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Research Article

Intensive Care Units Design and Quality Improvement: A Systematic Review

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Abstract

Aim: To review the intensive care units (ICU) quality improvement.

Data Sources: A systematic review of MEDLINE (PubMed, Medscape, Science Direct. EMF-Portal) and Internet was conducted on all articles published from 2002 to 2018.

Study Selection: English-language reports of the ICU quality improvement. The initial search presented 175 articles where 26 had inclusion criteria.

Data Extraction: Articles not reporting on the ICU quality improvement in the title or abstract were not included. 13 independent investigators extracted data on methods.

Data Synthesis: Comparisons were made by structured review with the results tabulated. 12 studies about Health care quality concepts and attributes, 7 about quality indicators in ICU, 7 about Application of the quality indicators in ICU.

Findings: Healthcare quality as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge. Safety is the foundation upon which all other aspects of quality care are built. ICU indicators included structure indicators such as compliance with national standards and an "adverse event" reporting system. As process indicators, routine multidisciplinary visits in the intensive care unit and a standardized transfer protocol were consented.

Conclusion: Quality improvement in ICU is depending on measurement of relevant quality indicators. This concept analysis of healthcare quality informs theory building for health science, as well as the critical attributes is essential to clarity, further instrument development, and theory building. Future research using this component of a theoretical framework, combined with an additional concept such as patient outcomes, may yield significant knowledge development in the provision of evidence-based nursing care.

Keywords: Application; Health Care Quality; Intensive Care Units; Quality Indicators

Introduction

We can't always cure patients; we can't always correct the problems that brought them to our doors, but we can and always should care for the whole person. Caring will be as important as curing in the overall 'healing environment' that will characterize the healthcare system of the future [1]. The goal of the design process is to create a healing environment that produces measurable improvements in the physical or psychological states of patients, staff, physicians and visitors (Optimal ICU design can help to reduce medical errors, improve patient outcomes, reduce length of stay. and increase social support for patients, and can play a role in reducing costs [2]. Quality indicators are standards which if upheld, will likely improve the quality of patient care by means of improved safety, better patient outcomes, and greater efficiency [3]. Interest

in measuring the quality of health care is increasing among both health care professionals as well as managers. To quantify the desired (positive) and undesired (negative) consequences of activities in health care, measurement of outcome is essential [4]. The underlying disease of intensive care patients may partly determine outcome of care, but also treatment at the intensive care units will have an effect on outcome. To reduce the risks of iatrogenic and organizational adverse effects on patient outcome, quality management is important in the intensive care units. Indicators can provide insight in quality of care and guide improvement of care in intensive care units [5]. A quality indicator is a screening tool to identify potential suboptimal clinical care [5]. Quality indicators provide a measure of quality of structure, process, and outcome of care, and can serve as instruments to improve health care. Structure indicators are related to the resources and means to be able to give treatment and care [6]. Outcome is defined as changes in the state of health of a patient that can be attributed to an intervention or to the absence of an intervention [6]. The aim of this work was to review Intensive Care Units Quality Improvement.

Materials and Methods

Data sources

A systematic review on Intensive Care Units Quality Improvement. Using MEDLINE (PubMed, Medscape, Science Direct. EMF-Portal) and Internet was conducted on all articles published from 2002 to 2018. During research focused on Health care quality concepts/ attributes/ quality indicators in ICU/Application of the quality indicators in ICU as searching terms. Additional records were identified by reference lists in retrieved articles. The search was established in the electronic databases from 2002 to 2018.

Study selection

Eligible articles were published in peer-reviewed journals and written in English. Articles not reporting on Intensive Care Units Quality Improvement. in the title or abstract were not included. Full-text articles were screened, and the final inclusion decisions were made according to the following criteria: original studies, systematic reviews or meta-analyses; primary or first-line treatment and, if necessary, secondary treatment described, and treatment success, complications and side-effects described.

Data extraction

Articles not reporting on the on Intensive Care Units Quality Improvement in the title or abstract were not included. 13 independent investigators extracted data on methods, health outcomes, traditional protocol. Surveys about symptoms and health without exposure assessment, report without peer-review, not within national research programmed, letters/comments/editorials/news and studies not focused on Intensive Care Units Quality Improvement.

The analyzed publications were evaluated according to evidence-based medicine (EBM) criteria using the classification of the U.S. Preventive Services Task Force and UK National Health Service protocol for EBM in addition to the Evidence Pyramid [7].

U.S. Preventive Services Task Force [7].

- Level I: Evidence obtained from at least one properly designed randomized controlled trial.
- Level II-1: Evidence obtained from well-designed controlled trials without randomization.
- Level II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.
- Level II-3: Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled trials might also be regarded as this type of evidence.
- Level III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Study quality assessment: quality of all the studies was assessed. Important factors included, study design, ethical approval, calculation of evidence power, specified eligibility criteria, appropriate controls, adequate information and specified assessment measures. It was expected that confounding factors would be reported and controlled for and appropriate data analysis made in addition to an explanation of missing data.

Data Synthesis: A structured systematic review was done with the results tabulated. 12 studies about Health care quality concepts, 7 about quality indicators in ICU, 7 about application of the quality indicators in ICU.

Results

Study selection and characteristics

A systematic review on the different ICU quality indices for practical application in intensive care units Using MEDLINE (PubMed, Medscape, Science Direct. EMF-Portal) and Internet was conducted on all articles published from 2002 to 2018. Articles not reporting on Health care quality concepts and attributes, quality indicators in ICU and Application of the quality indicators in ICU in the title or abstract were not included. 13 independent investigators extracted data on methods, health outcomes, and traditional protocol. Potentially relevant publications were identified, 63 articles were excluded as they are away from our inclusion criteria. 26 studies were reviewed as they met the inclusion criteria. 12 studies about Health care quality concepts and attributes, 7 about quality indicators in ICU, 7 about Application of the quality indicators in ICU.

Regarding these studies there were four prospective studies [8-11] come to level II-2 or (level B), and revealed that Healthcare quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge. A thematic analysis of the unique characteristics was subsequently collapsed into four categorical themes as the defining attributes: (1) effective, (2) safe, (3) a culture of excellence, and (4) desired outcomes. Also, four randomized control studies [12-16] come to Level I or (level A) reported that Hospital healthcare quality has been described as hospitals that take charge, work to establish new initiatives, and build protocols and programs. Turnaround time is one of the most important healthcare performance indicators when describing hospitals' healthcare quality. Safety is the foundation upon which all other aspects of quality care are built. While, three Cohort studies [17-19] Comes in the second level regarding the pyramid of EBM, we found that Described compassion as a necessary feature to provide good quality health care and a culture of excellence. Key cultural determinants in quality health care to be excellence in care delivery, ethical values, involvement, professionalism, value for money, and commitment to quality and strategic thinking (Table 1).

Study	Year	Type	Level of EBM	Results
IOM [8]	2013	A prospective study	level II-2 or (level B)	Healthcare quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.
AHRQ [9]	2012	A prospective study	level II-2 or (level B)	Adopted the IOM definition of healthcare quality, perhaps in an effort to focus the discussion and defining attributes.
Allen-Duck., *et al.* [10]	2017	A prospective study	level II-2 or (level B)	A thematic analysis of the unique characteristics was subsequently collapsed into four categorical themes as the defining attributes: (1) effective, (2) safe, (3) a culture of excellence, and (4) desired outcomes.
Burhans and Alligood, [11]	2010	A prospective study	level II-2 or (level B)	One feature of effectiveness is making sure that things are not missed or omitted.
Mosadeghrad [12]	2013	Randomized case-control study	Level I or (level A)	Used "consistently delighting the patient by providing efficacious, effective, and efficient care" as a descriptor of quality health care.
Kahn, [13]	2016	Randomized case-control study	Level I or (level A)	Hospital healthcare quality has been described as hospitals that take charge, work to establish new initiatives, and build protocols and programs.
Kim., *et al.* [14]	2015	Randomized case-control study	Level I or (level A)	Turnaround time is one of the most important healthcare performance indicators when describing hospitals' healthcare quality.

Mitchell [15]	2008	02	Level I or (level A)	Safety is the foundation upon which all other aspects of quality care are built.
Farr and Cressey [16]	2015	Randomized case-control study	Level I or (level A)	Staff values and personal and professional standards are essential elements in understanding quality.
Lionis [17]	2015	Cohort study	Comes in the second level regarding the	Described compassion as a necessary feature to provide good quality health care and a culture of excellence.
Carney [18]	2011	Cohort study	Comes in the second level regarding the	Key cultural determinants in quality health care to be excellence in care delivery, ethical values, involvement, professionalism, value for money, and commitment to quality and strategic thinking.
Dolovich., *et al.* [19]	2016	Cohort study	Comes in the second level regarding the	Utilized the attainment of a person's health goals as an outcome measure of quality.

Table 1: Health care quality concepts and attributes.

Additionally, two Randomized case-control studies [6,20] come to Level I or (level A) found that A task force of the European Society of Intensive Care Medicine (ESICM) has published a list of quality indicators. These included structure indicators such as compliance with national standards and an "adverse event" reporting system. As process indicators, routine multidisciplinary visits in the intensive care unit and a standardized transfer protocol were consented. Also, three prospective studies [21-23] comes to level II-2 or (level B) and reported that Outcome indicators included the standardized mortality rate (SMR) and the 48-hour re-admission rate, the rate of catheter-associated blood stream infections and the rate of unplanned extubating. Also, two Cohort analysis [24,25] Comes in the second level regarding the pyramid of EBM and found that Process-based quality indicators as measures that evaluate the dimension of quality with the strongest effects on a patients' outcome. However, constant modernization of the indicators is the "price" that has to be paid for this (Table 2).

Study	Year	Type	Level of EBM	Results
Donabedian, [6]	2003	Randomized case-control study	Level I or (level A)	A task force of the European Society of Intensive Care Medicine (ESICM) has published a list of quality indicators in 2012. These included structure indicators such as compliance with national standards and an "adverse event" reporting system. As process indicators, routine multidisciplinary visits in the intensive care unit and a standardized transfer protocol were consented.
Rhodes., *et al.* [20]	2012	Randomized case-control study	Level I or (level A)	
Kumpf., *et al.* [21]	2017	A prospective study	level II-2 or (level B)	Outcome indicators included the standardized mortality rate (SMR) and the 48-hour re-admission rate, the rate of catheter-associated blood stream infections and the rate of unplanned extubation.
Braun., *et al.* [22]	2012	A prospective study	level II-2 or (level B)	DIVI quality indicators comprise mainly process indicators which are used in the peer review process
Flaatten, [23]	2012	A prospective study	level II-2 or (level B)	Compared to the DIVI-qis, outcome indicators are mainly used in seven other countries and by the ESICM.
Berenholtz., *et al.* [24]	2002	Cohort study	Comes in the second level regarding the	The adverse event" indicator "pressure ulcer rate" is routinely reported in the quality reports of all German hospitals.
Curtis., *et al.* [25]	2006	Cohort study	Comes in the second level regarding the	Process-based quality indicators as measures that evaluate the dimension of quality with the strongest effects on a patients' outcome. However, constant modernization of the indicators is the "price" that has to be paid for this.

Table 2: The quality indicators in intensive care medicine.

Also, two Cohort studies [26,27] Comes in the second level regarding the pyramid of EBM and reported that in essence the implementation of the guidelines is the primary goal. To enable this implementation process has to be in the focus in the future. Innovative methods of implementation are needed like "blended learning" concepts, use of multiplier seminars. While, two Randomized case-control studies [21,28] come to Level I or (level A), theses reported that Patient data management systems (PDMS) are not widely used in German intensive care units, which could help technically to collect data for quality measurements. Existing systems do not regularly offer such functions although this would be desired by a majority of its users. On the other word, three prospective studies [3,4,29] come to level II-2 or (level B) and indicated that when beginning data collection for the indicators, a time-limited sample could be useful, particularly since the peer review process is also a method using point prevalence. Retrospective recording of data is also possible. A stepwise approach with an increasing number of indicator use or alternating use of the indicators can be employed (Table 3).

Study	Year	Type	Level of EBM	Results
Radtke., *et al.* [26]	2012	Cohort study	Comes in the second level regarding the	In essence the implementation of the guidelines is the primary goal. To enable this implementation process has to be in the focus in the future. Innovative methods of implementation are needed like "blended learning" concepts, use of multiplier seminars
de Vos., *et al.* [27]	2007	Cohort study	Comes in the second level regarding the	Evaluation of guideline implementation requires evaluation of quality indicators. Even if the QI are increasingly used, there are still deficits in widespread application.
von Dincklage., *et al.* [28]	2018	Randomized case-control study	Level I or (level A)	Patient data management systems (PDMS) are not widely used in German intensive care units, which could help technically to collect data for quality measurements. Existing systems do not regularly offer such functions although this would be desired by a majority of its users.
Kumpf., *et al.* [21]	2017	Randomized case-control study	Level I or (level A)	Manual computation is more time consuming and calculation may be complex but not an insurmountable obstacle because of the relatively simple calculation rules of the indicators.
Pronovost, [3]	2008	A prospective study	level II-2 or (level B)	When beginning data collection for the indicators, a time-limited sample could be useful, particularly since the peer review process is also a method using point prevalence. Retrospective recording of data is also possible
Mainz, [4]	2003	A prospective study	level II-2 or (level B)	A stepwise approach with an increasing number of indicator use or alternating use of the indicators can be employed.
Marschall., *et al.* [29]	2014	A prospective study	level II-2 or (level B)	The effort necessary is not too large compared to the possible positive effects. Moreover, to start the process of recording quality indicators it is recommended to carry out a peer review in intensive care medicine according to the recommendations of the DIVI.

Table 3: Application of the quality indicators in intensive care medicine.

Discussion

The IOM [8] defines healthcare quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge. Previously, the AHRQ [9] adopted the IOM definition of healthcare quality, perhaps in an effort to focus the discussion and defining attributes. A thematic analysis of the unique characteristics was subsequently collapsed into four categorical themes as the defining attributes: (1) effective, (2) safe, (3) a culture of excellence, and (4) desired outcomes [10]. Burhan's and Alligood, (11). concluded that one feature of effectiveness is making sure that things are not missed or omitted. Furthermore, Mosadeghrad [12] used "consistently delighting the patient by providing efficacious, effective, and efficient care" as a descriptor of quality health care. Hospital healthcare quality has been described as hospitals that take charge, work to establish new initiatives, and build protocols and programs [13]. More specifically, turnaround time is one of the most important healthcare performance indicators when describing hospitals' healthcare quality [14]. Mitchell [15] indicated that safety is the foundation upon which all other aspects of quality care are built. Additionally, Farr and Cressey (16) reported that Staff values and personal and professional standards are essential elements in understanding quality. Lionis (17) described compassion as a necessary feature to provide good quality health care and a culture of excellence. Similarly, Carney (18) found key cultural determinants in quality health care to be excellence in care delivery, ethical values, involvement, professionalism, value for money, and commitment to quality and strategic thinking. Additionally, communication between the healthcare team and with patients must be accurate, consistent, evidence-based, credible and reliable, and understandable. Dolovich., *et al*. [19] utilized the attainment of a person's health goals as an outcome measure of quality. These four defining attributes lay the foundation of healthcare quality and, as such, are attributes that must all be present for healthcare quality.

A task force of the European Society of Intensive Care Medicine (ESICM) has published a list of quality indicators in 2012 [20]. These included structure indicators such as compliance with national standards and an "adverse event" reporting system. As process indicators, routine multidisciplinary visits in the intensive care unit and a standardized transfer protocol were consented [6]. Outcome indicators included the standardized mortality rate (SMR) and the 48-hour re-admission rate, the rate of catheter-associated blood stream infections and the rate of unplanned extubating [21]. In contrast the DIVI quality indicators comprise mainly process indicators which are used in the peer review process [22]. Compared to the DIVI-QIs, outcome indicators are mainly used in seven other countries and by the ESICM [23]. Outcome indicators are a part of the German intensive medical core data set DIVI-Reverse (SMR and 48h resuscitation rates). The adverse event" indicator "pressure ulcer rate" is routinely reported in the quality reports of all German hospitals [24]. Overall, we consider process-based quality indicators as measures that evaluate the dimension of quality with the strongest effects on a patients' outcome. However, constant modernization of the indicators is the "price" that has to be paid for this [25].

Evidence based intensive care medicine should be based on consented guidelines and recommendations which are developed according to the most recent literature available. In essence the implementation of the guidelines is the primary goal. To enable this implementation process has to be in the focus in the future. Innovative methods of implementation are needed like "blended learning" concepts, use of multiplier seminars or web-based platforms [26]. Evaluation of guideline implementation requires evaluation of quality indicators. Even if the QI are increasingly used, there are still deficits in widespread application [27]. Ideally quality indicators are regularly measured and evaluated for internal quality management. This can't be achieved everywhere due to a variety of reasons. For example, patient data management systems (PDMS) are not widely used in German intensive care units, which could help technically to collect data for quality measurements. Existing systems do not regularly offer such functions although this would be desired by a majority of its users [28]. Manual computation is more time consuming and calculation may be complex but not an insurmountable obstacle because of the relatively simple calculation rules of the indicators [21]. When beginning data collection for the indicators, a time-limited sample could be useful, particularly since the peer review process is also a method using point prevalence. Retrospective recording of data is also possible [3]. A stepwise approach with an increasing number of indicator use or alternating use of the indicators can be employed [4]. The effort necessary is not too large compared to the possible positive effects. Moreover, to

start the process of recording quality indicators it is recommended to carry out a peer review in intensive care medicine according to the recommendations of the DIVI [29].

Conclusion

This review found that Quality improvement in ICU is depending on measurement of relevant quality indicators. This concept analysis of healthcare quality informs theory building for health science, as well as the critical attributes is essential to clarity, further instrument development, and theory building. Future research using this component of a theoretical framework, combined with an additional concept such as patient outcomes, may yield significant knowledge development in the provision of evidence-based nursing care.

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