A checklist for healthcare organisations undergoing transformational change associated with large-scale health information systems implementation

Judith Sligo [a,*], Vaughan Roberts [b], Robin Gauld [c], Luis Villa [d], Sarah Thirlwall [b]

[a] Department of Preventive and Social Medicine, University of Otago, Dunedin, New Zealand
[b] Counties Manukau Health, Auckland, New Zealand
[c] Dean's Office, Otago Business School, University of Otago, Dunedin, New Zealand
[d] Ko Awatea, Counties Manukau Health, Auckland, New Zealand

A R T I C L E   I N F O

Article history:
Available online 9 August 2019

Keywords:
Transformation
Organisational change
Health information systems
Checklist

A B S T R A C T

Objectives: Healthcare organisations are increasingly required to undertake transformational change in response to epidemiological and demographic changes, and rapid healthcare technological advances. However, transformational change is notoriously complex and challenging. This article presents a checklist that identifies key components of successful transformational change for organisations planning change.
Methods: The checklist was developed after an extensive review of the literature and from the learnings of a realist evaluation of a transformational change process in a New Zealand Healthcare organisation. The article describes the items in the checklist and provides justification from the literature and evaluation.
Results: A theoretical framework for the evaluation provided the structure for developing the checklist around four domains: organisational structures, resourcing, workforce, and information technology. These components are foundational: experiences of other organisations show that if these items are not in place or addressed, transformation will not occur.
Conclusions: The checklist provides healthcare policy-makers and organisations with a template which can identify each of the components of a complex system. The checklist is created to adapt as organisational transformation evolves so is an advancement in both the use of checklists and in successful implementation of transformational change.

© 2019 Fellowship of Postgraduate Medicine. Published by Elsevier Ltd. All rights reserved.

Introduction

Transformational change involves a significant change in an organisation's ways of working, requiring changes in structure, culture, and management. Organisational transformational change is usually required for successful adoption and implementation of large-scale Health Information Systems (HIS) [1–3]. Well-implemented HIS have potential to improve healthcare, safety, and efficiency, and reduce clinical errors in healthcare organisations [4–9]. The aim of transformation for healthcare organisations is to provide consistently safe, high-quality care for patients through improved organisational and clinical processes and implementation of new supportive infrastructure such as HIS. Transformational change, however, is complex to manage and outcomes are difficult to predict [10,11].

This article outlines the crucial pre-requisites for successful transformational change and provides a checklist for organisations planning and/or implementing transformational change. The authors identified the necessity for such a tool in the evaluation of a transformational change programme in a large healthcare organisation in New Zealand (abbreviated to NZHO). Part of the ongoing process of evaluation required the evaluation team to identify examples of successful large-scale HIS implementation and transformational change programmes from the literature. This proved more difficult than anticipated: there are multiple examples of HIS implementation challenges and failure in the literature, while identifying examples of unqualified success is much more difficult [12–14]. Moreover, successful transformational change programmes are rarely replicated in another setting and one reason for this is because the details of programmes of change are often poorly described, making it difficult for the programme to be reproduced in a new context [11]. Implementing HIS is complex, expensive, has unanticipated negative consequences, and is high risk, all of which have contributed to the relatively low implementation

* Corresponding author.
E-mail address: judith.sligo@otago.ac.nz (J. Sligo).

success rates [15]. Thus, the goal of this article is to identify factors from the literature that were consistently described as crucial to successful implementation of transformational change [16] and link them with the results from the evaluation of the NZHO transformational change programme. This will provide evidence and specific examples for other organisations undergoing transformational change and elucidate the inclusion of items on the checklist. It is important to note the evaluation of this NZHO's transformational change focused on the planning phase and was completed prior to any implementation. Hence, the examples from the NZHO's transformation in this article are restricted to the planning stage. The implementation items on the checklist are justified from an extensive search of the literature and the understanding that the requirements for successful planning and implementation overlap, given that the two processes are intrinsically linked and can be viewed as a continuum rather than a dichotomy [17].

The specific details of the NZHO evaluation are outside the scope of this article. However, in combination with the evidence from the literature, such as that cited above and throughout this article, the findings from the evaluation provide strong support for the inclusion of the components of the checklist.

Below we provide an overview of the benefits of checklists and their relevance and appropriateness for guiding transformational change projects, before outlining the methodology for the NZHO evaluation project. We then present the results: this is done by detailing and grouping related checklist items and then describing the relevant literature and findings from the evaluation which influenced our decision to include these items on the checklist. We conclude with some reflections on the limitations, significance and potential of the checklist.

Background

The authors developed the checklist presented in this article as a result of their evaluation of a transformational change programme in a New Zealand healthcare organisation. The literature revealed that other organisations had also encountered challenges in planning and implementation of change and focused broad guidelines linking to research evidence were not available (to our knowledge). Our decision to develop a checklist rather than guidelines or procedures for successful transformation was informed by the checklist literature, outlined below. In this context, the checklist strengths are in the detail a series of checklist items can contain, the ability for a checklist to be adapted to circumstances, and accountability for a team using a checklist for ensuring that the different dimensions incorporated are discussed and responded to. The checklist presented in this article differs from others used in healthcare in that its focus is processes of transformation. Others, as described below, are focused on clinical procedures, in particular surgery, although checklists have extended to areas such as home-based healthcare [18]. Thus, our checklist fills an important gap in the literature and has potential to contribute to improvements in management of transformational changes associated with large-scale HIS.

Checklists have practical origins and application in the airline industry where they have been used for over 70 years [19]. While the context for use in aviation differs from healthcare, the basic principle is the same. For aviation, this is to facilitate a process of ensuring that all procedures have been completed prior to commencing a flight, so that safety in normal circumstances is assured. For healthcare, especially surgery, where checklists have predominantly been developed and applied, it is to ensure that the surgical team have ample opportunity to ensure that all factors that could lead to error or patient harm have been considered and planned for, so that risk is reduced. Healthcare checklists were developed and applied much later than in aviation, in keeping with the more recent approach to patient safety and quality improvement. Studies of checklist use in surgery have appeared only since the 2000s [20,21].

In a general sense, a checklist has been described as "a list of factors, properties, aspects, components, criteria, tasks or dimensions, the presence or amount of which are to be separately considered, in order to perform a certain task" [22]. Checklists are useful where there is complexity and unpredictability, in situations that vary across settings and where the knowledge required exceeds that of any individual [23]. A checklist is not a prescription or formula but provides individuals working in a complex scenario with guidance about the basic steps [24]. It should be brief but effective, include both communication and task checks and use terminology that makes sense in the context where it is being used [23].

A checklist requires testing in the real world and should have frequent revisiting and ongoing refinement. Thus, the checklist attached in Appendix 1 is intended as a starting point for organisations implementing transformational change; it needs testing and refinement through application. There are examples of checklists being effective in behavioural change in healthcare organisations [25,26] but it is unclear whether the items on the checklist create change or if it is the conversations around the checklist that cause the improvement [27]. There are also queries about whether an instrument from one industry (aviation, which has a long history of checklist use) can be transferred to another (healthcare, where usage has, to date, mostly focused on surgical services), which is fraught with variations and unpredictability, particularly when the instrument relies on standardised processes [28]. It is also noted that checklists can produce a false sense of safety and that the focus can become 'ticking the box' rather than the multiple changing influences in a healthcare setting [29].

The literature querying the efficacy of checklists in healthcare settings notes the importance of addressing the complexity of healthcare settings. It is crucial that the historical, cultural and structural circumstances are taken into account in the development and implementation of a checklist. In this way, checklists can be used as a tool for developing rapport between disciplines and a commitment to change in a complex culture [29]. However, it is important to remember that checklists are just one component of a programme to alter the culture of an organisation [30]: "Checklists, by themselves, do not improve care, but when they identify a series of evidence based strategies, they can be employed as tools to support practices among staff individually and collectively committed to making them work [31]."

Readers intending to use this checklist in their own organisations should carefully review each of the items and evaluate its relevance in their organisation before including it in their own checklist. The success of a checklist is in its adaptation to the context and continual review and audit [30]. Each iteration of the checklist should have a publication date, and identify who is responsible for each item and when it is to be next reviewed. Using this checklist will provide healthcare organisations undergoing transformational change with a foundation for ensuring that they do not repeat the mistakes of organisations that went before them.

The theoretical framework and methodology that underpinned the evaluation is outlined below prior to the justifications for including the checklist components, using evidence from the literature and examples from the evaluation.

Methodology

The methodology for the NZHO evaluation was derived from realist evaluation theory which seeks to "unpack the mechanism of how complex programmes work (or why they fail) in particular contexts and settings" [32,33]. The underlying realist evaluation

question is "what is it about this programme that works for whom in what circumstances?" [33] This requires evaluators to identify and test the theories underlying the programme and investigate the capacities and interpersonal relationships of the people instigating and administering it. The evaluation research had ethical approval from the authors' institutions. The process of the evaluation involved reviewing and summarising the documentation from the NZHO project (such as reports, meeting minutes, correspondence, business cases and procurement plans) and interviewing 25 individuals who were intrinsically involved with the intended transformational change and included clinicians, managers and senior managers employed to oversee different aspects of the transformational change, information technology consultants, senior managers within the NZHO and people with governance and overseeing responsibilities. A focus group interview was also conducted with nurses who had tested an information technology device as part of the transformation. The interviews were transcribed and thematically coded by the first two authors using Nvivo computer technology [34]. Using a process of deductive analysis these initial themes were refined to seven latent themes [35]. These informed this current work and are detailed in Appendix 2.

The theoretical model that provided the foundation for this evaluation was an adapted version of Yusof et al's "HOT-fit" model evaluation framework, which prioritises interactions between the system and users [36]. This model incorporates the concept of 'fit', which is perceived as complex, abstract and subjective and describes the ability of humans, technology, and the organisation to align with each other for net benefits. From the literature, the authors identified and added one crucial factor for success that is not included in the HOT-fit model, adequate resourcing. Modifying the model in alignment with new evidence is consistent with the realist evaluation approach.

The domains of the theoretical model also provide a structure for the checklist, which is organised into four groups identifying the resources and the organisational, workforce, and technological factors required for successful transformation. These factors vary depending on the stage of transformation so the checklist is divided into two sections: the first for organisations planning transformation and a second for those implementing and maintaining transformation in a healthcare organisation.

The literature review process encompassed two approaches: a systematic search of nine general and medical databases for transformational/complex and program/me, hospital/healthcare and IT/IS (or technology). The focus was on large scale and transformational technology implementation with the goal of identifying the multiple factors involved in successful implementation of complex HIS; and a 'meta-narrative literature review' replicating the process used by Potts et al. [37], which involves an exploratory informal searching phase followed by identification of key concepts, theories and preferred methods to make sense of complex, heterogeneous bodies of literature. The search strategies are detailed in Sligo et al. [16]. The literature, evaluation results and theoretical perspective have all informed the checklist structure and items.

Results

Below the relevant details from the evaluation of a transformational change programme in a NZHO are used to provide examples to support findings from the literature to explain why these items within the four checklist categories (Organisational Structures, Resourcing, Workforce and Information Technology) are crucial for successful transformational change. Each section includes tables that detail the related checklist items for that section of the checklist. The left hand column of the table contains a statement that provides a summary description of related checklist items, which

have been grouped because they relate to each other. The numbers in the two right columns refer to the specific number of each checklist item from the planning and implementation checklists (in Appendix 1). Their presence in the checklist has been informed by the same literature. Each table is accompanied by the overview of the literature and examples from the NZHO evaluation, which justified the items' inclusion in the checklist.

The first (Table 1), below, outlines the importance of understanding the requirements of, and communicating with, the organisation and population they serve.

Organisational structures for planning, implementing and maintaining transformational change

The organisation's population includes all those who will be 'end-users' in the organisation as well as all stakeholders and the community whose healthcare will eventually see the impact of the intervention. Dedicated effort to foster high levels of trust and early engagement with end users can bring about widespread 'buy in' from clinicians, patients, and other stakeholders [38]. Developing stronger public involvement in the organisation and delivery of health-care is now central to health reform across Western economies [39–42] and a systematic review of literature involving patients in healthcare found that patient involvement contributed to new and improved services, better clinician attitudes to the public, and increased quality of care across a range of settings. However, there was also evidence of consultation as a source of legitimation of the decisions of policy-makers and administrators [43]. It is also noted that consultation can be time-consuming [44] and Ocloo and Matthews warn against tokenistic, narrow, and exclusive approaches to involving the public in healthcare improvement [45]. Bearing these caveats in mind, public involvement is important for democratic processes and can make services more responsive to the individuals and communities that use them [42].

The NZHO project evaluation participants indicated that the meaningful, reciprocal communication with the community was one of the strengths of the project. Community representatives felt that their views were heard, valued and provided valuable knowledge about the population's needs and expectations of care. Information from community representatives was used to create theoretical 'client journeys', which provided templates for the transformational project staff to understand the nature of existing problems and desired outcomes. The consultation with community representatives was described as useful, evocative, and meaningful by medical professionals in the organisation and it clarified and reiterated what was required of a transformed organisation.

Research also suggests that it is often external factors that undermine the success of change implementation or quality improvement [46,47]. Changes in national or regional policy, and problems within external organisations (such as IT companies) can derail transformation. Hunter et al. note that the ultimate fate of a transformational change will be at the mercy of political pressures and contextual features [48].

The evaluation of the NZHO transformational change identified that the organisation's understanding of the needs of the population was foundational to the process. Information about

Table 1
Healthcare Organisation's communication with the community.

	Planning Checklist items	Implementation Checklist items
Organisational structures		
Community understood/ consulted/communicated to and with	1, 2, 6, 11, 14	3, 4, 5, 7, 12, 15, 19, 26

Table 2
Governance characteristics.

	Planning Checklist items	Implementation Checklist items
Organisational structures		
Stable and supportive governance	3, 4	1, 2, 3

the population and their requirements was readily available from national and local records and the issues facing the geographic area were well-known. It was acknowledged that the combination of demographic changes, healthcare innovation, and public expectations within a constrained budget were the impetus for the required large scale changes. This NZHO also acknowledged that maintaining an understanding of the regional and national context surrounding the NZHO at all times was critical, and maintained frequent communication with external local and government bodies. For this NZHO a change in national government policy had significant impact on the potential for transformational change. This policy required the organisation to work collaboratively with neighbouring organisations on a proposed regional electronic health record, which impacted the existing transformational change plan. The NZHO was able to alter their plan before any further investments not in alignment with the regional strategy were made.

Thus, successful transformational change requires a clear understanding of every aspect of the external context of the organisation. Internal structures are also important and the importance of stable governance is the next of the checklist organisational categories to be addressed (Table 2). "Good governance in health systems promotes effective delivery of health services" [49].

This occurs through setting priorities, monitoring progress, holding staff to account and shaping culture [50]. However, healthcare organisations have complex organisational structures and diffuse decision-making [51–53] and, internationally, healthcare governance has undergone significant change in the last thirty years [51,54], making governance difficult to measure and understand. What is clear, however, is that ambiguous governance structures are correlated with poor outcomes: unity of command, direction, and accountability/responsibility are all key to quality governance [55]. Implementing transformational change requires committed, stable leadership, attention to team-building across disciplines and leadership development at many levels [56]. Along with a clear understanding of who leads the transformation, leadership should also be distributed so that managers, professionals, partner organizations and teams take responsibility for their aspects of the programme [1].

The individuals in senior management positions should be well-informed, forward-thinking and supportive of organisational change [56–58]. Effective change leaders require the ability to create a culture which can manage the human side of change, which is invariably challenging [59]. Caldwell et al's evaluation of strategic change in a large healthcare organisation found that leaders were crucial to the success and recommended that leaders need to focus on building support for changes via direct, relentless communication [60]. Leaders need to plan, implement, monitor and adapt to changes in the environment as they occur. This requires effectiveness and resilience from leaders and Collins et al. note that "specific training can help develop a deep understanding of transformational change theory and a comprehensive skill set for attending to the critical components of the transformational change process" [59].

The senior management of the NZHO were considered visionary and were largely in favour of the transformation but there were some governance board members who were described as

'risk adverse'. This meant that many levels of accountability were set in place, with multiple levels of scrutiny and frequent reporting requirements. The organisational structures were also complex, changed during the timeframe of the transformation, and included multiple steering groups. Clear, consistent, stable governance including people with good institutional knowledge and memory is vital for successful transformational change. It is also important that ongoing monitoring and evaluating of the process is established and maintained. Table 3 (below) identifies the checklist items that refer to external assessment and appraisal, which is the topic of the next section.

Using quality data for improving the quality of care is a powerful tool when indicators are clear, experienced, skilled evaluators are employed and good data collection, measurement and interpretation systems are in place [61]. "Measurement systems need to be explicitly designed into improvement activities from the start, and they need to be adequately resourced" [62]. Best et al. 's review of large scale transformation found that continual monitoring and feedback loops are crucial to transformation success but note that the measurement needs to be fit for purpose, and involve people across the organisation who understand and have faith in the measures [1]. They also recommend systematic incentives for acting on (or penalties for not) the indicators from ongoing measurement.

The evaluation of the NZHO's programme found that ongoing external assurance and evaluation satisfied management that processes were rigorous and justified the risks in the planned actions. Independent review of a competitive procurement process reassured staff that the NZHO had contracted the correct party. Different types of assurance were called on at different times and the authors were also brought in to provide external evaluation, all of which was positively received. Evaluation and external assurance need to be built into transformational change right from the planning stages throughout the implementation. Next, Table 4 identifies the checklist items that relate to the importance of having a transformational hub.

Healthcare organisations' dual hierarchical clinical and managerial structures can create challenges in the goal of transformation: unless clinicians can see the positive benefits of change for their practice and patients, the decisions of managers have a variable and limited effect [63]. Research suggests that within healthcare organisations there are disciplinary 'sub-cultures' which have their own hierarchies and values, which make a cohesive approach to transformation challenging [64]. A skilled and experienced 'change agent' who leads a team capable of dealing with ambiguity and managing setbacks and challenges is vital to successful transformation [65]. Transformational change requires engagement from

Table 3
External assessment and appraisal.

	Planning Checklist items	Implementation Checklist items
Organisational structures		
External assurance, monitoring, evaluation	5	6

Table 4
Developing and maintaining a transformational hub.

	Planning Checklist items	Implementation Checklist items
Organisational structures		
Instigation and maintenance of transformational hub with lead who has transformational change experience	7, 17	8, 20

Table 5
Effective resourcing.

	Planning Checklist items	Implementation Checklist items
Resourcing		
Cost calculated and monitored	8, 10	9

Table 6
Budgeting for personnel.

	Planning Checklist items	Implementation Checklist items
Resourcing		
Adequate funding for staff training, secondment, replacement	9, 14, 21	10, 11, 13, 16, 23, 24

clinical and managerial personnel as well as administrative staff, IT specialists, and contractors.

On reflection, several individuals involved in the NZHO transformational change identified the absence of a dedicated transformation multidisciplinary team as a shortcoming of the change process. It was suggested that clinicians and managers with IT knowledge and passion for change should be seconded out of their usual work to form a 'transformational change hub' led by a dedicated transformational change leader. In this case it was noted that a hub would alleviate the challenges of complex governance structures and allow the personnel from different disciplines to develop a shared language to work together for transformation. These people provide leadership to develop buy-in with end-users, and take on the role of advocate for the transformation with their colleagues who speak their professional language. A multidisciplinary hub brings together key individuals, with shared understanding about the processes and goals of transformation, who are able to translate these for personnel in the rest of the organisation.

Resourcing for planning, implementing and maintaining transformational change

Resourcing is the second grouping of checklist items. The first resourcing category is ensuring that the transformation cost is calculated and monitored (Table 5).

Adequate resourcing is a key component in successful transformational change [52,66–68]. "Adequately resourcing change means investment, but increases the likelihood of success, leading to greater efficiency and better outcomes in the long term" [69]. Budgeting for transformational change can be challenging because resources are not just financial but include personnel, project management, time, funding, and investment in infrastructure across participating organisations, all of which need to be adequately resourced across these domains [70,71]. It is also true that predicting cost-benefit analysis into the future is complex [72]. However, a centralised project manager can provide a central infrastructure and lower the need for internal resources [70]. Definition and maintenance of the original success criteria are optimal for successful change but if these are forced to change, deadlines and budgets need renegotiating [73]. This indicates the need for continual monitoring and external assurance.

The NZHO transformational change evaluated by the authors was described as initially well-resourced and had a dedicated team employed to run the project. However, as the project moved from initial business case to detailed design, resourcing requirements increased. Additional consulting staff needed to be brought on quickly to meet workload demands, which was challenging as some had no prior health sector experience. Of particular note was the lack of a full-time transformation lead to champion the transformational change, a position the NZHO sought to appoint but were unable to find a suitably qualified candidate in the timeframe of the project. Moreover, despite the NZHO's best efforts to ameliorate the risk via planning and external assurance, it became apparent that a system wide transformational change programme would be more expensive than initially expected due to the age and lack of flexibility in the existing IT infrastructure.

Budgeting for transformational change is complex and can be difficult to contain. Along with hardware and software costs, the cost of supporting the implementation of new systems requires quantification of the time spent by the implementation team, management and end users in training, simulation, practice, and related activities before, during and after implementation [71], which is the next of the resourcing items from the checklist (Table 6).

Organisational change is stressful and confronting for staff and research shows that successful transformational change in healthcare organisations is dependent on plentiful training and support [74–77] so that people at all levels and in all roles understand their tasks in the changing environment. Training across the organisation requires adequate funding to cover the costs of the individuals undertaking the training, their replacements and the staff to train existing staff. There is some suggestion in the literature that providing incentives for training also assists in positive attitudes around organisational change [67].

The evaluation of the NZHO found that this organisation had good commitment to funding cover for clinicians and other personnel involved in the early consultation processes. However, it was noted that meetings were often arranged at short notice, and whilst there was budget to provide cover for clinical staff to attend such meetings, replacing clinicians was not always possible within the timeframes required. This limited the pool of actively involved clinicians to senior clinicians who could fit those meetings into their non-clinical time, which impacted the extent those clinicians unable to attend could buy-in to the project.

The authors identified adequate funding as a foundational factor for successful transformational change and the specific checklist items are detailed in Table 7 (below). The research literature tends to focus on the influence of organisational and cultural factors [56,60,65,76,78] although cost and adequate funding is also acknowledged [70,79,80]. Healthcare organisation transformation inevitably requires technological advance and change, the cost of which is one of the most commonly cited barriers to upgrading [81].

Prior to the planned transformational change, the NZHO's governance team identified the cost as potentially inhibitive so were innovative and yet careful in their approach to funding. They investigated the funding systems used by other organisations, which had successfully undergone transformation. The scoping was continually reviewed and guided by the relevant bodies: Government ministries and a national health information technology organisation provided support and shared knowledge on best practice. The transformation working group reported to two project sponsors whose joint role was to approve the project plan and budget and any subsequent variations, and make decisions on recommendations and issues brought forward by the working group. The project sponsors also acted as the link be-

Table 7
Planned resourcing.

	Planning Checklist items	Implementation Checklist items
Resourcing		
All potential sources of funding identified, including partnerships	10, 24	

Table 8
Suitable workforce.

	Planning Checklist items	Implementation Checklist items
Workforce		
Sufficient, knowledgeable project management staff employed & supported	12, 13	11, 13, 14

Table 9
Communication with workforce.

	Planning Checklist items	Implementation Checklist items
Workforce		
Staff effectively informed, consulted and trained at all stages & reluctant staff issues addressed	11, 15, 16, 21	12, 15, 16, 17, 18, 19

tween the Governance Group and the Working Group. The decision was made to seek a strategic partnership with an external company for the transformational change programme. This arrangement is discussed further in the Information Technology section.

Workforce for planning, implementing and maintaining transformational change

Workforce features is the third grouping of checklist items identified as crucial for successful transformational change. The first workforce category is ensuring that there are sufficient management staff who have adequate institutional support.

Best et al. note that one of the five 'simple rules' for transformation is blending designated leadership with distributed leadership [82]. Transformation requires change management throughout the levels and branches of the organisation so that change can occur incrementally at a local level: "Major change emerges from aggregation of marginal gains." [83] While committed leadership is important, the literature warns of the limits of top-down approaches in healthcare settings and the importance of bringing together the views of different occupational groups at the front lines [84]. Facilitating collaboration between levels and disciplines within the organisation requires effective management from the change management team who need to understand the expectations, requirements and workflows of professionals, clinicians and managers. This mid-level management is crucial: "middle-level managers within an organization may, through their leadership of groups within the organization, either enhance or undermine the organization's ability to implement a strategic change" [60] (Table 8).

In the NZHO, there was some debate about whether successful programme, project, and change managers required healthcare experience and acknowledged that managers from other sectors may bring insight from other industries and could provide meaningful managerial and financial services to the change process as long as they had access to clinical expertise. However, it was also noted that an understanding of healthcare systems and structures provided valuable background knowledge for decision-making. Some of the external partner staff brought in to consult on the project, were recruited on short-term contracts at short notice, and, without prior healthcare experience, struggled to comprehend the culture of the organisation. The preference was for key individuals who can span the key groups and knowledge areas and mediate differences when foundational understandings are in place. Where possible, these people should be found within the organisation so that they already understand the culture of the organisation and are aware of the nuances of different personalities and styles. The next group of checklist items in this section is about communication and are detailed in Table 9.

Having staff who are committed to and enthusiastic about transformational change is crucial to its success [48,85]. One of the most consistent findings from transformation research is that including end-users in planning and implementation of change reduces resistance and builds trust [86]. Interdisciplinary teams including clinicians, consumers, providers, IT staff, and managers

can use their combined knowledge to redesign structures and processes [83]. Positive effects of strategic change are the greatest when staff support the new direction so leaders need to focus on building support via direct, relentless communication [60]. Communicating the vision and proposed changes throughout the organisation is crucial and should include opportunities for staff to have their concerns and queries addressed [86]. Staff need to know why the transformation is occurring and how it will improve the organisation and the services they provide. Having a champion to promote an innovation and support the requisite change effort was associated with a positive impact on the implementation process and success of various HIT projects [70,87], and not having a champion is a risk factor for lack of implementation [88].

The evaluation of the NZHO transformational change undertaken by the authors found that communication between the transformation management and the rest of the organisation (clinical, managerial and administrative staff) was pivotal. Staff described early communication as comprehensive and there was considerable support for the transformation. However, health organisation staff are busy and have discipline-specific ways of communicating which provided challenges for dispersing and accessing vital information. The objectives of the transformation project were not always clearly understood by all the NZHO staff, and there was confusion about whether the planned changes were transformational or technology upgrades and innovations. There was also a cautious approach to sharing information because of the transformation's sensitive commercial nature. Evaluation participants stated that the most effective communication was frequent, personal, engaging, brief presentations by trusted colleagues who were intrinsically involved in the transformation. Aiming the information at the least interested and engaged by making it relevant to their everyday working lives and encouraging those people to be more involved in the consultation would be a useful strategy. Clinical staff involvement is crucial and discussed below (Table 10).

It is important to include clinical staff at all stages of planning and implementation of change: and clinical resistance to change is detrimental to implementation of new systems [16]. Clinicians have a high degree of autonomy (collectively and individually) and decentralised decision making is common [52] so their attitudes influence the acceptance and implementation of change in their departments. Clinical leaders who have technical health IT skills and experience can act as champions in the role of technology in the change process and liaise in partnerships with IT professionals [89]. Including clinicians in governance can also have benefits: Research has found an association between clinical involvement in governance and quality of service [90–93]. However, Gauld warns that clinical governance needs to be clearly defined and re-

Table 10
Role of clinical personnel.

	Planning Checklist items	Implementation Checklist items
Workforce		
Involvement of clinical staff at all stages	13, 14, 22	14, 16, 25, 27

Table 11
Technology requirements.

	Planning Checklist items	Implementation Checklist items
Information Technology Existing and future technology platform and interoperability requirements identified & monitored. New technology is fit for purpose.	18, 19, 22, 23	21, 25, 26, 27, 28

Table 12
Technology professional development.

	Planning Checklist items	Implementation Checklist items
Information Technology Ongoing IT training is identified and resourced	21	23, 24

quires robust management–clinical partnerships, a coherent organisational developmental strategy and investment in training [94].

Clinical staff were consulted and remained actively engaged in the early stages of the transformation at the NZHO. Clinicians with IT expertise felt that their views were valued by the technical team and good collaboration occurred. However, there was some reflection that clinicians were engaged as advisors rather than in decision-making roles. And, as already noted, when their consultation was required for the transformational process, clinicians were often invited to attend meetings at short notice and were unable find relief for their clinical work. Whilst there were non-practicing clinicians on every level of governance, including five on the executive management team, some clinicians perceived having no practicing clinical staff at the senior governance levels of the organisation as an obstacle for transformation.

Information technology for planning, implementing and maintaining transformational change

Technology is a crucial component of the transformation from stretched healthcare systems with disorganised and inefficient delivery systems with high error rates and poor communication, to co-ordinated management of healthcare to provide better care, better health, and reduced costs [95,96]. Information Technology is the final grouping of checklist items included on the checklist. The first information technology category is the importance of knowledge about existing technology and interoperability (Table 11).

Usability is a critical factor in the design and development of healthcare IT systems. "Systems that are well designed from a usability standpoint increase the utility of the system, decrease potential error, enhance user acceptance, and can lead to improved productivity" [97]. To be successful technology needs to be compatible with the organisation's culture and work processes and superior to the previous systems. If the new system is perceived as difficult to use or detrimental to existing practice, staff are unlikely to use it or use it incorrectly [98].

IT is changing rapidly. The average life cycles of medical devices range from 18 to 24 months [99] and the use of information and communication technologies in healthcare is expanding dramatically [100]. As a result, healthcare organisations undertaking transformational change need to have sound IT management in place [78] and have a comprehensive understanding of the technology options available. Early health technology assessment is encouraged to evaluate technologies in development, to future-proof investment, and maximise the societal impact of research and development [99,101–103]. One of the key criteria in the assessment of new and existing technology is the requirement for interoperability, "the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged" [104]. Interoperability can reduce costs [105,106] but organisations need to ensure that they do not compromise the quality of their local systems for inter-organisation interoperability [2]. It is also important that organisations planning for transformation have a comprehensive understanding of their existing technology infrastructure and ensure that

new technology can be integrated. Heeks found that a gap between the requirements of a new system and the reality of existing organisational technology was a cause of health information system integration failure [107]. This was a significant issue for the NZHO transformation.

The NZHO undertook an assessment of the existing IT infrastructure as part of their programme and this knowledge proved instrumental in determining the path forward for the implementation of transformational HIS technology. Ongoing professional development was also intrinsic to implementing technology change (Table 12).

The technology component of transformational change requires training and support for staff to be successfully planned and implemented. Significant time and funding should be allocated for integrating technology into quality improvement activities [75] and a large part of this involves staff training. Gagnon et al's systematic review of articles about factors that can facilitate or limit IT implementation in clinical settings found that training was regularly cited as contributing to successful implementation [5]. Inadequate or non-existent training was likely to impede implementation. They also noted that having good strategies for training and support are important in a context where clinicians have very limited available time. Education and training needs to occur throughout the process of change: overcoming issues prior to implementation by including staff in design and testing, keeping everyone informed about the timing and effects of changes as well as ensuring staff know how to use the technology [17,75,85,108].

Few of the NZHO technological innovations intended to be part of transformational change were delivered within the timeframe of the evaluation period. This meant that training as an IT factor for success had not been tested in the organisation. However, the project initiatives that were implemented following the evaluation period included the strategies described here. It is clear from the literature that providing and resourcing adequate, comprehensive training and providing on-going IT support is crucial to successful transformational change [67,109–111].

Table 13 (below) records the checklist items that relate to the relationship between healthcare organisations and information technology companies. Managers of organisations undertaking transformational change have to decide to what extent it is profitable for their organisations to outsource IT services and the nature of the relationship with the IT company [112]. Outsourcing is "a decision taken by an organisation to contract-out or sell the organisation's IT assets, people and/or activities to a third party supplier, who in exchange provides and manages assets and services for monetary returns over an agreed time period" [113]. Outsourcing may involve a strategic alliance, which entails the sharing of risks and rewards [112]. Such partnerships are com-

Table 13
Connections with external IT providers.

	Planning Checklist items	Implementation Checklist items
Information Technology Relationships with external IT organisations clearly defined	20, 24	22, 28

mon in healthcare organisation transformational change projects, due to IT companies' greater expertise in and experience of large scale transformation. IT outsourcing literature details many risks including the potential for internal issues like backlash from internal IT staff; problems with the vendors such as biased portrayal of services; and issues around the relationship between the organisation and the vendor such as difference in cultural fit [114]. The key factors for successful outsourcing are contract management and formal and informal controls throughout the process for the success of an outsourcing endeavour [115, 116], but Lacity et al.'s literature review notes that outsourcing experience is vital: "Any organization that explores a new sourcing option in terms of new suppliers, new services, or new engagement models with existing suppliers must plan on false starts and many mistakes [114]. Although outsourcing is complex, dynamic and uncertain, the literature reiterates the importance of contract management and formal and informal controls throughout the process for the success of an outsourcing endeavour [115,116].

The NZHO's process for developing a strategic partnership with an IT company was robust: significant time was dedicated to ascertaining the potential of such a relationship and investigating the options. A rigorous procurement process occurred, which included internal due diligence and external assurance. A Strategic Relationship Agreement was signed and the NZHO and IT company entered into a period of joint validation, followed by an independent evaluation of the partnership and recommended improvements were adhered to. Thus, it was agreed that the process had been rigorous and, as much as possible, risks had been mitigated. However, despite this cautious and thorough approach, the strategic partnership suffered many of the issues commonly identified in such arrangements: there were communication problems between the arms of the transformation, the personnel changed over time, and the commercial interests of the partner organisation were not always in alignment with the goals of the organisation.

Discussion

Transformational change in healthcare organisations is notoriously complicated and challenging but there are now enough examples detailed in the literature to identify the factors that impede or support successful transformation. This literature and the evaluation of a specific transformational change project have informed this article and assisted the authors in developing a checklist for organisations undergoing transformation. To recap, the purpose of a checklist is to simplify complicated processes and identify the minimum necessary steps for complex actions [23]. The authors acknowledge that incorporating the factors related to successful transformational change is a huge challenge for a relatively simple checklist and reiterate Alspach's view that a checklist cannot be relied on to improve processes by themselves [31]. Instead, a checklist should be thought of as a tool to keep an organisation on track as it changes the culture around an intended change [30,117]. The checklist which is the focus of this article is a departure from the standard use of checklists encountered in healthcare organisations, which are usually to improve safety in clinical settings [23]. The checklist here relates to complex organisational change. The authors argue that this is an advancement in both the use of checklists and in successful implementation of transformational change as long as the checklist is used as a tool to guide the transformation of the culture in the specific context of a healthcare organisation. It is intended as a practical tool for managers, practitioners, healthcare professionals and those in governance who are committed to transformational change. The checklist can be related to the specific context and will provide guidance and act as a prompt for users to ensure that they are addressing the crucial implementation factors as identified in

other projects. In this way, the checklist will assist healthcare organisations to effectively implement transformational change.

The checklist detailed in this article is organised around a thematic framework, which identified organisational structures, resourcing, workforce, and information technology as key overriding themes containing essential components for successful transformation. These will not be the only components of successful transformation but they are foundational: experiences of other organisations show that if these items are not in place or addressed, transformation will not occur. Within each organisation there will also be other key items that need to be included in their checklist. These should be identified in communication across the organisation, ensuring that clinicians, managers, professionals, technicians, and end-users of all types are able to contribute to the transformation.

The checklist has also been divided into two sections: one for the planning of the change and the other for the implementation. However, both should be viewed as a starting point even when the organisation has included their own organisation-specific items. It is also clear from the literature that transformation is a process of continual evolution [10] so the checklist must be reviewed, refined and transformed in parallel.

The limitations of this work include that the evaluation was of only one organisation's experiences and the transformational change in this organisation was never completed. However, this provided particular insights, which enabled us to reflect on the specifics of what happened. The experiences from the NZHO were echoed in the literature, which adds validity to the items on the checklist. Some checklist items may appear to be very high-level and open to interpretation, for example, the checklist item "Senior management are supportive of change and provide visionary leadership", which had specific application in the NZHO and, in this scenario referred to the organisation's CEO and governance committee. The checklist is written in this way so that organisations using the checklist can adapt checklist items to fit their contexts. It is also likely that organisations will identify different items, which we encourage organisations to add to this checklist template. It is also acknowledged that the checklist has not been validated but because it has been developed with the intention that it can be adapted for specific settings, validation would be impossible. A compromise between identifying very specific characteristics and general principles was drequired for the checklist. Users will need to address this compromise in their own adaptations of the checklist.

Conclusion

The value of a checklist is to identify each of the components of a complex system that are necessary to ensure that the system operates without error. This checklist provides a high-level starting point and documentation of the change process for organisations intending to initiate transformational change. The checklist provides the foundational document for ensuring that the prerequisite organisational features are in place so that other healthcare organisations can avoid making the errors that the evaluation of this NZHO's attempt at transformational change identified, which were also noted in many other transformational change implementation processes across the transformational change literature. Avoiding pitfalls is not straightforward and requirements for successful implementation across the domains of the checklist will continue to evolve with the process: the nature of complex systems means that they will always be adapting and changing so the checklist must also adapt. If organisations ensure that they understand and use the checklist in this way, the authors suggest it will provide a foundational document to support transformational change.

Acknowledgements

Author statements

Funding

Competing interests

None declared.

Ethical approval

The evaluation project described in this article was approved by the University of Otago Human Research Ethics Committee, reference code H16/030

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2019.08.001.

References

[1] Best A, Greenhalgh T, Lewis S, Saul JE, Carroll S, Bitz J. Large-system transformation in health care: a realist review. Milbank Q 2012;90(3):421–56.
[2] Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful implementation and adoption of large-scale health information technology. J Am Med Inform Assoc JAMIA 2013;20(e1):e9–e13.
[3] Jaén CR. Successful health information technology implementation requires practice and health care system transformation. Ann Fam Med 2011;9(5):388–9.
[4] Doolan DF, Bates DW, James BC. The use of computers for clinical care: a case series of advanced us sites. J Am Med Inform Assoc 2003;10(1):94–107.
[5] Gagnon M-P, Desmartis M, Labrecque M, Car J, Pagliari C, Pluye P, et al. Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. J Med Syst 2012;36:241–77.
[6] Guard JR, Brueggemann RF, Fant WK, Hutton JJ, Kues JR, Marine SA, et al. Integrated advanced information management systems: a twenty-year history at the University of Cincinnati. J Med Libr Assoc 2004;92(2):171–8.
[7] Hillestad R, Bigelow J, Bower A, Girosi F, Meili R, Scoville R, et al. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. Health Aff 2005;24(5):1103–17.
[8] Kenney C. Transforming health care: Virginia mason medical center's pursuit of the perfect patient experience. CRC Press; 2012.
[9] Lapointe L, Mignerat M, Vedel I. The it productivity paradox in health: a stakeholder's perspective. Int J Med Inf 2011;80(2):102–15.
[10] Charlesworth K, Jamieson M, Davey R, Butler CD. Transformational change in healthcare: an examination of four case studies. Aust Health Rev 2016;40(2):163–7.
[11] Dixon-Woods M, Bosk CL, Aveling EL, Goeschel CA, Pronovost PJ. Explaining Michigan: developing an ex post theory of a quality improvement program. Milbank Q 2011;89(2):167–205.
[12] Lee S-YD, Weiner BJ, Harrison MI, Belden CM. Organizational transformation: a systematic review of empirical research in health care and other industries. Med Care Res Rev 2012;70(2):115–42.
[13] Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Ann Intern Med 2006;144(10):742–52.
[14] Goldzweig CL, Towfigh A, Maglione M, Shekelle PG. Costs and benefits of health information technology: new trends from the literature. Health Aff 2009;28(2):w282–93.
[15] Jha AK, Doolan D, Grandt D, Scott T, Bates DW. The use of health information technology in seven nations. Int J Med Inf 2008;77(12):848–54.
[16] Sligo J, Gauld R, Roberts V, Villa L. A literature review for large-scale health information system project planning, implementation and evaluation. Int J Med Inf 2017;97:86–97.
[17] Cresswell K, Sheikh A. Organizational issues in the implementation and adoption of health information technology innovations: an interpretative review. Int J Med Inf 2013;82(5):e73–86.
[18] Gershon RR, Dailey M, Magda LA, Riley HE, Conolly J, Silver A. Safety in the home healthcare sector: development of a new household safety checklist. J Patient Saf 2012;8(2):51–9.
[19] Clay-Williams R, Colligan L. Back to basics: checklists in aviation and healthcare. BMJ Qual Saf 2015;24(7):428.
[20] Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat A-HS, Dellinger EP, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009;360(5):491–9.
[21] Pulcini C, Binda F, Lamkang AS, Trett A, Charani E, Goff DA, et al. Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach. Clin Microbiol Infect 2019;25(1):20–5.
[22] Scriven M. The logic and methodology of checklists. Интернет–ресурс http://www.wmichedu/evalctr/checklists/papers/logic&methodology_dec07pdf 2000.
[23] Gawande A. The checklist manifesto. India: Penguin Books; 2010.
[24] Verharen C.C., Tharakan J. An appropriate technology checklist. Plenary Paper Session I: Water. p. 36.
[25] Berenholtz SM, Pronovost PJ, Lipsett PA, Hobson D, Earsing K, Farley JE, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. Crit Care Med 2004;32(10):2014–20.
[26] Pronovost P, Vohr E. Safe patients, smart hospitals: how one doctor's checklist can help us change health care from the inside out. Penguin; 2010.
[27] Catchpole K, Russ S. The problem with checklists. BMJ Qual Saf 2015;24(9):545–9.
[28] Hales BM, Pronovost PJ. The checklist—a tool for error management and performance improvement. J Crit Care 2006;21(3):231–5.
[29] Kitto S, Grant R. Revisiting evidence-based checklists: interprofessionalism, safety culture and collective competence. J Interprof Care 2014;28(5):390–2.
[30] Bosk CL, Dixon-Woods M, Goeschel CA, Pronovost PJ. Reality check for checklists. Lancet. 374(9688):444–5.
[31] Alspach JG. The checklist: recognize limits, but harness its power. Crit Care Nurse 2017;37(5):12–18.
[32] Marchal B, van Belle S, van Olmen J, Hoerée T, Kegels G. Is realist evaluation keeping its promise? a review of published empirical studies in the field of health systems research. Evaluation 2012;18(2):192–212.
[33] Pawson R, Greenhalgh T, Harvey G, Walshe K. Realist review-a new method of systematic review designed for complex policy interventions. J Health Serv Res Policy 2005;10(1_suppl):21–34.
[34] NVivo qualitative data analysis software. NVivo. 11 ed. QSR International Pty Ltd.; 2015.
[35] Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3(2):77–101.
[36] Yusof MM, Kuljis J, Papazafeiropoulou A, Stergioulas LK. An evaluation framework for health information systems: human, organization and technology-fit factors (HOT-fit). Int J Med Inf 2008;77(6):386–98.
[37] Potts HWW, Keen J, Denby T, Featherstone I, Patterson D, Anderson J, et al. Towards a better understanding of delivering e-health systems: A systematic review using the meta-narrative method and two case studies. Final Report. London, England: NIHR Service Delivery and Organisation Programme; 2011.
[38] Geissbuhler A. Lessons learned implementing a regional health information exchange in Geneva as a pilot for the Swiss national eHealth strategy. Int J Med Inf 2013;82(5):e118–24.
[39] Church J, Saunders D, Wanke M, Pong R, Spooner C, Dorgan M. Citizen participation in health decision-making: past experience and future prospects. J Public Health Policy 2002;23(1):12–32.
[40] Edgman-Levitan S, Brady C, Howitt P. Partnering with patients, families, and communities for health: a global imperative. Doha: World Innovation Summit; 2013. p. 10–11.
[41] Tritter JQ. Revolution or evolution: the challenges of conceptualizing patient and public involvement in a consumerist world. Health Expect 2009;12(3):275–87.
[42] Florin D, Dixon J. Public involvement in health care. BMJ Br Med J 2004;328(7432):159–61.
[43] Crawford MJ, Rutter D, Manley C, Weaver T, Bhui K, Fulop N, et al. Systematic review of involving patients in the planning and development of health care. BMJ Br Med J 2002;325(7375):1263.
[44] Todd S, Felce D, Beyer S, Shearn J, Perry J, Kilsby M. Strategic planning and progress under the all wales strategy: reflecting the perceptions of stakeholders. J Intellect Disabil Res 2000;44(1):31–44.
[45] Ocloo J, Matthews R. From tokenism to empowerment: progressing patient and public involvement in healthcare improvement. BMJ Qual Saf 2016;25(8):626–32.
[46] Connell NAD, Young TP. Evaluating healthcare information systems through an "enterprise" perspective. Inf Manag 2007;44(4):433–40.
[47] Kaplan HC, Brady PW, Dritz MC, Hooper DK, Linam WM, Froehle CM, et al. The influence of context on quality improvement success in health care: a systematic review of the literature. Milbank Q 2010;88(4):500–59.
[48] Hunter D, Erskine J, Small A, McGovern T, Hicks C, Whitty P, et al. Doing transformational change in the English NHS in the context of "big bang" redisorganisation: Findings from the north east transformation system. J Health Organ Manag 2011;29(1):10–24.
[49] Lewis M, Pettersson Gelander G. Governance in health care delivery: raising performance. Department TWBDE, &, Department HD; 2009.
[50] Bismark MM, Studdert DM. Governance of quality of care: a qualitative study of health service boards in Victoria, Australia. BMJ Qual Saf 2014;23(6):474.

[51] Eeckloo K, Delesie L, Vleugels A. Where is the pilot? the changing shapes of governance in the European hospital sector. J R Soc Promot Health 2007;127(2):78–86.

[52] Robert G, Greenhalgh T, MacFarlane F, Peacock R. Organisational factors influencing technology adoption and assimilation in the NHS: a systematic literature review. 2009.

[53] Weil TP. Governance in a period of strategic change in us healthcare. Int J Health Plan Manag 2003;18(3):247–65.

[54] Barnett P, Clayden C. Governance in district health boards. Wellington: Victoria University of Wellington; 2007.

[55] Wayne Taylor D. Facts, myths and monsters: understanding the principles of good governance. Int J Public Sect Manag 2000;13(2):108–24.

[56] Erskine J, Hunter DJ, Small A, Hicks C, McGovern T, Lugsden E, et al. Leadership and transformational change in healthcare organisations: a qualitative analysis of the north east transformation system. Health Serv Manag Res 2013;26(1):29–37.

[57] Degeling P, Carr A. Leadership for the systemization of health care: the unaddressed issue in health care reform. J Health Organ Manag 2004;18(6):399–414.

[58] Dickson G. Transformations in Canadian health systems leadership: an analytical perspective. Leadersh Health Serv 2013;22(4):292–305.

[59] Collins L, Parkes R, Seijts G. Leading complex change in healthcare: 10 lessons learned. Healthc Q 2008;11(4):38–44.

[60] Caldwell DF, Chatman J, O'Reilly CA III, Ormiston M, Lapiz M. Implementing strategic change in a health care system: The importance of leadership and change readiness. Health Care Manag Rev 2008;33(2):124–33 April/June.

[61] Raleigh V, Foot C. Getting the measure of quality. Opportunities and challenges. London: The Kings Fund; 2010.

[62] Dixon-Woods M, McNicol S, Martin G. Ten challenges in improving quality in healthcare: lessons from the health foundation's programme evaluations and relevant literature. BMJ Qual Saf 2012;21(10):876.

[63] Ham C. Improving the performance of health services: the role of clinical leadership. Lancet N Am Ed 2003;361(9373):1978–80.

[64] Morgan PI, Ogbonna E. Subcultural dynamics in transformation: a multi-perspective study of healthcare professionals. Hum Relat 2008;61(1):39–65.

[65] Chreim S, Williams BE, Coller KE. Radical change in healthcare organization. J Health Organ Manag 2012;26(2):215–36.

[66] Iles V, Sutherland K. Organisational change: a review for health care managers, professionals and researchers. London: National Co-ordinating Centre for NHS Service Delivery and Organisation Medicine LSoHT; 2001.

[67] Li J T-KA, Seale H, Ray P, MacIntyre C. Health care provider adoption of eHealth: systematic literature review. Interact J Med Res 2013;2(1):e7.

[68] Tsiknakis M, Kouroubali A. Organizational factors affecting successful adoption of innovative eHealth services: a case study employing the FITT framework. Int J Med Inf 2009;78(1):39–52.

[69] Allcock C, Dormon F, Taunt R, Dixon J. Constructive comfort: accelerating change in the NHS health foundation; 2015.

[70] Perla RJ, Bradbury E, Gunther-Murphy C. Large-Scale improvement initiatives in healthcare: a scan of the literature. J Healthc Qual 2013;35(1):30–40.

[71] Fleming NS, Culler SD, McCorkle R, Becker ER, Ballard DJ. The financial and nonfinancial costs of implementing electronic health records in primary care practices. Health Aff 2011;30(3):481–9.

[72] Meltzer D. Future costs in medical cost–effectiveness analysis. The elgar companion to health economics. Jones A, editor. Cheltenham, UK: Edward Elgar Publishing Inc; 2006.

[73] Lorenzi NM, Riley RT. Managing change: an overview. J Am Med Inform Assoc 2000;7(2):116–24.

[74] Anderson CL, Agarwal R. The digitization of healthcare: boundary risks, emotion, and consumer willingness to disclose personal health information. Inf Syst Res 2011;22(3):469–90.

[75] Fairbrother G, Trudnak T, Christopher R, Mansour M, Mandel K. Cincinnati beacon community program highlights challenges and opportunities on the path to care transformation. Health Aff (Millwood) 2014;33(5):871–7.

[76] Morrow E, Glenn R, Maben J, Griffiths P. Implementing large-scale quality improvement. Int J Health Care Qual Assur 2012;25(4):237–53.

[77] Takian A. Envisioning electronic health record systems as change management: the experience of an English hospital joining the national programme for information technology. Stud Health Technol Inform 2012;180:901–5.

[78] Caccia-Bava MdC, Guimaraes VCK, Guimaraes T. Testing some major determinants for hospital innovation success. Int J Health Care Qual Assur 2013;22(5):454–70.

[79] Kash BA, Spaulding A, Johnson CE, Gamm L. Success factors for strategic change initiatives: a qualitative study of healthcare administrators' perspectives. J Healthc Manag 2014;59(1):65–82.

[80] Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. Milbank Q 2004;82(4):581–629.

[81] Kruse CS, Kristof C, Jones B, Mitchell E, Martinez A. Barriers to electronic health record adoption: a systematic literature review. J Med Syst 2016;40(12):252.

[82] Best A, Saul JE, Cameron W. Doing the dance of culture change: complexity, evidence and leadership. HealthcarePapers 2013;13(1):64–8.

[83] Bohmer RMJ. The hard work of health care transformation. N Engl J Med 2016;375(8):709–11.

[84] Chreim S, Williams BE, Coller K, E. Radical change in healthcare organization:

[85] Harrison MI, Kimani J. Building capacity for a transformation initiative: system redesign at Denver health. Health Care Manag Rev 2009;34(1):42–53.

[86] Narine L, Persaud DD. Gaining and maintaining commitment to large-scale change in healthcare organizations. Health Serv Manag Res 2003;16(3):179–87.

[87] Shea CM, Belden CM. What is the extent of research on the characteristics, behaviors, and impacts of health information technology champions? A scoping review. BMC Med Inform Decis Mak 2016;16:1–17.

[88] Pare G, Sicotte C, Jaana M, Girouard D. Prioritizing the risk factors influencing the success of clinical information system projects. Methods Inf Med 2008;47(3):251–9.

[89] Ingebrigtsen T, Georgiou A, Clay-Williams R, Magrabi F, Hordern A, Prgomet M, et al. The impact of clinical leadership on health information technology adoption: systematic review. Int J Med Inf 2014;83(6):393–405.

[90] Veronesi G, Kirkpatrick I, Vallascas F. Clinicians on the board: what difference does it make? Soc Sci Med 2013;77:147–55.

[91] Weiner BJ, Shortell SM, Alexander J. Promoting clinical involvement in hospital quality improvement efforts: the effects of top management, board, and physician leadership. Health Serv Res 1997;32(4):491–510.

[92] Jones L, Pomeroy L, Robert G, Burnett S, Anderson JE, Fulop NJ. How do hospital boards govern for quality improvement? A mixed methods study of 15 organisations in England. BMJ Qual Saf; 2017. p. 978–86.

[93] Freeman T, Walshe K. Achieving progress through clinical governance? a national study of health care managers' perceptions in the NHS in England. Qual Saf Health Care 2004;13(5):335–43.

[94] Gauld R. Clinical governance development: learning from the New Zealand experience. Postgrad Med J 2013;90(1059):43.

[95] Bigus JP, Campbell M, Carmeli B, Cefkin M, Chang H, Chen-Ritzo CH, et al. Information technology for healthcare transformation. IBM J Res Dev 2011;55(5):6-1–6-14.

[96] Lynch K, Kendall M, Shanks K, Haque A, Jones E, Wanis MG, et al. The health it regional extension center program: Evolution and lessons for health care transformation. Health Serv Res 2014;49(1pt2):421–37.

[97] Shaw RJ, Horvath MM, Leonard D, Ferranti JM, Johnson CM. Developing a user-friendly interface for a self-service healthcare research portal: cost-effective usability testing. Health Syst 2015;4(2):151–8.

[98] Ash JS, Berg M, Coiera E. Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. J Am Med Inform Assoc 2004;11(2):104–12.

[99] Kolominsky-Rabas PL, Djanatliev A, Wahlster P, Gantner-Bär M, Hofmann B, German R, et al. Technology foresight for medical device development through hybrid simulation: the ProHTA project. Technol Forecast Soc Change 2015;97(Supplement C):105–14.

[100] Mamlin BW, Tierney WM. The promise of information and communication technology in healthcare: extracting value from the chaos. Am J Med Sci. 351(1):59–68.

[101] Ijzerman MJ, Steuten LMG. Early assessment of medical technologies to inform product development and market access. Appl Health Econ Health Policy 2011;9(5):331–47.

[102] Postma TJBM, Alers JC, Terpstra S, Zuurbier A. Medical technology decisions in the netherlands: How to solve the dilemma of technology foresight versus market research? Technol Forecast Soc Change 2007;74(9):1823–33.

[103] Templeman K. Sticking the quantum leap. Health Management Technology; 2007. (March).

[104] Healthcare Information and Management Systems Society. Definition of interoperability Chicago, Illinois: HIMSS; 2013. [Definition of Interoperability Approved by the HIMSS Board of Directors April 5, 2013].

[105] Brailer DJ. Interoperability: The key to the future health care system: Interoperability will bind together a wide network of real-time, life-critical data that not only transform but become health care. Health Aff 2005;24(Suppl1):W5–19.

[106] Walker J, Pan E, Johnston D, Adler-Milstein J. The value of health care information exchange and interoperability. Health Aff 2005;24:W5.

[107] Heeks R. Health information systems: failure, success and improvisation. Int J Med Inf 2006;75(2):125–37.

[108] Abraham C, Junglas I. From cacophony to harmony: A case study about the IS implementation process as an opportunity for organizational transformation at Sentara healthcare. J Strat Inf Syst 2011;20(2):177–97.

[109] Brokel JM, Harrison MI. Redesigning care processes using an electronic health record: a system's experience. Joint Comm J Qual Patient Saf Joint Comm Resour 2009;35(2):82–92.

[110] Sheikh A, Cornford T, Barber N, Avery A, Takian A, Lichtner V, et al. Implementation and adoption of nationwide electronic health records in secondary care in England: final qualitative results from prospective national evaluation in "early adopter" hospitals. Br Med J 2011;343.

[111] Takian A, Sheikh A, Barber N. We are bitter, but we are better off: case study of the implementation of an electronic health record system into a mental health hospital in England. BMC Health Serv Res 2012;12:484.

[112] Heiskanen A, Newman M, Eklin M. Control, trust, power, and the dynamics of information system outsourcing relationships: a process study of contractual software development. J Strateg Inf Syst 2008;17(4):268–86.

[113] Kern T, Willcocks L. Exploring information technology outsourcing relationships: theory and practice. J Strateg Inf Syst 2000;9(4):321–50.

[114] Lacity MC, Khan SA, Willcocks LP. A review of the it outsourcing literature: insights for practice. J Strateg Inf Syst 2009;18(3):130–46.

[115] Gantman S. IT outsourcing in the public sector: a literature analysis. In: Global sourcing of services. World Scientific/NOW Publishers; 2016. p. 83–134.

[116] Huber TL, Fischer TA, Kirsch L, Dibbern J. The emergence of formal control specificity in information systems outsourcing: a process-view. In: Hirschheim R, Heinzl A, Dibbern J, editors. Information systems outsourcing: towards sustainable business value. Berlin, Heidelberg: Springer Berlin Heidelberg; 2014. p. 141–85.

[117] Clay-Williams R, Colligan L. Back to basics: checklists in aviation and healthcare. BMJ Qual Saf 2015;24(7):428–31.