Information sources and methods for better quality and safer healthcare service design: towards a more integrated approach

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Abstract: Health care services are continuously redesigned to meet a range of complex quality requirements: patient safety; patient experience; efficiency; and clinical effectiveness. People across various disciplines, including operations researchers; systems engineers; ergonomists; and clinicians, use different information sources and methods to design a service to meet different quality requirements. Unlike product design processes where tradeoffs between different design requirements are managed and design activities across disciplines are integrated, healthcare service design activities are very often carried out separately to meet disparate quality requirements. As a first step toward integrating healthcare service design activities, this study classified and compared various methods applied to improve healthcare quality and safety by systematically reviewing published literature. A dozen representative methods were compared in terms of information sources, main purposes and application areas. Five different information sources were identified, including people’s behaviour, people’s opinion, medical records, complaint/incident reports and literature. The objective of this paper is to present these methods and discusses how to make the most of them to move towards a more integrated approach to healthcare service design.

Key words: healthcare service, design, safety, quality, integration

1. Introduction

Healthcare services around the world are under pressure to reform and to improve the quality of service delivery, where care should be safe, effective, patient-centred, timely, efficient and equitable [1]. In a recent UK government report, Lord Darzi, health minister for the UK government, further stated that healthcare quality should include patient safety, patient experience and effectiveness of care [2].

In order to (re)design healthcare services that meet these complex and often contradictory quality requirements, various professions have been involved in proving different quality aspects using different approaches: medicine has been trying to make the best use of current clinical evidence (evidence-based medicine) to improve the effectiveness of individual patient care [3]; operations management has been using abstract and mathematical models to improve efficiency at the level of processes [4]; ergonomists and systems engineers have been applying systems approaches to work system design for patient safety [5, 6]; and more recently, product designers have been applying user-focused approaches to improve patient experience [7].
Considering that healthcare service (re)design processes are driven by these multiple, intangible quality requirements involving various stakeholders with different concerns, it is very challenging to manage trade-offs between these interdependent quality targets. As a result, various healthcare service (re)design initiatives have been disjointedly implemented to address different quality requirements, but the effort to integrate different (re)design activities has been lacking.

Conversely, product designers have been managing product-related trade-offs in more integrated ways. Ulrich and Eppinger proposed methods intended to facilitate problem solving and decision making by integrating personnel from a variety of backgrounds and perspectives on concept development [8]. Pugh also proposed a concept of ‘total design’ meaning ‘the systematic activity necessary, from the identification of the market/user need, to the selling of the successful product to satisfy that need – an activity that encompasses product, process, people and organization [9].’ Through these efforts, various design requirements such as design for manufacture or design for assembly have been included as explicit steps particularly in the early stages of design.

As a first step towards a more integrated approach to healthcare service design, the objective of this paper is to understand how healthcare service design activities have been carried out by investigating what types of healthcare quality and safety improvement methods have been used, for what purposes and in what application areas. Recommendations for a more systematic and integrated use of information sources and methods will also be presented.

2. Methods

Initial investigation revealed a huge corpus of papers on healthcare quality and safety improvement approaches, hence it was necessary to be selective about which papers could be chosen for full-paper review. In order to identify a manageable number of papers efficiently, a search was conducted on PubMed using MeSH terms, where PubMed is a bibliographic database covering much of the literature in the fields of medicine, nursing, dentistry and the healthcare system. PubMed provides for MeSH (Medical Subject Headings) searching using a controlled vocabulary to indexing articles. The following MeSH terms were used to identify potentially relevant articles.

"Total Quality Management/methods" OR "Safety Management/methods"

A subheading ‘methods’ was used in conjunction with two subject headings ‘total quality management’ and ‘safety management’ to retrieve articles concerned with techniques, procedures and programs. A total of 3,464 articles were initially retrieved. The following criteria were additionally used to filter out articles from those initially retrieved:

- Papers published in non-peer-reviewed academic journals;
- Papers without abstracts in the PubMed;
- Papers published earlier than 2000;
- Papers published in languages other than English;

The year 2000 was taken as a starting point since the publication of ‘To err is human’ report initiated modern patient safety research [1]. A total of 511 articles were retrieved through the above criteria and their abstracts were content analysed to additionally filter out less relevant papers. A total of 82 papers were finally selected for full-paper reading and these were further content analysed using a review template designed to capture consistent information (method types, main purposes, application areas, etc) from each paper. Through the comparative
3. Findings
Forty different improvement methods were identified, with some of them proving to be methodologies, i.e. collections of methods, or differing only in their names. These methods were first categorised according to their primary information source, namely people’s behaviour, people’s opinion, medical records, reports and literature as illustrated in Table 1. This table also summarises the main purposes and application areas of the methods. For example, people’s behaviour has been captured either through direct observation or by video-recording in order to understand how clinical systems actually work and achieve safety improvements mostly in very confined settings. Conversely, people’s opinion has often been used to identify general quality and safety issues in a wide range of settings. Medical records have been assessed either through trained reviewers or via electronic trigger systems to identify medication-related errors. Complaint and adverse event reports have been used to gain an overall understanding of general quality and safety concerns, whereas published literature provided general evidence for the effectiveness of both clinical and process interventions. The advantages and limitations of each source and method are further compared in the sections that follow.

3.1 People’s behaviour
People’s behaviour is one of the most direct sources for understanding how care processes actually work, what factors make them work well (or not so well), and why adverse events occur. This source has been utilised with an increasing popularity through naturalistic direct observation, either with real time observers or via video data recording and analysis [10-16].

Direct observation
Direct observation is used to gain an in-depth understanding of contexts, e.g. interactions and relationships among staff members [17] or adverse events, e.g. types, frequencies, severity and causes. This method is considered more suitable to processes where clinical tasks have a clear start and end and where there are clear and consistent team roles, e.g. operating theatre [10] and elective care [11]. Care settings such as A&Es and ICUs can generate difficulties to observers owing to unpredictability and the greater movement of staff, nonetheless this method has been applied to such cases [12, 14].

Video recording
Video recording has the advantage over direct observation that you can create a permanent record that can be analysed offline as often as required. Such a record can be used for the purpose of clinician education [15] as well as quality and safety improvement [16]. However, the more difficult task is getting hospitals and clinicians to agree to let you videotape actual patient care. These issues of human subject consent, privacy, confidentiality, medicolegal concerns, and logistics are often obstacles to using video recording [16].
### Table 1. Classification and comparison of quality and safety improvement methods

<table>
<thead>
<tr>
<th>Sources</th>
<th>Particular methods</th>
<th>Main purposes</th>
<th>Application areas</th>
<th>Resources required &amp; related techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>People’s behaviour</strong></td>
<td>Direct observation</td>
<td>Understanding how clinical systems actually work, what factors make them work well and why adverse events occur.</td>
<td>Drug administration, operating theatres, anaesthesia, obstetrics, intensive care units and emergency departments</td>
<td>Task analysis, competent observer, bench mark visits</td>
</tr>
<tr>
<td></td>
<td>Video-recording</td>
<td></td>
<td>Critical events, trauma resuscitation, anaesthesia, and surgical tasks</td>
<td>Video recording systems, video-data management s/w</td>
</tr>
<tr>
<td><strong>Survey</strong></td>
<td></td>
<td>Identifying areas of improvement, especially of cultural or management issues</td>
<td>Region, trust or department-wide</td>
<td>Questionnaires</td>
</tr>
<tr>
<td><strong>Interview</strong></td>
<td></td>
<td>Identifying general areas of improvement</td>
<td>General</td>
<td>Critical incident technique, executive walkthrough, patient stories</td>
</tr>
<tr>
<td><strong>Focus group</strong></td>
<td></td>
<td>Identifying general areas of improvement</td>
<td>General</td>
<td>Brainstorming, process mapping, FMEA</td>
</tr>
<tr>
<td><strong>Peer review</strong></td>
<td></td>
<td>Assessing and improving quality</td>
<td>General practitioners</td>
<td>-</td>
</tr>
<tr>
<td><strong>Medical records</strong></td>
<td>Secondary review</td>
<td>Evaluating the effectiveness of interventions</td>
<td>Medication errors</td>
<td>Trained reviewers</td>
</tr>
<tr>
<td></td>
<td>Electronic trigger</td>
<td>Identifying errors at real time</td>
<td>Medication errors</td>
<td>Classification of errors</td>
</tr>
<tr>
<td><strong>Reports</strong></td>
<td>Incident reports</td>
<td>Learning from Incidents</td>
<td>General patient safety</td>
<td>Incident reporting systems, risk managers</td>
</tr>
<tr>
<td></td>
<td>Complaint reports</td>
<td>Identifying care concerns</td>
<td>General</td>
<td>Complaints reporting systems, quality managers</td>
</tr>
<tr>
<td><strong>Literature</strong></td>
<td>Literature review</td>
<td>Investigating the potential effectiveness of interventions</td>
<td>General</td>
<td>PubMed or Google</td>
</tr>
</tbody>
</table>

### 3.2 People’s opinion

People’s opinion is one of the easiest and widely-used sources of information for healthcare quality and safety improvement, and has been utilised by different methods such as surveys, interviews and focus groups.
Survey
Surveys are applied in assessing safety culture [18], effectiveness of potential interventions [19] and patients satisfaction [20] as well as capturing potential quality improvement recommendations from service providers [21]. Surveys can be very instrumental when respondents, bound by an implicit “code of silence” and a fear of challenging the institutional hierarchy, are uncomfortable with exposing weaknesses in processes for which they are responsible. The process of developing questionnaires requires several iterative revisions and pilot trials by various stakeholders.

Interview
Interviews have been used to identify general areas of improvement in conjunction with many other techniques, such as critical incident technique, executive walkthrough and patient stories. Semi-structured interviews have been applied along with the critical incident technique[22] to identify failure processes and potential recovery processes. Less formally, and in conjunction with executive walkthrough, interviews were used with frontline providers to identify general opportunities to improve care processes [23]. In addition, interviews have been applied along with storytelling to develop understanding based on patients’ and carers’ experiences, enabling healthcare providers to create better and new ways of meeting their needs [20].

Focus group
Focus groups, such as multidisciplinary team approaches, have very often been used to identify general areas of quality and safety improvement. They have been used, with less formality like brainstorming [24] to generate ideas for general improvement, or with very specific guidelines like FMEA (Failure Mode and Effects Analysis) [25] to analyse risks and identify recommendations for improving safety.

Peer review
Peer review groups are one of the most widespread methods of achieving quality improvement where peers from other practices critically discuss personal medical practices and make plans for change by audit, guideline setting or adaptation [26].

3.3 Medical records
Medical records have been reviewed to help understand the source of errors and to generate new improvement ideas. They have been reviewed either manually or by electronic triggers.

Secondary manual medical record review
This method has been used to investigate the effectiveness of new interventions in care processes, e.g. before and after mandatory drug use reviews [27]. While secondary manual reviews are usually labour-intensive, time-consuming and potentially inaccurate, electronic triggers can make this reviewing task much more efficient and accurate.

Electronic trigger
Electronic triggers have been developed to reliably identify, quantify, and track events related directly to patient harm. They have been integrated with hospital information systems to isolate adverse events [28-30]. In these systems, specific events—including the ordering of certain drugs, orders for antidotes and certain abnormal laboratory values—serve as triggers to initiate a more detailed concurrent audit. Each time a trigger event was identified in the pharmacy or physician order sheet of the medical record it was counted and referenced. Every day the reports of the patients identified with possible adverse events were provided to a pharmacist for further
in depth concurrent review. This electronic initial screening strategy, coupled with real-time evaluation, accomplishes a rapid review of a patient’s current record for the occurrence of adverse events [31].

3.4 Reports
Many healthcare institutions have encouraged service providers and service users to report their complaints as well as near misses and adverse events. The reporting patterns can help identify and prioritise areas for quality or safety improvement and generate new improvement ideas.

Incident reporting
Incident reporting has been carried out both locally and nationally; patterns and trends in patient safety incidents were analysed nationally [32] or in-depth investigation after incident reporting were carried out by local risk managers. Reporting can help identify and prioritise where interventions should be made.

Complaint reporting
Complaints from both healthcare workers and service users (patients or carers) highlight different aspects of patient care. These complaints are usually reviewed by quality managers and evaluated for formal peer review [33]. Frequently raised concerns facilitate the need for new ideas for interventions.

3.5 Literature
Literature review has been conducted to identify potential clinical or process interventions as well as find evidence of the effectiveness of them [19]. Various literature types from academic and grey literature have been searched through PubMed and Google and a systematic review has been widely adopted [34].

4. Discussion and conclusions
The classification and comparison of the methods applied for healthcare quality and safety improvement provides an overall picture of the types of methods, their purposes, their application areas and the information sources they are based on. It is important to be aware of these various methods, and their advantages and limitations so that the most appropriate methods can be used for managing different quality requirements. In order to show these methods and information sources in more simple and clear manner, Figure 1 illustrates more structured summary. First, two distinct types of sources are presented in the two rows of Figure 1: one from people (top row) and the other from documents (bottom row). Second, two distinct types are identified according to the location of the information source and shown in the columns of Figure 1: one existing within an institution (the first two columns); the other existing outside of an institution (the third column). For example, behaviour or opinion of the people within an institution can be utilised to investigate how the system internally works, whereas behaviour and opinion of the people in other institutions can provide new ideas through benchmark visit or peer review. Conversely, medical records and reports (incidents and complaints) tend to exist within an institution, whereas literature is located outside an institution and provides more general ideas. As a result, the overall awareness of these information sources and methods depicted in Figure 1 can provide guidance on how comprehensively we are using such sources and methods, and which have to be utilised more.
In addition to the overall awareness of these methods and information sources, it is also important to understand their main purposes so that they can be selected appropriately to be fit for purpose. The findings showed that the different information sources and methods have been applied for different purposes and in different application areas as illustrated in Table 2. In general, issues around patient experience have been tackled mostly using the people-based sources, since experience is the internal and subjective response individuals have to any direct or indirect contact with service providers [35]. Issues around patient safety have been addressed from both the people-based sources and the document-based sources, since safety problems occur in human components within complex socio-technical systems [36]. Issues around effectiveness of care have been mostly tackled from the document-based sources through either medical record review or systematic literature review. Such high-level links between the information sources and main purposes aids the appropriate selection of methods. However, in order to deal with multiple quality requirements in a systematic and integrated manner, the use of these various information sources and methods in healthcare need to be better integrated.

Table 2 Quality issues and appropriate information sources

<table>
<thead>
<tr>
<th>Quality issues</th>
<th>Appropriate information sources</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient experience</td>
<td>People-based</td>
<td>Observation, interviews, patient stories</td>
</tr>
<tr>
<td>Patient safety</td>
<td>People and document-based</td>
<td>Observation, video recording, surveys, interviews, focus groups, secondary medical record review, electronic trigger, incident reports</td>
</tr>
<tr>
<td>Effectiveness of care</td>
<td>Document-based</td>
<td>Secondary medical record review, literature review</td>
</tr>
</tbody>
</table>
Integration efforts made in product design can guide a more integrated and systematic use of methods and information sources. For example, stakeholders from a variety of backgrounds and perspectives (clinical and non-clinical staff, engineers, ergonomists and designers) need to be encouraged to collaborate on decision-making at the early stage of healthcare service design. Quality requirements, such as patient experience, might need to be included as explicit steps in the early phase of service design processes, as manufacturability has been in product design. In summary, healthcare service design processes have much scope for improvement, taking a lead from more integrated product design processes.

In conclusion, this paper, as a first step towards a more integrated approach to healthcare service design, has shown how healthcare service design activities have been carried out by classifying various quality and safety improvement methods and comparing them according to their information sources and main purposes. Different information sources and methods have been utilized to address different quality issues in different application areas. In addition, classifying methods and information according to their location and type provides a structured overview, which could encourage more systematic use. Further research is proposed to investigate more take-up of integration practices from product design to develop a more integrated healthcare service design process.

5. Acknowledgement

The author(s) acknowledge support for this work from the Engineering and Physical Sciences Research Council (award reference EP/E019900/1). Any views or opinions presented herein are those of the author(s) and do not necessarily represent those of RIGHT (Research Into Global Healthcare Tool), its associates or its sponsors.

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