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Transforming Personal Healthcare through Patient Engagement: An In-Depth Analysis of Tools and Methods for the Digital Age

Emily Hickmann, Peggy Richter, Maren Kählig, Hannes Schlieter

***Abstract*—**Patient engagement is a cornerstone of high-quality care and essential for patients with chronic diseases to achieve improved health outcomes. Through digital transformation, possibilities to engage patients in their personal healthcare have multiplied. However, the exploitation of this potential is still lagging. To support the transmission of patient engagement theory into practice, this paper's objective is to give a state-of-the-art overview of patient engagement tools and methods. A systematic literature review was conducted. Overall, 56 tools and methods were extracted and synthesized according to the four attributes of patient engagement, i.e., personalization, access, commitment, and therapeutic alliance. The results are discussed in terms of their potential to be implemented in digital health solutions under consideration of the "computers are social actors" (CASA) paradigm. It is concluded that digital health can catalyze patient engagement in practice, and a broad future research agenda is formulated.

***Keywords*—**Chronic diseases, digitalization, patient-centeredness, patient empowerment, patient engagement.

I. Introduction

CHRONIC diseases, including obesity, diabetes, and cardiovascular diseases, emerge as the leading cause of mortality, accounting for a significant seven out of 10 deaths worldwide [1]. The need for "informed, activated patients" to improve healthcare outcomes is highlighted in the Chronic Care Model developed by the World Health Organization and the Pan American Health Organization [2]. An important reason for this is the increasing complexity of healthcare, placing higher demands on patients with chronic conditions to engage in their healthcare [3]. Engagement may involve activities such as making informed treatment decisions, handling multiple appointments, keeping medical documents sorted, or self-managing a health condition [4]. Positive effects associated with patient engagement include an effective and appropriate resource allocation, increased patient and provider satisfaction, and a higher quality of life [5], [6]. Additionally, patient engagement correlates with an enhanced patient adherence to the mutually agreed-upon treatment regimen [7], which is crucial in the comprehensive management of chronic diseases [3]. For instance, it is estimated that up to 50% of patients with chronic diseases fail to adhere to their prescribed medication as agreed upon with their physicians [8]. Consequently, actively engaging patients in their healthcare has become a cornerstone of high-quality care and a frequently stated goal of policy and healthcare organizations [9]. For example, the US National Coordinator of Health Information Technology described patient engagement as the "blockbuster drug of the century" [10].

Through digital transformation in healthcare, possibilities for patients to engage in their care have multiplied. The Internet of Things offers numerous monitoring devices that patients can use to track their health. Virtual coaches support patients with personalized training plans in the realm of their homes [11]. Patient portals directly engage patients with their healthcare providers [12]. Furthermore, the world wide web grants every individual easy access to medical knowledge previously reserved for professionals. However, there is still a large gap between the tremendous potential of digital health technologies to foster patient engagement and their implementation in practice [13]. This gap between research and practice may exist because it is challenging for healthcare institutions or providers of digital health solutions to locate and implement tools or methods necessary to successfully support patient engagement, especially as some potential tools and methods may not be available in digital formats yet [9].

By answering the research question "What tools or methods can be used to engage patients in their healthcare?", this paper contributes by providing a state-of-the-art overview on tools and methods to engage patients in their personal care process. Additionally, the paper offers a clear differentiation between tools that have undergone digitalization and those that remain non-digitalized.

In the following, Section II provides the theoretical background on the conceptualization of patient engagement for this paper. Section III details the systematic literature review to acquire the engagement tools and methods, which are then presented in Section IV. The state of digitalization, as well as the practical and theoretical contribution, and future research agenda are subject of Section V. The paper closes with a conclusion.

II. Theoretical Background

There is still a lot of ambiguity concerning the conceptualization of patient engagement and related terms, as they are used interchangeably in literature [14]. Higgins et al. [15], however, performed a comprehensive concept analysis,

Emily Hickmann is with Technische Universität Dresden, Germany (e-mail: emily.hickmann@tu-dresden.de).

including 96 articles that utilized the term. Four main attributes were identified. They are the basis of this paper's conceptual understanding of patient engagement and serve to categorize the engagement tools and methods.

The first attribute is the personalization of interventions or strategies according to patients' individual needs. The concept of shared decision-making is relevant in this context and implies an active engagement of patients and providers in decision-making. This is achieved by exchanging information and personal preferences. Key elements include identifying the issue requiring attention, outlining the available options, and facilitating a discussion between the patient and the healthcare provider about the benefits and drawbacks of each alternative [4].

The second attribute refers to patients' ability to access information or self-management tools that are essential for ensuring consistent and high-quality care. Ideally, providing this access should facilitate patient empowerment, which encompasses acquiring the knowledge and skills necessary for patients to participate in their care actively [16].

Patients' commitment to engage in care is the third attribute of patient engagement. This refers to cognitive and emotional factors supporting patients to demonstrate effort over time. It is driven by intrinsic forces that may, for instance, be enhanced by social support or intellectual resources.

The final attribute of patient engagement, as described by Higgins et al. [15], is the therapeutic alliance, aiming to create an effective partnership between healthcare providers and patients. Clinicians are more likely to understand patients' problems and recognize preferences if a trusting relationship exists between them [17]. The alliance with a healthcare provider is the main attribute distinguishing patient engagement from related terms such as empowerment [4].

It is important to emphasize that this paper focuses on patients engaging in their own healthcare or collaborating with their healthcare providers. Tools and methods for patient engagement at an institutional level, in research or policymaking, are not addressed. Furthermore, an information system's general patient- or user-centered design principles are not considered. Instead, the paper explores explicit tools and methods that can engage patients in their care, with the aim of supporting their implementation in digital health solutions. This subject area is currently underrepresented in both information systems (IS) and healthcare literature.

III. Method

A systematic literature review was performed to create a state-of-the-art overview of patient engagement tools and methods. To clearly define the scope of the study, the established taxonomy presented by Cooper [18] is used (see Fig. 1).

To enhance clarity, especially the characteristic coverage is of central importance for this review: Even though all literature the search yielded was considered and documented, only selected work samples are cited in this paper. The reason for this selectivity is that certain engagement tools, particularly shared decision-making aids, are extensively established in the literature, leading to a considerable number of papers discussing these tools. The review aims to give an overview of the different engagement tools and methods described in the literature and not a long list of sources which discuss a specific tool.

Characteristic	Categories			
Focus	Research Outcomes	Research Methods	Theories	Practices or Application
Goal	Integration	Criticism	Identification of Central Issues	
Perspective	Neutral Representation	Espousal of Position		
Coverage	Exhaustive	Exhaustive with Selective Citation	Representative	Central or Pivotal
Organization	Historical	Conceptual	Methodological	
Audience	Specialized Scholars	General Scholars	Practitioners or Policy Makers	General Public

Fig. 1 Taxonomy of the literature review (as in [18])

Hickmann et al. [4] perform an in-depth conceptualization of the term patient engagement and related terms, which supported the development of the following search string, which was employed to conduct a systematic literature search in PubMed:

(Patient[Title] AND Empower*[Title] OR Engag*[Title] OR Involv*[Title] OR Shared decision making[Title] OR Patient participation[MeSH-Term]) AND (Method*[Title] OR Tool*[Title] OR Aid[Title] OR Aids[Title] OR Strategy[Title] OR Strategies[Title] OR Implement*[Title])*

Not all tools or methods to engage patients in their healthcare have been implemented technologically. Nevertheless, these tools or methods, although not explicitly discussed in the context of digital health solutions, may still possess the potential to be transformed into a digital engagement tool that can be integrated into an information system. Therefore, "technology", "information system", or related terms were not used to narrow down the search string.

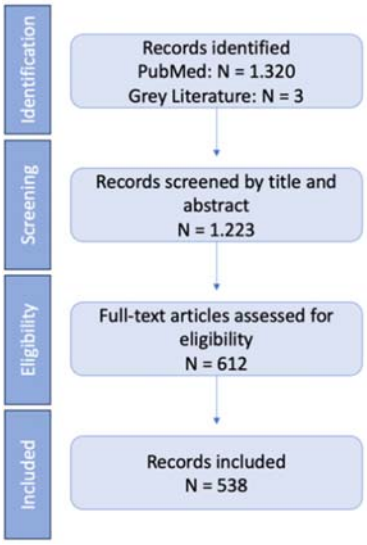

Fig. 2 PRISMA Flow-chart of literature selection process

Attribute / Category	Personalisation	Access
Brief Definition	Assures that interventions conform as closely as possible to the unique desires and circumstances of patients.	The ability of patients to obtain information, guidance, and tools to secure consistent and high-quality care.
# of Tools/ Methods	N = 17	N = 19
Subcategories	…of content …of the treatment option: shared decision-making …of the consultation	…to information …to education …to guidance …to self-management support
Attribute / Category	**Commitment**	**Therapeutic alliance**
Brief Definition	Cognitive and emotional factors that empower the patient to exploit available health resources and demonstrate effort over time.	Incorporates elements of the patient-provider relationship, including communication, empathy and mutual understanding.
# of Tools/ Methods	N = 10	N = 10
Subcategories	…through social support …through motivation ….through gamification	…through communication …through a low-threshold contact possibility with provider

Fig. 3 Attributes of patient engagement as in [15] and subcategories formed by the authors for the thematical categorization of patient engagement tools

he filters applied to refine the search included the English and German languages, as well as the availability of full-text articles. No restrictions were made concerning the date of publication. The initial search resulted in 1,320 articles in PubMed and an additional three grey literature publications. From these, 538 were included in the final set of publications after a two-stage screening process by two independent researchers (see Fig. 2).

Articles were included if they discussed at least one tool or method to engage patients in their healthcare. Common exclusion criteria included patient engagement in clinical trials, barriers and facilitators to engagement, and personal characteristics or attitudes of patients or healthcare providers towards engagement.

The large number of included publications (n = 538) is primarily due to the multitude of patient decision aids discussed (n = 338), which aim to support patients shared decision-making process. Tools and methods were extracted from the articles in a generalizable format (i.e., personalized information) and not by their given names, such as "InvolveMe" or "ShouldIScreen".

Literature was synthesized conceptually according to the four defining attributes of patient engagement described in Section II [15]. The tools and methods were categorized independently by four researchers with prior experiences in the field of patient engagement. A majority vote was used when the researchers sorted the tools and methods into different categories. If this was not possible, the decision on a category was discussed jointly. Herby, it became apparent that, depending on their configurations, some tools or methods may be sorted into more than one category. The objective was, therefore, to make a primary association, whilst secondary associations to a different attribute of patient engagement are addressed in the results section. However, it should be noted that one paper may still be sorted into different categories, as it may discuss more than one tool or method. In total, 73 papers discussed two tools or methods, and 13 papers discussed even more than two tools or methods. To enhance clarity, the tools and methods in the categories were then inductively divided into subgroups concerning a particular topic, such as supporting self-management or education.

IV. Results

This section provides an overview of tools and methods to engage patients in their healthcare. The number of tools and methods within each category, along with corresponding subcategories is illustrated in Fig. 3. Due to the limited amount of space provided, only some of the tools and methods are described below. The complete table of all engagement tools and methods with a detailed description of each is provided in Appendix A. Additionally, Appendix A includes the number of sources in the literature review that discuss each tool or method, as well as an indication of whether the tool or method has already been digitalized.

A. Personalization

Personalization refers to the need for tailoring interventions or strategies to patients' unique desires and circumstances. 17 tools and methods were categorized as personalization. These tools and methods were ordered into three subcategories: personalization of i) content, ii) treatment options, and iii) consultation.

Personalization of Content: Providing personalized content to patients is vital to accommodate them in their unique circumstances [15]. A potential method is to offer *personalized*

information [19]. This involves tailoring information to the patient, such as creating individual treatment plans and support options and adapting to different cultural backgrounds. *Personalized configurations* can also be used to enhance patient engagement [19], for example, concerning design, reminders or in what form (e.g., video or text) information is presented.

Personalization of Treatment Option: There are several engagement tools to personalize treatment options through shared decision-making. The tool *Best Case/Worst Case* [20] helps visualize and discuss available treatment options by comparing their best-case, worst-case, and most likely outcomes. *Decision boxes* [16] provide evidence-based summaries of treatment options with plain language versions for patients and detailed versions for physicians. *Decision coaching* [16] gives non-directive assistance to patients facing a treatment decision, while *Option Grids* [21] present summaries of all available healthcare options for a specific treatment decision. In contrast to decision boxes, the information is categorized as patients' most frequently asked questions considering these treatment options. Furthermore, *preference assessments* [22] use patients' personal information to propose already tailored treatment options. [23] *Three Talk Model*, also aiming to enhance shared decision-making, involves three distinct types of dialogue between patient and physician: team talk, option talk, and decision talk. The tools in this subcategory relate closely to the subcategories “Access to information” and “Access to guidance”, as information and guidance are also sole components of the shared decision-making process.

Personalization of consultation: Tools and methods supporting the personalization of consultation have the potential to make consultations more efficient and promote an individualized delivery of information. Hereby, the *goal elicitation tool* [24] is a simple questionnaire that asks patients to identify three goals for their consultation. The *self-report questionnaire* [25] focuses on patients' daily functioning to support physicians in adopting a more person- and context-centered approach during consultations. Also, *Question Prompt Sheets/Lists* [26] can be provided to patients during a consultation to prompt patients to ask more questions and support them in fulfilling their information needs. Tools in this subcategory can also support a strong therapeutic alliance through consultations in which patients feel heard and supported with their concerns.

B. Access

Access is an attribute of patient engagement, characterized by patients' ability to obtain the necessary resources to secure high-quality and appropriate healthcare [15]. In total, 19 tools and methods were sorted into four subcategories: access to i) information, ii) education, iii) guidance and iv) self-management support.

Access to Information: Information can be in *generalized formats* [27], such as brochures, books, apps, or websites. Furthermore, *complete and timely access to personal information* [19], such as lab reports, can support patients in becoming co-managers of their health. Furthermore, *audio recordings of consultations* [28] or the *physician's notes* [29] can be provided to patients as information sources. These tools and methods also relate to the personalization category.

Access to Education: Educational videos [30], as well as *workshops* and *education sessions* [31], are commonly used to provide patients with access to education. Furthermore, in *video blogs* or *forums* [32], patients can share their experiences by conveying information, know-how and coping strategies for their medical condition. These blogs or forums can be very educational for other patients with the same condition.

Referring to synergies between the categories, a higher competence level can also lead to higher intrinsic motivation and commitment, as patients may feel more in control of their situation.

Access to Guidance: Checklists [33] are valuable to guide patients through different processes, such as planned hospital admissions or discharges. Furthermore, *coaching* [34] involves providing patients with professional advice on a health-related issue, which may also be performed digitally or with the support of digital coaches. Another example is *navigation assistance* [35], helping patients to direct the healthcare system and find resources, (e.g. aid manufacturers, psychological or bureaucratic support).

Access to Self-Management Support: Several tools and methods were found to facilitate patients' self-management activities. The creation of an *action plan* [36] can support the achievement of a specific healthcare objective by creating small and realistic steps that can be taken by the patient to reach that goal. In contrast, *coping plans* [36] are a psychological simulation of how to overcome expected obstacles to perform the behaviors formulated in an action plan. Furthermore, *self-monitoring* [37] is a method in which patients measure and record their vital signs, symptoms, behaviors, or psychological well-being. *Wearables*, commonly tethered to a health or fitness application [38], can be used by patients to support this process. Finally, *patient portals* [39] are also a tool for patients to self-manage their health by entering, retrieving and sharing their health information.

C. Commitment

Commitment is defined by the cognitive and emotional factors that enable patients to utilize health resources [15]. Subdivided into three categories: i) social support, ii) motivation, and iii) gamification, ten tools and methods were identified.

Social Support: Self-help groups and organizations [40] represent a traditional illustration of social support available to patients. Also, the support of a *community* [41] can motivate patients and enhance their commitment. In an inherently online context, the support of a *chatbot* [19] can also be used to engage patients in their care, for example, through sending motivational messages reinforcing positive behaviors.

Motivation: Collaborative goal setting [41] involves healthcare providers and patients agreeing on a health goal and has the potential to significantly boost patients' intrinsic motivation. Also, *motivational interviewing* [34] can be used by healthcare providers to facilitate behavioral changes, which can

then, for instance, be reinforced through *reminders or alerts* [34].

Gamification: Gaming technology and gamified features [42] in medical products or applications can be used to enhance patients' commitment, for example, through earning points, creating a strike or quizzes. In this context, *educational entertainment* [43], combining entertainment with didactics, is also relevant. An example is a soap opera segment depicting a main character with a healthcare condition.

D. Therapeutic Alliance

The therapeutic alliance aims to create an effective partnership between a healthcare provider and a patient [15]. Two main subcategories were formed, into which 10 tools and methods were sorted: therapeutic alliance through i) communication and ii) low threshold contact possibilities with the provider.

Communication: Effective communication is a vital component in the development of a therapeutic alliance. *Basic communication techniques* [44] can significantly enhance patients' ability to self-manage their condition and play an active role in their healthcare. For example, specific language or phrases can be used to actively integrate patients into consultations, such as “I want to be sure I’ve explained things well. Please tell me what you heard” [44]. This phrase relates closely to the *Teach Back Method* [45], in which physicians assess patients' understanding of the provided information. Milne et al. [46] propose *screen sharing*, where physicians turn their computer screen towards the patient during consultations, allowing them to view what is being written or shown, thereby enhancing communication. Likewise, *conversation cards* [47] can be used by healthcare providers as communication tools. Conversation cards display a healthcare topic and its attributes in simple language.

Low Threshold Contact Possibility with Provider: Employing tools or methods that enable patients to easily communicate with their healthcare providers can foster a lasting connection and reassure patients that they are not alone in dealing with their health issues. For example, *electronic appointment systems* [48] and *teleconsultations* [49] are tools that support faster and more convenient contact with the healthcare provider. Furthermore, *secure messaging* [50] allows patients to share concerns or questions quickly. *Telemonitoring with feedback provision* [51] also sustains a connection between patient and provider. This subcategory strongly relates to the access category, as patients are given access to their healthcare providers.

V. Discussion

A. Patient Engagement Tools for Digital Health Solutions

This paper provides an overview of patient engagement tools and methods with the aim of enhancing their future implementation in digital health solutions. As not all engagement tools and methods have already been implemented technologically, every tool or method – digital or not – found in correlation to patient engagement was included in the review.

The findings of this study indicate the encouraging prospects of digital health solutions in promoting patient engagement activities. This is evident as numerous inherently digital tools, such as patient portals, secure messaging, and chatbots were identified during the search conducted for engagement tools. Hereby, it should be noted that digitally implemented engagement tools are already present in every review category. Therefore, relating to the attributes of patient engagement by Higgins et al. [15], digital health solutions have the potential to support the personalization of interventions, improve patients’ access to information, enhance patients’ commitment and strengthen the therapeutic alliance.

Moreover, traditional "offline" tools have been successfully transitioned into digital environments. For example, a preference assessment for shared decision-making would classically have occurred between patient and physician during a consultation. However, in the review, studies were found that digitalize preference assessments: patients enter their data, are guided through a set of questions and an artificial intelligence (AI) uses this information to recommend a personalized treatment option [22]. Additionally, decision coaching and self-help groups have already migrated to online platforms instead of local settings. Previously paper-based interventions, such as Option Grids or Question Prompt Sheets, have been transformed into digital formats, such as videos or tablet applications [21], [52].

Several patient engagement tools that have not yet been digitalized hold significant potential for future digitalization. Decision boxes, Picture Option Grids, action plans, and coping plans are examples of such tools that could be implemented as standalone solutions or incorporated as features within digital health applications. The digitalization of further tools, such as the Three Talk Model or the Teach Back Method, also become relevant when considering the “computers are social actors” paradigm as in [53]. The CASA paradigm implies that principles drawn from psychology, communication or sociology are relevant to human-computer interactions. As technologies become more interactive, interfaces are created that reflect human communication patterns, demonstrating sufficient social cues to indicate the potential to be a source of social interaction, e.g., voice assistants, virtual agents, or intelligent devices with social interfaces [54]. Therefore, computers as social actors, similar to physicians or personal trainers, may have the potential to enhance patient engagement.

Interfaces performing sufficient social cues could integrate patient engagement tools, which are usually designated to a personal interaction by deploying the same structured steps as a healthcare provider. For instance, the Three Talk Model, as exemplified in [55], can be implemented through a virtual coach, enabling patients to engage in a collaborative discussion about their treatment preferences. This virtual coach would follow the same three steps (team talk, option talk, and decision talk) typically undertaken by physicians, thereby facilitating a patient-centered and collaborative deliberation process. At this point, how well a program can adjust to the individual responses of a patient is decisive for a successful intervention. However, when used to guide patients in their decision-making process,

AI-enabled technologies have already shown promising results, such as improved decision quality, patient satisfaction and functional outcomes [22].

Furthermore, specific conversation techniques to engage patients in their healthcare may be used by a virtual agent or a social interface. Also, coaching or decision coaching could be performed by a virtual coach. Other tools relevant to the CASA paradigm are motivational interviewing, and personal stories or narratives. All these tools enhance patient engagement through a structured exchange between the patient and the healthcare provider.

Considering CASA and the engagement tools applied to this paradigm, it could also be hypothesized that the therapeutic alliance could become digital. Such deliberations are, for example, already common for mental healthcare [56]. In relation to patient engagement, the effects of a therapeutic alliance with a healthcare provider in comparison to a digital therapeutic alliance with a digital social interface should be explored. Even if it may seem preferable for patient engagement activities to enhance the relationship with a healthcare provider instead of a computer, this possibility cannot be ignored in light of skilled-worker shortages and demographic changes [57].

B. Praxis-Oriented and Theoretical Contribution

The provision of a comprehensive overview of engagement tools is relevant to several stakeholders in the healthcare sector. The following section provides a detailed description and deliberation of the contribution of this paper for digital health technology providers (practical) and digital health researchers (theoretical). Beforehand, the relevance of this review for patients and healthcare providers should also be stressed. Patients, especially with chronic conditions, could genuinely be interested in the results to promote their engagement or self-management activities. The same applies to healthcare providers, who can refer patients to specific tools or build them into their consultations. The results of this review are also of interest for decision-making entities, for example, to support funding decisions for or against digital health solutions, depending on the extent to which they support patient engagement.

Digital health technology providers: In their query of adjusting or creating digital health solutions that meet the needs of patients, the provided list of patient engagement tools can support the selection of the most suitable tools for a digital health project. For instance, a provider of digital health solutions may want to develop an application for patients with severe obesity using cognitive behavioral therapy approaches. Given the crucial role of patient engagement in promoting positive treatment outcomes for chronic diseases [2], the technology provider is motivated to ensure that the planned application incorporates a wide range of features that either enhance patient engagement or can be utilized by patients to actively engage in their care. To do this, the provider checks the complete list of engagement tools and methods, provided in Appendix A, searching for the ones applicable to the context of severe obesity and the framework of the planned app. During this process, the technology provider may opt to:

- make the difficulty of the language used in the app adaptable,
- ensure that the patient is addressed by his or her name as often as possible (personalized configurations),
- integrate an online decision-coaching feature supported by a preliminary preference assessment to identify if an invasive procedure could be right for the patient,
- include self-configurable question prompt sheets that patients can bring to their physician appointments,
- incorporate a goal-setting module to facilitate patients in setting and tracking their objectives,
- point out local sports groups, dieticians, specialized practices, or self-help communities (navigation assistance),
- provide a patient diary for self-monitoring,
- introduce a virtual coach to motivate patients and to provide low-threshold, timely answers to patients' questions,
- offer different competitions and collaborative friend quests between app users to learn more about nutrition, and
- use pre-configured questions to ensure patients' comprehension of the educational content and provide appropriate reformulations if any issues are detected (Teach Back Method).

It is important to note that this is merely an illustrative example demonstrating how the list of engagement tools and methods can be configured to enhance patient engagement through digital health solutions.

The patient engagement tools and methods could also be arranged and evaluated in diverse combinations to target a particular healthcare challenge. For instance, patients may experience anxiety during consultations and fail to communicate all their concerns [58]. To address this issue, a composite of engagement tools that can be adapted into a (digital) intervention may comprise the goal elicitation tool, Question Prompt Sheets, tell-us cards, and checklists. These combinations would need testing in the respective setting.

C. Researchers and Future Research Agenda

Providing an overview of patient engagement tools was necessary as the diverse efforts to engage patients in their healthcare are spread over different research fields and often miss an explicit allocation to patient engagement. For example, motivational interviewing is a communication method to motivate a person to carry out a specific action. Commitment, as a pillar of patient engagement, is reliant on motivation. Therefore, motivational interviewing (even if not primarily discussed in terms of patient engagement) is still a valuable tool to enhance patient engagement.

Furthermore, a facet to research is added through the thematical subcategories formed for the four overarching attributes of patient engagement. The subcategories contribute to the conceptualization of patient engagement, as in [15], as they further define the attributes and deepen the understanding of their relationships. The categorization utilized in this paper concerning the attributes of patient engagement proposed by Higgins et al. [15] could, however, be re-evaluated in the

context of alternative categorization approaches. For example, tool characteristics such as the degree of digitalization, automation, or main user (i.e., if the tool is patient- or provider-driven) could be used for categorization.

Additionally, further research, investigating the preferences, needs, and usability of different engagement tools among diverse populations is necessary. For instance, some patient engagement tools (e.g., conversation cards) may not be applicable to a digital setting, as they may require patients to physically hold and interact with the tools, possibly offering a more tangible experience compared to viewing them on a screen. Especially older patients with limited digital skills [59] may perceive digital patient engagement tools as burdensome. Additionally, evaluating and validating the effectiveness of patient engagement tools and methods in a digital environment can help identify specific scenarios regarding which digital health solutions are best suited for implementation. When considering the diverse coverage of the tools in literature, especially the ones not very common yet may need further studying to gain evidence and reach a broad conclusion. For example, in contrast to patient decision aids (n = 338), self-report questionnaires (n = 1) are not commonly discussed in relation to patient engagement. Further assessing each tool's impact on patient engagement is necessary for reliable implementation recommendations.

D.Limitations

Limitations of the study include the subjectivity of the review process. This was mitigated by two independent researchers performing the screening. In this manner, uncertainties or mistakenly omitted publications were mutually resolved. Subjectivity remains concerning the degree of abstraction in which the patient engagement tools were obtained from the literature. For example, an "Option Grid" is a specific tool with a precise definition and field of application. In contrast, "providing access to high-quality information" is more abstract and can be implemented differently. These differences occurred because the review's aim was to create a general list of engagement tools and methods that can be applied to different contexts. If a particular engagement tool was described, such as the "Personal Health Information Recommender" [60], the tool's functionality (i.e., giving access to high-quality information) was referred to in the results section. Also, if Option Grids had a specific name, such as the "Uterine Fibroid Option Grid" [61], this was not noted separately in the results section. Instead, the generic tool, i.e., an Option Grid, was added to the results.

VI. Conclusion

Actively engaging patients in their healthcare is a cornerstone of high-quality care, a patient's right and irrevocably needed to face current challenges in healthcare. Especially for patients with chronic diseases, positive treatment outcomes are closely linked to their ability to independently manage their condition, adhere to treatment plans, and effectively navigate the increasingly complex healthcare system. The digital transformation provides expanded possibilities for patient engagement and holds the potential to act as a catalyst for patient engagement in practical healthcare settings. However, the need for patient engagement must be recognized by digital health technology providers, healthcare providers, politicians, and patients alike. Furthermore, these stakeholders need to be supported in finding and utilizing appropriate tools and methods.

This paper offers essential support by presenting the findings of a systematic review of 56 patient engagement tools and methods, which are categorized according to four attributes of patient engagement: personalization, access, commitment, and therapeutic alliance. Especially considering the CASA paradigm, the results highlight the potential of these tools and methods for implementation in digital health solutions. In conclusion, this systematic review serves as a foundational building block for a future where digital health solutions not only connect with patients but empower them, ultimately transforming the landscape of healthcare into one that prioritizes engagement and partnership.

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Appendix

A. Categorized List of Patient Engagement Tools and Methods

Tables I-IV present a complete list of the patient engagement tools and methods found in the systematic literature review. The coverage defines the number of papers found relating to these tools and methods. One exemplary source is provided.

The column labeled "digitalization" provides information on the extent to which the tools and methods have been transformed into digital formats, indicated by the presence of an "x" to signify digitalization. This encompasses a broad spectrum of digital implementation stages, including pre-recorded videos, online conferences, features within digital health applications, and AI-based systems. However, this paper does not delve into a detailed examination of the specific digital formats employed for individual patient engagement tools and methods. To comprehensively capture the diverse digital implementations, a separate in-depth review dedicated to each tool and method would be necessary.

TABLE I
PATIENT ENGAGEMENT TOOLS AND METHODS PRIMARILY RELATING TO THE ATTRIBUTE "PERSONALIZATION"

Tool and description	Coverage	Digitalization
Personalization of content		
Considering different literacy levels Information should be delivered in a manner that patients can understand and value. This may vary for patients with different health literacy levels, so a possibility for the patient to adapt the difficulty level of the language used would be helpful. Also, statistics can be presented very differently: instead of a graph, an accurate but simple story could be used to explain the risk.	N = 6 [69]	x
Personalized configurations Personalized configurations concerning design, reminders or in what form (ex. video or text) information is presented can support patients' engagement. Room could also be given to personalized configurations by being able to add a profile picture or images of loved people to the home screen.	N = 1 [19]	x
Personalized information Patient engagement could also be enhanced if information, that is presented, is specifically tailored to the patient. This could include personalized treatment plans, support possibilities or cultural adaptations.	N = 5 [19]	x
Personalization of treatment option: shared decision-making		
Best Case/ Worst Case (BC/WC) BC/WC is a tool used by physicians during consultations to visualize and actively discuss the available treatment options. Hereby the best-case scenario, worst-case scenario, and most likely outcome for each treatment is discussed. Simultaneously a bar graph is drawn, with each bar representing one treatment option. The length of the bars indicates the range of outcomes and the relative magnitude of difference between the treatment options.	N = 1 [20]	
Decision box (DB) A DB is an evidence-based summary of the available treatment options. Benefits and harms of each option are described in the light of a patient's individual health status. There are two versions of the same DB: one for the patient in a plain language and one designed for the physician, discussing design, participants, and limitations of included studies. The DB for the patient is handed out during consultation and can be taken home for further considerations.	N = 4 [16]	
Decision coaching Decision coaching is the supportive, but non-directive assistance of a trained individual for a patient or family facing a treatment decision. Components include a needs assessment, information, values, and corresponding attributes of the treatment options, as well as possible barriers in the implementation process.	N = 9 [52]	x
Family group conference (FGC) FGC is a systematic process in which a patient and his or her family jointly reaches a decision for an intervention decision, from several options proposed by a physician.	N = 2 [70]	
Option Grid Option Grids are one to maximum three-page summaries of all available healthcare options for a specific treatment decision. In contrast to Decision Boxes, the information is categorized in form of the most frequently asked questions of patients considering these treatment options. For example, likely outcomes, risks, and benefits are commonly discussed.	N = 3 [21]	x
Patient Decision Aid (PDA) PDAs are tools that have been developed to support patients in making an informed and value-based choice for a treatment option. Regular PDA's include formats such as booklets, leaflets, short documents, videos, audio tapes or (interactive) websites.	N = 338 [62]	x
Picture Option Grid A Picture Option Grid conveys the different treatment options using a set of frequently asked questions and displays the information in the form of pictures or small graphics.	N = 2 [66]	
Preference assessment Preference assessments are decision aids that use personal information of the patient to propose a specific treatment option to the patient, which is tailored to his or her personal circumstances. These can include AI-enabled technologies and personalized outcome estimations.	N = 36 [22]	x
Roulette wheel/ dartboard A roulette wheel or dartboard is used to visualize the relative risks associated to different treatment options to support patients in the decision-making process.	N = 1 [68]	x
Three Talk Model (TTM) The TTM describes three steps to support the collaborative deliberation process during Shared Decision-Making: Team Talk, Option Talk and Decision Talk. Team Talk lets the patient know that they will not be left alone with the decision, Option Talk provides information on the options and Decision Talk supports the patients in considering their preferences (Elwyn, 2016).	N = 1 [23]	
Value clarification method Value clarification methods are processes helping patients clarify their personal values in relation to the importance of the different attributes underlying the available treatment options. Examples for value clarification processes include the analytic hierarchy process (AHP) [63] or the adaptive conjoint analysis (ACA) [72].	N = 9 [72]	x
Personalization of consultation		
Goal elicitation tool The goal elicitation tool is a questionnaire, given to patients prior a doctor's appointment, asking them to list three goals for their consultation or/ and shortly write down the most important aspects that they want to discuss with their physician.	N = 9 [24]	x
Self-report questionnaire The self-report questionnaire is a web-based consultation tool filled out by patients prior to consultation. Questions concentrate on the daily functioning of patients and the results are meant to support the doctor in adopting a more person-/context-centered approach during consultation.	N = 1 [25]	x
Question Prompt Sheets / Question Prompt Lists (QPS/ QPL) QPS/QPL provide patients with a list of commonly asked questions by other patients with the same medical condition. These are handed out to patient prior to a consultation to support them fulfilling their information needs.	N = 10 [26]	x

TABLE II
PATIENT ENGAGEMENT TOOLS AND METHODS PRIMARILY RELATING TO THE ATTRIBUTE "ACCESS"

Tool and Description	Coverage	Digitalization
Access to information		
Full and timely access to personal health information Giving patients full and timely access to their personal health information can support them in becoming co-managers of their own healthcare process.	N = 14 [19]	x
Information in regular formats Information about a patient's medical condition, for example including diagnostic procedures, treatment, side effects or self-care advice is a central tool for patient empowerment and is often presented in the regular formats of brochures, books, apps, websites or in the discussion with the healthcare provider.	N = 21 [27]	x
Providing access to high quality information The validity of information obtained online can be very limited. It can therefore be useful to give patients access to high quality information. This could be done through links or specific tools, that were designed to provide reliable material. An example is the Personal Health Information Recommender [60] consisting of a repository of documents, which are selected by experts.	N = 1 [60]	x
Sharing audio recordings of the consultation Patients are given access to an audio recording of their consultation with the physician.	N = 3 [28]	x
Sharing the physician's notes Patients are given full access to the notes the physician made during the consultation.	N = 1 [29]	x
Access to education		
Educational videos Videos can be used as a tool to convey educational content to patients.	N = 6 [30]	x
Video-blog/ forum In video-blogs patients can share their experiences online by conveying information, know-how and coping strategies for their medical condition. For other patients with the same condition these blogs or forums can be a very rich source of information.	N = 3 [32]	x
Visualizations Visualizations can support patients in understanding and interpreting information. Especially information relating to numerical concepts can be difficult for patients to understand. A prominent example is the common neglect of denominators, which can be counteracted through visual aids. Furthermore, information gained from monitoring activities (ex. symptom history) can be visualized to enhance understanding.	N = 4 [67]	x
Workshops/ education sessions Education sessions or workshops for patients are tools through which information can be conveyed to patients. These could occur in person or virtually.	N = 11 [31]	x
Access to guidance		
Checklists Checklists can be valuable tools to guide patients through different processes. For example, checklists are handed out to patients for them to prepare for a hospital stay or for discharge.	N = 7 [33]	x
Coaching Coaching is a process in which patients receive professional advice, guidance, and support on a specific (health-related) issue. This process can also occur digitally, supported by digital coaches.	N = 4 [34]	x
Navigation assistance Navigation assistance includes supporting patients in finding their way through the healthcare system, but also promoting and signposting patients to available resources. These could include physical activities, aid manufacturers, psychological or bureaucratical support.	N = 9 [35]	x
Access to self-management support		
Action plans/ Self-management plans Action plans support the achievement of a specific healthcare objective by creating small and realistic steps that can be taken by the patient to reach that goal. Time, place, and manner of the behaviors for achieving the objective are described. Often, they are created together with a healthcare provider, so that the clinical expertise is integrated into the concerns, priorities, and resources of the patient.	N = 4 [36]	
Coping plans A coping plan is a psychological simulation of how to overcome expected obstacles to perform the behaviors formulated in an action plan. For example, a patient aims to lose weight and the patient knows that eating healthy is particularly hard for him or her when eating in a restaurant (expected obstacle). Then, a coping plan for this obstacle may be that a light soup or salad is always ordered prior to the main meal, to enhance a feeling of satiety and lead to healthier choices.	N = 1 [36]	
Patient diary A patient diary is a tool that can be used by patients for self-monitoring. For example, daily recording of symptoms, body weight, blood pressure or activities is possible.	N = 4 [74]	x
Patient portals Patient portals are an access point for patients to retrieve personal health information and communicate with their healthcare team. Many providers also offer the possibility of linking the patient portal to other convenience tools, through which, for example, the patient can request appointments online or transmit monitoring data.	N = 18 [39]	x
Personal Health Records (PHR) A PHR is a self-management tool used by patients to manage their own health through entering, retrieving and/ or sharing their personal health information. This could for example include diagnostic information, lab results, current medications, or allergies. It is managed and maintained by the patient.	N = 20 [73]	x
Self-monitoring Self-monitoring takes place if patients independently measure, and record their vital signs, symptoms, behaviors, or psychological wellbeing.	N = 17 [37]	x
Wearables, health, and fitness applications Wearables, commonly tethered to a health or fitness application, can be used by patients to track personal healthcare information, for example steps per day. Often educational, motivational, or behavioral feedback is provided to the patient.	N = 3 [38]	x

TABLE III
PATIENT ENGAGEMENT TOOLS AND METHODS PRIMARILY RELATING TO THE ATTRIBUTE "COMMITMENT"

Tool and Description	Coverage	Digitalization
Commitment through social support		
Chatbot support A chatbot is a tool that can be used to engage patients in their care through sending messages, for example containing standardized information or feedback on current patient data. Furthermore, motivational messages can help to reinforce positive behaviors.	N = 1 [19]	x
Community support The support of a community can enhance patients' commitment, empowerment, and self-management strategies. Virtual communities can, for example, be found in social media channels or in community functions of health and fitness applications. Posting and receiving feedback on healthy activities or recent successes (e.g., weigh loss) can also support the further commitment to a chosen healthcare strategy.	N = 10 [41]	x
Personal stories/ patient narratives Personal stories by physicians or peers can provide illustrative examples of experiences and are seen as a useful way to communicate information about health and illness. Providing information within personal stories may affect the judgments and values people have, and the choices they make, differentially from facts presented in non-narrative prose.	N = 4 [64]	x
Self-help groups and organizations Self-help groups or organizations in healthcare are associations of patients, who choose to come together to exchange experiences, information and support each other in with their healthcare condition.	N = 6 [40]	x
Commitment through motivation		
Collaborative goal setting, reward mechanisms Collaborative goal setting is a process by which providers and patients agree on a health goal related to the healthcare condition. Financial, or other, incentives can be introduced as reward mechanisms to help patients achieve meaningful change. This is, for example, sometimes part of an insurance model.	N = 10 [41]	x
Motivational interviewing Motivational interviewing may be used by various providers (e.g., nurses, healthcare coaches) to address certain health behaviors. The goal is not simply to exchange information with the patient, but to promote a behavioral change by supporting the patient to explore and resolve ambivalences.	N = 4 [34]	
Reminders, alerts Reminders or alerts can be a valuable tool for patients to remember to take medication, perform a certain behavior or go to an appointment. Positive behaviors and adherence could therefore be enhanced.	N = 3 [34]	x
Commitment through gamification		
Educational entertainment Education entertainment describes a combination of didactics and entertainment. An example are soap opera segments depicting a main character with the respective healthcare condition.	N = 1 [43]	x
Gamified features Gamification features in medical products or applications can be used to enhance commitment and motivation of patients. These could include earning points, creating a strike or quizzes.	N = 3 [42]	x
Gaming technology Games can support patients, especially children, in dealing with their healthcare. An example is Re-Mission [42] an online game in which the player controls a robot which flies through the body to destroy cancer cells and tumors using chemotherapy and radiation.	N = 1 [42]	x

TABLE IV
PATIENT ENGAGEMENT TOOLS AND METHODS PRIMARILY RELATING TO THE ATTRIBUTE "THERAPEUTIC ALLIANCE"

Tool and Description	Coverage	Digitalization
Therapeutic alliance through communication		
Conversation techniques to actively engage patients Specific language or phrases can be used to actively integrate patients into consultations. An example is: *"I want to be sure I've explained things well. Please tell me what you heard."*.	N = 5 [44]	x
Conversation cards Conversation cards are used by the physician during a consultation. Each card encompasses a single treatment option or topic and describes its attributes in a simple language.	N = 2 [47]	
Screening for distress Through a systematic screening for distress, patients have the opportunity to communicate their concerns to their healthcare providers who can then more effectively address significant distress, for example for facilitating access to personalized mental health services.	N = 2 [71]	x
Screen sharing Screen sharing is a possibility for physicians to actively integrate the patient during consultation by turning the computer screen towards them, for example while explaining an x-ray.	N = 1 [46]	x
Teach Back Method The Teach Back Method consists of multiple steps involving i) the clinician introducing new information, ii) assessing the recall of the patient by asking them to repeat what they understood and then iii) rephrasing the information in relation to the patient's level of understanding. The physician then iv) reassesses the patient's understanding. Steps iii) and iv) are repeated until the patient has fully understood the information.	N = 1 [45]	
Tell-us card The Tell-us card is a communication tool used by nurses during the hospital admission. Patients are invited to write on the tell-us card what is important for them at that moment or in preparation for discharge from the hospital. By means of this card, patients' preferences and needs can be elicited and acted upon.	N = 1 [65]	
Therapeutic alliance through low threshold contact possibility with provider		
Electronic appointment systems Electronic appointment systems allow patients to easily book an appointment with their healthcare providers and support patients use of healthcare services.	N = 3 [48]	x
Teleconsultations	N = 5	x

Teleconsultations with the healthcare provider can be a tool to improve patient's accessibility to care and improve overall efficiency.	[49]	
Secure messaging	N = 9	x
A possibility for patients to securely message their healthcare providers, allows patients to share current concerns, questions, and information. This can enhance the patient-provider relationship and support a feeling of security in patients, knowing they have access to their provider at any time patient-provider relationship.	[50]	
Telemonitoring and feedback provision	N = 11	x
Telemonitoring is the use of information technology to monitor patients at a distance. Providing patients with feedback on their data can help sustain the patient provider connection and support self-management activities.	[51]	

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