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Bridging the voice of healthcare to digital transformation in practice – a holistic approach

Ann Frisinger^{1*} and Panagiotis Papachristou^{1*}

Abstract

Background Digital transformation is key for healthcare to meet future needs and expectations and compete equally with new actors on the market. Medical digital diagnosis tools and clinical decision support systems (CDSS) are improving and offer new opportunities. To introduce new technology in healthcare can however be a challenging mission, too often ending in failure, with excessive costs or the actual transformation work not being carried out at all. It is unclear how to drive the establishment to reach desired results in this environment, and how industrial experiences can be used to support healthcare.

Objective The objective of this study was to develop a holistic approach for introducing new information technology (IT), such as a CDSS, into a primary healthcare organization supported by industry best practices for digital transformation.

Methods This qualitative study used a combined inductive and deductive method where the perceptions and beliefs of selected primary healthcare stakeholders were used as directions for developing an approach that could utilize existing industry best practices for digital transformation.

Results A holistic healthcare-ified approach including 20 requirements was developed, that meet the needs of healthcare. The voice of healthcare was used as prism to healthcare-ify the industry practices and adapt it to match specific healthcare conditions. An example was provided showing how the research could be put into practice.

Conclusions This study proposed a holistic approach, based on industry best practices, but adapted to healthcare using the voice of healthcare as a bridge, that may be used to introduce CDSS and other IT into a primary healthcare organization and step up the needed digitalization.

Keywords Clinical decision support system, Digitalization, Digital transformation, Healthcare, Primary healthcare

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Introduction

Digital transformation in general

Digital transformation means a major change to an organization and is driven or enabled by digital technology [1]. It brings a disruption that changes the rules of business. It is about how an organization adapts to the new environment that new digital technologies bring [2]. Transformation and digital transformation can be very challenging, and many organizations fail to perform a sustainable change [3]. Several models explain how to perform a change [4], e.g., Kotter's change model [5] covering the following steps: create a sense of urgency to realize a change is needed, establish a steering committee, develop, and communicate a vision, enable action, and remove barriers, leverage quick wins, build on the flow, and extend it, make change part of the culture.

Since digitalization covers more than the actual implementation of new IT [6, 7], the transformation actions, going from a current to a future state [8], need to cover a variety of dimensions. Stoyanova identifies top-down, bottom-up or combined approaches for driving large- or small-scale digital change [6]. Regardless of approach the key to success is said to depend on how well the initiatives are planned, prioritized, and executed [9]. The focus should be to increase client value and thereby drive the business while the technology is seen as a "*favourable factor*" [6]. The practices mentioned are leadership, building of digital capabilities, opportunity for employees, new technology, and communication. Further Stoyanova [6] proposes the following success factors for digital transformation: Develop a digitalization strategy, rethink the workplace, change the operational model, communicate, focus client experience, and build digital platform.

While academic research may focus on different aspects of digital transformation, the availability of integrated frameworks is limited, and existing frameworks lack academic support [10]. Ivancic et al. presents a digital transformation framework resulting from a holistic investigation [11]. It covers seven dimensions: strategy, organization, client, people, technology, innovation, and eco-system. The framework is cross-industry generic, but not healthcare specific. Greenhalgh et al. proposes a seven-domain framework for considering influences on the adoption, non-adoption, abandonment, scale-up, spread and sustainability of technology in healthcare [12]. Lean covers the three main elements: management system, operating system, and mindsets with related behaviours [13]. Osmundsen et al. suggests eight success factors for digital transformation: culture for change, transformation management, build and leverage skills, engage managers and people, grow capabilities, develop a digital business strategy, and alignment with the information system [1]. A report from McKinsey mentions

21 success factors that fall into the categories of leadership, building of capabilities, practitioner empowerment, upgrade of tools and communication [3].

When a change is dependent on people's adoption, the complexity increases, and organizational culture becomes an important part of the transformation [14]. The transformation changes or even threatens established structures [10]. People's views, standards, understanding, and acceptance will therefore decide the success of a change [9, 14, 15]. Motivation is key to successful transformation to make people engaged [4]. Many transformation practices emanate from quality management theories where the methods are orchestrated by project- and change management approaches. Improvement frameworks have since long been used by industry to drive organizational performance improvements, including IT digitalization. There is a variety of methods and tools for improving and managing quality. Some well-known frameworks for quality management are Total Quality Management [16], Lean [13, 16–18], and Lean six sigma [5, 17, 19]. These can be used on daily basis to drive improvements. There are several themes of these initiatives, all with a similar intention [16], to make the organization focus on continuous improvements and thereby create value for the client [17]. Strategies (digital strategies [20]) and many tools and methods support these frameworks, e.g., business cases [21], flowcharts [16, 17], workshops, prioritization matrices [5, 16], progress reporting [22] and SWOT (Strength, Weakness, Opportunity, Threat) diagrams [17].

Primary healthcare and the challenge of performing digital transformation

Primary healthcare manages basic medical treatments and care that do not require medical skills provided by hospitals or other specialized institutions [23, 24]. In many countries (e.g., Sweden) the healthcare is predominantly politically governed, highly regulated, and the cost mainly covered by the tax system [23, 25, 26].

The primary healthcare population (i.e., the practitioners such as doctors and nurses) is a closed community, indeed capable but fostered to be sceptical to new unless there is convincing scientific evidence [27]. The professionals are under hard pressure and time is not sufficient for performing all demanded tasks [27, 28]. The reaction to change can therefore be that there is more to lose than to win. A change can also be seen as a threat since it changes existing structures [10, 27]. To drive change in this environment, there is advantageous to have medical background and be clinically active [27]. In healthcare, the power comes with the white coat [27]. In primary healthcare there is commonly less teaming, and each doctor is more self-governing. It is therefore key to

convince a lead doctor to sponsor the change or even act as a role model [27] to make the powerful frontline move in the desired direction.

The exploration of Information Technology (IT) in healthcare is lagging behind and digital transformation can be described as “*overdue*” compared to other industries that have come further [7]. This is due to many reasons, e.g., resistance to change, not having the time, unawareness of the opportunity, or not knowing how to drive digital change effectively in this environment [27]. The non-exploring or failure of implementation can be costly. Both healthcare providers and users suffer the consequences of this non-usage of new technology. This has become obvious when interviewing healthcare stakeholders [27].

Primary healthcare needs to improve its ability to drive digital transformation in a successful way. Healthcare has similarities to other industries however some factors differ which need to be considered when driving change. The holistic conditions for introducing new IT, such as an Artificial Intelligence (AI) based digital Clinical Decision Support Systems (CDSS), into a primary healthcare organization were previously investigated [27]. The analysis found that it requires a multidimensional perspective and handling and provided a holistic and healthcare-ified view of those conditions, including to “*learn from previous mistakes, adopt success factors for change, adjust according to healthcare differentiators, consider the level of IT maturity and quality management maturity of an organization, identify specific improvement areas (e.g., related to malignant melanoma diagnosis) and reflect on new challenges and prerequisites that will appear when changing the way of working. It also encompasses the needed commitment and trust from the stakeholders involved and impacted by the change*” [27]. The result of the content analysis was summarized in a table including 78 codes, 33 subcategories, 7 categories, and one central theme. Additional file 1 (A1) provides a copy of that table along with numbering of the codes. That study provided “*a view of the perceptions and beliefs of selected primary healthcare stakeholders*” related to the introduction of new IT [27]. It is however still unclear how the specific conditions for primary healthcare can be covered by an approach to introduce new IT and how experiences from other industries can be used to support healthcare.

Objective

The objective of this qualitative study was to develop a holistic approach for introducing new information technology, such as digital decision support systems, into a primary healthcare organization supported by industry best practices for digital transformation.

The specific research questions were: What can an approach for introducing new information technology into a primary healthcare organization look like?; How can the conditions in healthcare, expressed through the perceptions and beliefs of selected primary healthcare stakeholders, be catered for by the approach?; and How can industrial experiences and best practices support healthcare?

Materials and methods

This qualitative study was conducted through a combined inductive and deductive (hybrid) approach. A qualitative inductive approach is useful when the aim is to search for knowledge in the format of personal views and perception of the environment, whereas a qualitative deductive approach can be used when there are existing theories to start from [29, 30].

Materials used in this study

The study was based on the qualitative content analysis of semi-structured interviews performed by Frisinger et al. [27] which resulted in ~600 meaning units that were coded into 78 codes (A1, second column).

A selection of digital transformation best practice components was performed by the lead author (A.F.), a combination of those that the author was familiar with, guided by literature and findings from a previous interview study [27]. The set does not represent a full coverage of all components (frameworks, settings, techniques, methods, tools) that exist. The selection of components should be seen as an example and components and those are exchangeable by others as long as those address the requirement. A user of the approach may thus use another component that this person is more familiar with, as long as it matches the need.

Methods used in this study

The following two steps were performed to identify themes representing requirements that could be solutioned by healthcare-ified industry best practices: 1) The 78 codes were analysed through an inductive thematic approach [31] which resulted in healthcare-ified requirements (Additional file 2). The requirements were thus induced from the interviews with primary healthcare stakeholders. Originating from codes, one code could, in combination with other codes, be induced to one or several requirements (i.e., a many to many combination). See Additional file 3 (A3) for a schematic view of the induction of codes. The induction was iterated until (according to the authors) no more relevant combinations remained. The requirements were mapped deductively into an existing 7-dimensions framework to confirm a holistic

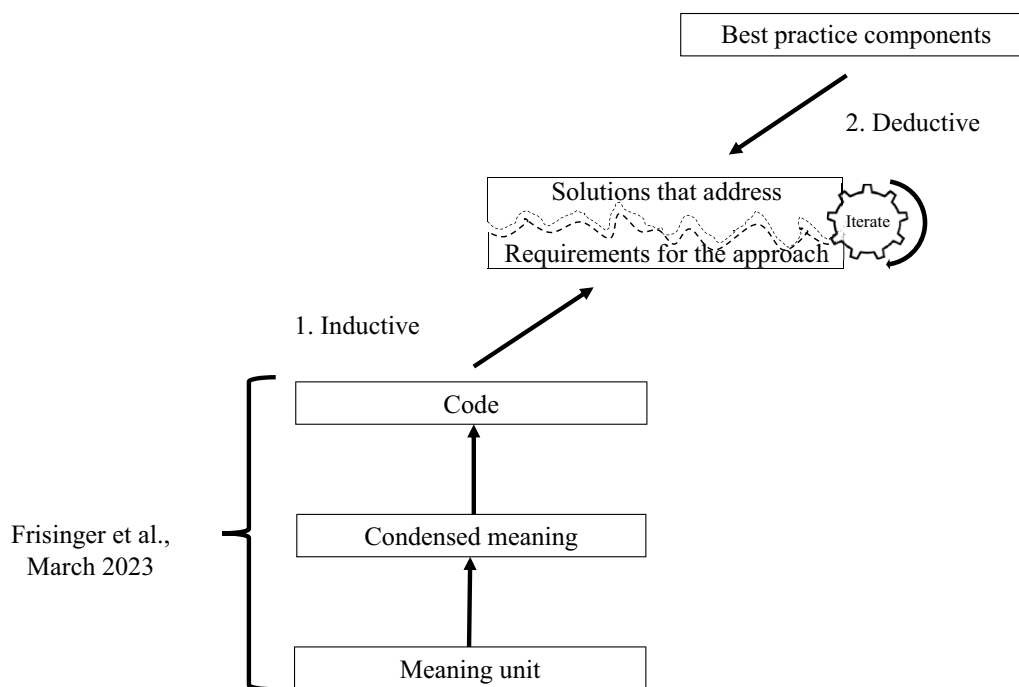


Fig. 1 A combined inductive and deductive method resulting in requirements and addressing solutions for an approach

coverage [11, 32]. The dimensions can on high level be described as follows, which is also in line with change related aspects discussed in a previous interview study [27], and in literature [1–3, 6, 13]: strategy (e.g., digital strategy, business strategy); organization (e.g., organizational structure, management system, leadership, project management); client (e.g., the market and the clients); people (e.g., people management, skills, resources, performance management, organizational culture and inclusion); technology (e.g., the requirements and usage of technology); innovation (e.g., creation and management of new ideas); and eco-system (e.g., cooperation, inspiration, sharing of knowledge and success-stories). Additional file 4 (A4) shows an example of the abstraction path. 2). A sample of industry best practices for digital transformation (including examples of industry best practice components) formed, according to a deductive approach [30, 32], solutions that addressed the requirements. The solutions were thus derived from a set of already existing best practice components. One best practice component could, in combination with others, be part of solutions and thus address one or several requirements (i.e., a many to many combination), see Additional file 5 for a schematic view of the deduction of best practice components. Additional file 6 (A6) shows an example of how best practice components form solutions that address requirements.

The induction and deduction in steps 1 and 2 were iterated to confirm all requirements could be solutioned. Figure 1 illustrates the combination of the inductive/deductive methodology providing the requirements and solutions for an approach.

Information from the actual interviews in Frisinger et al. [27] served as a prism to further "healthcare-ify" (adapt to healthcare) the requirement—digital transformation best practices package. The healthcare-ification was performed to adapt to something that according to healthcare stakeholders were more probable to work in a healthcare environment. See Fig. 2 for an example of the concept of healthcare-ification where digital transformation best practice components (the input) are turned into healthcare-ified digital transformation best practice components (the output) using the voice of healthcare as a prism (a catalyst).

Further, an action-oriented way of working was used, meaning that the research iterated in cycles of Plan, Act, Observe and Reflect, where one cycle provided input to the next with intention to make the background and requirements for the approach clearer for every cycle and refine the results [33]. In addition, a cross-disciplinary perspective [5] was used throughout the study, utilizing the authors' prior experiences in the fields of IT, management and medicine.

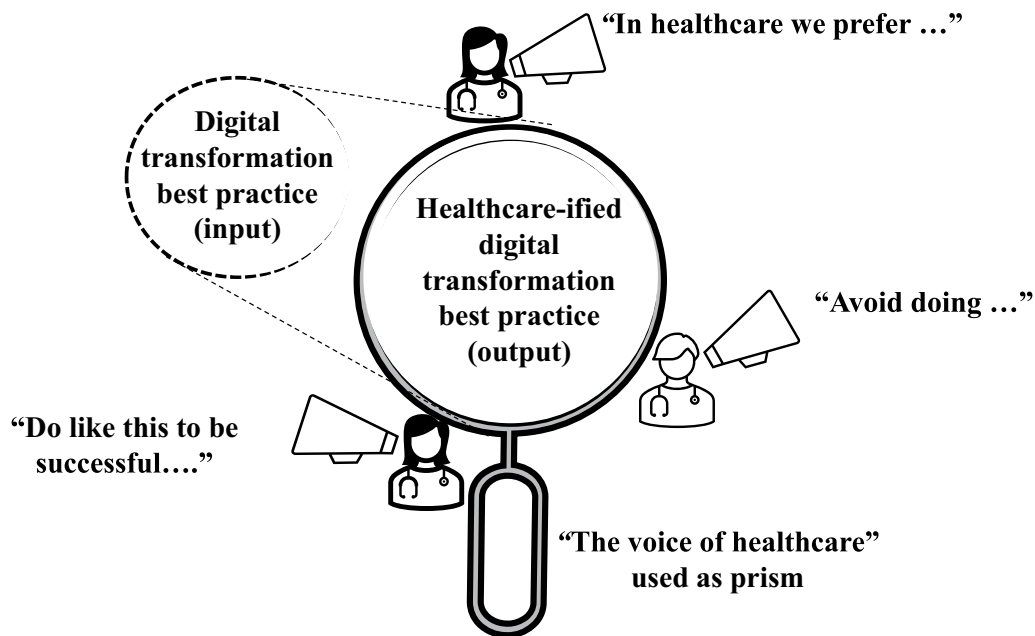


Fig. 2 The healthcare-ification concept turning unhealthcare-ified to healthcare-ified using the voice of healthcare as a prism

Results

A holistic approach for digital transformation in primary healthcare

In this study, a holistic approach for digital transformation emerged from an integration of requirements and a variety of components (frameworks, settings, techniques, methods, tools) which formed a proposed solution going from start to end, as described in the method. The transformation includes the phases: understand current state and areas for improvement, decide future state, the plan and perform of the transformation, the hand-over (from project to line organization) and follow-up of results.

Following action-oriented research, a couple of iterations (two major and ~ five minor adjustment generating) led to the given results.

A multidimensional, holistic perspective was needed to cover all aspects mentioned in interviews, represented by the 78 codes (Additional file 1).

Table 1 presents the approach constructed from the resulting 20 requirements (second column), addressed by best practice components (third column and Additional file 7), mapped into a seven-dimension framework (first column). The selection of best practice components is exchangeable to other components provided those address the healthcare-ified requirements.

Healthcare-ification

The following Fig. 3 exemplifies the healthcare-ification process, where the original digital transformation best practices commonly used in other industries (light grey

in background of figure) serves as input and is turned in to the output—a healthcare-ified digital transformation best practice that meets healthcare needs and values (seen clearly in black when looking through the prism), by using the voice of healthcare (what healthcare stakeholders said in the interviews) as a catalyst.

Application of the approach in practice

All of the 20 requirements in the approach (Table 1) are intended to be considered when performing a transformation, however some might need more attention. The focus can vary and depends on the goals, the complexity of the change, and the experience of the organization. For the introduction of new IT, such as a digital CDSS, a pilot is suggested to be run as a first step. The focus would then initially be on a selection of the requirements with corresponding best practice components, some in lighter format (as decided by the stakeholders). The pilot serves as a preparation for a broader deployment, provided the trial is successful, otherwise it should be valued as lessons learned. Success-stories could also be shared with others including do’s and don’ts. Figure 4 exemplifies the application of the approach. It shows how selected best practice components, representing the 20 requirements, becomes activities that are executed throughout a transformation initiative. Some activities have been given higher priority (marked with a solid line in the figure) whereas others have been given lower priority (marked with dotted line in the figure). The actual priorities, set by the involved team, may vary from time to time. On the

Table 1 A holistic approach for introducing digital decision support systems into a primary healthcare organization. It includes healthcare-ified requirements, best practice components addressing those, all mapped into a 7-dimension framework. The framework is adapted from Ivancic et al. [11]

Dimension	Requirement for the approach (non-prioritized order)	Example of best practice component(s) addressing the requirement (= solution)
Strategy	1. New IT solution to match intent of digitalization strategy ^{1,2,2,9,2,10,3,21,3,25,3,26,6,11}	Digitalization strategy, business strategy, SWOT, benchmark
	2. New IT solution to support the medical business ^{1,2,1,6,2,9,6,11}	Procurement (request for proposal, proposal, agreement), value proposition, business strategy and objectives
	3. Allocate time and resources to run pilot and deploy new IT solution ^{1,1,2,4,2,12,3,4,3,19}	Business case
	4. Coordinate initiatives ^{2,4,2,7,3,21,5,7,6,11}	Coordinator of initiatives, sharing of experiences and success stories
Organization	5. Have an active sponsor ^{2,5,2,6,3,1,7,1-7,4}	Sponsor of initiatives, steering committee
	6. Leadership for change ^{1,3,2,1,2,2,2,5,2,6,2,8,3,1,3,2,6,3,31,7,1-7,4}	Leadership for change, leadership, and management practices
	7. Motivate people to commit ^{2,1,2,2,3,14-17,3,31}	Culture for change, stakeholder analysis of their commitment to change, power vs interest grid, leadership, and management practices, build on strengths
	8. Communicate to understand ^{1,3,2,6,3,1,7,1-7,4}	Stakeholder analysis of their commitment to change, power vs interest grid, communication plan
	9. Use role model from the medical practice ^{2,5,3,4,3,6,3,10,3,11-12,3,18,3,31}	Role model, evangelists / project champion
	10. Structure the work, start with a pilot ^{2,4,2,5,4,1-4,5}	Project/program management methods, project charter, structured pilot, lessons learned, project handover, preparation for broader deployment
	11. Adjust the management system ^{6,3}	Management system review and adjustment, follow up and confirm compliance, quality assurance
Client People	12. Set goals and visualize progress ^{2,1,2,2,3,4,3,13}	Benchmark, set objectives, measure performance, follow up progress, visualize progress, scorecard
	13. Understand society and patient needs ^{3,1,3,5,3,7-3,9,3,26-3,30}	Market research with competitive analysis, Voice of Customer
	14. Build healthcare culture for change ^{1,4,1,5,1,7,2,3,3,4,3,14-17,3,31,7,1-7,4}	Stakeholder analysis of their commitment to change (stakeholder readiness), culture for change, build on strengths, communication plan, role model
Technology	15. Plan, acquire and leverage skills ^{1,1,1,8,2,3,2,5,2,8,2,11,3,4,3,10,5,1,5,2}	Resource capacity plan, resource management, train, educate, recruit, hire and leverage skills. Temporary roles to promote and make those important
	16. Practice continuous improvements on daily basis ^{3,3,3,4,3,20,3,22-3,24,4,1-4,5,5,1-5,7}	Quality management methods, PDCA, Continuous improvements training
	17. New IT solution to meet healthcare requirements ^{1,2,3,2,6,1,6,2,6,4-6,11}	Value proposition, proposal, product review (several aspects), IT security (strategy, risk analysis, policy, processes, methods, training, awareness, mechanisms), technology readiness assessment
Innovation	18. Enable interoperability ^{3,2,5,6,10}	Integrate solution, Compatibility confirmation / standard interface, transformation of existing IT systems to support the new solution
	19. Involve frontline employees ^{1,4,2,8,3,1,2,3,2,0,3,22-3,24,4,1-4,5,5,1-5,7}	Structured idea program / continuous improvement program, PDCA, 5 WHYS
Eco system	20. Inspire the team ^{1,8,2,7,3,4,3,11,3,26}	Structured sharing of success stories (also cross industry)

^{1,1-7,4} The superscript numbers show the theme and label origin of the requirement (Additional file 1)

top of the figure, the transformation phases are shown with continued iterations. To make the change effective the journey continues after the transformation or there is risk for erosion. After each cycle of change the result should be evaluated and new opportunities for improvement identified, a never-ending story for those who want to stay relevant since the environment is continuously changing.

Discussion

The present study identified 20 healthcare-ified requirements with accompanying best practice components (Table 1). Those are intended to be used as a holistic transformation approach to introduce new IT, e.g., digital decision support systems, into a primary healthcare organization. The results aim to advance the field of digital transformation for primary healthcare by covering the specific

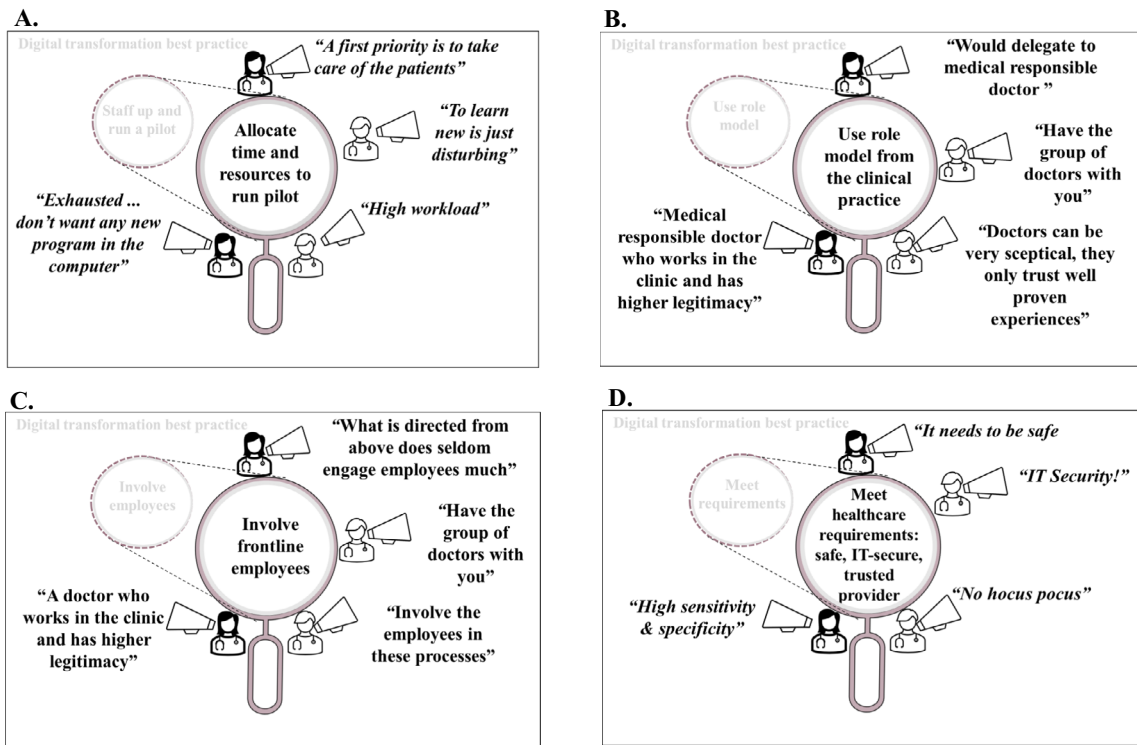


Fig. 3 Examples of healthcare-ification, using the voice of healthcare (interviews with selected primary healthcare stakeholders) as prism (here using interpretations of selected quotations). **A** Allocate time and resources to run pilot. **B** Use role model from the clinical practice. **C** Involve frontline employees. **D** Meet healthcare requirements: safe, IT-secure, trusted provider

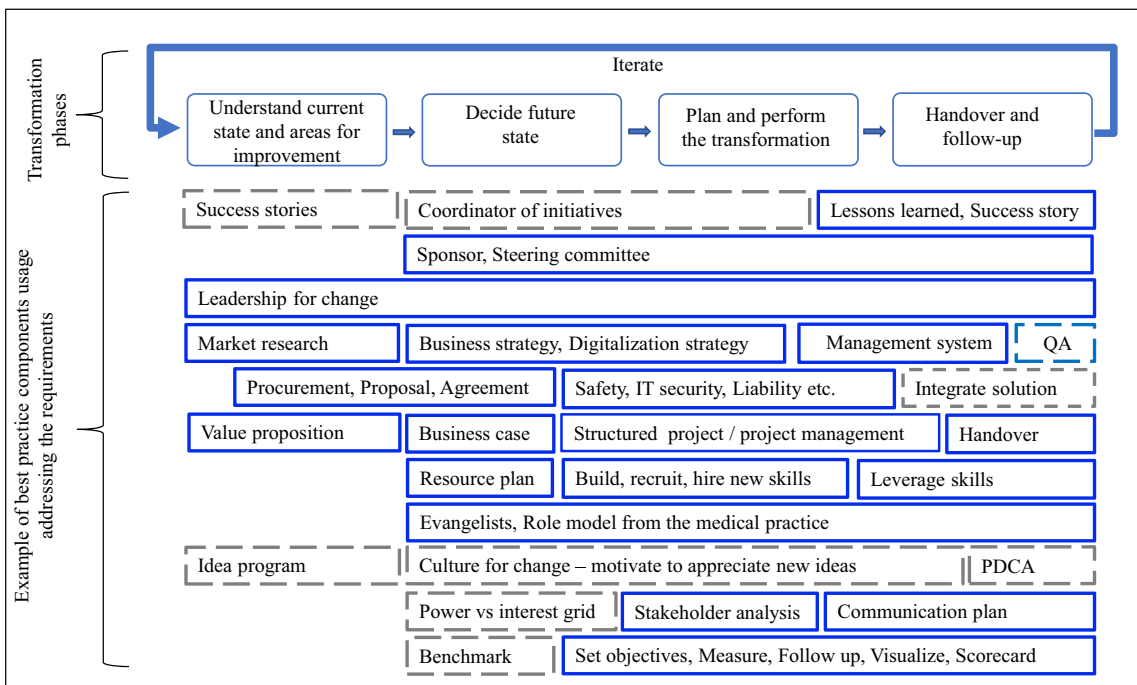


Fig. 4 Example of how to apply the holistic approach during transformation The lines surrounding the best practice components represent the priority where solid line means high priority and dotted line means lower priority or activity in lighter format. The actual priorities should be set by the involved team and varies from time to time

conditions for primary healthcare in an approach. The application of the approach was also exemplified (Fig. 4).

The introduction of new IT, such as digital decision support systems, into a primary healthcare organization can be complex [27] as it covers a lot more than just plugging in a new IT device. The challenges are many times non-technical [7]. A holistic approach can thus help cover a variety of needed aspects, e.g., business, organization, client, people, technology, innovation, quality. If one aspect is omitted, there is a risk this for failure and unnecessary cost. To become holistic a number of dimensions need to be covered. One can discuss how many dimensions there are. This study found that the twenty requirements induced from the interviews span over the seven dimensions suggested by a study by Ivanic et al. [11], and each can be related to (at least) one of the dimensions given. All twenty requirements are important to consider. If ignoring one there is risk to miss an important aspect of the problem and thereby reach an unsatisfying solution. Depending on the situation, some requirements can be more important to focus than the others, however all should be considered. Together, the components responding to the requirements form a solution, thus addressing the multidimensional area of implementing new IT into a primary healthcare organization.

This study did not find any evident reason not to use industry practices for digital transformation in healthcare, even though previous research identified conditions that are unique for healthcare [27]. The best practices should however be “healthcare-ified”, i.e., customized to give special attention to certain areas, preserve healthcare values and to earn trust from stakeholders.

There is not one single best practice for digital transformation, but there are a variety of useful components. In this study a selection was considered, seen by the lead author (A.F.) as the most relevant, but guided by findings from the interviews [27] and literature [2, 4, 5, 11, 13–22, 27, 33] (Additional file 7).

The presented approach is based on well proven industry best practices adapted to healthcare. Based on the authors’ own healthcare experiences, primary healthcare (the interviewed population [27]) does not, related to digital transformation, differ substantially from other healthcare environments. It is therefore the authors’ view that it, to a high extent, is healthcare generic and can help healthcare (a variety of healthcare environments) accelerate the needed digital transformation.

The approach was designed for primary healthcare and ready to pilot and use in the clinical practice, in contrast to previously presented digital transformation frameworks that are mainly generic [11] or academic [12]—a sign that this study covers unexplored territory. In addition, a cross-disciplinary perspective [5] was used, which

seems to differentiate from prior performed studies. A cross-disciplinary perspective (e.g., by having a mixed background or diversity in the team) can be advantageous when working with complex problems [34] as it may bring new and different perspectives to the table. By seeing different things and details, or experience things differently, depending on prior background, new solutions may come up never seen before. In the effort of advancing digital transformation in healthcare, a background in IT, management and medicine showed to be valuable. In addition, being part of the medical community made it possible to understand the innermost conditions of healthcare and gain trust from this closed community [27] to take part of their thoughts.

Strengths and limitations

The mixed method of inductive/deductive reasoning were useful approaches to go from objective to result. This study also used an action-oriented way of working which increased the understanding of the subject for every cycle performed [5, 17]. The voice of healthcare sample is currently based on interviews with 16 primary health care stakeholders [27]. The limited number can be seen as small for developing an approach. The way the approach was built was however intended to make it open and scalable. The current result, with requirements and corresponding best practices, may serve as a baseline where additional information, coming from real transformation-cases, can confirm or refine the approach (e.g., add, change or remove a requirement) by performing new iterations. Any additional or redundant group of requirements or dimensions will appear as more piloting and usage of the approach is performed and more data will be available. The approach will then get closer to right, however, the level of perfect might never be reached because all situations differ, and the environment will also change over time. The design aim to make the approach fault tolerant and adaptive.

Digital transformation in healthcare is not a new occurrence. Healthcare organizations have performed digital initiatives before, successful or non-successful and will not start from a zero experience. The perceptions of these experiences (what goes right and wrong) and what differentiates healthcare from other industries that have come further in their digitalization were captured in a previous study [27]. The current study did not consider the degree of digital maturity when describing the approach as such but aimed to present a healthcare generic approach. The aspect of digital maturity and digital transformation experience will however be of importance when using the approach.

The approach can be viewed as a tools portfolio to perform digital transformation in healthcare. As with any tool, the usefulness and result depend on the skill and experience of the user.

The requirements of the approach were directly derived from healthcare stakeholder's statements [27]. The approach was adapted to healthcare (healthcare-ified) by using the voice of healthcare as a prism. The prism can be seen as a metaphor for the adaption of the requirements—digital transformation best practices package to something that, according to what healthcare stakeholders say / the voice of healthcare (the catalysator) is more likely to work. It thereby preserved the needs and values important to consider for driving change in this specific environment [35]. By taking this knowledge into consideration, previous mistakes are more likely to be avoided, success-stories can be built on, and healthcare specifics can be catered for. It may turn the transformation journey to something that healthcare professionals feel relates to them. Since the approach is anchored in healthcare it might reach acceptance in the healthcare community. This may increase the chance to reach successful sustainable results and avoid wasted cost for abandoned initiatives [36].

Practical application

To stay relevant, any organization should continuously look for improvements [17] e.g., related to activities where IT can make a difference, i.e., not unique for primary healthcare environment. When a need has been identified, it has been confirmed there is a budget, available resources, and the timing is right, a lighter pilot may evaluate the appropriateness and function as a tollgate for broader deployment. This could especially be relevant for a business with several primary healthcare centres before broader deployment, but also for a single unit that would like to perform a smaller, non-committed trial ("toe in the water") before final deployment with larger impact on the business and surrounding environment. That would minimize risk for implementation failure. After a full deployment, the journey should continue with iterated cycles (similar to Plan-Do-Check-Act [17]). This is to avoid erosion or becoming irrelevant for the purpose. In addition to improve the actual solution, each time the approach is run, more learning is fed into the approach itself, with potential of making it better.

Initial use of the proposed approach is expected to face challenges. Even though the approach may serve as a guide to run digital transformation in healthcare, certain skills and experience will still be a prerequisite, e.g., related to IT and change management. Organizations will build this type of skills as they move forward, but will need some to get started. Another related problem is then that the closed healthcare community might be hesitant to consult people outside their own organization [27]. There might also be a variation in attitude and the degree of trust in new technology such as AI based applications that may be seen as a threat [28].

Future work

As a next step, the approach should be applied to real cases. There is a variety of needs out there e.g., Artificial Intelligence based [37]. CDSS for malignant melanoma [27] and other application systems for diagnostics, decision support systems, or systems related to medical records [7]. Such initiatives would evaluate and further explore the application of the approach. A real-world initiative is planned to evaluate the systematic approach's ability to perform successful digital transformation in the clinic using a 1st generation machine learning clinical system as example of new IT. This will evaluate the approach and likely—by using this systematic, holistic approach—also explore new research areas related to the introduction of AI in healthcare.

Conclusion

A holistic approach, based on industry best practices but adapted to healthcare can be used to introduce new information technology, such as digital decision support systems, into a primary healthcare organization and may help healthcare in general to accelerate the needed digitalization. Industry has long experience of driving digital change and practices can be transferred to support digital transformation in primary healthcare but needs to be healthcare-ified to adapt to the specific healthcare environment to preserve values and earn trust from stakeholders. The specific conditions and values in healthcare can be catered for by using the voice of healthcare as a bridge to digitalization in practice.

Abbreviations

CDSS	Clinical Decision Support System
IT	Information Technology
PDCA	Plan, Do, Check, Act

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s44247-024-00066-z>.

Additional file 1: A1 Table. Qualitative content analysis result.

Additional file 2: A2 Table. Going from code to requirement

Additional file 3: A3 Figure. Schematic view of the induction of codes to identify requirements. This is an example (not showing the actual induction)

Additional file 4: A4 Table. Example of abstraction path going code to requirement, and then mapped to dimension

Additional file 5: A5 Figure. Schematic view of the deduction of best practice components to form solutions that address the requirements. This is an example (not showing the actual deduction).

Additional file 6: A6 Table. Example of how best practice components formsolutions that address requirements.

Additional file 7: A7 Table. Description of best practices components ("the toolbox").

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Authors' contributions

AF and PP analysed and interpreted the data. AF was the major contributor in writing the manuscript. Both authors read, revised and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations**Ethics approval and consent to participate**

This study has been conducted according to the principles expressed in the Declaration of Helsinki, referring to the ethical principles for medical research involving human subject [38]. According to the study protocol, it has not collected any sensitive information from the human subjects that falls under the obligations of the Swedish Ethical Review Act [39]. All participating human subjects have provided their written informed consent prior to study participation. The institutional review board at the department of NVS, Karolinska Institutet, Sweden has provided their ethical statement regarding the present study.

Consent for publication

Not applicable.

Competing interests

The author P. Papachristou is a co-founder of the CDSS (Dermalyser). No conflicts of interest are declared for other authors.

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