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A review of historical developments of quality assessment in industry and healthcare
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Keywords: *Quality improvement, quality methods, industry, healthcare*

Category: *General review*

Introduction

The quality of healthcare has been a major problem in many Countries for many years. Finding a definition, methods of evaluation, monitoring and improvement have been the major problems that researchers and healthcare practitioners have had to investigate over the years (Idvall et al, 1997).

Donabedian (1966) noted that the quality of healthcare is a “remarkably difficult notion to define.” Based on a definition offered by Lee and Jones (1933), he concludes that the criteria of quality of care are mere value judgements that are applied to aspects of a process called healthcare. Deming (1986) cites and shares W. A. Shewhart’s view that the difficulty in defining quality emanates from the need to translate future requirements of the user into measurable characteristics so that the product or service can be designed and turned out to satisfy the user. Regarding the quality of healthcare, Deming states that a definition is a “perennial problem”. He adds that healthcare quality has been defined in many ways and that each way seems to serve a special type of problem. In spite of this difficulty in defining the concept, there has always been the need to measure and improve quality.

Moreover, it is evident that better quality has been achieved at different levels in different industries or organisations. For example, Young et al (2004), Merry (2004), Laffel et al (1989), and Mohammed (2004) provide evidence that healthcare practitioners can adopt some of the quality improvement techniques in practice in other industrial systems mainly in the manufacturing sector. Currently there are several cases of attempts being made to apply some industrial systems improvement techniques in healthcare (Komashie and Mousavi, 2005; Moore, 2003; Dodds, 2005).

This paper attempts to extract information from a comparative analysis of quality improvement methods in industry and healthcare and to suggest some directions for further study. It is primarily concerned with the general concepts of quality assessment within these industries at various points in time and how these concepts have changed. It must also be noted that there are volumes of publications

on quality both in healthcare and industry but this paper is not an exhaustive review of relevant literature. It is however believed that the sources selected for this study are representative of the major trends in quality particularly in the United Kingdom and the United States of America.

Methodology

Firstly, a review of the evolution of quality assessment in industry and in healthcare was conducted. This was based on books written by prominent experts in the field of quality. Secondly, a study of the current approaches in healthcare was undertaken. Publications from varied sources were selected and reviewed. The literature consulted includes worldwide operations research and healthcare sources including dissertations, the internet and reference lists of relevant articles.

The journal papers and conference proceedings were selected according (but not limited) to the following criteria: *Objective*: the study must be aimed at measuring or improving quality or both. It could also be aimed at developing new ways of measuring the quality of health care; *Method*: observational studies, experimental trials or systematic reviews; *Setting*: study should be in a hospital setting and not narrowed to quality of clinical cares.

Results and discussions

Concern for quality

Understanding the basics of quality is important to our ability to improve it (Folaron 2003). Thus, this section briefly examines the main concerns that led to the pursuit of quality both in industry and healthcare.

Juran (1999), Ellis and Whittington (1993), Berwick and Bisognano (1999), Maguad (2006), Dooley (2001) all agree that the concept of quality is timeless both in industry and healthcare. However, a close examination of the literature shows that there is a difference in the concerns that led to the need to improve quality. In the days of the village market place, the *caveat emptor* which means “let the buyer beware” was the norm. The producer supplied the goods but the buyer was responsible for assuring the quality of the goods before making a purchase. Juran (1999) explains that the buyer “looked closely at the cloth, smelled the fish, thumped the melon, and tasted the grape.” It can be deduced from this evidence that the primary concern for quality in that era was the need to obtain value for money. Thus the buyer did everything to avoid any dissatisfaction that may arise after paying for goods. This value for money principle remains inherent in some quality techniques or methods today, for example customers are allowed to try on clothes in the shop before buying.

Consumers of healthcare on the other hand have not had much choice until in recent years. There is therefore no clear evidence of healthcare consumers demanding any level of quality. Bull (1992) noted that from 1854 to 1870, the motivation for systematic quality evaluation was primarily professional in Great Britain. Also early evidence of healthcare quality efforts like the Hippocratic Oath, the work of Ignaz Semmelweis and Florence Nightingale were all cases of professional concern. Thus it can also be hypothesised that the pursuit of healthcare quality came out of a concern for better health or lost lives as perceived by individual professionals. In recent years however, it is evident that the primary concern for quality comes from a pressing need to satisfy the customer (or patient) both in industry and healthcare. This has become the prerequisite for staying in business and most of the experts (Deming, Juran, Crosby, Feigenbaum) in the field of quality have argued that focusing on

quality is more beneficial than focusing on profit and consider top management involvement as vital.

Another observation is the “demand” and “supply” of quality over the years which summarises the argument in this section. Figure 1 is a representation of the ”demand” and ”supply” of quality over the years based on evidence from literature. The figure shows that the level of quality around the time of the *Caveat Emptor* was relatively high and could be beyond the customer’s expectations. There was a direct contact between the producer and the buyer. Ellis and Whittington (1993) relate that in such context, it was possible for individual customer’s wishes to be designed into the product at anytime. On the contrary, the industrial revolution ushered in an era of production that led to the fall of the craft system and degradation of quality of products (Maguad, 2006). Productivity became the goal of industry and the demand of consumers for quality began to rise above its “supply” from industry. Then, the technological explosion in the latter part of the twentieth century which further degraded quality by the complexity of the resulting systems and products. With the consumerism of the twenty-first century, it has become even more difficult to satisfy customers as the demand for quality goods and services continuous to rise.

On the other hand, consumers of healthcare did not have much choice and were less informed about health issues around the time of the village market place. Thus the quality of healthcare was “supplied” by professionals and improved gradually as they sought ways to avoid unnecessary deaths and errors. Berwick and Bisognano (1999) noted rather arguably that the modern era of quality in healthcare, particularly in America, began at the turn of the twentieth century. This demand for quality care rose very quickly to levels that left healthcare organisations in search of new ways of assuring quality (Ferlie and Shortell 2001). As a result of this difference in fundamental concern, the tools and methods used managing quality have also differed considerably.

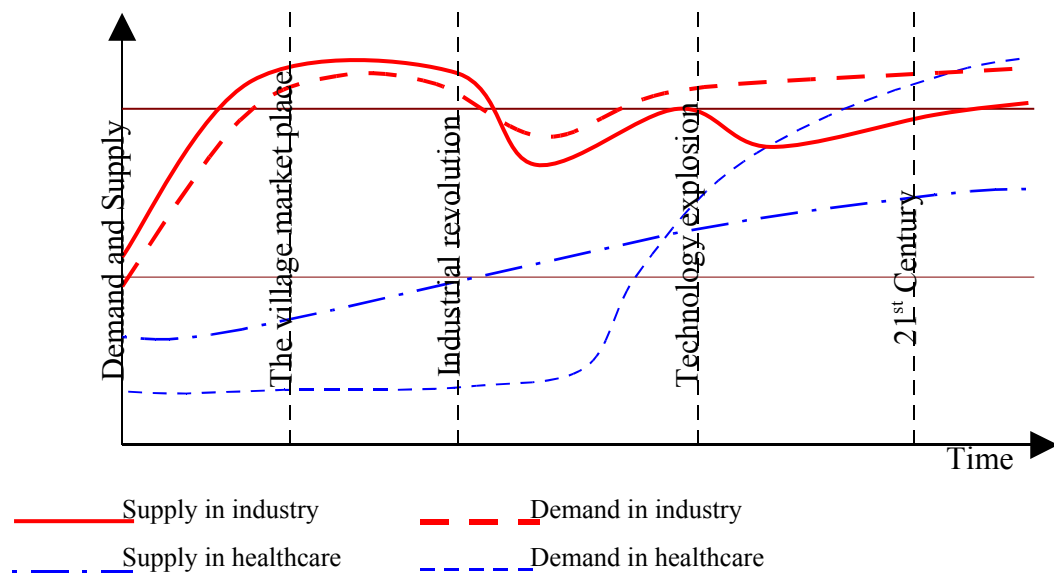


Figure 1. The Demand and Supply of Quality

Use of quality tools and methods

Quantifying and improving quality requires the use of specific methods or tools. In this study it has been observed that though it may appear that several methods are common to healthcare and industry, the majority of techniques have their

origin in industry. According to Montgomery (2005), though quality has always been an integral part of almost every product and service, our awareness of its importance and the introduction of systematic methods for its control has been an evolutionary process. Table I provides a comparison of this evolutionary process in industry and healthcare. The table shows that developments in quality methods have occurred in quite distinct ways in the two sectors.

The development of control charts in the early parts of the twentieth century by W. A. Shewhart shows the rigour with which industry approached the problem. As Hare (2003) stated, faced with the problem of process variability, Shewhart had to find an answer to the question “how much of a scientific observation is deterministic and how much is random?” Shewhart concluded that the answer was in the application of statistical methods and began by a definition of a control as quoted by Hare (2003) that “A phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in the future. Here it is understood that prediction within limits means we can state, at least approximately, the probability that the phenomenon will fall within the given limits.” This is evidently a focus on the process and can be claimed to mean that the quality of the product is in the process. The concept of reduced variability resulting in improved quality has been proved over the years and still remains the fundamental principle in some modern quality philosophies like Six Sigma. Shewhart’s work laid the foundation for industrial quality methods for the subsequent years.

The approach in healthcare is observed to be more of a reactive one to start with. About the same time of Shewhart’s work, part of the efforts in healthcare was a survey undertaken by Groves (1908) cited in Bull (1992). According to Bull, Groves, a British Physician, surveyed fifty hospitals having over two hundred beds each for patient mortality from surgical procedures. He found that mortality ranged from 9% for appendectomies to 44% for procedures related to malignancies. Other efforts around the time were professional certification and legislations (Bull 1992; Berwick and Bisognano 1999), nursing standardization (Bull 1992) and Dr Codman’s recommendation to review all patients one year after surgery (Sale 2000). These efforts help us understand the issues and will also inform strategic decisions but are lacking in achieving quality at the level where it matters most. If care is to be patient-centred, then the most important level is, as Donabedian (1966) said, the level of “physician-patient interaction.”

However, these differences in approach or methods applied in industry and healthcare can quite reasonably be attributed to the difference in processes (product based and service based) and differences in the concern for the pursuit of quality as discussed previously. Examining the end of table 1, period of 2000 and beyond, one has to bear in mind that whenever an organisational task can be effectively automated, it eventually will be (Dooley 2001). Dooley used this argument to predict that quality methods in industry will eventually be automated. Montgomery (2005) also sees this period as one in which quality improvement will break traditional boundaries into healthcare, insurance and utilities. Although Sale (2000) reports that the introduction of the Salmon Report (DoH 1966) caused an enormous change in British nursing by its introduction of industrial management techniques, it is still not sufficiently evident what the extent of this change has been in terms of the appropriate and effective application of industrial techniques for healthcare quality improvement. Therefore, there is the need to appropriately apply to healthcare some of the rigorous quality techniques in industry.

Table I: A comparison of quality methods in industry and healthcare

| Period | Industry methods | Healthcare methods |
|---------------------|---|---|
| Up to 1900 | <ul style="list-style-type: none"> Guilds membership Inspection Standardisation Supplier certification | <ul style="list-style-type: none"> Physician licensing Specialty societies Individual efforts (record keeping) |
| 1900 to 1920 | <ul style="list-style-type: none"> Systematic inspection and testing Experimental design Control Charts | <ul style="list-style-type: none"> Surveys e.g. E. W. Groves (1908) Professional certification Legislations Nursing and hospitals standardisation Follow-ups, e.g. Dr Codman (1914) |
| 1920 to 1940 | <ul style="list-style-type: none"> Acceptance sampling Statistical methods Professional regulation | <ul style="list-style-type: none"> Studies on nursing conduct Health insurance legislations Government legislation and standards |
| 1940 to 1960 | <ul style="list-style-type: none"> Training in statistical quality control Quality societies Quality publications Total Quality Control Experimental design Top management involvement Standards Awards e.g. "Deming prize" | <ul style="list-style-type: none"> Regulatory bodies formed Landmark publications Internal and external inspection Professional standards Performance measures Accreditation of hospitals |
| 1960 to 1980 | <ul style="list-style-type: none"> Quality Circles SPC widespread More quality societies and publications Introduction of TQM | <ul style="list-style-type: none"> Rapid increase in literature Focus on process and inspection oriented More surveys e.g. Drew Supervisory and record audit Hospital accreditation Audit tools e.g. Phaneuf's audit, Rush Mediscus, Qualpacs |
| 1980 to 2000 | <ul style="list-style-type: none"> Spread of Experimental design SPC National and international certification, awards and standards Six sigma QFD TQM | <ul style="list-style-type: none"> Increase in published standards Publications on indicators Focus on measurement and monitoring More regulatory bodies Government involvement raised |
| 2000, beyond | <ul style="list-style-type: none"> New international standards e.g. ISO 9000:2000, ISO 14000 Automation of quality Enterprise quality systems | <ul style="list-style-type: none"> Import of industrial techniques New and tighter standards Consumer societies |

Some current research in healthcare quality

This section seeks to take a snapshot of current research in the area of healthcare quality from the year 2000 till date. This is intended to give a broad idea of the methods of assessment that are still being used by researchers and not meant to be an exhaustive review.

One method that remains prominent in healthcare quality research is the review of literature to determine factors or indicators that will improve or measure quality of care. Some recent reviews are Berenholtz et al, (2002), Campbell et al,

(2000), Campbell et al, (2002), and Mainz, (2003). These reviews all had different objectives. For example, Berenholtz et al (2002) were looking at quality indicators in intensive care units whilst Campbell et al, (2002) were reviewing research methods used in developing indicators in primary care. Other methods identified are interviews (structured or unstructured) as by Che Rose et al, (2004) and Baltussen and Ye, (2006), surveys, by Wisniewski and Wisniewski (2005) and the use of the Analytic Hierarchy Process (AHP) together with the Delphi method by Tavana et al, (2003). These all had different objectives and show how researchers look at the same concept of quality differently. The problem with relying on these methods alone is that though they are effective for measuring the state of affairs, they do not provide the necessary control that will ensure continuous quality improvement.

According to Hutchins (1990), what is needed is that localisation of quality that “encourages a feeling of ownership and greater likelihood of pride in personal and group achievement akin to the internalised values of the medieval craft groups. Without such internalization, a climate of quality cannot be said to exist”. Jessee (1981) also noted that “...The most accurate diagnosis of a health care problem and the most valid assessment of the factors contributing to it will not produce the desired improvement unless effective techniques for changing individual and organizational behaviour can be applied when necessary.” Our analysis has identified this as a key factor in moving quality improvement to the next level and we refer now to a relatively new approach.

A proposal for a new approach

Researchers and quality professionals continue to make a strong case for the application of industrial quality techniques in healthcare. Some examples are Reid, (2006); Young, (2004); Laffel, (1989). The possibility of this being the norm in the near future is not far-fetched but the problems that need to be addressed are appropriateness and practicalities. Several possibilities exist but one technology that is proving to be an effective decision support tool in healthcare is Discrete Event Simulation (Eldabi et al, 2007). The proposed new approach uses a real-time computer model of the healthcare environment that displays a Healthcare Quality Index (HQI) and other key performance factors. The benefits of this are that healthcare managers and staff on the ground can access a user-friendly approach to understanding current activity (e.g. hospital throughput, waiting times) by viewing simulation models. Changes can be made to the ‘current’ model (i.e. current picture of what is happening) in order to test for different outcomes and assess which would represent the best quality (e.g. reduced length of stay). This would represent one of the most sophisticated advancements in healthcare quality as it would allow clinicians to be directly involved in decision making on an ongoing basis, thereby improving the feeling of ‘ownership’ and enhanced efficiency at the organisational level. Evaluations of this approach in healthcare settings are now required to assess its full potential and applicability.

Conclusions

It has been highlighted that the concept of quality management and its control in healthcare is not as advanced as it is in industry. Two reasons have been suggested for this difference, thus the difference in the fundamental concern for quality and the nature of industrial and healthcare processes. The study also pointed out that with the growing interest in applying industrial techniques in healthcare, issues of appropriateness and practicality must be robustly examined. It was also deduced that

the way forward in healthcare quality is the development of systems that give staff "ownership" and pride in a way that is akin to the era of the craftsmen. A computer simulation based tool was proposed and briefly described.

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References:

- Baggott, R., (1998), *Health and Health Care in Britain, 2nd ed.*, Macmillan Press Ltd., London, pp 191
- Baltussen, R. & Ye, Y. (2006), "Quality of care of modern health services as perceived by users and non-users in Burkina Faso", *International journal for quality in health care : journal of the International Society for Quality in Health Care / ISQua*, vol. 18, no. 1, pp. 30-34.
- Berenholtz, SM., Dorman T., Ngo K., Pronovost P. J., (2002), "Qualitative review of intensive care unit quality indicators", *Journal of Critical Care*, 17, 1, 1-15.
- Berwick, D. M. and Bisognano, M., (1999), "Health Care Services", in Juran, J. M. Godfrey, A. B. (ed), *Juran's quality handbook*, 5th edn, McGraw-Hill, USA, pp32.1-32.20.
- Bull, M. J., (1992), "Quality Assurance: Professional Accountability via Continuous Quality Improvement", in Meisenheimer C. G. (ed), *Improving Quality: A guide to effective programs*, Aspen Publishers Inc, USA, pp 3-20.
- Campbell, S. M. , Braspenning J. , Hutchinson A. and Marshall M., (2002), "Research methods used in developing and applying quality indicators in primary care", *Quality and Safety in Health Care*, 11, 4, 358-364.
- Campbell, S. M., Roland M. O. and Buetow S. A., (2000), "Defining quality of care", *Social Science and Medicine*, 51, 1611-1625
- Che Rose, R., Uli J., Abdul M., Looi Ng K., (2004) Hospital service quality: a managerial challenge. *International Journal of Health Care Quality Assurance*, 17, 3, 146-159.
- Cooke, L., (1992), "Computers: Quality assurance applications", in Meisenheimer C. G. (ed), *Improving Quality: A guide to effective programs*, Aspen Publishers Inc, USA, pp 197-225.
- Deming, W. E., (1986), *Out of the crisis*, MIT, USA.
- Dodds, S., (2005), "Designing improved healthcare processes using discrete event simulation", *British Journal of Healthcare Computing and Information Management*, 22, 5, 14-16.
- Donabedian, A., (1966), "Evaluating the quality of medical care", *Milbank Quarterly*, vol. 44, no. 3, pp. 166-206.

- Dooley, K., (2001), "The paradigms of quality: Evolution and revolution in the history of the discipline", *Advances in the Management of Organizational Quality*, vol. 5, pp. 1–28.
- Eldabi, T., Paul, R. J., and Young, T., (2007), "Simulation modelling in healthcare: reviewing legacies and investigating futures", *Journal of the Operational Research Society*, 58, 262-270.
- Ellis R. and Whittington D., (1993), *Quality Assurance in Health Care; A Handbook*, Edward Arnold, Lon
- Ferlie, E.B. & Shortell, S.M., (2001), "Improving the Quality of Health Care in the United Kingdom and the United States: A Framework for Change", *The Milbank quarterly*, vol. 79, pp. 281-315.
- Fuchs, E., (1999), "Customer service", in Juran, J. M. Godfrey, A. B. (ed), *Juran's quality handbook*, 5th edn, McGraw-Hill, USA.
- Hare, L., (2003), "SPC: From chaos to wiping the floor", *Quality Progress*, July, 2003, available online at www.asq.org/pub/qualityprogress/past/0703/58spc0703.html (accessed on 20/12/2006).
- Hutchins, D., (1990), *In pursuit of Quality*. Pitman, London.
- Idivall, E., Rooke L., and Hamrin E., (1997), "Quality indicators in clinical nursing: a review of the literature", *Journal of Advanced Nursing*, Vol. 25, no. 1, pp 6-17.
- Jessee, W. F., (1981), "Approaches to improving the quality of healthcare: Organizational change", *Quality Review Bulletin*, 7, 7, 13-18.
- Juran, J. M. (1999), "How to think about quality", in Juran, J. M. Godfrey, A. B. (ed), *Juran's quality handbook*, 5th edn, McGraw-Hill, USA.
- Komashie, A., and Mousavi A., (2005), "Modeling emergency departments using discrete event simulation techniques", *Proceedings of the 2005 Winter Simulation Conference*, Kuhl, M. E., Steinger, N. M., Armstrong, F. B., and Joines, J. A., eds., 2681-2685.
- Laffel, G. & Blumenthal, D. (1989), "The case for using industrial quality management science in health care organizations", *JAMA: The Journal of the American Medical Association*, vol. 262, no. 20, pp. 2869-2873.
- Lee, R. I., and Jones, L. W., (1933), *The Fundamentals of Good Medical Care*, University of Chicago Press, Chicago.
- Madhok, R., (2002), "Crossing the quality chasm: lessons from health care quality improvement efforts in England.
- Maguad, B.A., (2006), "The modern quality movement: Origins, development and trends", *Total Quality Management and Business Excellence*, vol. 17, no. 2, pp. 179-203.
- Mainz, J., (2003), "Defining and classifying clinical indicators for quality improvement", *International Journal for Quality in Health Care*, vol. 15, no. 6, pp. 523-530.
- Merry, M. D., (2004), "What Deming says", *Quality Progress*, Sept. 2004, 37, 9
- Mohammed, M.A., (2004), "Using statistical process control to improve the quality of health care", *Quality and Safety in Health Care*, vol. 13, no. 4, pp. 243-245.
- Moore S., (2003), "Capacity planning – modelling unplanned admissions in the UK NHS", *International Journal of Health Care Quality Assurance*, 16, 4, 165-172.
- Okes, D. (2006), "Promoting quality in your organisation", *Quality progress*, May 2006, Vol. 39, no. 5, pp. 36-40
- Ranade W., (1997), *A future for the NHS? Health Care for the Millennium*, 2nd ed., Addison Wesley Longman Ltd., New York, pp 153

- Reid, R. D., (2006), "Developing the voluntary healthcare standard", *Quality Progress*, Nov. 2006, 39, 11, 68-71
- Sale, N. T., (2000), *Quality Assurance: a pathway to excellence*, Macmillan Press Ltd., London.
- Tavana, M., Mohebbi, B. & Kennedy, D.T., (2003), "Total quality index: A benchmarking tool for total quality management", *Benchmarking*, 10, 6, 507-527.
- Wisniewski, M., and Wisniewski H., (2005) "Measuring service quality in a hospital colposcopy clinic", *International Journal of Health Care Quality Assurance*, 18, 3, 217-228.
- Young, T., Bailsford S., Connel C., Davies R., Harper P., and Klein J. H., (2004), "Using industrial processes to improve patient care", *BMJ* Vol. 328, 162-4.