# The impact of digital health technologies on moral responsibility: a scoping review

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## Abstract

Recent publications on digital health technologies highlight the importance of 'responsible' use. References to the concept of responsibility are, however, frequently made without providing clear definitions of responsibility, thus leaving room for ambiguities. Addressing these uncertainties is critical since they might lead to misunderstandings, impacting the quality and safety of healthcare delivery. Therefore, this study investigates how responsibility is interpreted in the context of using digital health technologies, including artificial intelligence (AI), telemonitoring, wearables and mobile apps. We conducted a scoping review with a systematic search in PubMed, Web of Science, Embase, CINAHL and Philosopher's Index. A total of 34 articles were included and categorized using a theoretical framework of responsibility aspects, and revealed two main findings. First, we found that digital health technologies can expand and shift existing 'role responsibilities' among caregivers, patients and technology. Second, moral responsibility is often equated with liability or accountability, without clear justification. Articles describe new ways in which physicians can be held accountable, particularly in the context of AI, and discuss the emergence of a 'responsibility gap' where no-one can be fully responsible for AI-generated outcomes. The literature also shows that m-Health technologies can increase patients' accountability for their own health. However, there was limited discussion in the reviewed literature on whether these attributions of accountability are appropriate. We conclude with implications for practice and suggestions for expanding the theoretical framework of moral responsibility, recommending further study on responsibility of collectives and artificial entities, and on the role of virtue in digital health.

**Keywords** Responsibility · Digital health · Technology · Ethics · AI

## Introduction

The use of digital technology has transformed healthcare delivery by allowing for new modes of communication and the digital exchange of vital information (Iyawa et al. 2016, European Commision 2018, WHO 2019). The new field of 'digital health' holds promise for addressing problems of scarcity and rising costs within healthcare while improving its overall efficiency, reducing the workload of healthcare practitioners, and empowering patients (European Commision 2018, WHO 2019, Van der Vaart et al. 2023). In order to ensure these promised benefits, policy and research is focused on the 'responsible' use of digital health technologies (Grinbaum and Groves 2013; Böhm et al. 2020; Andersson et al. 2021; Kang and Exworthy 2022, Woldamanuel et al. 2023). Unfortunately, remarks concerning responsibility in these documents often lack definition and "appear to be employed as a placeholder for notions like moral goodness or ethical approval, thereby inciting psychological

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connections to self-regulation, social acceptance, or political correctness" (Tigard 2021a). Similarly, the European Union's framework of 'Responsible Research and Innovation' (RRI) for assessing the ethicality of new technology, features no definition or discussion of what is understood as being responsible in this context, despite including this concept in its name (European Commission 2013).

It seems that discussions on 'responsible digital health' allude to moral responsibility, that is, the extent to whether an actor can be blamed or praised for their actions. However, these discussions often remain superficial and are limited in their exploration of the meaning of responsibility and its practical implications (Böhm et al. 2020; Andersson et al. 2021; Kang and Exworthy 2022, Woldamanuel et al. 2023). This is also stressed by Vincent (2011) who illustrates that the concept of responsibility is pluralistic and open to various interpretations, but only occasionally acknowledged "in anything other than footnotes" (Vincent 2011, p.15). This results in ambiguities and potential misunderstandings that can affect daily healthcare practices. Namely, new digital technologies come with new tasks and different ways of working which has an impact on the experienced responsibilities of healthcare practitioners and patients (Nyrup 2021; Ahmadpour et al. 2022; Landers et al. 2023). For example, telemonitoring requires patients to measure, interpret, and communicate their vital signs to their healthcare practitioner using mobile equipment. However, uncertainties in who is responsible for the quality of the measurements will have an influence on the subsequent treatment and may obstruct the quality of care provision (Cengiz et al. 2021; Davies 2021). Therefore, it is essential to delve deeper into the concept of responsibility and provide a comprehensive overview of how it is understood in the context of using digital health technologies.

To address this research gap, this review aims to systematically analyse moral responsibility in the context of using digital health technologies with the following research questions: (1) How do digital health technologies change the moral responsibilities of various stakeholders? (2) Who bears what kind of moral responsibility for the responsible use and implementation of digital health technologies? This includes the assessment of the impact of digital health technologies on the responsibilities of healthcare stakeholders such as patients, physicians, and nurses. Of note is that we focus on responsibility of using these technologies, which differs from the general focus of technology ethics on the design and development process (Umbrello 2020; Jongsma and Bredenoord 2020, McLennan 2022). Fewer studies asses the ethical concerns after the design phase, when digital health technologies are implemented and used in practice; and if they do study this, then responsibility is often a secondary concern (Lucivero and Jongsma 2018; Lupton 2013a, Kreitmar 2023). We think that better understanding of what

responsibility implies, will help to remove ambiguities and provide insights for policy and empirical research on the meaning of 'responsible' use of digital health technologies.

## Approach

### Theoretical framework

Responsibility is a concept that is used in various disciplines. The focus of this review is on moral responsibility, which should be distinguished from legal responsibility. Legal responsibility pertains to the duties of an individual as defined by law, whereas moral responsibility is based on societal norms and values. A traditional approach in assessing moral responsibility is to distinguish between *forward-looking* and *backward-looking* responsibility. Forward-looking responsibility focuses on the virtues and obligations of an actor related to preventing or mitigating future harms (Sand et al. 2022). On the other hand, backward-looking responsibility is retrospective and established based on past actions and outcomes. However, this distinction into two types fails to take into account the more nuanced and pluralistic interpretations of moral responsibility. The question remains: What exactly does it mean to say that someone is responsible for something? Does it imply a relationship of causality, the expectation of a particular behaviour, or liability for claims? This plurality of moral responsibility is widely recognized in the literature (Moritz and David 1939, Hart 1968, Shoemaker 2011, Van de Poel 2011, Vincent 2011).

Thus, a more comprehensive framework is needed to recognize this pluralistic character of moral responsibility. Vincent's (2011) responsibility taxonomy is such a framework that incorporates diverse interpretations of responsibility, making it a relevant analytic tool for this review (Vincent 2011). This taxonomy, which is built upon the responsibility interpretations previously formulated by Hart (1968), aims at clarifying ambiguities when discussing moral responsibility. The framework delineates six different aspects of moral responsibility and describes how they relate to each other (Box 1):

- **Outcome responsibility** can be attributed to an actor as a result of what he or she did. In general, outcome responsibility is attributed to humans or organizations. This view of responsibility that looks backward in time focuses on assigning blame or praise for an event and the activities that led up to it.
- **Causal responsibility** considers what or who caused or contributed to an outcome, focusing on the specific action that was significant in bringing about that result. According to Vincent (2011, p.18) "causal responsibil-
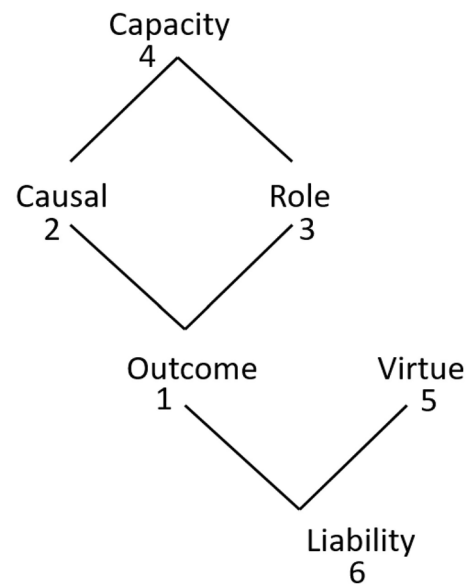
ity is a thinner and less morally imbued concept than outcome responsibility".

- **Role responsibility** focuses on specific duties and obligations that fall under an actor's role. These obligations can stem from different sources, including formal job descriptions outlining official responsibilities and informal societal roles and obligations.
- **Capacity responsibility** focuses on an actor's ability to comprehend what is expected of them and adjust their behaviour accordingly. These abilities are mainly referred to as cognitive skills, which are required for understanding one's role and causal contribution to an outcome.
- **Virtue responsibility** is about an actor's character traits and intentions. Somebody is seen as virtuous when they inhibit character traits and intentions that align with the standards that society holds dear.
- **Liability responsibility** is about who will ultimately be held responsible for something that has happened or occurred. This is about what an actor needs to do and how to deal with them to correct the action, behaviour and or situation.



**Fig. 1** This figure illustrates the interrelationships among six responsibility aspects proposed by Vincent (2011)

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### Box 1: The plurality of moral responsibility: a parable based on vincent´s taxonomy

According to Vincent, there are three main ways in which the different responsibility aspects are related to one another. These interrelations will be demonstrated in the following parable, which is an adapted version of Hart´s (1968) parables. Hart (1968) originally introduced several interpretations of responsibility with a parable about a drunken captain who lost his ship at sea. We have adapted the parable to an example with digital health technologies. The numbers in the parable indicate which aspect of responsibility is referred to (Fig. 1).

*Janssen, who has always been a responsible physician (5), is responsible for the safety of care delivery to her patients (3). In her hospital, a recent implementation of an Artificial Intelligence-powered decision support system (AI-DSS) resulted in a fatal outcome during its first use. While the family of the patient deemed Janssen to be responsible for the death of the patient (1), her colleagues argued that the AI tool was responsible for causing the outcome (2). They argued that Janssen could not have known how the opaque AI tool generated its advice, which at the time did not seem like an unreasonable decision. Thus, she cannot be held fully responsible for this medical decision (4). Consequently, Janssen should only be expected to formally apologize to the patient's family, being a responsible physician (5). In contrast, if the AI tool is found to be faulty, the developer or hospital should be held responsible for introducing the tool, depending on whether the fault could have been known to the hospital (6).*

The parable illustrates the nuanced interpretations of responsibility. To unravel the connections among various interpretations, we start with the parable's outcome—the unfortunate death of the patient. Firstly, according to Vincent's theory, Janssen bears outcome responsibility only if her actions directly caused the fatality and if she breached her professional obligations. In this example, we assume that Janssen adhered to her role responsibilities in medical decision-making. However, the outcome was generated by the AI technology and not by the physician, so it can be argued that Janssen cannot be attributed with causal responsibility. The second interrelation claims that statements about Janssen's causal and role responsibilities should align with her capacity. As a practicing physician, we assume that Janssen is cognitively competent and is able to understand her actions and behaviour. However, the AI tool's opaque nature precludes her from comprehending how it makes its recommendations. Consequently, Janssen cannot be fully attributed with capacity responsibility, given the inexplicability of the AI technology. Finally, the third relationship is the influence of outcome and virtue responsibility on the attribution of liability. In light of her incomplete outcome responsibility and the mitigating factor of her acting as a virtuous physician, it becomes evident that she should not bear liability responsibility. Of note, is that whether any liability claims towards the hospital where Janssen works, are justified, depends on whether the hospital could have known (capacity responsibility) that the AI tool was not 'state of the art'.

## Method

We conducted a scoping review with a systematic search to explore the impact of using digital health technologies on moral responsibility, which is a relatively underexplored area. Given the exploratory nature of our research questions and our aim of clarifying how the concept of moral responsibility is interpreted in the context of digital health technologies, a scoping review was deemed the most suitable approach (Munn et al. 2018). The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for scoping reviews were followed (Tricco et al. 2018).

### Search strategy and screening

We identified relevant literature by searching five databases (PubMed, Web of Science, Embase, CINAHL, and the Philosophers' Index) for articles published between January 1, 2013, and April 17, 2023. To create search strings (Supplementary information—S1), we used three sets of keywords which contained terms related but not limited to: (1) moral responsibility, accountability, obligation, and duty; (2) digital health, AI, telemonitoring, eHealth, mHealth, and big data; (3) healthcare, health, and medicine. The search string on digital health technologies included various forms of technologies, as the concept is pluralistic and lacks a clear consensus on its precise definition (Iyawa 2016, Adjekum 2018). In this review we define digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health" (WHO 2019). To structure the different domains of digital health technologies described in the reviewed literature, we applied the terminology proposed by Cowie et al. (2016) and Singhal & Cowie (2021) (Fig. 2). They describe four main areas of digital health: Big Data, Genomics, AI, and e-Health (including m-Health, telemonitoring, and clinical information systems), which they derive from the conceptualization of the World Health Organization (WHO) (WHO 2019).

The screening and selection process is visualized in Fig. 3. In total, we identified 5663 articles. After removing duplicates and screening titles and abstracts, EM and MB evaluated 228 full-text articles for eligibility. Articles were excluded that did not focus on moral responsibility, lacked connection with using digital health technologies, or were written in a language other than English, German, or Dutch. Articles that did not clearly fit these categories were discussed extensively and included when no agreement could be reached. Through backward reference searching of the selected articles, additional publications were found.
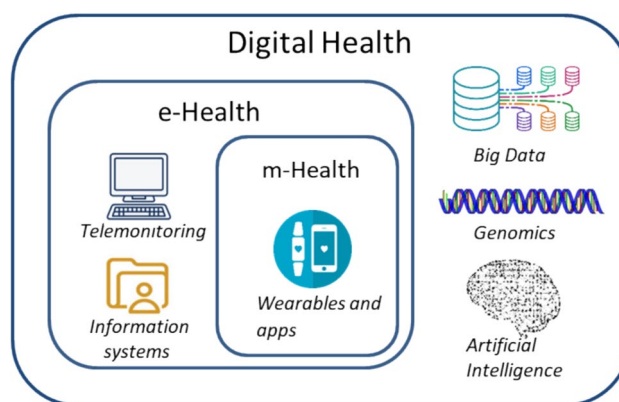


**Fig. 2** Overview of domains of digital health technologies, simplified version of Singhal and Cowie (2016)

### Data extraction and qualitative analysis

The next step concerned the extraction of bibliographic data (Supplementary material—Table S2), which depicts the first author, year and country of publication, type of analysis (empirical or theoretical), the actor, the type of digital health technology, and which aspect of responsibility best fit the description in the literature. Finally, the last category of the table summarizes the main findings of the article.

We identified various aspects of responsibility using an iterative method combining inductive and deductive analysis. Inductive or open analysis, inspired by Feredy & Cochranes (2006), involved data familiarization, code generation and theme development. The inductively generated codes are subsequently aligned with Vincent's (2011) responsibility taxonomy. EM and MB discussed the emerging responsibility aspects until consensus was reached. Finally, we used Vincent's responsibility taxonomy as an analytical tool to interpret the literature's conceptualization of responsibility. In Vincent's taxonomy, one responsibility aspect is defined as liability. Our search revealed that the term 'liability' is most commonly used in legal contexts (Barwa 2014, Chan 2021). However, as previously indicated, our emphasis is on moral responsibility. Consequently, we opted to redefine this aspect as accountability, which is quite similar but appears more often in debates regarding digital health technologies, such as AI, and is more morally oriented than liability. We adopted the definition of accountability provided by the OECD AI policy observatory: "Accountability is the expectation that organizations or individuals will ensure the proper functioning (…) of the [AI] systems that they design, develop, operate or deploy, in accordance with their roles and applicable regulatory frameworks, and for demonstrating this through their actions and decision-making process" (OECD 2023).

**Fig. 3** PRISMA flowchart
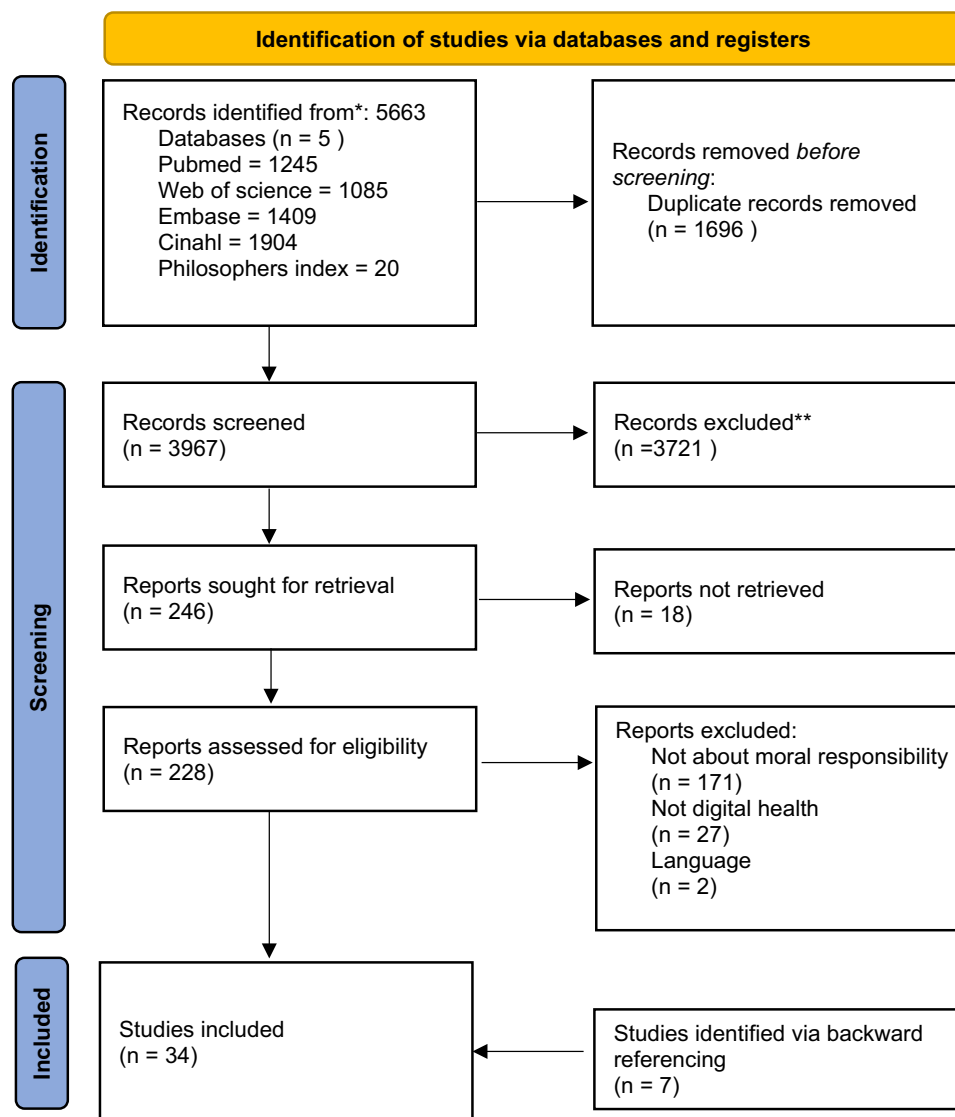


## Results

A total of 34 articles were included in this review (Fig. 3). A comprehensive overview of the characteristics and results of each included article is available in Supplementary Material S2. The majority of included articles were based on theoretical argumentation (n = 24), with a smaller subset (n = 10) grounded in empirical data. They covered various aspects of digital health technologies, focusing on AI technology (n = 13), m-Health applications (n = 10), telemonitoring (n = 5), and single articles on genomics and clinical information systems. The impact on responsibility was mainly discussed for physicians (n = 14), patients (n = 14), or their relationship (n = 5), with fewer articles addressing nurses (n = 4), informal caregivers (n = 1), developers (n = 1), or the technology itself (n = 5).[1] Most articles (n = 27) originated from Europe (DK, NL, DE, UK, AT, IE, ES, SE, FI, CH), and a limited number of articles came from the United States of America (USA) (n = 4), and from Australia (n = 3). A summarized overview of the characteristics of the included articles can be found in Supplementary Material S3.

Reviewing the literature resulted in two main observations about responsibility in the context of using digital health technologies. Our first aim was to study how digital health technologies change the perceived moral responsibilities of various stakeholders. In the literature, the impact

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[1] Several articles presented the influence of digital health technologies on more than one stakeholder. Consequently, the total number of articles in this list exceeds the 34 articles included in this review.

of these technologies on moral responsibility is most commonly (n = 20) discussed in terms of changing 'role responsibility' (Bødker and Nielsen 2015, Andersen and Whyte 2014, Boers et al. 2020, Ruckenstein and Schüll 2017, Ignatowicz et al. 2018, Lucivero and Jongsma 2018, Lupton 2013a, Lupton 2013b, Kamp and Hansen 2019, Nickelsen 2019, Braun et al. 2020, Holm 2020, Carter et al. 2020, van Baalen 2021, Grote and Berens 2020, Gross et al. 2021, Jongsma et al. 2021, Sand et al. 2022, Svensson and Jotterand 2022, Bunnell and Rowe 2023). We found that use of these technologies leads to a shift in and general expansion of 'role responsibilities'. Our second aim was to explore who bears what kind of moral responsibility for the use of digital health technologies. Here we discovered that the literature often (n = 15) interpreted responsibility as 'accountability' of physicians and patients (Silven et al. 2022; Carter et al. 2020; Habli et al. 2020; Durán and Jongsma 2021; Tigard 2021b; Verdicchio and Perin 2022; Martani et al. 2019; Felt et al. 2022; Davies 2021; Lupton 2013a; Bødker and Nielsen 2015; Lucivero and Jongsma 2018; Kamp and Hansen 2019; Jongsma et al. 2021, Bunnel and Rowe 2023).

Besides the descriptions of 'role responsibility' and the 'accountability' attributions, we found less literature on 'capacity responsibility' and 'causal responsibility', and one article about 'virtue responsibility'. We found no articles about 'outcome responsibility', probably because this is often not separated from accountability. Finally, we identified one interpretation of responsibility, namely 'collective responsibility', that is not included in Vincent's responsibility aspects. Since the literature primarily discussed role responsibility and accountability, we chose to focus on these aspects in our description of the results. Table 1 provides an overview of how all different aspects of responsibility apply to each actor, as discussed in the included articles.

## Shift and expansion of role responsibilities

In response to our first research question —how do digital health technologies change the moral responsibilities of various stakeholders?— the reviewed literature mostly describes the impact of these technologies in terms of shifting and increasing 'role responsibilities' of physicians, patients, nurses, informal caregivers, and even the technology itself. The following paragraphs discuss the impact and interpretations of the role responsibilities of each actor that uses digital health technologies, as found in the literature. Figure 4 provides an overview of the expansion of and shifts in these responsibilities.

### Physicians' role responsibility using AI technologies

When working with digital health technologies, physicians are assigned new 'role responsibilities' (Holm 2022, Sand et al. 2022, Bunnell and Rowe 2023, Svensson and Jotterand 2022, Ignatowicz et al. 2018). In the reviewed literature, this was mainly described in the context of AI technologies, such as AI-powered decision support systems (AI-DSS) which support clinical decision-making by providing recommendations regarding diagnosis and treatment options based on patients' health data. As such, the literature describes that there is a transfer of role responsibilities in terms of medical decision-making from physicians to AI-DSS technologies (Braun et al. 2020; Carter et al. 2020; van Baalen et al. 2021; Bunnell and Rowe 2023). As a result, physicians' medical and technical skills may decline, while an emphasis on administrative and counselling skills becomes the new focus of their role responsibilities (Bunnell and Rowe 2023), as well as the continuous monitoring of the AI system's output (Sand et al. 2022). Furthermore, physicians that use AI-DSS are said to become responsible for communicating and explaining new kinds of information to patients, such as the quality of the system and the sensitivity of the generated outcomes (Holm 2022; Grote and Berens 2020; van Baalen et al. 2021). This new 'role responsibility' of physicians links to 'capacity responsibility' as it requires them to have a good understanding of the input data and the workings of the model, making them competent users of medical AI and thereby reducing the risk of harm (Svensson and Jotterand 2022; Bunnell and Rowe 2023; Grote and Berens 2020; van Baalen et al. 2021). Fulfilling this role, requires training and education of physicians about the technical aspects of AI (Sand et al. 2022).

### Responsibilization of patients with medical tasks

Digital health technologies are also described to impact on patients' role responsibility, in particular, by altering and expanding their duties for self-care and self-management (Andersen and Whyte 2014; Ruckenstein and Schüll 2017; Boers et al. 2020; Santaló and Berdasco 2022; Verdicchio and Perin 2022; Jansky et al. 2023; Kreitmair 2023). Especially when using m-Health technologies for telemonitoring, patients are ascribed to have new role responsibilities regarding collecting, measuring, transmitting, and monitoring health data (Lupton 2013a; Bødker and Nielsen 2015; Ruckenstein and Schüll 2017; Lucivero and Jongsma 2018) and managing and controlling health risks (Lupton 2013b). Lucivero and Jongsma (2018, p. 2) describe how "(…) apps and selfmonitoring devices (…) seem to assign extra responsibilities to patients. In fact, these apps and wearables delegate some tasks to patients that are traditionally carried out by healthcare professionals". Similarly, Andersen and White (2014, p. 266) describe: "(…) doing something about one's risk condition becomes imperative; numerical results of medical check-ups and home monitoring are appreciated and become central in individual processes of

**Table 1** Summary of responsibility aspects derived from the literature

| Responsibility[a] | Physician | Patient | Nurse and (informal) caregiver | Technology |
|---|---|---|---|---|
| Outcome (n=0) | – | – | – | – |
| Causal (n=7) | Black box problem (Carter et al. 2020; Tigard 2021b) and many hands dilemma (Bleher and Braun 2022; Verdicchio and Perin 2022) hamper causal responsibility of physician for erroneous outcomes of AI technologies | Difficulty to establish causal responsibility between patient behaviour and health consequences when using m-Health technologies (Martani et al. 2019; Santaló and Berdasco 2022) | – | – |
| Role (n=20) | New role responsibilities due to 'always-on' digital availability when using digital patient communication methods (Ignatowicz et al. 2018). When working with AI technologies, role responsibilities increase in terms of explaining decision making (Grote and Berens 2020; van Baalen et al. 2021; communicating the quality of technical aspects (Holm 2022; Sand et al. 2022) as well as counselling and administrative tasks (Svensson and Jotterand 2022; Bunnell and Rowe 2023) | New role responsibilities regarding medical tasks, such as measuring and transmitting health data and ensuring its quality (Lupton 2013a, 2013b; Andersen and Whyte 2014; Bødker and Nielsen 2015; Lucivero and Jongsma 2018; Ruckenstein and Schüll 2017; Ignatowicz et al. 2018; Boers et al. 2020) | New role responsibilities regarding medical decision-making as first signaler (Kamp and Hansen 2019; Nickelsen 2019; Gross et al. 2021; Jongsma et al. 2021) | New role responsibilities for AI-DSS regarding cognitive tasks in medical decision-making, such as diagnosing and making treatment recommendations (Braun et al. 2020; Carter et al. 2020; van Baalen et al. 2021; Bunnell and Rowe 2023) |
| Capacity (n=12) | Insufficient capacity responsibility of physicians when working with opaque AI technologies (Lupton 2013b; Habli et al. 2020; Jongsma et al. 2021; Svensson and Jotterand 2022; Grote and Berens 2020; Silven et al. 2022) | Patients may lack the capacity (in terms of necessary environment or skills) to fulfil new m-Health tasks (Martani et al. 2019; Davies 2021; Felt et al. 2022; Santaló and Berdasco 2022; Jansky et al. 2023; Kreitmair 2023) | – | – |
| Virtue (n=1) | Placing accountability on physicians may foster epistemic vices, such as gullibility or dogmatism in relying on AI outcomes (Grote and Berens 2020) | – | – | – |
| Accountability (n=15) | Physicians are increasingly held accountable for the outcomes of digital health technologies (Silven et al. 2022) and especially those of AI technologies (Carter et al. 2020; Habli et al. 2020; Durán and Jongsma 2021; Tigard 2021b; Verdicchio and Perin 2022) | The use of m-Health technologies is causing patients to be held increasingly accountable for their health management (Martani et al. 2019; Felt et al. 2022; Davies 2021; Lupton 2013a; Bødker and Nielsen 2015; Lucivero and Jongsma 2018) | Increased accountability of nurses for patient care when using telemonitoring (Kamp and Hansen 2019; Jongsma et al. 2021) | Discussion on whether artificial entities (digital health technologies) can be held accountable in order to bridge the responsibility gap (Tigard 2021b; Bunnell and Rowe 2023) |

**Table 1** (continued)

| Responsibility[a] | Physician | Patient | Nurse and (informal) caregiver | Technology |
|---|---|---|---|---|
| Collective[b] (n = 3) | Collective responsibility among physicians and healthcare organizations for patient safety when working with AI technologies (Habli et al. 2020; Nichol et al. 2023) | Collective responsibility for creating an environment that supports the individual patient in their health management with the use of digital health technologies (Chiapperino and Testa 2016; Santaló and Berdasco 2022) | – | – |

[a] Several articles describe multiple responsibility aspects. Consequently, the total number of articles listed in this column exceeds the 34 articles included in this review

[b] We identified one additional aspect of responsibility from the literature which was not included in Vincent's (2011) framework, namely 'collective responsibility'

taking control over and responsibility for one's health". In addition, patients are attributed with role responsibility for the quality of these measurements (Lucivero and Jongsma 2018). This shift in role responsibility is closely related to the concept of patient 'responsibilization', which describes the phenomenon that patients take on tasks which have previously been the sole responsibility of physicians or nurses (Lupton 2013a; Lucivero and Jongsma 2018; Jongsma et al. 2021). The literature indicates that patient responsibilization is not necessarily the same as patient empowerment. For example, Jongsma et al. (2021) note that patients may feel relieved when they share the responsibilities of measuring and transmitting data with healthcare practitioners.

### Nurses' and informal caregivers' role responsibilities in medical decision-making

The literature demonstrates that digital health technologies increase nurses' and informal caregivers' role responsibilities regarding medical decision-making (Kamp and Hansen 2019; Nickelsen 2019; Jongsma et al. 2021). In particular, telemonitoring is described as increasing the role responsibility of nurses as the 'first signaler', especially when there is a physical distance between nurse and physician which limits options for ad hoc feedback and support in decision-making (Nickelsen 2019). This leads to a shifting of role responsibilities from physicians to nurses (Nickelsen 2019). For instance, a Dutch telemonitoring program for high-risk pregnant women indicated that nurses are found to be increasingly responsible for making decisions about additional testing, the frequency of clinical visits, and hospitalization (Jongsma et al. 2021). The reviewed literature indicates that not all nurses feel adequately equipped for these new responsibilities, as they lack control over clinical follow-up. Despite this, nurses are held accountable for their new roles and are expected to fulfil these obligations (Jongsma et al. 2021). Similar to nurses, informal caregivers also perceive an increase in role responsibility, feeling that supervising measurements and logging data is an additional commitment. This was found by Gross et al. (2021) in a case study on m-Health tools for dementia care, who observed a contradiction between the increasing role responsibilities for informal caregivers on the one hand, and feeling empowered and supported by these tools on the other.

### AI technologies' role responsibility in medical decision-making

The literature depicts another shift in role responsibilities, namely, towards the digital health technologies themselves. Especially AI-related technologies, such as AI-DSS, are described to have role responsibilities regarding the provision of diagnostic support and treatment recommendations
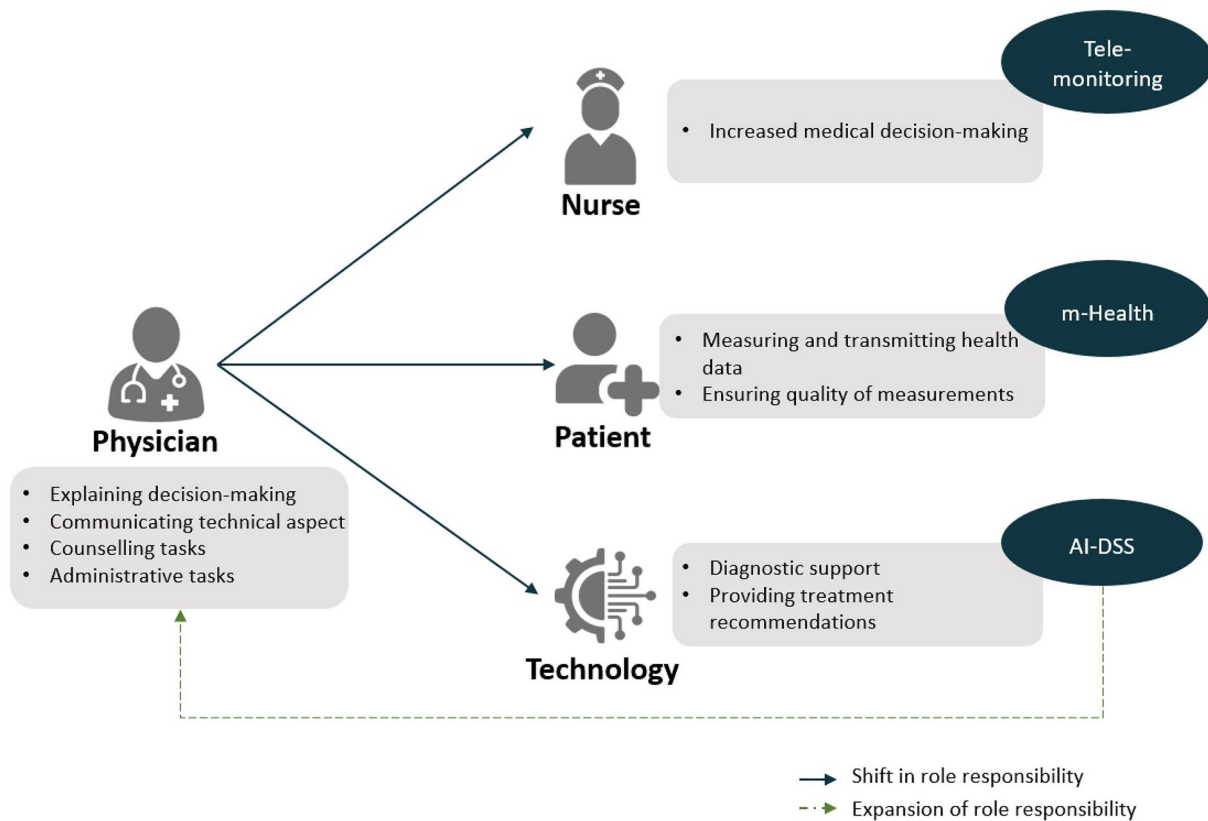
**Fig. 4** Shifts in and expansion of role responsibilities due to the implementation of digital health technologies

(Braun et al. 2020). These roles transpose from the domain of physicians towards the technologies. However, it is stated that these growing role responsibilities of AI technologies cannot result in accountability for the outcomes they produce. According to Braun et al. (2020), the oversight and management of AI should stay in human hands because technologies are not regarded to be moral entities. The question whether technology can be held accountable seems to transcend the responsibility framework of Vincent and the OECD's definition of accountability, which focusses on individuals and organizational entities (OECD 2023). This shows that the literature here brings up another research question: whether AI can be held accountable for its new roles (Tigard 2021b; Bunnell and Rowe 2023).

## Accountability claims towards physicians and patients

In answer to our second research question—who bears what kind of responsibility in the context of digital health technologies—we found that responsible use of digital health technologies is often equated with 'accountability', which was mostly discussed in relation to physicians and patients. Several authors, such as Verdicchio and Perin (2022, p. 6), define responsibility implicitly as accountability: "The

'responsible' agent is the one suitable to be 'motivated' by moral (…) rules of conduct and, therefore, they are possible recipient of sanction". The reviewed literature depicts two major accountability claims: first, towards physicians in the context of AI technologies (Verdicchio and Perin 2022; Durán and Jongsma 2021) and second, towards patients using wearables and mobile applications (Lucivero and Jongsma 2018; Martani et al. 2019; Davies 2021). Only a few articles discuss accountability claims towards nurses and technologies, and these were mentioned in Sects. "Nurses' and informal caregivers' role responsibilities in medical decision-making" and "AI technologies' role responsibility in medical decision-making", so they will not be elaborated on here. The following sections describe the accountability claims towards physicians and patients.

### Medical AI and the difficulty of attributing accountability to physicians

The reviewed literature demonstrates that, especially in the context of using AI-DSS, physicians are frequently held accountable for the risks and errors associated with the AI systems. However, this accountability claim towards physicians comes with two fundamental issues related to 'capacity

responsibility' and 'outcome responsibility', which may result in a responsibility gap.

First, the reviewed literature discusses physicians' limited capacity to understand how AI technologies generate an outcome. According to Svensson and Jotterand (2022), the general capacities of physicians (such as their unique medical knowledge, expertise, experience, and epistemic judgment) impose a duty on physicians to remain accountable when working with AI. Several authors argue that human oversight is necessary due to the inherent limitations of AI technologies (Durán and Jongsma 2021; Tigard 2021b; Verdicchio and Perin 2022). However, this is complicated by the 'black box problem' of AI systems—which refers to the opacity of how AI generates outcomes— making it challenging for physicians to fully understand how these systems work (Grote and Berens 2020; Habli et al. 2020; Carter et al. 2020; Tigard 2021a; Lucivero and Jongsma 2018; Martani et al. 2019). Hence, this line of reasoning suggests that physicians cannot be deemed fully 'capacity responsible' and, consequently, this complicates physicians' accountability for AI-generated outcomes (Habli et al. 2020; Grote and Berens 2020). It is described by Grote and Berens (2020) that without the necessary capacity to understand AI algorithms, placing such accountability on physicians may foster epistemic vices, such as gullibility or dogmatism in relying on AI outcomes to "minimize their risks of being blamed for medical maltreatment" (p. 208).

The second difficulty described in the reviewed literature regarding physicians' accountability is the 'many hands problem', which highlights the challenge of assigning accountability in situations involving numerous contributors.[2] The 'many-hands problem' is particularly relevant to digital health technologies because of the large number of stakeholders involved and their interdependencies in the development, implementation, and usage of these technologies (Bleher and Braun 2022; Verdicchio and Perin 2022). Specifically, it is described as a key concern for distributing accountability between the AI developer and the physician (Bleher and Braun 2022; Verdicchio and Perin 2022). For example, Nichol et al. (2023) describe developers as 'capacity responsible' by having the technical expertise for the AI-DSS they create, while physicians are held 'outcome responsible', because they are the final medical decision-makers. Consequently, this creates ambiguity in accountability claims because the conditions for being accountable—namely, having capacity and thereby outcome responsibility—are assigned to different actors.

These two issues may result in a 'responsibility gap',[3] where no one can be individually held accountable (Boers et al. 2020; Grote and Berens 2020; Habli et al. 2020; Tigard 2021b; Bleher and Braun 2022). In the reviewed literature, we encountered this responsibility gap particularly in terms of attributing accountability. The concerns about the emergence of such an accountability gap, might be explained by an overly narrow focus on individuals (Grote and Berens 2020). The majority of the reviewed articles approach responsibility at an individual level, while three articles advocate for a collective perspective. They define responsibility, and in particular accountability, as something that is distributed within a collective (Habli et al. 2020; Nichol et al. 2023; Chiapperino and Testa 2016). However, achieving joint accountability is challenging due to potential conflicts in moral values between stakeholders at different levels, such as between employees and employers. As Habli et al. (2020, p.253) note, "one of the important current debates in patient safety is how to balance accountability across individual clinicians and the organization they work in".

## Wearables and mobile applications place accountability on patients

Accountability is also attributed towards patients. This growing emphasis on patients' accountability for their own health management is linked to the current political debate concerning healthcare rationing (Martani et al. 2019; Kamp and Hansen 2019; Felt et al. 2022). In particular, m-Health technologies like wearables and apps can increase patients' role responsibility for controlling and managing their disease as well as for taking preventive actions to safeguard their health (see Sect. "Responsibilization of patients with medical tasks"), which leads to accountability claims (Martani et al. 2019; Davies 2021; Lupton 2013a; Bødker and Nielsen 2015; Lucivero and Jongsma 2018). An example is given by Martani et al. (2019) who discuss a mobile application for patients with type II diabetes which enables patients to track their food intake and exercise habits. This mobile application is described to create expectations towards patients to manage their disease by providing real-time data for continuous insulin level monitoring; eventually, patients might be held accountable for the deterioration of their health state (Martani, et al. 2019). Such an accountability claim, however, comes with two issues regarding 'causal responsibility' and 'capacity responsibility'.

First, accountability claims towards patients are problematic because it is often difficult to assign causality between behaviour and unfavourable health consequences (Martani, et al. 2019; Santaló and Berdasco 2022). In the example of Martani et al. (2019), patients can digitally track their eating and exercise habits, however, it is impossible to single out

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[2] The 'many hands problem' has been described by Dixon-Woods and Pronovost (2016).

[3] The responsibility gap was first described by Matthias (2004).

these habits as sole contributing factors to their health state (Martani et al. 2019). Second, these new monitoring and tracking tasks rely on patients' capacity to interpret data and achieve predetermined targets. For instance, type II diabetes patients must have the capacity to understand and act upon the specific insulin level displayed by the mobile application, and this capacity can vary significantly from one individual to another (Davies 2021; Martani et al. 2019). Subsequently, multiple articles state that reliance on these capacities may lead to discrimination against disadvantaged groups that lack the necessary skills or environment to fulfil these new m-Health tasks, thus exacerbating structural and epistemic disparities (Jansky et al. 2023; Kreitmair 2023; Martani et al. 2019; Santaló and Berdasco 2022). Despite Vincent's focus on individual cognitive capacities, the reviewed literature shows that capacity responsibility also includes environmental factors such as the access to healthy food and the presence of (digital) health role models (Santaló and Berdasco 2022; Kreitmair 2023; Chiapperino and Testa 2016). This reminds of the idea of 'collective responsibility' mentioned in 3.2.1, but in this case for creating an environment that supports the individual patient in using digital health technologies to manage their health.

## Discussion

This scoping review demonstrates that the use of digital health technologies leads to a general expansion and shift in role responsibilities among physicians, patients, nurses, informal caregivers and technologies. Furthermore, we show that responsibility is primarily interpreted as accountability, with physicians being held accountable for AI-generated outcomes and patients being increasingly held accountable for their health when using m-Health technologies. Before reflecting on these findings we note that our review was not without limitations. Firstly, digital health technologies come in many shapes and sizes (telemonitoring, e-Health, m-Health, personalized medicine, big data, etc.) and this heterogeneity could affect the generalizability of our results. Secondly, to achieve a narrow search string, the authors focused on moral responsibility and its synonyms. This may have resulted in the exclusion of literature that discusses digital health technologies and responsibility without explicitly mentioning responsibility in their title or abstract (Sharon 2017; Fotopoulou & O'Riordan 2017; Sanders 2017; Ajana 2017; Lupton 2014). Thirdly, most of the literature on responsibility in the context of digital health technologies is theoretical. Therefore, it is important to conduct further research on the perceived responsibilities of various actors using real-world examples. Fourthly, most of the studies included in this review originate from European countries, with several articles from Denmark, Germany

and the Netherlands. This may be due to several factors, such as database usage, terminology and the language in which articles are published. However, it might also indicate a lack of ethical research on digital health technologies in other regions with a different healthcare system. Finally, our synthesis does not differentiate between interpretations of responsibility from empirical and theoretical articles. However, while we acknowledge the ongoing debates between argument-based and empirical ethics, this distinction seemed less critical for our analysis because both types of articles interpreted responsibility aspects in a similar way. Hereafter, we first discuss the practical implications of our findings and then reflect on the theoretical contribution to debates about moral responsibility in digital health.

## Implications for practice: new role responsibilities and top-down accountability claims hamper appropriate use of digital health technologies

This review indicates that the concept of responsibility is broadly used in the context of using digital health technologies without awareness of its pluralistic meaning. Especially accountability claims often fall short of justification and lack deeper exploration of the underlying role responsibilities. This poses a threat to the appropriate implementation and use of digital health technologies, which is in contrast to the promises of firstly, empowering patients and secondly, reducing workload for healthcare practitioners.

First, patients are described to often be responsibilized rather than empowered. The risk of 'patient responsibilization' with m-Health technologies, where accountability largely shifts towards the patient, was a prominent theme in the literature. Here, it becomes evident that top-down accountability claims towards patients for their ill-health ignore underlying structural factors, such as education opportunities and social environment, and that this could further widen disparities. In addition to these structural issues mentioned in the reviewed literature, we find it should be recognized that some patients favour a paternalistic approach and desire a more authoritative position for healthcare personnel (Rosenbaum 2015), and that neglecting patient preferences may threaten the ethical implementation and use of digital health technologies.

Second, regarding the impact on healthcare practitioners, we highlighted how the literature raises concerns about the increased role responsibilities and accountability. While physicians' role responsibilities and accountability are described mostly for AI technologies, our findings might be applicable to other technologies too; however, there currently is limited literature providing further insight. Moreover, it remains unclear whether physicians are capable or comfortable to carry these new duties, and as such, whether it is appropriate to extend physicians' role responsibilities while also

holding them accountable for AI-generated outcomes that they cannot control or explain due to the 'black-box problem' (Wadden 2022). Placing accountability on physicians in such a top-down manner may also make them reluctant to use AI technologies. Similarly, the new role responsibilities and accompanying accountability claims made towards nurses, particularly in the context of telemonitoring, are problematic if nurses are not adequately supported to fulfil this new role. However, we encountered a lack of literature on nurses' experiences so we recommend further empirical research to gauge their perspectives. Further research on healthcare practitioners' role responsibilities and accountability could also inform the development of specific training or education.

In general, to ensure that patients' and healthcare practitioners' accountability claims do not hamper the appropriate use of digital health technology, the various responsibility aspects need to be delineated and evaluated systematically. This should involve exploration of how these claims are established and whether or not they are justified. A noteworthy first step is an 'annual performance review' tool for AI technologies developed by the University of Utrecht (2024), that requires the end-users to outline, among others, who has what kind of responsibilities regarding the AI system's outcomes. We suggest that such initiatives could use the responsibility framework of Vincent, with the incorporation of the additional elements we propose in 4.2, that covers the pluralistic meaning of this concept. We think that utilizing such a framework prevents the establishment of ambiguous responsibility claims since it compels those using digital health technology to clarify what is meant when using the term 'responsible'.

## Implications for theory: existing responsibility frameworks need to be expanded

This review employed Vincent's (2011) responsibility taxonomy as an analytical framework, but the reviewed literature showed that even this pluralistic and interrelational taxonomy falls short of comprehending the diverse aspects of responsibility for using digital health technologies. We identified three ways in which the responsibility framework could be broadened.

First, we suggest incorporating 'collective responsibility' to Vincent's (2011) individualized responsibility framework (Fig. 5). The framing of responsibility as something applicable to individuals only, particularly in the context of using m-Health technology, separates health from its broader social, political and cultural components (Sharon 2017; Fotopoulou & O'Riordan 2017; Sanders 2017; Ajana 2017; Lupton 2014). This may result in unfairly holding individuals accountable to take on the responsibility for their own health (Sharon 2017). Moreover, this review described that
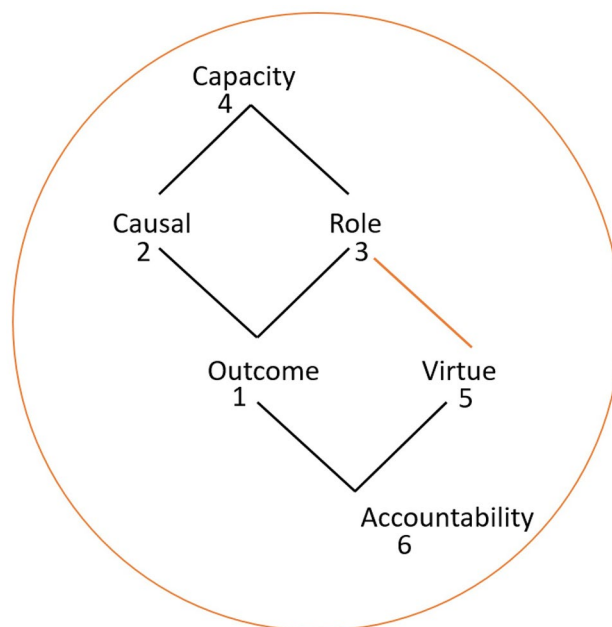


**Fig. 5** Expansion of the existing responsibility framework by Vincent (2011)

AI-generated outcomes lead to the emergence of a responsibility gap in terms of accountability. The responsibility gap, first described by Matthias (2004), refers to situations where the introduction of autonomous intelligent machines leads to outcomes for which no one can be individually held responsible. Several authors in the philosophical literature suggest that a collective approach, whereby responsibility is shared between developers, institutions and caregivers, might be a solution to this gap, at least conceptually (Lang et al. 2023, Nyholm 2023). However, it remains unclear how to ensure in practice that everyone equally accepts their responsibility. This difficulty is acknowledged by Ziosi et al. (2023) who discuss the challenges of translating collective accountability into clear legal norms, for instance in the AI liability directive, and that this requires further legal study. Moreover, further thought is needed on who should be included in the collective; while the reviewed literature focused on care professionals, patients, and developers, there are also stakeholders in the broader collective (e.g. ethicists, data protection officers, hospital directors, policy makers, etc.) who we suggest might bear at least some of the responsibility for good use of digital health technology.

Second, we signal a need for further exploration on whether *artificial entities* can be responsible actors. Vincent's (2011) responsibility framework and the OECD definition of accountability apply to humans rather than artificial entities, making it difficult to assign accountability for AI-generated outcomes that are not explainable. This topic is discussed in the philosophical literature by authors such as

Tigard (2021a), Kiener (2022), Verdicchio & Perin (2022), and Wallach & Allen (2008). While this general philosophical discussion is beyond the scope of this review, we believe that further ethical and legal research into the responsibilities of autonomous technologies is essential, particularly in the context of digital health technologies.

Third, we find that more emphasis is needed on *virtue responsibility,* which is barely described in the reviewed literature, and if it is, only as a result rather than as a condition of accountability. According to Susan Wolf "to be responsible, in this sense, is to possess a virtue, or at least a virtue-like trait".[4] Even though the literature depicts major accountability claims, no arguments related to the corresponding virtues of actors interacting with technologies are given to substantiate these claims. A similar omission is seen with talks of 'trustworthy AI' where the virtues of trustworthy persons or entities are not discussed. In recent years, there has been a growing focus on the importance of virtues in discussions about bioethics (Beauchamp and Childress 2001, Susan Wolf 2024, Garcia 2020). In particular, Garcia (2020) argues that virtue ethics is a fundamental aspect of normative ethical theory and that virtues are essential for fulfilling one's role in relationships. In this approach, virtue ethics might be a valuable conceptual link, which is currently missing in Vincent's (2011) framework, to consider what virtues are necessary to fulfil one's role responsibility and which ones are not. Therefore, we propose to extend the existing responsibility framework by Vincent, to include this conceptual link between role responsibility and virtues (Fig. 5). One pitfall, however, is given by Wieczorek and Rossmaier (2023) who highlight that the introduction of m-Health technologies is causing healthiness to (unjustly) be framed as a virtue. Further discussion on virtue is necessary to better understand what 'responsible use of digital health' entails. This requires empirical ethics research to identify the virtues (and vices) of physicians, patients, and nurses in their interaction with digital health technologies.

## Conclusion

The notion of 'responsible digital health' is often used without further justification, leading to ambiguities and misunderstandings in healthcare practice. In this review, we have described the various interpretations of how responsibility is defined in the context of using and implementing digital health technologies. Our review demonstrates that digital health technologies give (in)formal caregivers and patients more and new role responsibilities. Furthermore, this analysis reveals that responsibility is often equated with accountability towards physicians and patients, without clear justification. These findings appear to contradict the goals promoted by the deployment of digital health technologies, such as improving efficiency, decreasing workload and empowering patients. The results emphasize that it is important to clarify who is responsible for what and provide reasons for why certain responsibilities are assigned. Better understanding of the concept of responsibility would lead to more appropriate policies regarding good use of digital technology in healthcare.

## Declarations

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