.
 - 22 Gregory JW, Cameron FJ, Joshi K, et al. ISPAD clinical practice consensus guidelines 2022: diabetes in adolescence. *Pediatr Diabetes* 2022;23:857–71.
 - 23 BMG (Federal Ministry of Health). Gemeinsam digital – digitalization strategy for healthcare and nursing. 2023. Available: https://www.bundesgesundheitsministerium.de/fileadmin/user_upload/BMG_Broschuere_Digitalisierungsstrategie_bf.pdf [Accessed 16 Jun 2023].
 - 24 Lindholm Olinder A, DeAbreu M, Greene S, et al. ISPAD clinical practice consensus guidelines 2022: diabetes education in children and adolescents. *Pediatr Diabetes* 2022;23:1229–42.
 - 25 Scholl I, Zill JM, Härter M, et al. An integrative model of patient-centeredness - a systematic review and concept analysis. *PLoS One* 2014;9:e107828.
 - 26 Zeh S, Christalle E, Zill JM, et al. What do patients expect? Assessing patient-centredness from the patients' perspective: an interview study. *BMJ Open* 2021;11:e047810.
 - 27 Hower KI, Vennedey V, Hillen HA, et al. Implementation of patient-centred care: which organisational determinants matter from decision maker's perspective? Results from a qualitative interview study across various health and social care organisations. *BMJ Open* 2019;9:e027591.
 - 28 Leidner C, Vennedey V, Hillen H, et al. Implementation of patient-centred care: which system-level determinants matter from a decision maker's perspective? Results from a qualitative interview study across various health and social care organisations. *BMJ Open* 2021;11:e050054.
 - 29 EU General Data Protection. Regulation (EU) 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing directive 95/46/EC (general data protection regulation, GDPR). *Off J Eur Union* 2016;28:44–50.
 - 30 Rathmann K, Salewski L, Vockert T, et al. Tools to strengthen organizational health literacy in the health care sector. *Z Evid Fortbild Qual Gesundheitswes* 2022;170:21–8.
 - 31 Farmanova E, Bonneville L, Bouchard L. Organizational health literacy: review of theories, frameworks, guides, and implementation issues. *Inquiry* 2018;55:46958018757848.
 - 32 Rathmann K, Vockert T, Wetzel LD, et al. Organizational health literacy in facilities for people with disabilities: first results of an explorative qualitative and quantitative study. *Int J Environ Res Public Health* 2020;17:2886.
 - 33 Dietscher C, Pelikan J. Gesundheitskompetente krankenbehandlungsorganisationen. *Präv Gesundheitsf* 2016;11:53–62.