

The present use of quality indicators in the intensive care unit

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Quality indicators (QIs) are increasingly used in medicine in order to compare and eventually to improve quality of delivered health care. During the last decade, QIs also have been used within intensive care medicine. This paper shortly describes this development and gives an overview of QIs in the intensive care unit (ICU) reported to be in use at national level. Using a search on PubMed and through World Wide Web, QIs documented to be in use at a national level were retrieved. The various sets of QI were compared, and the method to select QIs was found. The search retrieved national indicators from eight countries (United Kingdom, the Netherlands, Spain, Sweden, Germany, Scotland, Austria and India). A total of 63 QIs were in use, and no single indicator was common for all countries. The most frequently used indicator was the standardised mortality rate (in six of eight countries). Measurements of patient/family satisfaction, the

presence of an ICU specialist 24/7 and the occurrence of ventilator-associated pneumonia were all used by five countries. All primarily used a physician-driven process to select national QIs. This survey reveals that the concept of QIs is perceived differently throughout countries, also within developed countries in Western Europe. At present, it will be difficult to use national QIs to compare the quality of intensive care between countries.

Accepted for publication 4 January 2012

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IN the last 10–15 years, quality measurements and quality management have found its ways with full strength into medicine as well as intensive care. Of course, physicians and nurses have, for a much longer time, been occupied with the delivery of high quality treatment and care of patients, but the more structured approach to quality issues and comparisons between units is a more recent phenomenon. The extensive work of Donabedian has been crucial for all interested in health-related quality of care.^{1,2} More than 40 years ago he suggested using three different approaches in order to assess the quality of care: structure, process and outcome.

Structure quality implies the more or less 'fixed' conditions where care is given. Such structure includes facilities and all types of equipment, human resources (number and qualifications) and some organisation characteristics like the organisation of nurse and physician work, teaching and research function, reimbursement of care etc. In the intensive care unit (ICU), both physical structure of

the buildings, room design and space as well as all type of medical technical equipment naturally belongs here.

With process quality, it was meant for the activities that constitute health care such as diagnosis and treatment, follow-up, prevention etc. Today often called a 'care pathway' or 'bundle'. A typical example here is the prescription of appropriate antibiotics for sepsis within a short time frame (like 1 h) after admission.

Outcome quality was meant to describe the changes (wanted and unwanted) in the patients/clients or populations that could be ascribed to the health care. Survival, as well as health-related quality of life in survivors are typical examples. Also, length of stay in the ICU, time on ventilator and adverse events are usually considered as parts of the outcome quality, although the latter is often considered as a specific quality indicator (QI) today.

In order to approach quality, one must have results to describe or measure that could be used in

comparison. In addition, there must be a 'gold standard' to measure against. Quality can then be described as quality achieved relative to the selected quality standard. The area of interest is often called an indicator, hence the term Health Care Quality indicators (QIs). This concept was introduced as a MeSH term in PubMed in 1998, and the term has been used with ICUs 222 times since its introduction (PubMed search by August 2011).

The introduction of severity of illness scoring systems in the 1980s was probably the first indicator systematically to be used within intensive care,^{3,4} although they were not originally called QIs. Using such scoring, the unit mortality rate could be compared with an estimated mortality (derived from the severity score). This is most often referred to as the standardised mortality rate (SMR), wherein < 1 indicates better performance and > 1 worse performance compared with the standard.

Although of large importance, the SMR have received a lot of criticism since its introduction

- It is time consuming to perform (at least when performed manually).
- The inter-rater variability is large.⁵
- The case mix from ICU to ICU varies a lot and continues to make direct comparisons difficult.
- Mortality is not the only outcome indicator of importance in the ICU.
- Indicators of structure, process and outcome are also regarded necessary.

In the start of this century, Pronovost and co-workers published several papers regarding QIs in the ICU. Both the general background⁶ to selection of evidence-based indicators⁷ and their performance in a group of ICUs⁸ were published. This gave inspiration to a number of countries with the goal to create a set of local, regional or national QIs in intensive care.

The aim of this overview is to document the selection of ICU QIs developed at a national level. The present use of these QIs will be documented and discussed.

Methods

By performing a search in PubMed (MeSH Terms Quality Indicator AND Intensive Care Units OR Critical care Units), relevant published papers were selected. Also by performing a World Wide Web search using the search phrases Quality indicator, Intensive Care Units and National Intensive Care registries, additional documents available on the

web, but not formally published in peer-reviewed journals, were also retrieved. Only documents representing a national level (governmental, National intensive care Society or national registries) were included. Also, non-English documents were retrieved.

When analysing these data, a summary table of different indicators was constructed, showing the use of the different QIs used at the different national level and the type of QIs according to Donabedian¹: representing structure, process or outcome/adverse outcome. These QIs were also compared with the list of the QIs suggested by Pronovost et al.⁶ in order to find out how many of their 'original' QIs had found their use.

In addition, the methods described in order to reach the chosen QIs were identified.

Results

The search on PubMed revealed three publications: from the Netherlands,⁹ India¹⁰ and Germany.¹¹ The web search revealed five national consensus documents about ICU QIs: from Spain (<http://www.semicyuc.org/temas/calidad>), from United Kingdom (http://www.ics.ac.uk/intensive_care_professional/standards_safety_and_quality), from Sweden (http://www.icuregswe.org/Documents/Guidelines/Nat_Q_Ind_2012.pdf), the latter one in Swedish, from Scotland (http://www.sicsag.scot.nhs.uk/Quality_indicators_V1_0_141111.pdf) and Austria (P. Metnitz, personal communication). The total number of QIs was 63 and varied from 10 to 20, although in Spain, the 20 was just a subset (fundamental indicators) of the total 120 QIs.

Table 1 shows the 26 QIs shared by at least two countries, ranked with regards to their use. No single indicator was found to be common for all countries. The most frequently used QI was the SMR (in six of eight countries). Measurements of patient/family satisfaction, the presence of an ICU specialist 24/7 and the occurrence of ventilator-associated pneumonia were used in five countries. Thirty-eight QIs were only used in a single country (not shown in the table).

Table 2 shows the present use of the 18 original QIs proposed by Pronovost et al. in 2001.⁷ None were used in all countries, one (SMR) in six countries, and two were used in five countries. Four original QIs were not used in any of the six countries. Spain and Austria used seven of the 18 QIs and Germany only two. In table 3 information regarding the methods used to develop national QIs are listed.

Table 1

Quality indicators (QIs) from the eight countries used in more than one country.

	QI type	Germany	The Netherlands	India	United Kingdom	Sweden	Spain	Scotland	Austria
Year introduced or year of last revision #		2010	2007	2009	2009	2011	2011	2011	2008
Name of QI/total number of QI		10	12	17	20	10	20	10	14
1. Standardised mortality rate	OI		X	X	X	X	X	X	X
2. Measurement patient/family satisfaction	OI		X	X	X	X	X	X	X
3. Intensive care specialist present 24/7	SI	X	X	X	X	X	X	X	X
4. Ventilator-associated pneumonia	AEI		X	X	X	X	X	X	X
5. Intensive care unit (ICU) readmission rate	OI		X	X	X	X	X	X	X
6. Early enteral nutrition	PI	X		X	X	X	X	X	X
7. Central venous line infection rate	AEI	X		X	X	X	X	X	X
8. Hand disinfection solution used	PI	X		X	X	X	X	X	X
9. Number of inter-clinical transports	OI		X		X	X			
10. Days of bed occupancy rate >100%	OI		X		X	X		X	
11. Number of night discharges	OI		X	X	X	X		X	
12. Length of stay in ICU	OI		X	X					X
13. Adverse events rate	AEI			X			X		X
14. Monitoring of sedation	PI	X		X			X		X
15. Monitoring of analgesia	PI	X					X		
16. Incidence of decubitus	AEI		X	X			X		
17. Upper body elevation	PI	X					X		
18. Documented meetings with relatives	PI	X					X		
19. Nurse to patient ratio	SI		X		X			X	
20. Mortality and morbidity follow-up	PI				X			X	
21. End-of-life pathways in place	PI								
22. Use of daily goal sheets	PI		X						X
23. Duration of mechanical ventilation	OI								
24. Follow-up after death in the ICU	PI	X							X
25. Therapeutic hypothermia	PI				X				X
26. Reintubation rate	OI	80%	75%	47%	60%	70%	50%	60%	86%
% QI shared with one or more country									

OI, outcome indicator; SI, structure indicator; AEI, adverse event indicator; PI, process indicator.

Table 2

The original quality indicators suggested by Pronovost et al. and their use in eight countries.

QI according to Pronovost et al. ⁷	Germany	The Netherlands	India	United Kingdom	Sweden	Spain	Scotland	Austria
1. Standardised mortality rate (SMR)		X	X	X	X		X	X
2. Measurement of patient/family satisfaction		X	X		X	X	X	
3. Ventilator-associated pneumonia			X		X	X	X	X
4. Intensive care unit (ICU) readmission rate			X	X	X			X
5. Central venous line infection rate			X	X			X	X
6. Length of stay in ICU		X	X					X
7. Monitoring of sedation	X					X		
8. Monitoring of analgesia	X					X		
9. Duration of mechanical ventilation		X						X
10. Multiresistant bacteria in the ICU					X			
11. Occurrence of thromboembolism						X		
12. Inappropriate red blood cell transfusion						X		
13. Ulcus prophylaxis during mechanical ventilation						X		
14. Delayed ICU discharge								X
15. ICU length of stay \geq 7 days								
16. Delayed ICU admissions								
17. Emergency department bypass hours								
18. Cancelled surgery								

Table 3

Methods described how to select suitable national quality indicator.

	Spain	The Netherlands	United Kingdom	India	Sweden	Germany	Scotland	Austria
Expert group/panel	X			X		X	X	X
Physicians	X	X	X	X		X	X	X
Intensive care unit nurses							X	
Patients or relatives								
Other		X*					X†	
Delphi method			X			X		
Survey			X					
Consensus					X			

*Experts (undefined).

†One nurse, one pharmacist, one quality assurance manager.

Discussion

Several countries, mainly European, obviously have been inspired to develop national QIs for intensive care. A lot of work is at present, put into producing indicators to compare ICUs at national levels. It is of interest that out of the 63 different QIs used in the seven countries, none were common for all countries, and only seven were common for half or more of the countries. Most QIs were only used in a single country. The number of QIs within a given country used by at least one other country varied from 47% to 86%.

The result clearly demonstrates several interesting traits:

- The concept of quality in the ICU are perceived different from one country to another, at least if we judge from the choice and priority of QIs.

- The profile of the choice of QIs also varies, with some countries using more process-based QIs than others. All countries, though, have several outcome QIs in their set.
- Most QIs are outcome based; very few are related to structure.

Usually, when describing quality in general, it is useful to have a perception of the ultimate quality or 'gold standard'. In other areas than medicine, it is not difficult to find a gold standard, for example in process industry. This is evidently much harder in care processes, being a lot more complicated. As an example, it will be impossible to achieve a zero goal regarding ICU mortality. Hence, quality in health care is often measured up against 'best evidence' or 'best practice' found in medical research. This is probably the explanation that most of the QIs not being outcome related are process related. A typical

example of the latter is the adherence to guidelines and protocols. Process QIs may represent a particular problem in his respect, because the evidence may suddenly change, recently illustrated by the sudden withdrawal of drotrecogin alfa [Xigris, (Eli Lilly and Company, Indianapolis, Indiana, USA)] in severe sepsis. Another example is the adherence to various blood-sugar protocols. Less than 10 years ago, blood-glucose level was recommended to be within normal values during the ICU stay. Hence, a process QI with this goal would have been judged as reasonable. Today's evidence is that this probably is more dangerous than accepting higher levels.¹²

This is an important reason to re-evaluate a given set of QIs at regular intervals. At present, this was found to be done in Sweden and Spain.

Working with indicators and benchmarking have been a natural activity in most national intensive care registries. The road to the development of a national set of ICU QIs is hence apparent, and many of the present national QIs are derived through such a process. The degree of 'official status' of the national ICU registries varies from being an integral part of the National Health Service to an independent body often associated with a intensive care society. Hence, in some countries, the QI is voluntary for each ICU, and in some, obligatory, although it is difficult from the present study to document details about these aspects.

The development of QI is usually profession driven, and other stakeholders like former patients, relatives, hospital administrators or non-ICU medical personnel involved are seldom involved. To include groups other than ICU physician was important when developing the set of competences for intensive care physicians (CoBaTrice).¹³ In the initial phase of this project, patients, relatives as well as ICU nurses also contributed to the choice of competencies, finally to be selected by the expert group. This could also be an interesting approach in a future process of developing cross-national QIs for intensive care.

Is it important to have some QIs in common for different countries, and if yes, how could this be implemented?

Some would obviously question the necessity to have a core set of common QIs throughout a region, like Europe. European intensive care is far from homogenous and is performing at very different levels. How a given QI would act in a country with a well-developed and high-capacity ICU system compared with countries with much less-developed system with smaller capacity is largely unknown.

Quality is also perceived differently, and an indicator like ICU length of stay may be interpreted as a good QI by some but less relevant by others. This may be the explanation that only 3/8 of the countries has this QI on their list.

To develop QI is only the first step in the chain of quality improvement. After defining the QI, they must be used and reported by all, or at least most national ICUs. This could be a difficult task because at least, some QI require a lot of effort to collect in a correct and comparable way. Registration of central venous line infection is just one such example. Should only ICU unit infection rate be registered, what about lines not removed at discharge but are used further on in the ward, what about double lines, should they count as one and how to diagnose line infection correctly in a critical ill patient are just some of the difficulties encountered.

The next step is feedback from a central register to all participating units and then the use of these data at the level of the individual ICU in order to foster quality improvement. Only then is the 'quality circle' closed, and the QIs have found its use.

There is probably a long way ahead until we in Europe can agree on a common set of QIs. In the meanwhile, it will be difficult to compare QIs across national borders, simply because there are no uniform QIs. Hopefully, an ongoing project within the European Society of Intensive Care Medicine about a set of European ICU indicators may lead us forward. (A. Rhoads, personal communication). Possibly, the only QI of uniform value across different countries and cultures are ICU survival and post-ICU function/quality of life, however, these may be difficult to compare.

Conflicts of interest: The author declares no conflict of interest.

Funding: no funding was received.

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