

# Quality of Care

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## **Technology for the continuous improvement of the quality of health care**

*N.T. Racoveanu & Kirsten Staehr Johansen*

*Since medical technology impinges on the structure, process and outcome of health care it has a profound effect on attempts to achieve improvement in this field. The present article discusses the links between medical technology and continuous quality development, with particular reference to utilization, appropriateness and cost-benefit.*

In 1993 a proposal was made by the WHO Regional Office for Europe and the Danish health authorities for a policy of continuous quality development in health care involving:

- definition of quality and the main components of health care;
- description of the basic principles of continuous quality development;
- identification of the main actors, responsibilities and activities at all levels in a country's health care system.

The essence of continuous quality development is to make use of the best results of care on the following basis:

- setting goals for quality;
- assessing quality and identifying the best results;

- improving quality by analysing and using know-how to achieve the best results;
- following the continuous application of the process.

The process thus encompasses the control, assessment, improvement and assurance of quality. The following elements are essential.

- Patients' experiences should be taken into account.
- Activities at local level should be an integral part of the daily work of all categories of staff.
- The ultimate responsibility for quality of care development should lie with managers at all levels, although every health care provider clearly has a part to play.
- The process should be based on self-assessment and self-regulation rather than on control and legislation.

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Dr Racoveanu was formerly Chief, Radiation Medicine, World Health Organization: now retired, he lives at 6B rue Carteret, 1202 Geneva, Switzerland. Dr Staehr Johansen is Manager, Quality of Care and Technologies, World Health Organization, Regional Office for Europe, Copenhagen, Denmark.

### **What is good quality?**

In the present context, quality is considered to be care or service that meets specified require-

ments and, given current knowledge and resources, fulfils expectations for maximizing benefits and minimizing risks to the health and well-being of patients. Health care of good quality is thus characterized by:

- a high degree of professional excellence;
- efficiency in the use of resources;
- minimal risk to patients;
- satisfaction of patients;
- a favourable impact on health.

These major components are attainable only if a knowledge of them exists which can be used constructively in the following areas:

- *structure*, referring to the organizational settings of care, including economic conditions, management, personnel, equipment, facilities and information systems;
- *process*, referring to the skills deployed in the delivery of information and preventive, diagnostic, therapeutic and rehabilitative services to patients;
- *outcome*, i.e., the effects of the care given on the health and well-being of patients, the degree to which patients are satisfied and the efficiency of resource utilization, with which the measures taken should be correlated in a scientifically proven manner (1).

In this connection medical technology clearly has an essential role to play since it is a component of structure and process and can determine outcome. It includes hardware, i.e., equipment, apparatus, instruments and facilities, and software such as methods and procedures, used in the prevention, diagnosis and treatment of disease, the rehabilitation of patients and the re-establishment of health. Medical technology draws on many fields of science and is continuously expanding as new discoveries find application in health care.

In a recent survey, 30% of 507 physicians questioned in Canada expressed the view that

the Canadian health system was overused and abused, while 17% considered that access to facilities was a major problem. In Germany the major shortcomings in the health system were seen as the high cost of services by 32% of 517 physicians asked, while 25% cited bureaucracy and administrative burdens as serious problems. In the USA, access to care by indigent patients and the high cost of services were considered to be major problems by 55% and 38% of 601 physicians questioned respectively (2). Serious problems concerning medical practices which were identified by physicians in the same countries are indicated in Table 1.

In 1990 the per capita expenditures on health in Canada, Germany and the USA were US\$ 1770, \$ 1486 and \$ 2566 respectively.

Table 1  
**Serious problems in medical practices according to physicians**

Problem	Percentages of physicians citing the problem		
	Canada	Germany	USA
Patients unable to afford fees	25	15	73
Patients not attending soon enough	36	42	51
Excessive delays in reimbursement	24	39	78
External review needed to limit costs	28	43	53
Limited supply of necessary technology	50	20	14
Patients want unnecessary services	53	49	42
Limited time for examination	44	58	35
Shortage of competent nurses	56	77	54
Limitations on hospital stays	30	29	57

Given the views expressed by the physicians in these countries it is apparent that Canada and Germany offer better conditions for care to the whole population than the USA,

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despite their lower per capita expenditure and the problems of access to facilities in Canada, probably attributable to low population densities and long distances between many people's homes and the medical institutions they attend.

The same study identified misuse of the health services in terms of both overutilization and underutilization, an important factor relating quality of care to medical technology. This provides an opportunity to analyse the relationship between technology and the quality of care. How does medical technology contribute to the process of continuous quality development, and how does the latter influence the rational and cost-effective utilization of technologies?

### **Utilization of technologies**

The principal reasons for introducing and diffusing new technologies are:

- technical advantage;
- health impact;
- cost-effectiveness (leading to affordability);
- acceptability to patients and health personnel.

These elements fall within WHO's definition of appropriate technology; an additional condition laid down in that definition is that

technologies should be maintained with the skill and resources available to the users.

More explicitly, the relationship between technologies and the quality of care can be seen in terms of:

- utilization;
- outcome;
- cost.

The following categories of utilization of a technology can be described if it has been properly assessed with regard to its clinical or health impact and its cost-effectiveness.

- Appropriate utilization produces a high quality of care at an acceptable cost and risk.
- Overutilization is usually easier to detect and can have various causes, among them unjustified patient demand, fear of malpractice, financial interest, and poor professional performance.
- Underutilization is easily identified when access to a given technology is limited because of shortages of equipment and skilled manpower, difficult geographical conditions, and so on, but is less apparent when access is limited by economic factors such as unaffordable fees or where particular population groups are a factor.

The utilization of diagnostic imaging has been well evaluated in various countries. The available data suggest that 400 to 600 X-ray examinations per 1000 population per annum represent appropriate utilization of diagnostic radiology in Western Europe, while figures in the range 1200-1400 for such examinations may indicate overutilization of this technology. In many developing countries, 30 to 100 radiological examinations per 1000 population per annum have been reported. These comparatively low values, clearly representing underutilization, can be explained by the lack

of facilities associated with unfavourable economic conditions.

WHO's Basic Radiological System was introduced with a view to improving the coverage of this technology, with recommendations for the rational utilization of diagnostic imaging (3–6). Clear indications are given on the avoidance of unnecessary X-ray examinations, such as those made for administrative or other reasons that cannot be justified on clinical grounds, and on the most effective examination algorithms for given clinical situations. An intervention study based on the WHO recommendations in a large Copenhagen hospital has led to a substantial reduction in unnecessary radiological examinations (7).

Changes in utilization are due to the adoption of new technologies and the replacement of obsolescent ones. Thus in British Columbia, Canada, there was a gradual increase in the requests for multiple compared with single chemical analyses between 1979 and 1988, with similar changes in the utilization of haematological services (more multiple than single analyses) over the same period. Pneumoencephalography has totally disappeared with the introduction of the CT (computerized tomography) scanner. The cost of chemistry and haematology services did not change but that of imaging increased threefold (8). In the absence of information on outcome it is impossible to evaluate the health benefit obtained as a result of the financial investment.

Between 1985 and 1989 there was a continuous increase in the utilization of new medical technologies in the USA's Medicare system (9). A clear tendency existed for some less invasive technologies, such as percutaneous transcatheter coronary angioplasty, to replace coronary artery bypass graft, and for open surgical stone removal to be replaced by either the endoscopic procedure or extracor-

poreal shock wave lithotripsy in the urinary or bile tract. Reasons for the adoption of emerging technologies are that they are less invasive, have improved outcomes and are less

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costly. However, 40% of patients undergoing extracorporeal shock wave lithotripsy required a second stone removal procedure, usually an endoscopic one, within 60 days.

Magnetic resonance imaging and CT scans provide similar diagnostic information but also have some specificities that are not sufficiently differentiated and understood by specialists. Consequently, instead of magnetic resonance imaging having replaced CT or other imaging technologies, the new technology is being overutilized by being added to other diagnostic tests in the hope of increasing the sensitivity and specificity of diagnosis. In contrast there are signs that a more rational approach to the utilization of CT examinations is being adopted in the USA and in the Scandinavian countries. This technology has probably reached its maturity and is therefore being employed with higher clinical relevance, thereby contributing to improvement in the quality of care.

### ***Reasons for large variations in utilization***

The large variations between and within countries in the utilization of medical technologies may be linked to the following factors:

- availability, measured as the number of installations per million people;
- accessibility;
- criteria for appropriate use.

Availability and accessibility depend heavily on economic conditions and the political commitment of governments in regard to health services. Availability is not equivalent

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to accessibility because the system of payment for services may severely restrict access, particularly to expensive technologies.

The application of criteria for appropriate use provides a method for selecting patients who can be expected to derive the greatest possible benefit from a given technology and for limiting its overuse or abuse. In 1970 the American College of Radiology initiated a project aimed at achieving efficacy in the use of diagnostic radiology, and a similar approach has been adopted by the Royal College of Radiologists in the United Kingdom. Both of these initiatives have produced data on categories of X-ray examinations which are not clinically justifiable, e.g., systematic chest radiography on admission to hospital or during pregnancy, and have identified patients belonging to groups categorized as being of high, intermediate and low yield in so far as radiological investigation is concerned.

### Appropriateness of technologies

The concept of rating appropriateness provides an objective approach to the selection of patients for submission to various health technologies (10). An analysis of the views of a United Kingdom and an American panel on the appropriateness of coronary angiography indicated that more discriminative criteria were applied by the United Kingdom panel in respect of 320 cases, since it considered only

49% of them to be appropriate, as compared with 71% found appropriate by the American panel (Table 2). The differences between the panels in respect of coronary artery bypass surgery were smaller for appropriate and equivocal use and greater for inappropriate use. Nevertheless, it is noteworthy that relatively large proportions of both procedures were not appropriate and therefore represented a waste of resources and indicated low quality of care (11).

Bureaucratic and administrative measures are not sufficient to improve the appropriateness of care; a better solution is to develop clinical leadership. Physicians should participate actively in a process that distinguishes technologies that work, and should promote them. Systematic repetition of the process leads to continuous quality development.

An audit of ultrasound in the diagnosis of gall-bladder calculi indicated that this technology, which carries practically no risk and is relatively inexpensive, was highly sensitive and specific (12). Another study indicated that ultrasound was more accurate than cholecystography in measuring the largest diameters of gallstones and also in determining their number, except where two to five were pres-

Table 2  
**Appropriateness of coronary angiography in 320 patients in the United Kingdom**

American panel	United Kingdom panel			Total (%)
	Appropriate (%)	Equivocal (%)	Inappropriate (%)	
Appropriate	49	19	3	71
Equivocal	0	5	7	12
Inappropriate	0	6	11	17
Total	49	30	21	100

ent (13). Cholecystography carries a degree of risk and is more expensive, and should be used only when there is a need to be sure of the patency of the cystic duct and the concentration capacity of the gall bladder, or when information is required on the chemical composition of the stones, although in this context a CT scan is more reliable.

An audit of the treatment of stage IB carcinoma of the uterine cervix in 137 patients suggested that primary surgery was more effective than radical radiotherapy. There was no induced morbidity in patients treated by surgery alone; morbidity appeared in patients treated by surgery combined with radiotherapy and was more pronounced in those given radical radiotherapy only (14).

**Cost-benefit**

A major problem associated with the use of technologies in the development of the quality of care, particularly new ones, concerns the relationship between cost and benefits. A model has been proposed for comparing alternative technologies (15) (see figure). It suggests four adoption zones, each with a policy action: any intervention promising

increased benefits at no increased cost or the same benefits at less cost should be adopted. Any loss of benefits without a cost advantage should not be adopted. When the cost and benefits of the two alternatives are identical the choice can go either way without major consequences. The difficult choices are at the top left and bottom right corners: how much more should be paid for how much benefit, and how much benefit should be sacrificed for how much cost reduction? In these circumstances a well-designed and well-monitored field investigation would be necessary to guide decision-makers as to whether they should accept or reject a technology.

The concept of continuous quality development in health care has been put into practice with good effect in some areas, and the subject has captured the imaginations of many leaders of health services. Reorientation of medical research can be expected to produce major changes in the development of medical technologies, and it is to be hoped that this will lead to significant advances in many fields, including vaccination against parasitic diseases, contraception, and the prevention of chronic degenerative and other diseases having a large impact on public health. Furthermore, the prospect exists of galvanizing the currently neglected area of health promotion. ■

**A model for comparing alternative technologies in respect of costs and benefits**

Benefits	Costs		
	More	Same	Less
More	Difficult choice	Adopt	Adopt
Same	Do not adopt	Either	Adopt
Less	Do not adopt	Do not adopt	Difficult choice

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### ***Killing the patient by killing the pain?***

*If shortening of life results from the use of adequate doses of an analgesic drug, this is not the same as intentionally terminating life by overdose. Any hastening of death that is linked to adequate pain control measures simply means that the patient could no longer tolerate the therapy necessary for a bearable and dignified life.*

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