# The Potential Role of Digital Nudging in the Digital Transformation of the Healthcare Industry

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**Abstract.** New information technology has led to an ongoing transformation of the healthcare industry, supporting caregivers and caretakers. In some cases, such technologies may not be used in practice as intended by those who designed or implemented them. In other cases, the full potential of such technologies in terms of guiding user behavior has not been exhausted to the fullest. This is where "digital nudging" can help to overcome according issues. Nudging was invented in behavioral economics and aims at eliciting behavior that is beneficial for the individual, at the same time respecting the individual's own preferences and freedom of choice. *Digital* nudging can therefore help to guide user behavior in information systems. In this work, we investigate the potentials of this concept in hospitals. We come to the conclusion that digital nudging in hospitals can positively influence the use of technology, new value creation, the change of structures and consequently financial dimensions of digital transformation, supporting not only caregivers but also caretakers.

**Keywords:** Digital nudging · Healthcare · Hospital · User behavior · Adoption

## 1 Introduction

The digital transformation of life and work in western societies as well as their economies is omnipresent [1, 2]. Despite the lack of a generally held definition for the digital transformation, current literature mentions many different descriptions of the phenomenon providing a well-rounded understanding of what digital transformation processes are. Therefore, we understand that digital transformation processes include: (1) any integration of technologies into formerly held analogous processes [3], (2) a restructuring of the organizations culture and behavior [4], or (3) a transformation from partly digitized into fully digitized business models [5]. While the integration of new technologies into organizational processes (e.g. a new project management software) describes interorganizational transformation processes on the micro-level, the transformation of an

organizations' business model due to new products or ways of work describes the macro perspective of digital transformation processes. As both aspects of transformation also take place in this works' research area of interest, we will provide relevant distinctions when assessing possibilities and future potentials for the digital transformation of the *healthcare industry*. Moreover, the different stakeholders involved are also not to be neglected when speaking of digital transformation processes in hospitals. For that reason, we chose to take a dual perspective including both, caregivers and caretakers, as relevant players in the digital transformation of the healthcare industry.

Due to the fast-paced life with ever changing innovations and growing consumer needs dictating the free market, the digital transformation has become one of the key strategies for businesses [6]. The healthcare industry too feels pressure to adapt to the status quo and demands of its patients as its digitization processes often lag behind other industries (e.g. retail or automotive industries) [7, 8]. As described in literature, this lacking behind other industries dictates the changes that are anticipated in the healthcare industry. Accordingly, researchers expect many strategic changes of the current service- and healthcare-delivery-driven business models, for instance in hospitals, to become more customer-(patient)-centric in the future [9, 10]. Researchers further anticipate, that the mentioned business model transformation could increase and improve the access to patient care.

One particular phenomenon that emerged in a variety of different fields of application is the concept of *nudging*. Originally developed as a concept to assist and improve customer decision-making in the offline world [11], nudging has especially been given renewed attention as a concept of user assistance or guidance in digital environments (see e.g. [12–14]). Thaler and Sunstein [11], the founding fathers of nudging, first conceptualized it as a form of overt and predictable behavior change. They state that nudging methods, such as encouraging prosocial behavior in 'nudgees' (individuals who are nudged), can be effective, all the while being libertarian, in that the nudgees' freedom of choice remains untampered with. More specifically, this is guaranteed by not excluding any possible choice, or not introducing (financial) incentives to extrinsically alter behavior [11].

Introducing the concept of nudging into digital healthcare services can therefore bring benefits to the stakeholders of both sides of the equation. That being said, one of the nudging examples in digital environments involves the simplification of user interfaces (e.g. color codes to assist navigation and highlight preferential choices). That way, caregivers can implement elements of assistance and guidance in new patient-centric technologies to improve their services. Similarly, the same nudging measures can be implemented to assist caretakers' decision-making processes while using computerized software to fill out prescriptions for instance.

In this paper we will discuss current possibilities for implementation and future potentials for digital nudging in the healthcare industry, especially in hospitals. In a first step we will provide the background on digital transformation and according dimensions. On the basis thereof, we will assess potentials of digital nudging in hospitals in a second step. In the next step, we will discuss the overall findings and provide implications for science and practice. The paper ends with a conclusion and outlook to further research.

## 2   Digital Transformation

Most literature revolving around the digital transformation in organizations is preoccupied with research efforts on how new (digital) technologies can be implemented on the micro-level to advance overall business performances and consequent competitive advantages [10, 15]. Research further states that the implementation of new technologies and the strategic changes involved in these processes are so fundamental that organizational cultures may change as well. Further, and most importantly it has also been pointed out that the value created by digital transformation processes can bring both, tangible as well as intangible benefits [10].

Building on the Digital Transformation framework as developed by Hess et al. [16], and more recent research efforts to transfer the framework into the healthcare context by Ghosh et al. [8], we will consider four different dimensions when reflecting on digital transformation processes in the healthcare industry. This includes (1) use of technologies, (2) changes in value creation, (3) structural changes, and (4) financial attributes as the four pivotal dimensions in our work. Said dimensions will be shortly introduced in the following and are important to consider in the assessment of possible nudging implementations in the digital health sector.

The first dimension, use of technology, deals with the way institutions either build on existing technologies or the degree to which institutions may choose to integrate new technologies as part of the strategic goal alignment in their organizational infrastructures on the micro-level. Given the rise of electronic health (eHealth) startups working to make useful contributions in the industry, we can find some possibilities to implement nudges. These include nudges to support the digital transformation process of either expanding existent or adopting new technologies in the health sector. Here, caregivers can be nudged to more easily adopt and accept new technologies in their work environments. Meanwhile, caretakers can also be nudged to adopt to new technological innovations implemented in the patient care.

The second dimension, considering the changes in value creation, is closely connected to the former. Here, research describes a digital transformation process in which both, micro- as well as macro-level innovations can bring about new ways of creating value for the organization [10, 16–18]. In the healthcare industry, micro-level innovations may include technologies that allow a new way of interacting with patients or slimming down patient care processes to improve healthcare services [19]. On a macro-level transformation process, value creation may imply expanding healthcare services into new markets, which could be realized by providing wearables for better preventative care of outpatients for instance.

Meanwhile, the third dimension, structural changes, is often a direct consequence of the former dimension. This level of transformation can be realized in an institution where macro-level value creation processes have been nudged already. In this dimension, technologies enable the organization to undergo internal transformation processes in form of e.g. less hierarchical communication structures (e.g. [20, 21]), acquiring new skills or introducing agile business processes [10]. Nevertheless, some institutions, such as hospitals, keep transformational processes mostly separate from their core business. Here structural changes can be viewed more as a form of transformation integrated

within existing technologies [10]. Therefore, a nudge would be implemented as a form of an add-on to support or improve existing technology functionalities.

Lastly, the fourth dimension concerning financial attributes of the digital transformation, is most important and distinctive for the level of integration of all other dimensions [10]. While this dimension mainly influences the possible degree of change in most industries, financial attributes are not the only driving factor in the healthcare industry. Here, other factors such as patient safety [22], or patient satisfaction [23] can often be equally as important [10]. Nevertheless, as hospitals too face budget shortages, and tight competition amongst one another, nudging measures can be implemented especially in the work environments of caregivers. When implemented in already existing technologies, nudges could steer caregivers towards making more cost-effective decisions when prescribing medicine for instance. As demonstrated above, there are several possibilities to integrate nudging into what is understood as digital transformation processes in the healthcare industry. In the following we will elaborate on the concept of nudging in more detail to highlight relevant aspects. Further this will help us distinguish nudging from the explicit manipulation of decision-making processes, which should have no standing in the healthcare industry.

## 3    Digital Nudging

### 3.1    Background and Definitions

It is important to get a thorough understanding of nudging in its original context of behavioral economics before applying it to digital or health contexts. The concept of nudging was first introduced by Thaler and Sunstein in 2009 [11]. They proposed a way of influencing human decision-making based on social-psychological and cognitive theories. Accordingly, they defined nudging as *"(…) any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives"* [11, p. 6]. Thereby nudging applies to cognitive thinking processes that guide human decision-making. A choice architecture, also simply referred to as a set of choices people may choose from, is thereby arranged in a more simplified or preferential way to assist and guide decision-making processes. Further, in distinction to manipulation and persuasion, Thaler and Sunstein [11] argued that nudging introduces a way of influence according to the affected person's own preferences. In literature, this aspect of nudging is also often simply referred to as a liberty preserving form of paternalism. More recently, nudging is frequently introduced in the Information Systems (IS) research field, applying the concept to digital contexts including the healthcare industry.

The IS research field focuses its research efforts on challenges and problems with information technologies applied in organizational contexts. That is why many of the epistemological perspectives and theories introduced in the discipline are based on sociotechnical paradigms entailing the analysis of human and technical factors in enterprise settings [24]. Therefore, the sociotechnical paradigm is a core piece and also establishes its legitimization among other research fields, such as computer sciences [25] and HCI. Digital nudging refers to "*a subtle form of using design, information and*

*interaction elements to guide user behavior in digital environments, without restricting the individual's freedom of choice*" [13, p. 3]. Simply put, nudging and its extended implementation in the digital environment follow the same basic principles. The fundamental difference lies in the greater versatility and opportunities for constructions of choice architectures in the virtual world. Namely because virtual environments have a much more dynamic character, often demanding users to process and comprehend large amounts of information. Therefore, the decision-making in digital environments is based on automation processes and simple heuristics, which simplify decision-making but also lead to poor decisions [26]. As digital interfaces are human-made and therefore follow a certain purpose and consequent choice architecture, we understand digital (user) interfaces as the environment which influences decisions [27] in the healthcare industry. Accordingly, the choice architecture of digital interfaces and their consequent influence on both, caregivers as well as caretakers in hospital contexts will be at the core of our research agenda in this work.

## 3.2    Rationalities of Nudging

Due to its rather novel introduction to IS research and the multifaceted applicability in many different research fields, nudging is a controversially discussed topic. Therefore, there are some aspects that have to be considered especially when introducing the concept into the healthcare industry. Some researchers criticize the broad definition of nudging, leaving several questions unanswered and too much leeway for interpretation. The researchers Nys and Engelen [28] criticize for instance, that the current definition of nudging neither defines roles and responsibilities in nudging situations nor does it specify the boundaries of libertarian paternalism. They claim that a nudge does not necessarily have to be designed towards the nudgees own interests but can also be working towards the interest of the nudgers, as long as they are not paternalistic [28]. Another often criticized aspect of the broadly defined nudging concept is its similarity to persuasion. Previous research even suggests that both nudging and persuasion are comparable as they aim to influence people towards a specific behavior [29].

In computer science, the concepts of persuasion and persuasive technologies mainly evolved around the ideas introduced by Fogg [30]. According to Fogg [30], persuasion can be defined as *"an attempt to change attitudes or behaviors or both (without using coercion or deception)"* (p. 15). By strongly distinguishing persuasion from manipulative characteristics such as coercion and deception, similarities between nudging and persuasion become apparent. However, the most fundamental difference between both concepts prevails that both, nudging and persuasion have been developed in different disciplines with partially different goals for implementation. As pointed out before, nudging was developed in economics and aims to preserve the liberty of the nudgee to choose freely. Persuasion on the other hand allows a more freely interpreted level of technically enabled influences. Nevertheless, despite this fundamental difference, research by Meske and Potthoff [13] focused on the similarities between nudging and persuasion in the attempt to provide a valuable contribution by borrowing from both concepts. Amongst other things, the researchers derived an overview of integrative digital nudging components they believed to be important to operationalize behavioral change [13]. Accordingly, the researchers' integrative overview will provide

the key components we can transfer to digital nudging in the healthcare industry as well. All in all, the researchers Meske and Potthoff [13] were able to show that (digital) nudging and persuasion, two related concepts with separate bounded rationalities stemming from distinct research streams, entail important elements that can be integrated to expand the complexity of design components in digital environments. The resulting nudging components are illustrated and shortly explained below in Table 1. The illustrated components in Table 1 are applicable, for instance, in hospital affiliated decision situations, which e.g. include user interfaces in computer software [12].

**Table 1.** Nudging elements [13]

| Nudging elements | Related to nudging | Related to persuasion |
|---|---|---|
| Anchoring *(providing pieces of information, e.g. numbers as anchors for decision-making)* | [11, 31, 32] | |
| Customized information (Tailoring) *(personalized information to provide a better environment-individual fit)* | [33] | [34, 35] |
| Decision staging (Tunneling) *(highlighting preferential options but including all possible options)* | [33] | [35] |
| Default setting *(normative information or adjusted settings according to individuals' preferences)* | [31, 36–40] | |
| Framing *(a change in environment or wording when presenting information)* | [32, 36, 41–44] | |
| Informing *(distribution of (personalized) information)* | [31, 32, 45–49] | |
| Limited time window *(providing limited time windows for certain choices)* | [33] | |
| Praise and reward (Gamification) *(subtle form of reinforcement to increase motivation)* | | [50, 51] |
| Pre-commitment strategy *(seeking commitment and preferential choice set to reinforce target behaviour)* | [11, 42, 48] | |
| Priming *(using implicit memory effects through subtle exposure to information)* | [48, 52] | |
| Reminders *(e.g. notification to help people counteract undesired behaviour)* | [48] | [35, 53] |
| Simplification (Reduction) *(reduced information to prevent overload and yet still provide the entire choice set)* | [32, 33, 41, 52] | [53] |

**Table 1.** (*continued*)

| Nudging elements | Related to nudging | Related to persuasion |
|---|---|---|
| Social influence (Social comparison) <br> (*providing information about others to influence alignment with social norms*) | [11, 31, 44] | [35, 50] |
| Warning <br> (*signaling risks to provoke natural instincts*) | [11, 32, 48, 52] | |

## 4 Potential Use Cases for Digital Nudging in Hospitals

As pointed out above, there are four relevant digital transformation dimensions that we consider for the implementation of digital nudging components in hospitals. In the following we will attend to each dimension by providing possible use case examples.

### 4.1 Opportunities for Digital Nudging to Increase and Support *the Use of Technology*

The use of technology dimension of the digital transformation in the context of hospitals describes the institution's ability as well as its willingness to make use of new digital technologies [16] on the micro-level. There are several opportunities to make use of nudging components, which have been tested in other contexts outside of the healthcare industry (e.g. [27, 54]) and anticipate that nudging components can also help caregivers as well as caretakers to adopt new digital environments in hospitals. Several theories model the user adoption of new technologies; however, two theories have become widely accepted for the prediction of user adoption of new technologies [55]. The technology acceptance model (TAM) [56] and the unified theory of acceptance and use of technology (UTAUT) [57] explain the rationale behind users' adoption behavior and assess individuals' behavior when deciding to adopt an innovation. UTAUT for instance describes social influence, performance expectancy, effort expectancy and facilitating conditions as predictors of technology adoption and use. As a consequence thereof, we assume, that nudging components could apply to exert e.g. social influence by providing information (e.g. pop-up windows, banners) of how many other colleagues use the new technology in the hospital or department. The mechanism at play is, that caregivers (e.g. doctors) could feel encouraged to use a new technology (e.g. a new system to monitor patients) if they are under the impression that doing so has become an institutional (social) norm. Meanwhile, caretakers (e.g. diabetes patients) could also be nudged to use new technologies to help control the disease in and outside of hospitals if nudging components such as simplifications, decision staging or default settings based on patient information and preferences could help increase the performance expectancy and hence perceived usefulness of the technology.

## 4.2    Opportunities for Digital Nudging in Providing *New Value Creation*

Meanwhile, the second dimension of digital transformation in the context of hospitals describes the influences and changes new technologies (e.g. new products, markets or services) have on the institution's value creation [16]. Based on the success and acceptance of the first digital transformation dimension in a hospital, new forms of value can be created on the macro-level.

There are already a few examples of how wearables or mobile applications help patients manage their chronical diseases or stay ahead of their preventative checkups. This is where the implementation of such technologies can be seen as both, a primary example of the digitization in form of the introduction and use of new technologies on the micro-level (dimension one) as well as in terms of new value creation for the hospital (dimension two) on the macro-level. Creating new value in terms of extended patient care and new health products beyond the dismissal of the patient from the hospital is part of a hospitals' patient centered or value centered outcome approach. One aspect distinctive of this healthcare approach is that hospitals continue to monitor vital signs of patients with pacemakers, in order to inform them of cardiac fibrillations when necessary. Nowadays, contacting the affected patient is still done by hospital personnel via the telephone. However, due to the digitization efforts, there are some new possibilities to introduce technologies or services, which undertake contacting the patients. Accordingly, hospitals have the opportunity to introduce new products and thereby tap into new markets by partnering with research institutions or health service providers (e.g. fitness trackers) to improve preventative medical care. There are many opportunities to implement nudges within the technological infrastructures for the prolonged care of outpatients. Here, caretakers could be nudged to arrange their regular preventative check-ups on time (e.g. via reminders, informing). In general, the entire list of integrative nudging components can be implemented as preventative measures in wearables, to not only trigger, remind, or motivate patients to reach their average goal of steps per day but also integrate praise and reward nudges or anchoring to nudge a healthier diet or a more frequent checkups at the doctors.

In terms of value creation through providing new services, there are already digitization efforts in the telemedicine such as the tele intensive care unit or the digital diabetes ambulance. These are digital services offering medical care to caretakers independent of time and space. Here, caretakers have remote access to caregivers who offer virtual medical care. These services are distinctive of the increasing diversification of medical care made possible through the digital transformation. Nudging components can play an important role in motivating or encouraging caretakers in remote areas to make use of the services. This can be done through simplification nudges on mobile applications or website interfaces to encourage the technology use as well as informing nudges by providing statistical information on the expected benefits of using the telemedicine services in acute emergencies, increasing the usage of according technology and hence increasing the added value for the hospital.

### 4.3   Opportunities for Digital Nudging in Eliciting and Guiding *Structural Changes*

The structural changes dimension of the digital transformation in the context of hospitals describes the institution's efforts to introduce or manage new organizational structures, work processes or skills in order to make efficient and effective use of the new technologies [16]. As macro-level value creation brings about structural changes in the institutions, macro-level nudging components also have a continued effect on the intra-institutional level. Hereby, it is important to point out that technologies, which bring about structural change do not just re-structure patient care processes as described above but also have an influence on the way caregivers work in general. Large parts of the caregivers' work not directly done on the patient involves computers and therefore provides many different opportunities for nudging. That is why managers and researchers (e.g. in research hospitals) have taken a particular interest in the analysis of the large amounts of data for evidence-based quality management to improve internal processes or statistical analyses of trends in diagnoses and suggested treatments to improve the patient care. However, because of traditional routines, caregivers prefer using free text, which they can type in to document diagnoses, rather than using structured data entries. This creates a big pain point for evidence-based management and research, as only structured data are valuable for quantitative analyses. In this context, nudging components could be used to trigger and encourage caregivers to invest the extra time to choose the pre-formulated data entries. Another possibility to use nudging components during the caregivers' decision-making process concerns the treatment of the patients. Here, nudging components could entail statistical decision staging mechanisms, which nudge caretakers to reflect on planned treatments and hence the planned process of caregiving. In both cases, nudging could be implemented in the context of changes processes and may lead to improved medical decisions.

Also, on the micro-level, where caregivers and caretakers are already within physical proximity, nudging mechanisms may be used to slim down administrative processes or improve services. For instance, the admission processes of new patients often leave long paper trails. Therefore, hospitals are already working on digital substitutes, which not only regulate the initial admission of new patients but also track new information of re-admissions in form of a digital patient diary. Here again, nudging components (e.g. signaling, decision staging) can be implemented to remind patients to thoroughly fill out admission forms. Upon continued hospital visits, different nudging components can become effective to make admission processes more effective. Nudging patients to revise outdated information about their physical conditions is one way of increased effectivity, potentially leading to new or changed processes and hence structures. Thereby, digital nudging could encourage patients to inform their caregivers of new symptoms ahead of or after their new physical examinations for instance. Another use case could regard the coordination of caretaker appointments and examinations. Here, through GPS tracking of the caretakers' whereabouts in the hospital, e.g. informing nudges could be used coordinate capacities of waiting rooms or hallways by suggesting patients to take a walk or visit the cafeteria in-between appointments.

### 4.4 Opportunities for Digital Nudging in *Providing Financial Gains*

The financial dimension of the digital transformation in the context of hospitals describes competitive pressure between institutions as well as the availability of required resources to fund the transformation [16]. Even though the treatment of patients and providing care are at the core of the business, staying profitable and competitive in the industry remain important business aspects of hospitals. Therefore, digital transformation processes are inevitable and mandatory for the continued success of hospitals given the overall digitization of the healthcare industry. We determine, that financial gains through nudging can be realized on both, the micro- and macro-level of digital transformation processes. Overall, we argue, that the financial dimension and hence potential, external funding of transformational endeavors is indirectly supported through the successful implementation of nudges in the other three domains of technology use, value creation and structural changes.

## 5 Discussion

On the basis of existing conceptualizations of digital transformation dimensions and the body of knowledge on nudging in digital environments, we conclude that digital nudging has a rightful place in the healthcare industry. Altogether, there are four digital transformation dimensions, which we regarded more closely and used as reference for the implementation of possible nudging components. Taking the different dimensions into consideration allowed us to reflect on possible micro- or macro-level nudging implications in hospitals from multiple angles.

Even though structural change and financial attributes are important dimensions of the digital transformation on the macro-level, we want to point out to the importance of influences of nudging on micro-level technology use and value creation dimensions. This being the case, the caregiver-caretaker perspective was in the focus of this work. On the caregiver side we recognize that nudging components primarily assist the hospital personnel in creating value by offering new services as well as making daily work routines more time and cost effective. Digital nudges can also primarily be used to encourage technology use in the first place or assist the technology adoption processes.

Meanwhile, caretakers experience value creation more directly in terms of technology use and thereby save time during initial hospital admissions as well as reoccurring admission processes. Digitizing the admission process in hospitals is a popular digital transformation topic that does not yet involve nudging components. Here nudging could play a central role in easing the caretakers into the technology use in hospitals. At the same time nudging components such as reminders or customized information could assist caretakers to revisit and update their patient information when filling out digital questionnaires. Nudging caretakers to keep their patient history up to date in turn could help provide the necessary paper work and gather important information about the progression of the sickness or the appearance of new symptoms to help prepare the caregiver before the actual patient-care.

Finally, nudging components applied on the macro-level dimensions are equally as useful, as structural changes and financial attributes on the institutional-level eventually

also have an influence on the transformation processes on the micro-level. Nudging may apply and contribute in every dimension of digital transformation process in hospitals. It is a relatively easy and inexpensive implementation into already existing technological infrastructures, which, if implemented correctly and hence also respecting the freedom of the users' choice, can have a significant impact on the development, acceptance and continued use of technologies in hospitals for both sides, caregivers as well as caretakers.

## 6   Conclusion

In this work, we show that digital nudging can be a useful instrument to support digital transformation in the healthcare industry by discussing hospital context specific case examples in which nudging components can find an immediate implementation within existing technological infrastructures. Additionally, we also provide case examples of how nudging could find seamless implementation in future digital technologies and processes in the hospital context. In general, we highlight several nudging potentials in hospitals in order to lay out the possible future and necessity for nudging in the healthcare industry. Future research may empirically investigate the effectiveness of different nudges in varying settings from the caregivers' as well as caretakers' point of view. It should also be analyzed, how an important principle of nudging, respecting the individuals' preferences and freedom of choice, can be achieved in domains such as the healthcare industry.

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