Chapter 10
Nudging to Change, the Role of Digital Health

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Abstract The use of nudges, i.e., design changes in the way choices are presented to steer users towards predetermined choices, has dramatically increased over the last few years. These interventions have moved online to become digital and are present across many fields from politics to healthcare. As the use of these mechanisms in healthcare has grown exponentially recently, it is crucial to understand the opportunities they offer and the risks they pose. However, at this stage, such an analysis is lacking. This chapter specifically addresses this issue by (1) analyzing how digital nudges can be applied in the continuum of care and (2) mapping the current empirical research landscape on the topic. To do so, this chapter presents a scoping review of the literature by searching relevant research in the electronic database of JMIR (Journal of Medical Internet Research). The search yielded 150 unique articles, of which 19 articles satisfied the criteria for inclusion in this study. The results indicate that feedback and reminders are the most commonly used digital nudges for behavior change in digital health. Moreover, the results show that most digital nudges research focuses on prevention and the post-acute phase of the continuum of care, with none of the studies investigating nudges for the acute phase. Finally, the results indicate that current empirical research on digital nudging in healthcare rarely discusses ethical considerations.

Keywords Digital Health · Digital Nudging · Nudging · Continuum of care Ethics of nudging · Scoping review

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10.1 Introduction

Most diseases can be prevented by assisting people to change their habitual risky behaviors (Kelly 2000). A variety of risky behaviors are negatively associated with health, including being sedentary (Bakker et al. 2021), smoking (Wang et al. 2021), eating unhealthy foods (Marucci et al. 2021), and binge-drinking (Åberg et al. 2017). If people change their health risk behavior, they can reduce their risk of developing diseases that cause premature sickness and death, like cancer and heart disease (Kelly 2000). A case in point would be that millions of premature deaths are preventable if individuals stop smoking cigarettes, which not only cause lung cancer (Sasco et al. 2004) but also increase the risk of pulmonary and cardiovascular diseases (Stallones 2015).

Historically, interventions to change risky health behaviors were offered in service settings or within communities, but today, this is no longer the only way to do so. Through the IT infrastructure that has been developed with data from patients and service providers (Shah and Adusumalli 2020), research and practice in digital health have become more relevant to clinical needs. Through continuous, real-time, and objective measurements of physiological parameters and motion activity, it has become possible to change risky behaviors through digital interventions. However, this is a challenging task as it requires combining evidence-based approaches with trust in technology while respecting patient autonomy and consent.

A potential behavioral theory that could be leveraged to address this issue is nudge theory (Sunstein and Thaler 2008). Behavioral economists have proposed the idea of nudging, which uses human cognitive processes to direct people towards the desired behavior without restricting user choice (Sunstein and Thaler 2008). This theory is gaining traction in the digital health context as researchers have started to apply it to different contexts such as mental health (Okeke et al. 2018), smoking cessation (Free et al. 2011), weight management (Valle et al. 2020), medicine adherence (Angellotti et al. 2019), and digital well-being (Purohit and Holzer 2021) to name a few. Despite these examples, there is currently no unified picture of how digital nudges are used in healthcare and where the state of research stands. In this chapter, we address this issue by mapping the landscape of digital nudging for healthcare. In particular, the chapter will summarize which specific health behaviors are targeted, which nudging techniques have been employed for behavior change and how these strategies have been delivered including their ethical implications. In an examination of the nudging landscape in digital health, two main research questions will be addressed:

- RQ1: What kind of digital nudge strategies can be leveraged to improve health?
- RQ2: How can digital nudge strategies be used to support behaviour change on the continuum of care?

The remainder of this chapter is structured as follows. First, the background provides a definition of “nudging” and “digital nudging” in the context of behavior

change. Second, existing digital nudging strategies are detailed and their employment in continuum of care is illustrated. Third, the current state of the literature is discussed through a scoping review of the JMIR electronic database. Finally, the chapter wraps up with a conclusion.

10.2 Background

Originally, Sunstein and Thaler (2008) suggested that policymakers can design nudges to promote change in behavior among citizens. They defined a nudge as "any aspect of the architecture of choice that changes people's behavior in a way predictable without prohibiting all options or significantly changing their incentives" (Sunstein and Thaler 2008). To modify behavior, nudges change how we see things and make people more receptive to one option (Levy 2017). A typical example is the way products are displayed in cafeteria, the more prominent, the greater the chance a customer will select them (Sunstein and Thaler 2008). Meanwhile, researchers and practitioners have taken the nudging concept online, resulting in so-called digital nudges. The term digital nudges refer to nudges that are provided through digital technology and employ user-interface design elements to influence people's decisions and behaviors (Weinmann et al. 2016), again without restricting choice (Jesse and Jannach 2021). For instance, intuitively reminding individuals by giving them feedback about their Instagram use while they are mindlessly scrolling through their Instagram news feed can help them reduce their consumption (Purohit and Holzer 2021). Especially, digital nudges delivered via mobile devices are becoming increasingly common. As a result of recent technological advancements, mobile phones have acquired new and distinctive characteristics that make them a compelling behaviour change support system. These characteristics include (1) their ability to gather contextual and bio-metric data from users, such as location, movement, or heart rate, (2) their ability to be reached by users at anytime as they carry their phones around almost 24/7, and (3) their ability to potentially reach their users any time through notifications.

These characteristics imply that delivery of digital nudges can be much more fine tuned than traditional nudges to fit optimal timing (Purohit and Holzer 2019). More precisely, through adequate identification of user context, nudges can take advantage of so-called *teachable moments* (Purohit and Holzer 2019) i.e., "naturally occurring health events thought to motivate individuals to adopt risk-reducing health behaviours spontaneously." For example, a woman might benefit from a smoking cessation intervention during the perinatal period (Ockene et al. 2002). In an attempt to motivate incremental dietary behaviour change, Intille et al. (2003) suggested that information should be provided on a PDA (personal digital assistant) at the time of purchase (the nudge moment). Another study examined how weight loss could be achieved by altering eating behavior in obese adolescents (Ford et al.

2010). The study indicated that real-time feedback was given to the participants during meals (the nudge moment) to help them eat more slowly. It should be noted that despite these examples, of "just-in-time" technology, most other studies do not address digital nudges explicitly with timing.

10.3 Digital Nudging Strategies

This section outlines different strategies of digital nudging used to influence human behavior exemplified in the context of digital health. The digital nudges outlined here have been adopted from Caraban et al. (2019), they are: defaults, reminders, feedback, social, framing, suggesting alternatives, and positioning. Several nudges such as hiding, scarcity, and deceptive visualisations and many others are not included as they do not fall within the scope of healthcare.

In addition to different digital nudging strategies and examples from healthcare research, we also present scenarios that illustrate how clinicians and designers might apply digital nudges in healthcare. Consider James. He is overweight and sedentary. Through the app store, James has downloaded an application called *Fitness* to his smartwatch that will help him increase physical activity and manage his weight.

10.3.1 Default Nudge

A default nudge occurs whenever there is a predefined option chosen by a system designer. A prime example of default is the initial organ donation status of a person in a country, i.e., their default status. In some countries, people are organ donors by default and they have to actively opt out, whereas in other countries, people are not organ donors by default and they have to actively opt in. The status quo bias of human psychology is such that people will tend not to change default settings. As a result, the number of people on the organ donor list increased by 60% in the countries where it is the default option compared to the national average of 38% (Thaler et al. 2014) in the countries where it is not. On top of the status quo bias, defaults produce such large effects because individuals do not have explicit preferences for every possible good or service offered (Van Dalen and Henkens 2014). For instance, If individuals are assigned permanent appointments by default, assuming they have consented beforehand, they are more likely to have a flu vaccine appointment, thus increasing the possibility of being vaccinated (Lehmann et al. 2016). Figure 10.1 illustrates a default nudge.

10.3.2 Reminder Nudge

A reminder nudge is a nudge that brings a choice to the user's attention. With the ubiquity of mobile phones, this nudge can typically be delivered through a visual, sound, or haptic cue to a user (e.g., a push notification). Most of the time, people have a lot on their minds, and they may forget to start an activity (Karlsen and Andersen 2019), become preoccupied, or simply put it off. A reminder can act as a helpful digital nudge to help them follow through with a certain behavior. For instance, text messages sent by the clinician to remind or alert patients to read relevant health resources or to perform an activity. Figure 10.2 illustrates a reminder nudge.

Fig. 10.1 Default nudge on the Fitness app. The app's log in page requires users to agree with the terms and conditions, but they are free to choose to subscribe to the newsletter or not. However, as James logs into the application, the subscription option is ticked by default in order to steer his behaviour towards simply leaving it as is and subscribing to the newsletter

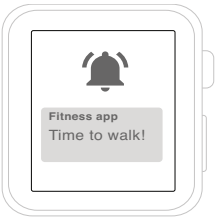

Fig. 10.2 Reminder nudge on the Fitness app. The sensors in the watch recognize that James is sitting idle for some time. While James sits on the couch watching TV, a notification is sent to his watch to make it vibrate and displays a message to steer him towards doing some physical activity

10.3.3 Feedback Nudge

Feedback nudges aim to inform users about their performance on some task in order to raise their awareness and potentially rectify a misconception a user has about their problematic behavior by presenting evidence that their behavior is inconsistent with what is actually deemed acceptable (Clayton Neighbors et al. 2015). For instance, to motivate an individual, a feedback nudge can be utilized to provide feedback on goals achieved by the end of the day, or the total number of steps taken during a certain period. Moreover, a feedback nudge can be tailored/personalized to an individual to solve the problem of heterogeneity, i.e., individuals' behaviors differ despite being nudged in the same way. Figure 10.3 illustrates a feedback nudge.

10.3.4 Social Nudge

A social nudge is a nudge that informs individuals about what other people are doing. This is also known as a peer comparison nudge. Nudges of this type aim to establish social norms that users will be motivated to follow (Arigo and Suls 2018). For instance, a user could receive the following message on their app "Approximately half of your co-workers walk at least 10,000 steps per day. And you?" Figure 10.4 illustrates a social nudge.

10.3.5 Framing Nudge

The way information is presented affects the way people make decisions (Tversky and Kahneman 1985), and framing is the deliberate phrasing to encourage the target behaviour. A good example is the fact that people respond differently to information presented as a loss or a gain. Consider the following framing example: "If skin cancer is detected early, it can be treated before it becomes life-threatening" stresses

Fig. 10.3 Feedback nudge on the Fitness app. The sensors in the watch record James' physical activity using the accelerometer and GPS. James' steps are recorded whenever he moves. To further motivate James, the health application provides James with feedback on his weekly move goal. The presentation of the feedback makes it easier for James to track his performance

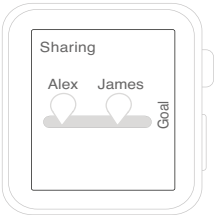

Fig. 10.4 Social nudge on the Fitness app. The app provides a peer comparison feature. James can invite his friends and compete against them. Whenever James exercises, the watch records the activity via its sensors. It then informs him about how well or poor he is doing in comparison to his friend Alex to motivate him to follow through on his exercise goals

Fig. 10.5 Framing nudge on the Fitness app. The app features a Q&A section that answers question related to health. When James visits the Q&A section within the app, he is presented with various questions and related answers that are framed as a loss or a gain. To encourage James to increase his physical activity the answer to why walking is important is framed positively

more on benefits while "if skin cancer is not detected early, it cannot be possibly treated before it becomes life-threatening" stresses more on costs. Figure 10.5 illustrates a framing nudge.

10.3.6 Suggesting Alternatives Nudge

This nudging strategy aims at providing individuals, about to make a decision, with alternatives that they might not have considered at this point (Forwood et al. 2015). For instance, to reduce the antibiotic over prescription, patients/clinicians could be suggested alternatives to antibiotics medication at the time decision is to be taken. Likewise, an individual who is mindlessly switching between social media apps could be given alternative tasks to complete: Take a walk. Figure 10.6 illustrates a suggesting alternatives nudge.

Fig. 10.6 Suggesting alternatives nudge on the Fitness app. As a means to motivate James and support him in his decision-making, the health app offers James a variety of activities to improve his health each morning that he may not have thought of before. Moreover, the options have been ordered to favor the first three options visible on the screen (example of a positioning nudge)

10.3.7 Positioning Nudge

Positioning nudges tap into the status-quo bias by changing the way the options are presented visually (Caraban et al. 2019). Intuitively, options that are more salient, will be chosen more often than options that are less salient. In the extreme, system designer can hide certain options to make users less likely to select them. For instance, re-positioning the food choices to make nutritious food more prominent in a physical setting can increase their sales (Ensaff et al. 2015). In the digital context, Wyse et al. positioned nutritious food at the top of the list on the food ordering web-platform, resulting in an increased selection of nutritious food (Wyse et al. 2021a). Figure 10.6 also illustrates how positioning of physical activity options can assist James in being more active.

10.4 Digital Nudges in the Continuum of Care

In medicine, continuum of care is the provision of health care over time. The term refers to all the phases of a patient's illness, from before the diagnosis to the end of life. The continuum of care can be split in five general phases: prevention, pre-acute, acute, post-acute and chronic home-care (Cohen et al. 2020; Spring et al. 2020). Below, readers are provided with an overview of what it means for digital nudges to be used in digital health and how they can be leveraged to address each aspect of the health care continuum (Fig. 10.7).

10.4.1 Prevention

In the prevention phase the goal is to employ digital nudge interventions before the onset of a disorder and discourage risky health behaviours and prevent individual risk factors for a certain medical condition. The following study presents a case in

Fig. 10.7 Continuum of care

point, Milkman et al. employed text-based nudges delivered on a phone that used a framing nudge to boost vaccine adoption, i.e., to prevent influenza (Milkman et al. 2021). The application of framing led to increase in influenza vaccination rate by 5% when individuals were reminded twice to get their flu shot and were also informed that their vaccination appointment was already booked. Within the prevention phase of patient care, digital nudges are generally used to target individuals toward increasing behavior such as physical activity, food intake.

10.4.2 Pre-Acute Care

The pre-acute phase encompasses the time when a patient starts to experience a deteriorating health condition and starts self-monitoring. Patients with a progressing health condition following the prevention phase receive pre-acute care that often includes services such as health screening, lifestyle behavioural modification (healthy living) and disease risk reduction. One among many case in point for pre-acute care are digital interventions such as feedback and reminders to improve dietary intake and physical activity behaviour. To illustrate, Xu et al. employed feedback nudges to improve dietary behaviour and increase physical activity for the patients who were at high risk for type 2 diabetes (Xu et al. 2020).

10.4.3 Acute Care

The acute phase starts with medical diagnostic by medical professional and treatment. Following the prevention phase, patients with potentially unstable health condition then receive acute care that often includes services such as the provision of urgent, targeted, primary care or hospital-based care. An example of the area where acute care and chronic care is crucial for recovery is motor training for individuals affected by stroke (Krakauer and Cortés 2018). The game-based digital therapy supports user motivation. The goal of gamification is to use game mechanics such as competition, awards, and timely feedback to motivate and reward players. These elements of the game such as feedback, rewards and social comparison are in fact digital nudges integrated into the game mechanics. For instance, Perez-Marcos et al. employed gamification-based games for functional training of upper limb after brain damage (Perez-Marcos et al. 2017). Also, it has been proposed that immersive

VR therapy based on gamification can be beneficial in treating balance problems associated with chronic ischemic stroke (Cortés-Pérez et al. 2020). Moreover, digital nudges are also employed for clinicians in acute phase. One classic example is by Boillat et al. to prevent the human error-related complications in operating rooms. They proposed smart glasses to overcome the challenge where surgeons in an operating room have to rely on a poster or paper to complete a time-out checklist that takes place before the surgery (Boillat et al. 2019). There was a 100% completion rate with an 18% decrease in the average checklist duration, demonstrating the efficacy of reminders digital nudge in reducing patient complications from surgery.

10.4.4 Post-Acute Care

Patients with stabilized conditions following acute hospitalization receive later care services such as nursing care, monitoring, drug administration, rehabilitation, health education and residential care (Wang et al. 2019). The employment of various digital nudges in post-acute care phase has shown some promise. For instance, elderly patients who recently suffered a heart attack were significantly motivated to become more physically active with loss-framed incentives and personalized goals using a wearable device (Chokshi et al. 2018). In context of residential care, medicine adherence is one of many self-management behaviors in which digital nudges are being employed. In a recent clinical study, Horne et al. identified the medicine adherence barriers using proprietary recursive machine learning algorithms (Horne et al. 2022). Based on augmented intelligence, digital nudges were formulated on the content, frequency, timing, delivery method, and feedback metric. These digital nudges were distributed via computer-generated emails, SMS messages, and interactive voice response phone calls. A 12-month randomized controlled trial indicated that the participants in the nudge group adhered to their medicine significantly more than the participants in the control group.

10.4.5 Ethical Considerations

As illustrated above, digital nudging in the health context seems to have promising applications, as it could potentially steer behaviour in a very cost-effective fashion. However, one important aspect to note is that most digital nudges such as feedback, social comparison, or reminders require a multitude of data. Therefore, it is important to put some attention on the ethics of digital nudging and how existing studies are taking care of it. As to ethics, Thaler proposed a set of design guidelines that should be used to design what he called nudges for good (Thaler 2018). Nudges should be (1) transparent, (2) easy to opt-out, and (3) designed with the wellbeing of the user in mind (Gold et al. 2020; Sunstein and Thaler 2008). Transparency can be understood both as the goal of the nudge, which should not be deceitful or

obfuscated, but also as the mechanism of the nudge by which it operates (Purohit and Holzer 2021). This second aspect involves transparency about data usage and privacy. Opting out easily means that users should have the autonomy to follow the nudge or to decide not to follow it. However, individuals being nudged are often unaware of the nudge or the psychological mechanisms employed by the choice architect (Stuart Mills 2020; Reijula and Hertwig 2022). Lastly, the well-being of users should be the central focus for nudging and not the well-being of the designer (Purohit and Holzer 2021); however, even with the noblest intentions, who is to decide what is in the user's best interest? An ethical analysis of nudges is particularly important to mitigate potentially undesirable or harmful consequences through design changes.

10.5 Landscape of Digital Nudging in Digital Health

To better understand the current landscape of existing empirical research on digital nudges in the digital healthcare field, we performed a scoping review. The review also attempts to answer RQ1 and RQ2. This analysis is based on the three main grids of analysis presented above: digital nudging strategies, continuum of care and ethics of nudging. The inclusion criteria consisted of three main points: (1) the focus of the research had to be a digital intervention for behaviour change, (2) the intervention had to be evaluated empirically, and (3) the intervention had to target patients or healthcare professionals. A search for articles was conducted on the electronic database of JMIR (Journal of Medical Internet Research), which is the leading peer-reviewed journal for digital health and medicine. We searched for the term "nudging", "nudges" or "nudge" or "digital nudges" or "digital nudging" or "digital nudge" in the content of the articles.

The database search yielded a total of 150 articles, 131 articles were excluded based on not fulfilling inclusion criteria, resulting in 19 full-text articles for inclusion. The results in Fig. 10.8 seem to indicate that inclusion of digital nudging in digital health is increasing exponentially. For instance, the number of studies that include digital nudges have increased more than 160% since 2018. Among the 19 included studies, 30 nudges were used, as 7 studies employed two or more nudging techniques. In most of these 7 studies, nudging strategies were used in combination. The most common nudges used were feedback and reminders. Their application lied on prevention and post-acute care. Surprisingly, none of the studies investigated default nudges. Figure 10.9 provides a full overview of the analysis.

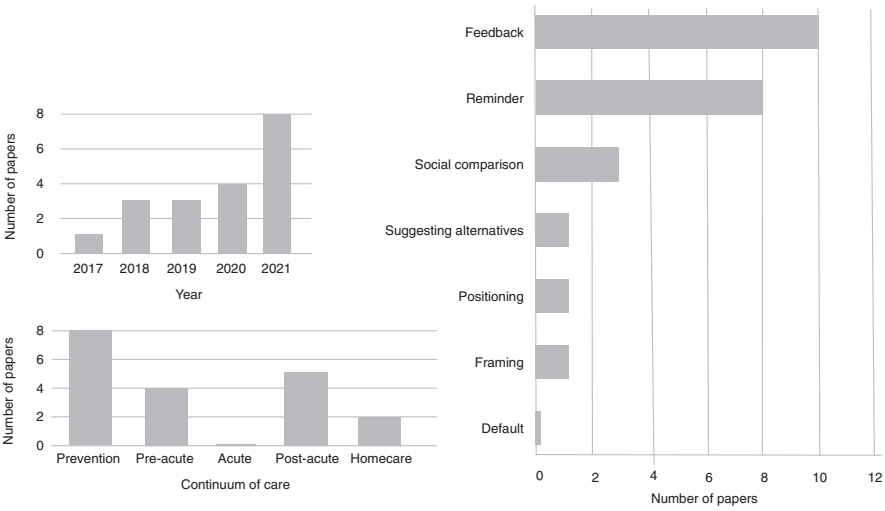

Fig. 10.8 Results of the scoping review

10.5.1 Increasing Desired Behaviour

The results of this review suggest that digital nudging can be applied to a wide variety of health objectives, i.e., from increasing the uptake of contraceptives in Africa to increasing treatment adherence to HIV treatment. It should be noted that most papers focus on increasing a desired behaviour (e.g., increase in vaccination rate, increase physical activity). Sometimes increasing a desired behaviour is coupled with a decrease in an unwanted behaviour, such as increasing activity is implicitly coupled with decreasing sedentary behaviour. Nevertheless, in the reviewed studies, nudges are not used to solely reduce an unwanted behaviour. This presents a potential opportunity for further investigation. There are several challenges in nudging patients away from an undesired behaviour, the first linked to the identification of such a behaviour (e.g., inferring when a smoker lights up a cigarette), and the second linked to providing adequate feedback on a negative behaviour (e.g., "you have not smoked today").

10.5.2 Personalized Mobile Feedback

In terms of nudging strategies, most research has focused on feedback nudges and reminders. Social comparison has also been investigated a few times, but the other strategies are only marginally studied (once in the reviewed papers). The rise of feedback nudges is not surprising given the wide adoption of smart devices such as wearable and smartphones, which allow tracking motion, steps, heart rate and other

Authors	Evaluation	Objective	Nudging strategy	Medium	Continuum of care	Transparent	Easy to opt-put	Wellbeing	Ethics discussed
André et al., (2021) [30]	RCT	Increase physical activity	SC		Prevention	✓	✓	✓	-
Azulay et al., (2019) [5]	RCT	Increase colonoscopy followup	R		Pre-acute	✓	X	✓	-
Belli et al., (2021) [7]	RCT	Improve Diabetes management	SC, SA		Post-acute	X	✓	✓	-
Bredbenner et al., (2017) [9]	RCT	Promote child growth	R		Prevention	X	✓	✓	-
Coorey et al., (2021) [13]	RCT	Improve cardiovascular disease management	F, R		Pre-acute	✓	✓	✓	-
Elnaggar et al., (2021) [15]	RCT	Motivating patients to sustain physical activity	F		Homecare	✓	✓	✓	-
Green et al., (2018) [21]	RCT	Increasing uptake of contraceptives	R		Prevention	✓	✓	✓	-
Manne et al., (2020) [31]	RCT	Improve sun protection behavior	F, SC		Prevention	✓	✓	✓	-
Neto et al., (2021) [36]	Longitudinal study	Promote optimal child growth	R		Prevention	✓	✓	✓	Yes
Nsagha et al., (2020) [37]	RCT	Increase treatment adherence to HIV treatment	R		Homecare	✓	X	✓	-
Orme et al., (2018) [40]	RCT	Reduction of sedentary behavior	F		Post-acute	✓	X	✓	-
Sankaran et al., (2019) [45]	Cross-over study	Motivate to achieve rehabilitation targets	P, R		Post-acute	✓	X	✓	-
Summers et al., (2021) [51]	Pre-post	Improving glycemic control and enabling weight loss	F		Homecare	✓	✓	✓	-
Suzuki et al., (2021) [53]	RCT	Increasing the willingness to take vaccine	FR		Prevention	X	X	✓	-
Signal et al., (2020) [58]	Cross-over study	Increase upper limb movement	F		Post-acute	✓	X	✓	-
Vandelanotte et al.., (2018) [60]	RCT	Increase physical activity	F		Prevention	X	X	✓	-
Whelan et al., (2019) [64]	RCT	Improve diabetes self-management	F		Pre-acute	✓	X	✓	-
Wyse et al., (2021) [66]	RCT	Increase intake of healthy food	PO, R, F		Prevention	✓	✓	✓	-
Xu et al., (2020) [67]	RCT	Improving dietary and physical behaviour	F		Pre-acute	✓	✓	✓	-

Fig. 10.9 Characteristics of the articles included in the review. Abbreviation of nudging strategies: F (Feedback), R (Reminders), SC (Social comparison), SA (Suggesting alternatives), PO (Positioning)

physiological metrics. Furthermore, these devices allow to easily reach users at any time (potentially an identified teachable moment) through push notifications, sounds or vibrations, which make them ideal delivery channels for reminder nudges. Moreover, this ubiquitous nature of devices has led to the use of digital nudges in the different phases of the continuum of care. For instance, from averting illness by

encouraging individuals to vaccinate in the prevention phase to using feedback nudging strategies to rehabilitate stroke patients in the post-acute phase. However there were no studies focused on acute care in the reviewed articles. This might not be surprising as this stage of the continuum of care is the most challenging to study empirically. Furthermore, in the acute phase, patients are potentially more passive than in other phases, and as such, nudges might have to focus on medical practitioners rather than patients. Future research could further investigate this phase, since nudge can present undeniable opportunities, as exemplified by the reminder nudge to improve checklist compliance during an event of surgery presented above (Boillat et al. 2019).

10.5.3 Ethical Nudging Boundaries

There is no denying that the omnipresence of connected devices can present opportunities for innovative and effective digital nudges along the continuum of care. However, there are ethical risks associated to these technologies in terms of privacy, autonomy, and consent. Understanding the amplitude of these risks requires in-depth analyses of the intervention design in their specific contexts, but the reviewed literature only rarely discuss these issues. Indeed, only 1 out of 19 studies conferred about ethical considerations while designing the intervention and others paid little or no attention to even explaining the mechanism and working of the nudge. The criteria of transparency work well with certain digital nudges such as feedback and reminders. For instance, provision of feedback to increase physical activity is pretty transparent in its objective like in the study by Xu et al. (2020). However, digital nudges such as framing, default and social comparison are inherently not transparent, as individuals are often unaware about the objective of the nudge until revealed before deployment. For instance, Suzuki et al. (2021) employed framing in a brief web-based educational intervention to increase vaccination rates. The participants were blind to the mechanism that was employed to change their mindset. The criterion of ease of opting out is also met in certain cases. For instance, in a study by Purohit and Holzer (2021) participants could opt out of the feedback nudge by just turning off the feedback automation themselves. The process to opt-out would become challenging for nudges like default, framing (Suzuki et al. 2021), positioning (Wyse et al. 2021b). Finally, surprisingly, as shown in Fig. 10.9, the ethical analysis reveals that out of 19 studies, only one study of Neto et al. (2021) explicitly discusses the nudge designs and ethical implications. Future research should further investigate this issue. It should also be noted that understanding the ethical boundaries of digital nudging will also allow practitioners to identify potential unintended nudges present on their digital support systems. This can typically happen as nudges such as positioning or defaults are unavoidable when a system is designed. The challenge is to make sure these design decisions are aligned with the welfare of the patient and are not so called dark patterns, manipulating them.

10.5.4 Limitations

It should be noted that this chapter is not without limitations. Despite carefully following the guidelines for scoping reviews, the results are confined to the initial search, as is inherent to their nature. For instance, the nursing field may have applied a type of digital nudge like feedback without calling it that. Moreover, our search for the scoping review was limited to JMIR database and mainly focused on digital nudging for patients. Future research could include other digital health databases and review digital nudging for clinicians to provide a full-fledged systematic review of the topic.

10.6 Conclusion

This chapter mapped the landscape of a growing topic, namely digital nudging in healthcare. This chapter allows practitioners and healthcare system designers to get a better understanding of possible applications of digital nudges to increase the effectiveness of health applications along the continuum of care. It first gave an overview of the potential opportunities offered by digital nudges through the continuum of care. It then discussed the current state of the empirical literature on digital nudging in healthcare through a scoping literature review. The review highlighted the fact that current research efforts mainly focus on feedback and reminder nudges applied to an increasingly desired behaviour for prevention and post-acute care. At the current stage, several otherwise effective nudging strategies such as defaults are absent from the reviewed literature and none of the interventions was applied to acute care. Furthermore, the review revealed that only one paper out of 19 discussed ethical aspects of nudging. As such it appears that the development and promotion of an ethical analysis grid that will guide practitioners and researchers in designing not only low cost and effective, but also *ethical* nudges is crucial to unleash the full power of nudging to improve digital health.

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