Quality improvement in hospitals' surgery-related processes: A systematic review

Tina Beyranvand¹, Aidin Aryankhesal*,¹, Asgar Aghaei Hashjin¹

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Abstract
Background: There is a growing global movement toward quality and safety in healthcare and quality improvement (QI) in general surgery. The fundamentals of QI begin with an understanding of the underlying theoretical framework. This study aims to provide an overview of the existing QI models and frameworks for general surgery.

Methods: In this systematic review, published literature from January 2007 until September 2018 were retrieved from PubMed, Scopus, Web of Science and Embase databases, and Google Scholar using the MeSH terms related to QI and surgery. In total, 25 full-text articles were finally included, and data extraction was based on research objectives.

Results: Nine models were identified for QI in general surgery. These models were categorized into two main groups: (i) conceptual models or frameworks designed for QI in industry and applied in surgery, and (ii) those designed specifically for QI in surgery. Identified QI models were more used for improving postoperative processes and pre-hospital trauma care, identifying causes of prolonged periods of stay and lowering LOS index, improving surgical antimicrobial prophylaxis and antibiotics administering during surgery process, reducing and controlling infections, reducing complications, reducing mortality and morbidity, reducing waiting times and start time delays, reducing variability and improving surgical clinic experience, reducing costs, improving operating room efficiency by removing processes that add no value, and lowering per-capita costs.

Conclusion: According to the findings of this study, there are different models and frameworks with different aspects and dimensions for QI in surgery, which is recommended to use either of these models alone or with each other for specific circumstances. The use of these models in surgery is increasing, and it is recommended that these models could be used according to their functions in cases such as reducing the unnecessary use of resources, increasing the satisfaction of patients and their families with health care and improving the efficiency, safety and quality of healthcare in the surgical departments.

Keywords: Quality improvement, Improvement model, surgery, hospital, Systematic review

Introduction

The WHO has highlighted the quality of health care as a key element in improving the health-centered outcomes and the efficiency and effectiveness of hospitals, and a framework for strengthening health systems, especially in resource-poor countries (1). Due to the rising costs and demand for healthcare, quality improvement has been a necessity and an opportunity for improvements in continuous monitoring, reduce repetitive processes, and elimi-
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The purpose of this systematic review was to review QI models in surgery. Databases PubMed, Web of science, Cochran library, Scopus, Embase, and Google scholar search engine were searched with the keywords quality improvement/ improvement of quality, operating room/ operation room/ theatre/ surgery, model/ framework and their synonyms from January 2007 to the end of September 2018 (Appendix 1). As the quality issue in surgery has been more considered by WHO and researchers (according to the “Results by year” chart in PubMed database) since 2007, this period was selected for the study (11).

The references of the included studies were examined. Only English articles were included. The search process was conducted in September 2018 for 4 months.

First, the titles and abstracts of the articles were screened, and data were extracted by two reviewers independently. Studies that did not have inclusion criteria were removed. Also, the quality of all steps was monitored by the team supervisor. Results were reported using the PRISMA flowchart (20).

97 studies of the 4941, were selected after reviewing the title and abstract. After reviewing the full-text of the articles and regarding the inclusion and exclusion criteria, 25 articles were selected.

Data extraction was performed based on study objectives. The data extraction table included general (first author, year of publication, country, and type of study) and specific variables (the type of used or presented model, the purpose of using the model, and expected results from the application or presentation of each model). Data were entered into Microsoft Excel.

Inclusion and exclusion criteria
We included all types of peer-reviewed researches. The inclusion criteria in the study were publications that developed or implemented at least a model or framework for quality improvement in all contexts of surgery. All types of studies published between January 1st, 2007 and September 31st, 2018, were included. Also, studies in English were included, but those published in a language other than English were excluded.

Given that our study design was a systematic scoping review, and our purpose was identifying QI models in surgery, so articles on quality assessment was not evaluat-ed (21).

Analysis and descriptive synthesis
Data were extracted based on study objectives and analyzed qualitatively using the content analysis method (22). The main objective of our study was to investigate the type of used or proposed models for quality improvement in surgery. A descriptive synthesis was done. The studies were split into two main categories. The first category included studies that used one of the existing quality improvement models for surgery (models that entered from industry to surgical healthcare) and the second group included studies that provided a new model or framework for quality improvement in surgery. Finally, we designed a table to synthesize the findings that had 2 dimensions; one dimension is the type of QI model and another is expected outcomes from using them.
Results

Ninety-seven out of 4941 papers were selected after screening based on titles and abstracts. Twenty-five articles were finally included in the review after the full-text screening, based on the inclusion and exclusion criteria (Fig. 1).

Table 1 shows the characteristics of the reviewed studies, including country, the type of model used or presented, the scope of the study, and the purpose of the application of these models.

From 25 included studies, 14 of them were conducted in USA, four in UK, three in Ireland, two in Canada, one in Italy and one in India. The largest number of studies published in 2015 and 2018, respectively.

In total, nine models were identified. These models were categorized according to their origin in two general groups: models designed for industry and applied in surgery (Group 1), and models designed specifically for surgery (Group 2) (Table 2).

Description of QI models in surgery

An overview of the identified QI models in surgery is presented in this section.

1. Models designed for industry and applied in surgery

PDSA (Plan-Do-Study-Act): PDSA model refers to a systematic approach to testing and measuring ideas in an iterative manner that may lead to an improvement in processes or outcomes. (23). This model includes the following steps: Plan (developing the required processes to achieving outcomes in accordance with expected goals), Do (implementation of the new process in small scale), Study (measure and evaluate the new process and understand the differences between it and the expected outcomes), and Act (analyze the differences between observed and expected outcomes and determine the causes of these differences) (18).

In the reviewed studies, this model used in various surgical context and for objectives such as: to improve the quality of postoperative neonatal procedures, process mapping and finding improvable points in general surgery, to improve the quality of patient education after surgery, to identify the causes of long-term stay after surgery and reduce it, to improve surgical antimicrobial prophylaxis and infection control, to improve communication between patient and medical staff, to reduce patient waiting time before surgery, reduce complications, and improvements in processes and outcomes.

Six sigma: Six sigma refers to a rigorous methodology that seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in providing a product or service. This model has the following steps: Define, Measure, Analysis, Improvement, and Control (DMAIC). This approach is increasingly used in health care and is used to improve the efficiency and reduce problems, and standardization of care processes (23).

In the reviewed studies, this model used for objectives such as: to improve the efficiency and standardization of care processes, process mapping and finding improvable points in general surgery, to improve efficiency in the operating room, to reduce the waiting time of the surgeon between each surgery, to reduce length of stay, infection control, to administrate antibiotics prescribing and use,
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Table 1. Characteristics of Included Studies

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Country</th>
<th>Model</th>
<th>Field of surgery</th>
<th>Aim</th>
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</thead>
<tbody>
<tr>
<td>Newcombe/ 2018</td>
<td>USA</td>
<td>PDSA</td>
<td>Intensive Care Unit</td>
<td>To improve postoperative neonatal nutritional practices</td>
</tr>
<tr>
<td>Conaty/ 2018</td>
<td>Ireland</td>
<td>PDSA</td>
<td>Orthopedic surgery</td>
<td>To improve surgical antimicrobial prophylaxis</td>
</tr>
<tr>
<td>Divi/ 2018</td>
<td>USA</td>
<td>PDSA</td>
<td>Otolaryngology– Head and Neck Surgery</td>
<td>To reduce the surgery time wasted</td>
</tr>
<tr>
<td>Chandra/ 2018</td>
<td>India</td>
<td>PDSA</td>
<td>Pediatric Surgery</td>
<td>To reduce preoperative waiting-time by optimizing process flow</td>
</tr>
<tr>
<td>Newton/2017</td>
<td>UK</td>
<td>PDSA</td>
<td>A preoperative ward in pediatric surgery</td>
<td>To identify the different aspects of why children fasted for prolonged periods in the institution</td>
</tr>
<tr>
<td>Scott/ 2017</td>
<td>USA</td>
<td>Continuous quality improvement (CQI)</td>
<td>Pre-hospital emergency care service</td>
<td>To improve pre-hospital trauma care</td>
</tr>
<tr>
<td>Luckenbaugh/ 2017</td>
<td>USA</td>
<td>Collaborative quality improvement</td>
<td>Urological surgery</td>
<td>To improve urological care, with the goal of measuring and improving the quality of care provided to patients</td>
</tr>
<tr>
<td>Cameron/ 2016</td>
<td>USA</td>
<td>PDSA, Lean, Six sigma</td>
<td>Pediatric surgery</td>
<td>To improve in processes or outcomes Lean: To optimize efficiency by removing processes that add no value Six sigma: Utilize in healthcare to improve efficiency and standardize care processes</td>
</tr>
<tr>
<td>Hart/ 2016</td>
<td>USA</td>
<td>Framework for surgical improvement</td>
<td>Surgical fields</td>
<td>To propose a surgical measurement framework that provides a systematic, longitudinal approach for identifying key steps and processes in the management of surgical condition</td>
</tr>
<tr>
<td>Zinnicki/ 2015</td>
<td>USA</td>
<td>PDSA</td>
<td>Patients undergoing planned stoma surgery</td>
<td>To enable staff nurses to perform preoperative stoma site marking and education</td>
</tr>
<tr>
<td>Robertson/ 2015</td>
<td>UK</td>
<td>Lean PDSA</td>
<td>Plastic surgery</td>
<td>To improve surgical safety</td>
</tr>
<tr>
<td>Buck/ 2015</td>
<td>USA</td>
<td>Lean PDSA</td>
<td>Pediatric surgery</td>
<td>To reduce the intraoperative use of single-dose vials of fentanyl</td>
</tr>
<tr>
<td>Improta/ 2015</td>
<td>Italy</td>
<td>Lean and Six Sigma</td>
<td>Hip replacement surgery</td>
<td>To develop a clinical pathway which allows to improve quality and to reduce costs in prosthetic hip replacement surgery</td>
</tr>
<tr>
<td>Minanni/ 2015</td>
<td>USA</td>
<td>PDSA, Six Sigma, Lean, and Lean-Six Sigma</td>
<td>Surgical fields</td>
<td>PDSA: To structure an iterative approach to change Six sigma: To reduce variation and improve complex problems within large organizations Lean: To eliminate waste Lean-Six sigma: To remove the eight kinds of waste: time, inventory, motion, waiting, over-production, over-processing, defects, and skills</td>
</tr>
<tr>
<td>Mason/ 2014</td>
<td>UK</td>
<td>Lean and Six Sigma</td>
<td>General surgery</td>
<td>To optimize outpatient efficiency and experience, improve operating theatre efficiency, decrease operative complications, reduce mortality, limit unnecessary cost and length of stay</td>
</tr>
<tr>
<td>Marshall/ 2014</td>
<td>Canada</td>
<td>Continuous Quality Improvement (CQI)</td>
<td>Hip and knee replacement surgery</td>
<td>To improve care, improve the patient experience, lower per-capita cost</td>
</tr>
<tr>
<td>Blackmore/ 2013</td>
<td>USA</td>
<td>Lean</td>
<td>General surgery</td>
<td>To improve quality and safety in surgical sterile instrument processing</td>
</tr>
<tr>
<td>Farrokhi/ 2013</td>
<td>Ireland</td>
<td>Lean</td>
<td>Invasive spine surgery</td>
<td>To improve quality and efficiency in operating room instrument availability</td>
</tr>
<tr>
<td>Mazaleski/ 2011</td>
<td>USA</td>
<td>PDSA</td>
<td>Total joint replacement surgery</td>
<td>To organize and evaluate a weekly postoperative class for support persons of patients who have undergone total joint replacement surgery in an effort to enhance patient- and family-centered care</td>
</tr>
<tr>
<td>Nicolay/ 2011</td>
<td>UK</td>
<td>PDSA, SPC, CQI, Six sigma, TQM, (SOC), Lean, Lean Six sigma</td>
<td>Surgical healthcare</td>
<td>PDSA: Control infection, reduce complications SPC: Reduce complication, reduce infection, analyze surgeon performance and set a benchmark and reduce waiting time and Length Of Stay (LOS) CQI: Improve quality indicators TQM: Improve process of care Six sigma: Antibiotics administrating, reduce start time delays, reduce patient Length Of Stay (LOS) Lean: reduce infection, improve appropriate use of antibiotics, Reduce variability and improve surgical clinic experience, reduce patient Length Of Stay (LOS)</td>
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and to reduce start time delays.

Lean: Lean is a collection of philosophies and methods that helps to create maximum value through reducing the amount of waste and waiting times and optimal use of resources (23, 24). The main purpose of this model is to eliminate errors, efficiency improvement, and focus on analyzing a process and eliminating worthless or inefficient steps in them. This model has been increasingly used in healthcare to highlight costs and issues related to quality and safety. Also, the use of this model in surgery is recommended due to the nature of its costs and its high consumption (25-28).
In the reviewed studies, this model was used to optimize performance by eliminating worthless and unnecessary processes, to improve surgical safety, to improve the quality and safety in the process of sterilization of the operating room equipment, to improve the quality and efficiency in access to the operating room equipment, to infection control, to improve the proper use of antibiotics, to reduce variability and improve surgical clinic experience, and to reduce length of stay.

SPC (Statistical Process Control): SPC model is a philosophy, strategy, and set of methods for continuous improvement of systems, processes, and outcomes that is based on the use of data. Using this model requires understanding the processes by mapping them, and then understanding the causes of the changes and fixing them when they occur. This model is more used to continuous monitoring of the processes and to identify potential problems, and as a tool to assess the impact of other quality improvement interventions (18).

In the reviewed studies, this model has been used for different cases, such as: to reduce waiting time, the LOS for postoperative patients, and side effects, to control infection, and to analyze the surgeon's performance.

TQM (Total Quality Management) and CQI (Continuous Quality Improvement): TQM and its extension, CQI, is a management philosophy to continuously improve the quality of products and processes in order to meet customers' expectations, which can be used to influence profitability, costs, patient and staff satisfaction, and clinical outcomes (29-31). So that the quality must be the responsibility of everyone involved in the production or the provision of the services, including manager, personnel, suppliers, and even clients themselves (32). CQI is an expansion the SPC model, and it should be designed and institutionalized within the process (4).

In the reviewed studies, these two models have been used to improve the quality indices, care processes, pre-hospital care, and patient experience and satisfaction, and also to reduce waiting times, and per capita cost.

In general, many of the mentioned models contains continuous and cyclic projects, but their sustainability is uncertain over time (18).

2. Models designed specifically for surgery

C.K Hart framework: This model provides a comprehensive surgical measurement framework, which facilitates the identification of outcomes, key steps and processes in the management of surgical conditions, and provides a context that allows clinicians to translate these measures into clinical improvement. The purpose of this model is developing an assessment framework for surgery, in order to improve the patient's interim and long-term outcomes. This framework will facilitate standardization of care processes and measures to achieve ideal outcomes. This framework facilitates improvement by focusing on three primary areas: (1) measurement of outcomes during each phase of care, (2) identification of reliable processes of care, (3) mitigation of complications. These three areas were selected as the key aspects necessary to build a useful framework (33).

Proven Care: This model focuses on the processes and redesigns them. This model was developed in three phases: (1) review and validation of best practice evidence, (2) redesign of the process, (3) implementing the new process.

From this model's perspective, quality improvement is equal to process improvement. This model is suitable for episodic surgical interventions. Although this model has been used to improve the quality of the heart surgery, however, it can be used for the quality improvement in all surgical fields and interventions. To better performance, strong communication tools and timely feedback are required. This model may be difficult to run when the independency of the physician and surgical department personnel is low. Also, this model is not functional for high-volume surgical departments and because it has been
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implemented in a small community, generalization problems may occur (34).

Collaborative quality improvement: Collaborative quality improvement model focuses on cooperation in surgical quality improvement. This model utilizes a ‘measuring to improve’ philosophy consisting of core principles – quality data collection, feedback to physicians and practices, dissemination and implementation of strategies amongst collaborative members – with the goal of improving the care provided, treatment outcomes and costs. It is a comprehensive model that has two main dimensions: collaborative support and surgical quality improvement framework. The initial phase of this model is a QI need assessment, which ultimately leads to outcome improvements by changing the system and processes. Actually, in this model, the quality improvement framework and collaborative support are complementary (35).

Data synthesis

After analyzing the studies, a table was drawn for synthesizing the results. One dimension is the type of QI model and another is expected outcomes from the application of these models in different surgery fields. (Table 3).

According to the results, identified QI models were more used to improve postoperative processes and pre-hospital trauma care, identify causes of prolonged periods of stay and reduce LOS index, improve and administer surgical antimicrobial prophylaxis and antibiotics during surgery process, reduce and control infections, reduce complications, reduce mortality and morbidity, reduce waiting times and start time delays, reduce variability and improve surgical clinic experience, reduce costs, improve operating room efficiency by removing processes that add no value, and decrease per-capita costs.

Also these models rarely used for important purposes like: enabling staff and educating them to perform pre-operative activities, enhancing patient and provider communication, improving patient education, and accurate pain assessment, reducing readmission rate, analyzing surgeon performance, improving surgical safety, improving quality and efficiency in operating room instrument availability, and facilitating standardization of processes of care, as well as care evaluating to achieve ideal outcomes.

Discussion

The use of the identified models is often based on process mapping. Since implementing these models will be easier through designing and tracing the process. Each of these models can be used together or alone as an independent framework to guide healthcare QI projects (9). As noted in the result, two principal groups of the models were found by reviewing studies.

The first group included the models that entered the surgery from industry, and another group was those that presented to QI in surgical sections only. Most included studies that showed the positive impact of interventions, used the first group models, and there is a little evidence about unsuccessful attempts or implementation barriers to using these models in healthcare (36). Indeed, these models can be QI key in surgery and also be effective in reducing costs. These models have been successfully applied in various fields and aspects of surgery, especially in

<table>
<thead>
<tr>
<th>Model</th>
<th>Improve process maps improve postoperative processes and pre-hospital trauma care</th>
<th>Enhance patient and family centered care</th>
<th>Identify causes of prolonged periods of stay and reduce LOS index</th>
<th>Improve surgical antimicrobial prophylaxis and antibiotics administration</th>
<th>Reduce mortality and morbidity</th>
<th>Reduce readmission rate</th>
<th>Reduce waiting times and start time delays</th>
<th>Reduce variability and improve surgical clinic experience</th>
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<th>Improve surgical safety</th>
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<td>Proven care</td>
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http://mjiri.iums.ac.ir

Med J Islam Repub Iran. 2019 (2 Dec); 33:129.
repetitive processes, such as infection control and reduce the preoperative delay (18).

The PDSA model in the first category is often used for small QI projects or changes, or rapid assessment of inter-
ventions, as well as for continuous feedback to overcome
the resistances (37-39). This model is also more used to
delay waiting times. The use of this model in various
studies has confirmed its efficacy, feasibility and appro-
priateness, and immediate effect on the quality of care
(40). The Lean model has been used more to improve the
quality of medical equipment in the operating room, and
Six Sigma model always has been used to reduce the vari-
ance in the operating room processes through a set of pro-
cess criteria and statistical analyses, in order to improve
the efficiency and quality. The strengths of Lean and Six
Sigma models are roughly quadrupled when used together
in a complex healthcare environment (19, 27).

The SPC model was more used to reduce, improve and
control surgical procedures such as waiting time, and
length of stay in the surgery department (41). Indeed, all
models in the first group use different terms, but their ap-
proach is based on data and their purpose is to improve
care processes (9). There is also an overlap between the
models. For example, the elements of the PDSA and SPC
are similar to COI, TQM, six sigma and Lean, or SPC
itself is a model, but it can be used as a real-time meas-
urement tool for other models (18).

The first group of QI models can easily identify and
resolve process control problems that occur in surgery
(41). Also, one of the strengths of these models is that
they are flexible, and they can be used for similar
challenges at a specific time and place. All of them use a
systematic approach with a flexible process to QI, which
can be used for a wide range of outcomes between
different patient groups and different surgical fields (19).

Interrupted time series analysis before and after using
these models, shows that the impact of these models is
often immediate and stable. The efficiency and quality of
surgical care can be improved significantly with minimal
investment in data collection, statistical analysis, personal-
t raining, staff management and feedback at the
right time (18, 42). Of course, significant improvements
can be made in a short period of time and with relatively
low resources, but commitment to continuous data
collection, intervention, and awareness of the unintended
consequences of these changes is essential. Also the
leadership, continuous support and participation of the
surgical management team will be necessary to facilitate
and sustain quality improvement initiatives (40, 43).

The results of the studies showed that all first group
models have the potential to use in the health system,
especially in surgery (9). Due to these models entered
from industry to the health, helps cost saving through
reducing LOS and complications, continuous
improvement (not instantaneous and short-term improvement) (44). It is notable that these models when
applied in health, faces some challenges such as the
necessity to clear identification of process and patient
flow paths and allocate the required resources (45). One of
the main weaknesses of these QI models is excessive
simplification of the relationships between various steps
of a process. Also, these models do not combine patient
and system factors.

The second group of identified models is exclusively for
surgery. Common feature of them is comprehensive and
holistic view to the QI process (46). These models have
highlighted the nature of health context and provided a
method for effective organizational implementation and
essential infrastructure to success (47, 48).

Hart framework in the second group can be implement-
ed in all surgical fields easily. This model is a systematic
approach to measure and standardize surgical care and
achieve ideal care in any surgical field. Although this
model is very useful and it can fill the known gaps in
surgery, it has some limitations such as need to simplify
surgical processes in order to use the model. All model
components don’t exist in all surgical processes. Also,
various situations may happen that we can’t fit them easily
into the framework. However, the ability to organize
complex processes and identify existing gaps has trans-
formed this model into a tool for mapping surgery proce-
dures in all surgical fields and provide a foundation for QI
initiatives in surgery (33).

The results of reviewed studies revealed that using the
QI models in surgery is increasing, and the purpose of
using them is to reduce unnecessary consumption of re-
sources, increase the satisfaction of patients and their fam-
ilies, improve the efficiency, quality and safety of
healthcare in surgical wards. Also, the results showed that
more focus has been done on determining the effective-
ness of QI models in surgery so far (49-51).

It can be stated that using the first group models is wid-
er than the second in surgery. This is perhaps due to the
simplicity and ease of using them. It should be noted that
there are differences in the context of countries, and the
obstacles and limitations of each set to use the QI models
are unique. The infrastructure, access to resources, priori-
ties, and the challenges faced by countries are very differ-
ent (18, 19). So it isn’t possible to offer evidence-based
recommendations for different conditions, because the
most studies highlighted different aspects of the models to
different fields, and in different settings (52-54).

Integration of the required infrastructure and their sus-
tainability in QI initiatives are usually challenging (55).
Three main factors that lead to successful implementation of
the QI models include: changeable leadership, organiza-
tional culture, and teamwork. Of course, communica-
tion can be very difficult sometimes, and there are
numerous examples of the lack of understanding changes.
When implementing changes, continues leadership and
regular monitoring and evaluating are essential (56).

Each of the identified models, had different approaches
and aspects. Since the aim of our study was to review the
QI models in surgical care rather than healthcare in its
entirety, this creates an inherent selection bias in the
search terms. For example, studies on infection control in
medical patients may have been published, that could be
attributed equally to surgical patients. Also, there are dif-
ficulties in conducting researches in this area. Publication
bias is one of them. There may be studies that have unsuc-
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successful results in quality improvement and therefore, were not published. On the other hand, some studies may not have been published despite successful results (18).

Heterogeneity of the studies in this field is one of the main limitations of our study; this makes it difficult to generalize findings. Also, the concept of QI challenged the sensitive search for this review. Moreover, there is a confusion of terminology and concepts about the QI models and methodologies and they are often used interchangeably -sometimes as synonyms and sometimes as two different approaches. We consider the methodology and model as a concept in this study. Moreover, the quality of care assessment and evaluation bias in reviewed studies is one of the study limitations.

Because only the peer-reviewed studies have been included, there may be other models in gray literature that have not been identified. Also due to the complexity of the type of studies and surgical environments, a detailed description of these models is not provided. Also, the frequency of using the models in the reviewed studies cannot be the evidence for strength of them. It also worth mentioning that over time, disorders and ambiguities would be created in the model’s definition, which will be solved by developing and adding new parts into them (18). In total, there are several challenges in using and implementing the QI models in surgery; for example, wide range of patient problems, extensive procedures, and unexpected events.

In total, the present study is ongoing work. The QI models are constantly evolving, even in different organizational cultures that may change. Finally, despite the existing limitations, this review has helped in integrating QI models in surgery and seeing them together.

Conclusion

Hospitals comprise a large proportion of expenditures in health system and operation room activities have the largest share in hospital expenditures. This has caused that surgery to be an attractive target for QI initiatives. Reducing inefficiencies in surgery-related processes and improving the quality of care, especially in the current economic crisis, is one of the requirements of budgetary and resource-poor health systems. There are different models and frameworks with different aspects and dimensions for QI in surgery, which is recommended to use either of these models alone or with each other for specific circumstances. The use of these models in surgery is increasing, and it is recommended that these models could be used according to their functions in cases such as reducing the unnecessary use of resources, increasing the satisfaction of patients and their families with health care and improving the efficiency, safety and quality of healthcare in the surgical departments.

Acknowledgments

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Conflicts of Interests

The authors declare that they have no competing interests.

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Appendix 1. Search Strategy
PubMed/ Medline
((Improvement AND Quality) OR (Improvements AND Quality) OR (“Quality Improvements”) OR (“Quality Improvement”) OR (Management AND total quality) OR (“quality improvement”) OR (“quality management” [Ti/Ab]) AND (“Operative Surgical Procedure”) OR (Surgery) OR (“Operative Surgical Procedures”) OR (Procedures AND Operative Surgical) OR (“Surgical Procedure” AND Operative) OR (“Operative Procedure”) OR Procedure AND Operative OR (Procedures AND Operative) OR (Procedure AND “Operative Surgical”) OR (Diagnosis AND surgical) OR (“diagnostic techniques” AND surgical) OR (operation) OR (“operation care”) OR (“operative intervention”) OR (“operative repair”) OR (“operative restoration”) OR (“operative surgical procedure”) OR (“operative treatment”) OR (“research surgery”) OR (specialties AND surgical) OR (surgical care) OR (“surgical intervention”) OR (“surgical management”) OR (“surgical operation”) OR (“surgical practice”) OR (“surgical procedures” AND operative) OR (“surgical repair”) OR (“surgical research”) OR (“surgical service”) OR (“surgical specialty”) OR (“surgical specialty”) OR (“surgical therapy”) OR (“surgical treatment”) OR theatre [Title/Abstract] AND (model* OR frame-work*) [Title/Abstract])