Information Quality in Healthcare Delivery Improvement: A Critical Realist Approach

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Abstract

Electronic health record systems (EHS) are the primary source of information for improving healthcare delivery processes. Research on adoption and use of this technology is now spanning more than four decades, but how to transform data in EHS into improved delivery processes is a persistent challenge for healthcare organizations. Insufficient quality of EHS data has previously been suggested as one possible impediment, but the role of information quality throughout the improvement process remains unclear. Thus, this article is investigating the role of information quality in a public hospital improvement intervention. Based on a critical realist analysis, an underlying mechanism for succeeding with improvement is proposed; for commitment to improvement to take place, production and communication of improvement information must incorporate certain information quality elements, and facilitated by management involvement and improvement culture. This mechanism must be triggered on different organizational levels until improvement commitment is achieved among clinicians.

Keywords

Information quality, improvement information, healthcare, quality improvement, mechanism.

Introduction

Electronic health record systems (EHS) have been identified as the key technology for healthcare quality improvement (Byrd et al. 2013). The ever-increasing amount of routinely collected patient medical data in EHS mirrors patient treatment, clinical arguments, pathways, logistics etc., collectively constituting vast opportunities for improving healthcare delivery processes. However, anticipated improvements in healthcare delivery based on adopting this technology are still far from realized (Byrd et al. 2013). Recent technologies, like business intelligence and data analytics, exist with the promise of leveraging the use of EHS data for improvement, but despite these benefits, the adoption of such technology in healthcare is low. This might be related to the current situation where healthcare organizations are under constant and increasing pressure to do more with less (Foshay and Kuziemsky 2014). Thus, the mainstream healthcare is struggling to exploit EHS to improve delivery processes, without sophisticated analytic tools available.

One important impediment for improvement is claimed to be insufficient quality of EHS data to inform healthcare delivery improvement efforts (Byrd et al. 2013). Yet, another important reason is related to cumbersome processes in healthcare for accessing improvement information for quality improvement (mostly ad-hoc), no standards in terms of empirical measures of core processes, lack of understanding of information needs, and labor intensive and time consuming processes of obtaining value from data, often by manually exporting and manipulating data in third party tools (Foshay and Kuziemsky 2014). Data collection in design, planning, and feedback during quality improvement efforts is considered one of the top challenges in improving healthcare quality (Dixon-Woods et al. 2012).

One of the challenges could be related to the nature of data in the healthcare context; “Medical data are a particular thorny problem: they are copious, complex, hard to verify, and entered by many uncoordinated hands” (Karr et al. 2006, p. 139), and often a mix between structured, unstructured (narratives), and semi-structured data. This complex mixture of data makes it hard for healthcare organizations to draw a broad picture of the current situation of healthcare delivery processes, and even harder to transform this into meaningful improvement action possibilities.
The research reported in this article contributes to understanding the role of information quality in improvement of healthcare delivery, through analyzing an improvement case in a large Norwegian hospital. The research question guiding this study is: How is information quality impacting healthcare delivery improvement interventions?

The paper is structured as follows: the first part reviews existing literature on information quality and quality improvement. The second part describes the methodology, followed by findings, discussion, and conclusion.

The Concept of Information Quality

In the past three decades, numerous models and frameworks have tried to capture the concept of information quality (IQ). Common to these models are the entities of which they are constituted – quality dimensions or quality elements – describing parts of the information. Often used dimensions include accuracy, reliability, timeliness, relevance, and completeness. The main differences between models are how these dimensions are grouped into perspectives. In their seminal article, Wand and Wang (1996) took an ontological approach, and argued for the existence of different views – internal and external view. External view is related to the use and effect of an information system, and internal view is the “given” information system intended to represent the real-world system. External and internal views have also been referred in research as subjective and objective views (e.g., Naumann and Rolker 2000), since the external view represents the subjective user perception and internal view represents the objective information system view (or the information system designer’s view).

Additionally, it is generally acknowledged that the concept of information quality not only include the quality of the information product (e.g., Wang and Strong 1996) or the content (e.g., Eppler 2006) alone, but also the quality of information dissemination – that is, the quality of the process making data available for relevant users. This view has been referred to as process quality (e.g., Naumann and Rolker 2000), media quality (e.g., Eppler 2006), and service quality (e.g., Seppänen and Virrantaus 2015). Information can be disseminated without human mediation (when users are actively seeking information in information systems) and with human mediation (when users actively disseminate information to other users). To stress the human factor in information dissemination, I agree with Seppänen and Virrantaus (2015) that the ‘service’ term is more appropriate than the terms ‘process’ and ‘media’, due to their emphasis on communication channels and technological processes.

Seppänen and Virrantaus (2015) suggest the following four dimensions of information quality: Internal product quality (does information meet specification or closely mirror reality?); External product quality (does the information fit my needs?); Internal service quality (can information be created and managed efficiently?); External service quality (does accessing the information meet users’ needs?). These dimensions of information quality are used in this research. The quality elements of the dimensions are listed in Table 1.

<table>
<thead>
<tr>
<th>Internal perspective</th>
<th>External perspective</th>
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<tbody>
<tr>
<td><strong>Product quality</strong></td>
<td></td>
</tr>
<tr>
<td>Conciseness (to the point)</td>
<td>Comprehensiveness (adequate scope)</td>
</tr>
<tr>
<td>Consistency (free of contradictions)</td>
<td>Clarity (understandable)</td>
</tr>
<tr>
<td>Accuracy (free of error)</td>
<td>Applicability (usable and applicable)</td>
</tr>
<tr>
<td>Currency (up to date)</td>
<td>Value added (add value to operations)</td>
</tr>
<tr>
<td><strong>Service quality</strong></td>
<td>Reputability (reputation of the source and data)</td>
</tr>
<tr>
<td>Convenience (provision is convenient)</td>
<td>Accessibility (continuous and unobstructed access)</td>
</tr>
<tr>
<td>Timeliness (time from creation to publication)</td>
<td>Security (protected against loss or unauthorized access)</td>
</tr>
<tr>
<td>Traceability (background information available)</td>
<td>Speed (infrastructure response time)</td>
</tr>
<tr>
<td>Interactivity (information process adaptability)</td>
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Table 1. Information quality perspectives (Eppler 2006; Seppänen and Virrantaus 2015)

**IQ and Quality Improvement**

According to Berwick et al. (2003), improvement information is information collected by health systems (e.g., hospitals) from local datasets “to understand and improve its own care processes” (pp. I-33). Improvement information includes performance data (process-level) and result data (outcome-level) and is suggested to improve healthcare processes in two ways: 1) by informing how healthcare process procedures and guidelines can be improved at system-level, and 2) by improvement information...
mediation in guiding individuals to recognize when their own practices are deviating from existing guidelines (Berwick et al. 2003).

Based on a literature review, Hausvik (2017) presented a framework of how Information Quality impacts healthcare organizations using the following four conceptualizations – Organizational performance, process performance, process improvement, and decision-making. The conceptualization of IQ and process improvement emphasizes the role of IQ in organizational improvement, and includes concepts like process improvement, quality improvement, continuous quality improvement and operational improvement, since these concepts tend to be used interchangeably. Existing literature has focused on how IQ is related to quality improvement, and whether routinely collected is of sufficient quality for supporting improvement or not. This literature is summarized below.

**How is information quality related to quality improvement?** In their research, de Vos et al. (2013) found commitment (time and resource constraints), lack of involvement, and difficulties to translate feedback into effective action to be major barriers in a multisite quality improvement intervention. The research drew on previous findings indicating that multifaceted feedback to clinicians is more effective than single element feedback (e.g., feedback report), and reported that a multifaceted feedback program increased motivation and trust in data, and positively affected clinicians’ attitude towards using improvement information. A study of how nurse leaders could leverage data to transform nursing care, emphasized that data outcome alone, even for high quality data, was insufficient to motivate clinicians to translate data into improvement (Jeffs et al. 2015). The research concluded that the nurse leaders should be viewed as catalysts for data dissemination, and that relevant, reliable, timely, and meaningful information aligned with corporate performance priorities and standards, made nurse leaders able to “connecting the dots” for clinical nurses. Ginsburg (2003) examined hospital performance data usefulness by line and mid-level managers in acute care hospitals, and found that data quality, data relevance, report complexity, and intensity of dissemination were significantly related to perceived usefulness of hospital performance data, and that this relation was moderated by improvement culture. The hypothesized relation between experience with performance data and perceptions of usefulness of hospital performance data was not supported. Finally, Turpin et al. (1996) found a strong link between clinicians’ perceptions of relevance and believability of improvement information and action actually taken.

**Is routinely collected data of sufficient quality for quality improvement?** Some of the identified research focused on assessing the quality of information from multiple EHS for quality improvement programs and policy making at regional and national levels. In their study, Byrd et al. (2013) showed that data from 200 randomly selected coronary procedures extracted from 10 medical centers demonstrated excellent validity and completeness, and increasingly timely availability, and concluded that this data is crucial in improving practices and for overall cardiac care. Others, like Liaw et al. (2012), raised concerns of the fitness of use of routinely collected chronic patient data in EHS because of variations in information quality (Liaw et al. 2012). Needham et al. (2009) note that there is little assurance supporting the assumption of underlying data in public reporting to be accurate, and that consumers of improvement data could be misinformed. They further conclude data quality control to be essential in quality improvement projects. Information quality issues for quality improvement were not only related to the underlying data, but could also be caused by the data extraction process, making the data unreliable and potentially harmful (Liaw et al. 2013). de Lusignan et al. (2006) remind us that people working with routinely collected data for quality improvement need to fully understand the complexity of the data entry context to infer meaning from the data.

**Research Method**

A case study approach was chosen to gain deep insight into the role of IQ in a real-life situation. This approach implies getting close to constructs and their relationships, and are considered to be key advantages of case research (Siggelkow 2007). This section is structured as follows: First, a brief description of the case organization is presented, followed by data collection, and data analysis.

**The Case of Coastline Regional Hospital**

Coastline Regional Hospital (CRH) is a large Norwegian public hospital providing medical health services at specialist-level to both rural and urban communities. At the topmost level, the formal ownership of all
public health institutions in Norway lies with the Ministry of health. The next level in the chain of command includes chairmen of the four regional hospital trusts. These regional trusts consist of several autonomous hospitals with their own boards of trustees. Figure 1 illustrates the line of management for each hospital. The hospital CEO runs the hospital on a daily basis in accordance to the instructions of the board of trustees and imposed by the Commissioner's Directives provided by the Government. Further, division directors are responsible for specific medical disciplines, both financially and operationally. Each division consists of departments with its own managers. All departments are sectioned into units of varying number, where some units are further divided into teams due to division of labor. Formally, the team level is not in the line of management, since unit managers are responsible of HR for clinicians.

**Figure 1. Line of management**

Improvement information is frequently used in CRH to indicate needs for process improvement interventions, and is primarily obtained from the EHR in three ways; monthly extract of structured performance data into a performance measurement system (balanced scorecard), ad hoc analysis of structured data, and by performing medical audits. Since the medical records consist of narratives (free-text documents), compliance to delivery process guidelines can only be assessed by medical auditing. In this case, the use of patient record narratives as the source of improvement information has been under scrutiny.

**Data Collection**

Data was collected by conducting semi-structured interviews of employees and meeting minutes from various levels of the focal organization. The strategy was to collect data from all organizational levels following the line of management from division level down to Unit #1 in Department #1 who was known for good results in previous audits, so the case would serve as a powerful example (Siggelkow 2007). Thus, this intensive strategy emphasizes depth rather than breadth. The improvement intervention was traced from its origin (division management level) to its implementation (clinician level). Thus, employees at division level were first interviewed, and employees further down the line of management were recruited by snowballing.

Eleven interviews were conducted – Two from division management (Psychiatric division), three from department management (Department #1), two from unit management (Unit #1 and Unit #2), two from team management (Team #1 and Team #2), and two clinicians (from Team #1 and Team #2). The average length of the interviews was 1 hour. All interviews were transcribed and imported into Nvivo 11 qualitative software suite for further analysis.

**Data Analysis**

The ontology of realism is strongly advocated in critical realism (CR). Thus, the world is believed to exist independent of our knowledge. Explanations of cause and effect are important, but CR differs from both positivism and constructionism, by rejecting reductionism and the belief that the world is reduced to human knowledge (Mingers et al. 2013). In the tradition of CR, the aim of research is to understand how events occur. This is done by identifying the underlying structures of causal powers producing or restraining certain outcomes, called ‘generative mechanisms’ (Bhaskar 2005).

CR recognizes that access to the world is limited, and can only be observed empirically. The objects of knowledge exist of different types, like physical, social and conceptual, and CR accepts these objects regardless of their ontological and epistemological origin (Mingers et al. 2013).

Data was analyzed by following a methodology for identifying generative mechanisms (Bygstad and Munkvold 2011; Bygstad et al. 2015), where the following steps were used in analyzing the case data: 1) Description of events (clusters of observations identified as important to the research question); 2) Identification of key objects (key components of the case, i.e., persons, systems and organizations, and
how they interplay to constitute structures with causal powers); and 3) Retroduction (identification of mechanisms by investigating how objects interact to produce the key events).

**Findings**

In this section, findings are presented. First, the two major events of the case are presented (the division and unit audits), followed by the key objects of the case, including the observed interplay between objects. Second, and since this study focuses on the role of IQ, the final two sub-sections are dedicated to the outcome of the audits; division improvement information and unit improvement information, and their interplay with other identified objects.

**Events and Key Objects**

Challenges with the quality of patient records were acknowledged for several years in the Division of psychiatry, and previous attempts of resolutions were unsuccessful. In preparation for an upcoming external quality accreditation, the division management decided to conduct a patient record audit to identify the needs for improving the quality of delivery processes. The audit was performed by two specialist psychologists and a psychiatric nurse. The patient-critical standards of the quality system (e.g., medical assessments and clinical arguments for chosen diagnosis) were chosen as focus of attention, and the auditors assessed the degree of compliance to the given guidelines. 45 randomly selected patient records in the EHS were assessed, and documented into an electronic surveying tool. The results were analyzed by the quality advisor and departmental reports were produced. The results showed considerable departmental variations.

A quality conference was arranged where all the eight department managers, their management staffs, and all unit managers were invited. The purpose of this conference was to present the audit results, and engage the departments to analyze their own results and propose initiatives to resolve their own challenges. Department #1 chose to focus on their results in a consecutive department meeting and decided to perform individual small-scale audits on all units. The meeting minute and the audit results were distributed in the line of management.

Since the units in Department #1 had different challenges and already ongoing improvement interventions, the focus and audit criteria were not coherent between the units. The units did not audit their own patient records, but patients belonging to a peer-unit on a different location. However, the units chose different strategies of auditing: some chose to perform the audit in teams and co-localized with peer-units, with the intention to learn from each other, and some chose to audit their peer-units by themselves. The latter was chosen for Unit #1, where the unit manager audited the peer-unit (Unit #2), and a psychologist for Unit #1. The audit was performed on patient records from the EHS, and the audit results were documented in a report. The unit audits showed considerable variations between units, where Unit #1 was among the best achievers, though with some areas of improvement.

The manager of Unit #1 presented the audit results received by the peer-auditor at a consecutive unit meeting, to inform the team managers and the psychiatrist of the results. The meeting minute and the audit report were further presented to all the clinicians at team meetings by the team managers.

The key objects, described in Table 2, were observed to be interplaying in several ways. First, the instantiation of the quality system was observed through the line of management, leading to an improvement culture on all organizational levels. The division audit was a direct consequence of the quality system as preparation for the upcoming accreditation. At this stage, only the division management was involved. Second, the meeting structure in the organization facilitated the distribution of the audit result. Initially, the audit results were presented at a quality conference, thus extending the involvement to include department and unit managers. Third, it was further concluded at the department level that the division audit was not comprehensible to be readily used, as expressed by the assistant department manager in Department #1: “It doesn’t have the same effect when the division management conducts a patient record audit. [...] [The employees] say that they won’t relate to it unless it is broken down to their units. Thus, the department management decided that all units should be audited locally - a decision mirroring the improvement culture and management involvement at the department level. Fourth, the manager of Unit #1 was directly involved in the local audit process where the meeting structures at unit
and team levels further facilitated distribution of the results to clinicians. And finally, the improvement culture at team level, characterized by open and constructive discussions of specific cases (in oppose to blame culture), lead to employee commitment for improvement among clinicians.

<table>
<thead>
<tr>
<th>Objects</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational structure</td>
<td>The formal line of management, as depicted in Figure 1.</td>
</tr>
<tr>
<td>Improvement culture</td>
<td>The division followed an international system for healthcare quality, and was currently accredited. This was reflected in the improvement culture through the line of management. On unit level, openness and team discussions were emphasized, in opposition to blame culture</td>
</tr>
<tr>
<td>Improvement information</td>
<td>The level of compliance to healthcare delivery guidelines was assessed, and presented in audit reports</td>
</tr>
<tr>
<td>Meeting structure</td>
<td>Meeting structure was found to be a critical component for information distribution and discussions. The meeting structure followed the organizational structure, with meetings on all levels. Unit #1 had meetings every second week and Team #1 had brief meetings four days a week, and one day with extended meeting</td>
</tr>
<tr>
<td>Management involvement</td>
<td>Manager involvement was found on all levels. Manager of Unit #1 was one of the auditors of the local audits</td>
</tr>
</tbody>
</table>

Table 2. Key objects of the case

**Improvement Information**

Since this research focuses on the role of IQ in improving healthcare delivery processes, the information used in the improvement intervention becomes pivotal for further scrutiny. This sub-chapter explains how improvement information, based on the producer’s perspective (internal view) and the user’s perception (external view), interplays with other objects of the case. Not all IQ elements from the framework by Seppänen and Virrantaus (2015) (Table 1) were found in this case. This does not imply that these elements are not important, but reflects the practitioners’ perception of what IQ constitutes as conveyed during the interviews. The different views and elements of performance data found in the divisional and local audits are summarized in Table 3.

<table>
<thead>
<tr>
<th>Perspectives</th>
<th>Division improvement information</th>
<th>Local improvement information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product quality</td>
<td>Conciseness (problem domain)</td>
<td>Conciseness (problem domain)</td>
</tr>
<tr>
<td></td>
<td>Conciseness (org. level)</td>
<td>Conciseness (org. level)</td>
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<tr>
<td></td>
<td>Conciseness (completeness)</td>
<td>Consistency (audit guide used)</td>
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<td></td>
<td>Credibility (experts)</td>
<td>Generalizability (problem domain)</td>
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<td></td>
<td>Generalizability (problem domain)</td>
<td>Generalizability (problem-to-unit)</td>
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<td></td>
<td>Generalizability (problem-to-unit)</td>
<td>Generalizability (problem-to-unit)</td>
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<tr>
<td></td>
<td>Objectivity (coherency)</td>
<td>Value added (relevant for improvement)</td>
</tr>
<tr>
<td></td>
<td>Objectivity (unbiased)</td>
<td>Clarity (clear and understandable)</td>
</tr>
<tr>
<td>External</td>
<td>Comprehensiveness (too high org. level)</td>
<td>Comprehensiveness (on correct org. level)</td>
</tr>
<tr>
<td></td>
<td>Comprehensiveness (too wide scope)</td>
<td>Accessibility (information reached all org. levels)</td>
</tr>
<tr>
<td></td>
<td>Applicability (conflicting tasks)</td>
<td>Accessibility (information reached all org. levels)</td>
</tr>
<tr>
<td></td>
<td>Applicability (usable for further investigations)</td>
<td></td>
</tr>
<tr>
<td>Service quality</td>
<td>Convenience (presented to department and unit managers)</td>
<td>Convenience (information presented to units and teams)</td>
</tr>
<tr>
<td>Internal</td>
<td>Convenience (presented to department and unit managers)</td>
<td>Timeliness (result presented immediately)</td>
</tr>
<tr>
<td>External</td>
<td>Accessibility (information reached all org. levels)</td>
<td>Accessibility (information reached all org. levels)</td>
</tr>
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</table>

Table 3. IQ elements identified in the case audits

**Division-Level Improvement Information**

At the macro-level, the quality improvement intervention at CRH was rooted in the already existing quality management system; the need for assessing the quality was a result of the upcoming accreditation. The assessment was performed by conducting the division audit, where patient record data from the EHS was transformed into an audit report. In the transformation of raw data to information, the auditors emphasized several perspectives (see summary in Table 3) to engage the organization. As stated by Quality advisor 01: “they need to own the problems themselves”.
Four elements of *internal product quality* were identified. First, *conciseness* of the information was perceived to be important regarding the problem domain (i.e., concise description of the identified problems), to the organizational level (i.e., that the information was broken down to departmental levels), and completeness (that all information was disclosed). Second, *generalizability* was important in producing the information – the number of patient records audited led to a certain degree of generalizability; whether the problem was a single event or a more systematic in nature, being able to generalize the problems to departmental levels. Fourth, by using clinical experts as auditors, *credibility* of the information was expected. And finally, *objectivity* of the information was tackled by using unbiased auditors with high clinical competence, where all decisions were based on mutual agreement.

The division audit was presented to all department and unit managers, where the main purpose was to achieve commitment to quality improvement; “They worked in teams, so the information they received could definitely not stop with one individual. And I believe that is important, because otherwise it could turn into a bottle-neck, and the information flow will stop” (Clinical advisor 01). The *internal service quality* element observed was *convenience*. That is, the audit results were first presented in plenary, and then departmental reports were handed out to facilitate group work at the second part of the conference.

From the information recipient’s perspective, two elements of *external product quality* were observed; comprehensiveness and applicability. Regarding *comprehensiveness*, the scope of information presented at the quality conference was perceived to be too wide – “it was a pretty big thing […] probably 50-60 pages” (Unit manager 02) and “It was a quick and shallow presentation […] the report was really thick” (Advisor 03). On the other hand, the scope was also perceived to be too narrow; the information was only produced for department levels, not for unit or team levels. Further, participants from Department #1 questioned the *applicability*, and how these findings would impact already ongoing improvement interventions in the department. On the other hand, Unit manager 02 explained one important application of the information: “It demonstrated some challenges, so it is a means for trigging the managers”.

Informants in all organizational units received information of the division audit results, indicating that the *accessibility* element of *external service quality* was satisfactory.

**Unit-Level Improvement Information**

Despite different emphasis of the internal and external quality elements of product quality, the division audit triggered the department management of Department #1 in committing to further quality improvement by deciding to perform local audits at the unit level.

Three *internal product quality* elements were emphasized by the producer of the information; conciseness, consistency, and generalizability. *Conciseness* was related both to the description of the problem domain (pointing directly at the challenges) and to the organizational level of the information (at unit level, so that the peer-units could compare the results). *Consistency* of the information was desired by providing a guideline / template for conducting the audit. The guidelines were not followed consciously by all units, and only a subset of the information was thus comparable between all units. Even though the number of patient records per unit was low, the information producer believed it was sufficient for *generalizing* the problem domain itself and generalizing problems to Unit #1.

The information was presented to all unit managers, to all team managers in Unit #1 by the unit manager, and to all clinicians by their team managers. Thus, *convenience* was important for the unit manager (*internal service quality*) – that the information was distributed to all employees both orally (meetings) and textual (meeting minutes). *Timeliness* was also mentioned as a significant element, and the information was distributed and discussed with team managers as soon as it was available.

From the information recipient perspective (*external product quality*), clarity and comprehensiveness was perceived as two critical information quality elements. By *clarity*, the information was clear and understandable – “It was nice and clear […] all the way down, pointing at issues on individual patients” (Unit manager 01). As for *comprehensiveness*, the information was now perceived to be on the correct organizational level for clinicians to comprehend the information – “we have always, in our part of the unit, been very persistent to get the results split up on unit-level. We need to know our own areas of improvement” (Team manager 01). Information was perceived to be *value added*, where improvement
information was discussed in team meetings with clinicians how this information could be implemented into daily work routines.

Informants in all organizational units received information of the division audit results, indicating that the *accessibility* element of *external service quality* was satisfactory, also for the local audit.

**Discussion**

Previous research has concluded that simply mediating (producing and distributing) improvement information from EHS alone will not lead to improvement of healthcare services (Berwick et al. 2003; Ginsburg 2003). The intended users of this information must perceive the usefulness and applicability of the information, implying that the quality of the information is also a determinant of employee commitment to improvement. However, the quality of improvement information alone is insufficient to transform the information into action (Jeffs et al. 2015), resulting in a more complex picture where certain interplay between structure, culture, and human agency must exist for actual improvement to take place.

At the bottom line, it is the actions taken by clinicians performing core businesses that determine the quality of healthcare services. Thus, change will not occur without their commitment. As seen in this case, commitment is not achieved unless improvement information contains certain quality elements perceived by clinicians. However, information quality and improvement commitment was found to be required at all organizational levels. Even though informants perceived improvement information from the division audit not to be comprehensible for immediate use in the line of management, it was found applicable to commit to further investigations. Thus, current improvement information only led to commitment at the department level. By departmental improvement culture and management involvement, it was decided to conduct a local audit to mediate tailored information to unit and team levels in the department. Furthermore, improvement information was once again produced from EHS-data and disseminated throughout the department, but this time with a different focus on information quality elements. This information, facilitated by unit and team manager involvement and improvement culture, led to local commitment among clinicians. This interplay is illustrated in Figure 3, and is proposed as a mechanism necessary for generating employee commitment to quality improvement.

**Figure 2. Quality improvement commitment mechanism**

The proposed mechanism was first triggered by human agency fulfilling the commitments of the quality structure. Improvement information was produced with the intention to commit the department managers to the intervention with certain quality elements imposed: the information was intended to be concise in identifying the problems and where the problems were found; it was intended to be credible by involving domain experts in information production; and it was intended to be generalizable to separate single incidents from trends, and it was intended to be objective and as close to reality as possible.

Even though the users perceived the information not to be comprehensible – that the scope was too wide, and on a too high organizational level – the information was of sufficient quality: the department committed to the improvement intervention by deciding to investigate further, triggering the mechanism once again (illustrated by a feedback loop from improvement commitment to improvement information mediation in Figure 2), but now on the next organizational level. This commitment was achieved by sufficient information quality, management involvement and improvement culture at this level. The second triggering of the mechanism successfully produced commitment among clinicians as the outcome – the quality of the information was sufficient and the process was further facilitated by local level manager involvement and local improvement culture.
This double triggering of the mechanism was necessary to achieve commitment among clinicians in the bottom of the hierarchical structure. The reason for this was related to the intention of, and thus, the quality of improvement information; the intention was to achieve commitment at the department-level management. Previous research suggests senior leadership to prefer high-level summary of information over detailed unit-level information (Ginsburg 2003). This issue of conciseness was noted by the unit managers, but was not impeding commitment. This is the characteristics of a ‘strong improvement culture’ (Ginsburg 2003); where improvement information is perceived as useful even when the information has low relevance. Further, the commitment and agenda-setting role of senior management and line management is a determinant of the response to improvement information in the organization (Ginsburg 2003) and, thus, resulting in the second triggering of the mechanism.

Both times the mechanism was triggered, improvement information was produced (audit reports). The characteristics of the information showed that information was produced with different intentions and perceived by users with different criteria. This illustrates that product information quality is a crucial factor to achieve commitment to improvement at different organizational levels. Additionally, the service information quality (dissemination) was an influential factor where both reports were accessible for clinicians and discussed in meetings. This multi-faceted feedback has previously been reported to positively affect motivation and trust in data and clinicians’ attitude to use the information (de Vos et al. 2013). Moreover, the organizational structure and meeting structure facilitated the managers to operate as catalysts for information dissemination, making frontline managers able to translate and align the information to the organizational goals of the improvement intervention to clinicians (Jeffs et al. 2015).

One important observation in this case and a matter for further research is the information reduction that was evident when information was produced in each cycle of the mechanism. This information reduction is primarily related to the information product; in the first cycle, only a fraction of the data in the EHS was turned into improvement information. Obviously, the EHS still contains endless possibilities for improvement. In the next cycle, only parts of the improvement information were further transformed into actionable information with specific quality characteristics. The reason for this reduction is related to the tradeoffs between the internal and external perspectives (Eppler 2006), in this case conciseness and comprehensiveness – the information producer emphasized conciseness (completeness), while the receiver perceived the scope of information to be too wide (not comprehensive). This leads to the following questions: What happens with the residual information? What is the reasoning behind this selection of information? These important questions should be addressed in future research to succeed with improvement interventions focusing on multiple improvement targets.

**Conclusion**

This research has investigated the role of information quality in healthcare improvement processes. Empirical data from a large Norwegian hospital shows that IQ of improvement information is affecting employee commitment to healthcare delivery improvement. The research suggests an improvement commitment mechanism needed to be triggered preceding employee action. The mechanism must be triggered at various levels in the organization. The perceived quality of the information along with improvement culture and management involvement will determine whether commitment is achieved at the current organizational level. If commitment is achieved, the next cycle of the mechanism is triggered. For actual improvement to take place, improvement commitment must be achieved among clinicians. Thus, the mechanism must eventually be triggered at the lowest part of the organization; where frontline managers are involved, facilitated by improvement culture among clinicians, and provide information that adds value, is clear and understandable, and broken down to the lowest organizational level.

**REFERENCES**


