UNIT NO. 4

QUALITY IMPROVEMENT TOOLS

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ABSTRACT

Quality improvement (QI) tools are at the heart of any QI activity. To help us in the QI journey, there are now many tools that have been developed as well as numerous websites that try to provide repositories of such tools and know-how about the use of these tools. Given the plethora of QI tools, there is a risk of the newcomer to QI journey being overwhelmed. The basic QI tools can be categorised into the information gathering tools, the seven process analysis tools (or statistical process control tools), the documentation tools, and the meeting tools. A broad view of the topic has been taken to include the QI concept models as tools. These are: the Model of Improvement which incorporates the PDSA Cycle, the Six Sigma Improvement System, the Balanced Score Card, the Chronic Care Model, and the Chain of Effect.

INTRODUCTION

Quality improvement (QI) tools are at the heart of any QI activity. These activities are in turn a means to an end of continuing improvement as an ideal in healthcare delivery[1]. Why QI? QI in health delivery brings efficiency¸ effectiveness, and satisfaction to both the healthcare provider and the healthcare receiver.

How does QI integrate with content of care and the process of care in our practices? The answer is in an equation shown in Figure 1[2]. To help us in the QI journey, there are now many tools that have been developed and also numerous websites that try to provide repositories of such tools and know-how about the use of these tools.

One useful website is that of the Institute of Healthcare Improvement (IHI). It has on its website the most useful tools they have developed and adapted to help accelerate improvement; as well as tools other organizations have developed – including protocols, order sets and forms, instructions and guidelines for implementing key changes. They are all free fulltext and downloadable documents. Another useful website is that of the Quality Assurance Project (QAP) which also has useful free fulltext downloadable documents. Other useful websites are given in the references.

I have broadened the topic of quality improvement tools to beyond the basic tools to include concept models as tools.

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Content of care: What is done	+	Process of care: How it is done	=	Output/outcome: Improved quality of care and health status
o Norms o Standards o Protocols o Guidelines		o Quality improvement approaches o Cycle of learning and improvment		(e.g., standards developed and applied)

Source: Massoud, QA Brief 39

Figure 1. How QI Integrates with Content of Care and Process of Providing Care

QUALITY IMPROVEMENT TOOLS AND CONCEPT MODELS: A ROAD MAP

Given the plethora of QI tools, there is a risk of the newcomer to QI journey being overwhelmed. Table 1 shows the categorization of the basic QI tools into information gathering tools, process analysis tools (or statistical process control tools), documentation tools, and meeting tools. Table 2 shows the QI concept models that have been developed globally so far.

INFORMATION GATHERING TOOLS

The information gathering tools are shown in the first row of Table 1.

Walk-through

This enables providers to understand the experience of care from the patient and the family's point of view better – by going through the experience themselves. This tool is most useful in answering the first of the 3 questions in the Model for Improvement (described in greater detail in Unit 6) – *What are we trying to accomplish?*

Using the walk-through tool has the following benefits:

- It provides first hand knowledge of what it is it like to be a user of the organisation.
- It builds incentive for the organization to improve the process of providing care and enhancing the patient experience.
- It generates information that address the total experience of the patient, including direct observations as well as feels of confidence, confusion, or frustration.
- It generates ideas for process improvement and innovation.

Sampling

Measurement is a means to an end. Sampling saves time and resources while accurately measuring performance. It can be a systematic sampling or a block sampling.

Systematic sampling. This is a method to collect data at fixed time or count intervals – for example, every hour on the hour, or every fourth patient. Systematic sampling is useful for a high-volume process. Use it to gain a general picture of the performance of a process and to sample data over extended periods of time. Decide on the number of

Table 1. Categories of the Basic Quality Improvement Tools

Category	Description of tool	Remarks
Information gathering tools	o Walk-through o Sampling o Simple data collection planning o Short survey o Interview guide o Successful visiting guide o Idea generation tools: brainstorming o Change Assessment Indicator (CASI)	These are useful in the topic selection stage and the study stage of the clinical audit project described in Unit 2, and in the steps of the SEA described in Unit 3.
Process analysis tools (also called statistical process control or SPC tools)	o Flowcharts o Control charts – common cause; special cause o Pareto Diagrams o Cause and effect diagrams – Ishikawa diagram (fishbone diagram); affinity grouping (KJ method); relationship diagram o Run Charts o Scatter diagram o Histogram	Useful in the study stage of a QI project
Documentation tools	o Check sheets o Project Planning Forms o Plan-Do-Study-Act Worksheets o Storyboards	Useful in the study stage of a QI project
Meeting tool	o Running effective meetings	

Sources: Paddock et al, 2001; IHI, 2005; QAP 2005

data points you need and use it to arrive at the sampling interval. For example, if you see 300 patients per week, and you need 50 data points, collect data on every sixth patient (300 divided by 50).

Block sampling. This is a method designed to select sample units in a block of predetermined size, instead of measuring at a fixed time or count interval, as in systematic sampling, measure a straight sequence within a limited time frame. Block sampling is used to gain a picture of the data that is time- or sequence-dependent. It is helpful when attempting to capture the detailed behaviour of the process. Your can learn from very small samples of data. For example, if you are trying out a new method of registering patients, you can learn a great deal from trying the method with the next five to eight patients. You can use the PDSA cycle to process the information, take what you learned, incorporate it, and try the revised method again with the next 15 patients and continue, until you feel comfortable implementing the new methods for all patients.

Select the location and the time to begin the data collection. Select the first unit at that time and location and every unit that follows until you have the needed number of units. Be sure to preserve the sequence of the data.

Simple Data Collection Planning

Simple data collection planning is effort that is worth spending. It will ensure that the data collected is put to good use, is as accurate as possible, is easy to collect, and is achievable with minimal disruption to service delivery. See the IHI website for details.

Short survey

Short surveys are intended to provide just enough sample and prompt feedback to tell you whether the attempts to improve are going in the right direction. These surveys are useful for answering question 2 in the IHI Model for Improvement *(How will we know that a change is an improvement?)* and in running the PDSA cycles. Identify the purpose of the survey. Design 1 to 5 simple questions that will provide the needed information. Collect the data on a daily or weekly basis. Display the data on a run chart whenever possible and analyse for trends, and data points out of control limits. Be prepared to respond quickly on action to take with the survey results.

Interview guide and guidelines for successful visiting

These are IHI tools that help the person in charge on how to arrange and run the interview and visit respectively. The details are at the website.

Brainstorming

This is organised problem solving. When looking at problems, people tend to lock on to one perspective of the problem to the exclusion of other view-points or perspectives. The purpose of organised problem solving is to pry loose a person from being stuck on one perspective on a problem. The techniques of organised problem solving try to get people to see problems from all angles.

In the initial stages of gathering information there should be no judgment made to the usefulness of a suggestion or idea. After all the options, ideas, solutions are in, an attempt at the organization of these is done. Out of these, some answers will emerge.

A six-step brain storming process

- Identify and select problem
- Analyse problem causes
- Generate potential solutions
- Select and plan solution
- Implement solution
- Evaluate solution.

PROCESS ANALYSIS TOOLS

These are a set of tools that uses mathematical principles to analyse the processes that constitute the clinic's function. The 7 tools that are used are flow charts, control charts, Pareto diagrams, cause and effect diagrams, run charts, scatter diagrams, and histograms[3].

Flowcharts

A flow chart provides a visualization of a process by the use of standard symbols that represent the beginning, end, decision points, and flow of activities. Arrows are used to direct the flow of each step and circled numbers indicate that the flow chart continues on another page.

Flow chart can be simple or complex. If the purpose of a flow chart is to identify the most cost-effective method, less details are needed. If the purpose is to identify all steps involved, much more details are needed.

Figure 2. Process Flow Chart

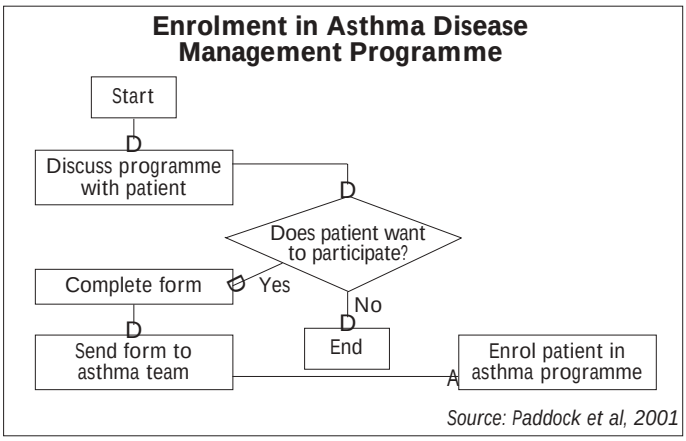
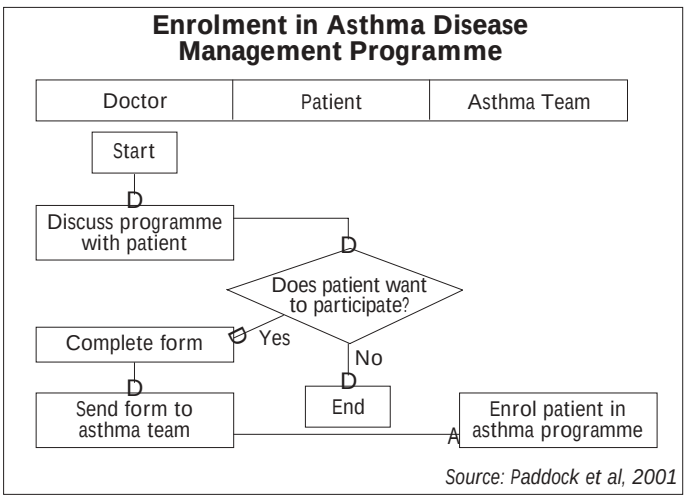


Figure 3. Deployment Flow Chart



The most common type of flow chart is the process flow chart. This is used to highlight a process and how it proceeds. An example of this is Figure 2 which shows a flow chart of enrollment of an asthma disease management programme.

Another type of flow chart is the deployment flow chart. This differs from the process flow chart by showing a particular relationship between the person doing the task and the steps in the process. The chart reads from left to right[3]. The persons involved in the process are labeled across the top of the chart and their corresponding tasks are shown below their label. Figure 3 shows the same flow chart for enrolling patients as in Figure 2, but also identifies who is responsible for each task.

Once constructed, flow charts can be analysed to determine ways of streamlining the process by eliminating steps, combing steps or creating new steps to operate the process more efficiently. A beneficial technique is to map the ideal process and the actual process and compare the two to identify the differences as targets for improvements.

A Flowchart is used for:

1. defining and analyzing processes
2. building a step-by-step picture of the process for analysis, discussion, or communication purposes
3. defining, standardizing, or finding areas for improvement in a process. Analyze the flowchart for such items as:
   - Time-per-event (reducing cycle time)
   - Process repeats (preventing rework)
   - Duplication of effort (identifying and eliminating duplicated tasks)
   - Unnecessary tasks (eliminating tasks that are in the process for no apparent reason)
   - Value-added versus non-value-added tasks.

Control Chart

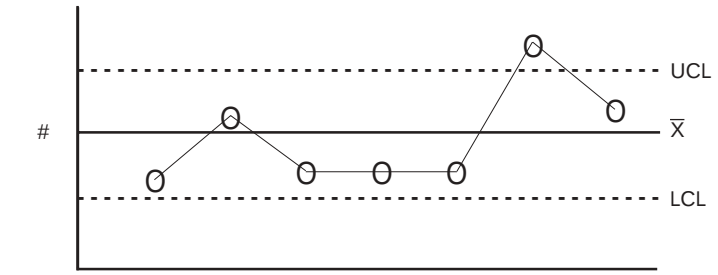
Every continuing process shows variation. The control chart is a line chart with control limits. It is based on the work of Shewhart and Deming. By mathematically constructing control limits at 3 standard deviations above and below the average, one can determine what variation is due to normal random ongoing causes (common causes) and what variation is produced by unique events (special causes).

Special cause variation is eliminated by altering the identifiable cause, and the process is said to be out of control. Common cause variation being random, affects all the individual values of the system being studied and can be eliminated only by altering the entire process, which is harder to do. Hence, the principle is to eliminate the special cause variation first and the common cause variation later.

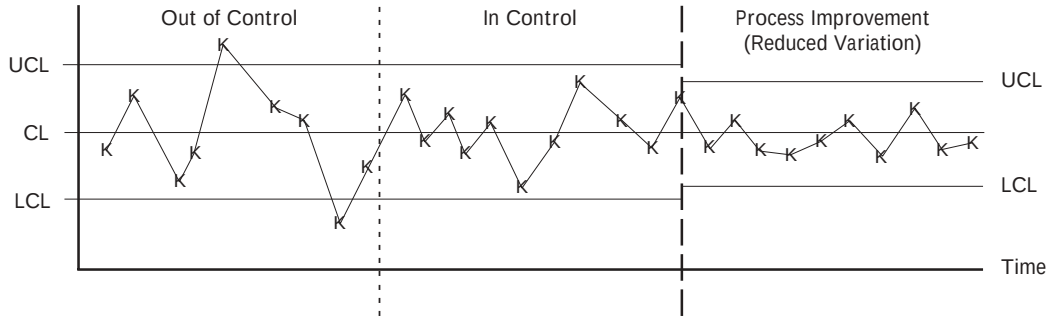
Pareto diagram

The Pareto diagram is a bar graph used to show the distribution of items (e.g. problems or situations) arranged from the most frequent to the least frequent with the final

Figure 4. Control Charts



Basic control chart showing the UCL and the LCL. There is one reading outside the UCL.It will be necessary to establish if this is randomEvent or is the result of an identifiable cause.



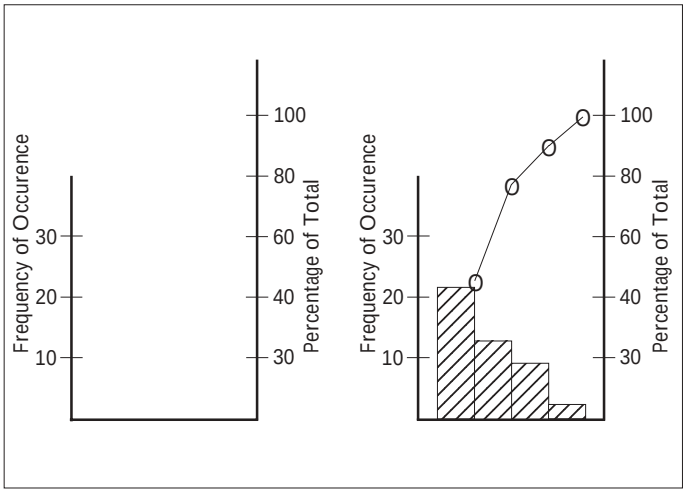
The graph above illustrates the typical cycle in Statistical Process Control (SPC). First, the process is highly variable and out of statistical control. Second, as special causes of variation are found, the process comes into statistical control. Finally, through process improvement, variation is reduced. This is seen from the narrowing of the control limits. Eliminating special cause variation keeps the process in control; process improvement reduces the process variation and moves the control limits in toward the centerline of the process.

bar being miscellaneous. This tool is a graphical picture of the most frequent causes of a particular problem. It shows where to put your initial effort to get the most gain. The tool is named after Wilfredo Pareto, the Italian economist who determined that wealth is not evenly distributed. Some of the people have most of the money. The number of bars that make up 80% of the whole contain the items that need to be fixed to deal with the vital few.

A pareto diagram is used for:

1. Focusing on critical issues by ranking them in terms of importance and frequency
2. Prioritizing problems or causes to efficiently initiate problem solving
3. Analyzing the before and after impact of changes made in a process.

Figure 5. Pareto Diagram



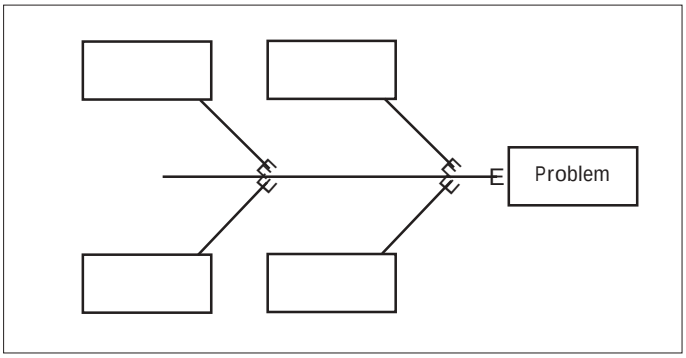
Cause-and-Effect Diagrams

Cause-and-effect diagrams show the relationships between causes and the net effect. Understanding the causal structure of a problem is essential in process performance[3]. Three commonly used models are presented here.

Ishikawa diagrams (fishbone diagram)

The Ishikawa diagram was developed by Professor Ishikawa of Japan in 1943. It is also called the fishbone diagram because of its appearance when completed. Its most frequent use is to list the cause of particular problems. The head is the problem and the lines coming off the core horizontal line are the main causes and the lines coming off those are sub causes (Figure 6). The graphic nature of the diagram allows groups to organize large amounts of information about a problem and pinpoint root causes.

Figure 6. Ishikawa Diagram - Before Completion



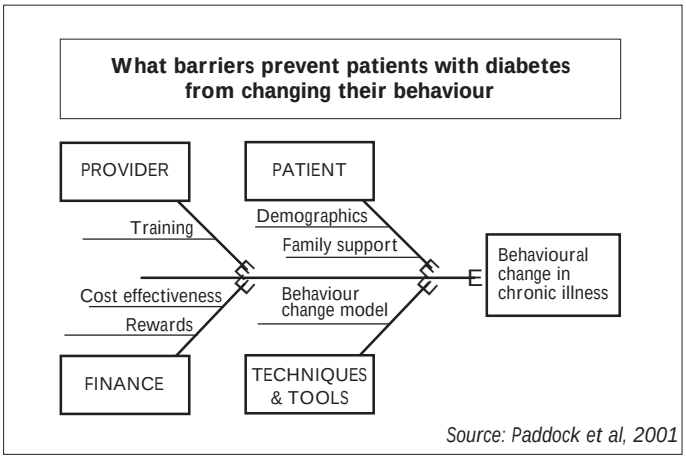
The Ishikawa diagram is used for:

- Identifying potential causes of a problem or issue in an orderly way.
- Summarizing major causes under major categories (e.g., People, Machines, Methods, and Materials or Policies, Procedures, People, and Plant).

Figure 7 provides an example of an Ishikawa diagram dealing with behaviour change in chronic illness as a cause and effect issue.

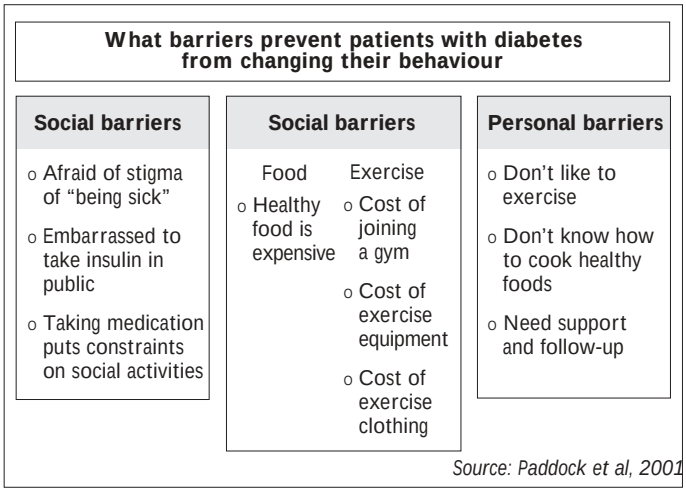
Figure 8 shows the second type of cause-and-effect diagram that has been used in recent years. This is called the affinity diagram and otherwise known as the KJ method after its creator, Kawakita Jiro. The affinity diagram is most useful for gathering large amounts of data and organizing abstract thinking into groups[3,4]. The idea is organize the information under a problem label which in this example in Figure 8 is "What barriers prevent patients with diabetes from changing their behaviour?' The barriers are grouped into social barriers, economic barriers, and personal barriers in the course of discussion and the completed grouping is the affinity diagram. Using the affinity diagram, the diabetes disease management team can gain a better understanding of the difficulty of behaviour change. Also, the team might identify a reason why an individual might be struggling with behaviour change (e.g. cost of healthy food) and suggest methods to deal with the problem to begin the process of behaviour change.

Figure 7. Ishikawa Diagram - After Completion



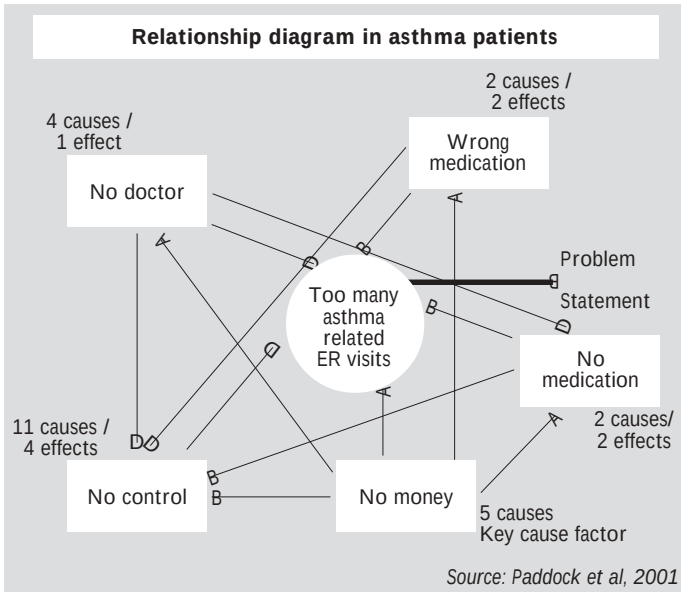
Source: Paddock et al, 2001

Figure 8. Affinity Diagram



Source: Paddock et al, 2001

Figure 9. Relationship Diagram



Source: Paddock et al, 2001

The third type of cause-and-effect diagram is the relationship diagram. Figure 9 shows the relationship diagram drawn up to analyse the causes and effects of a high rate of asthmatic related emergency (ER) visits. This is a tool to use to demonstrate complete cause and effect relationship. While an affinity diagram aids in identifying a problem, a relationship diagram analyses what is related to the problem. In a relationship diagram, one factor might influence two or more factors. This cannot be easily demonstrated by a hierachical cause-and-effect diagram (i.e. the Ishikawa diagram) or a non-relational diagram (i.e. affinity diagram).

Run Chart

The run chart shows the plot of data over time and shows history and pattern of variation. Time is plotted on the horizontal axis and the variable on the vertical axis[3]. It is helpful to indicate on the chart whether up is good or down is good. This tool is used at the beginning of the change process to see what the problems are. It is used at the end to check the effects of the change process to see whether the change has resulted in permanent improvement (Figure 10).

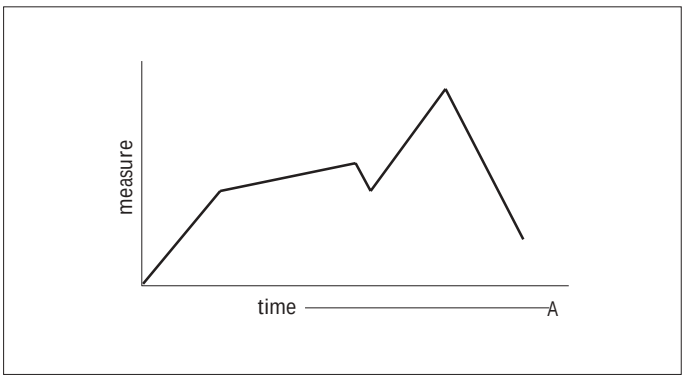


Figure 10. A Run Chart

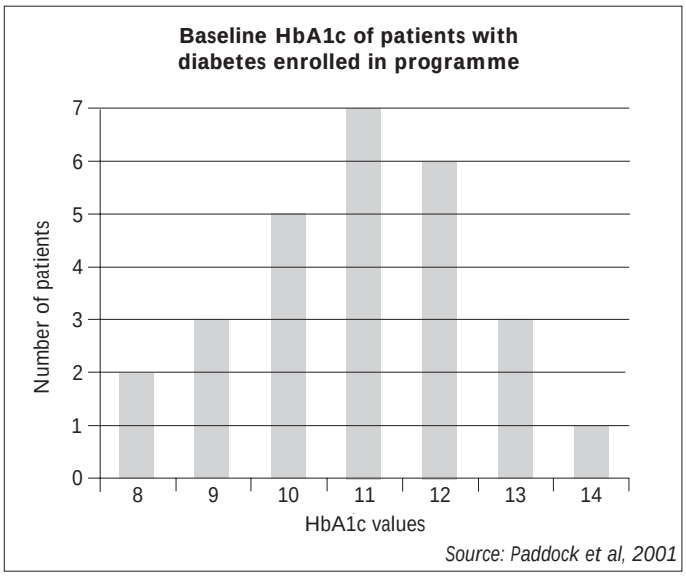


Figure 11. A Histogram

Scatter diagram

A scatter diagram is a graph of points representing a pair of measurements (X, Y) plotted at the intersection of the X,Y intervals. The purpose is to determine if there is a correlation between the two variables (X, Y) either, positive, negative, or none.

Histogram

A histograms is a bar chart showing the spread or distribution of a measured process e.g. a defect rate over time. This tool helps identify the size of the problem by the shape of the distribution as well as the width of the distribution. This information can be compared with a similar histogram taken at the end of the cycle of improvement to assess the impact of the project (Figure 11).

QUALITY IMPROVEMENT CONCEPT MODELS

Table 2 shows the quality improvement concept models that now guide the quality improvement activities in medical practice. The PDSA model is the most commonly used problem solving tool. It is described in some detail in Unit 2 and Unit 6 of this set of readings and would therefore not be further elaborated here.

There are three significant developments in the present era of quality improvement which are driven by different needs, namely, (1) low tolerance for errors which led to the six sigma improvement system; (2) the need for organizational sustainability which led to the balanced score card paradigm; and (3) the need for patient safety as a quality of healthcare championed by the Institute of Medicine in the United States which led to the development of national quality initiatives in

TABLE 2. Quality Improvement Concept Models

Category	Description of tool	Remarks
Clinical quality improvement project model	PDSA (plan-do-study-act) model	This is most commonly used problem-solving tool. The IHI Model of Improvement is the modern version of the problem solving cycle which went through continuing refinements. Initially, it was known as the PDCA (plan-do-check-act) cycle of Stewart (1934) and Deming. Later, it became known as the quality assurance cycle and presently it is named the PDSA cycle.
Organisation improvement model	Six Sigma Improvement system	This is essentially the PDSA model with refinement of the process improvement methodology into MAIC (measure-analyse-improve-control); first developed by Motorola to meet the need of low tolerance for errors[5].
Organization improvement model	Balanced score card (Kaplan)	This paradigm is developed to meet the need for organization sustainability.
Community improvement model	Chain of effect in improving the quality of health in the community (IHI)	Systems change is at the heart of the improvement in service delivery. Every system is perfectly designed for the results it gets. To have a better performance you need to change the system.[13,14].
Community improvement model	Chronic care model (Wagner)	This model describes the 6 components in the systems approach to chronic disease management[10,11,12]

the United States from 2000 onwards. The chain of effect of improving clinical quality is one quality improvement concept model that has since been developed. Finally, the vision of reduction of disease burden as the best solution to healthcare costs is translated into the key objectives of preventive health care, disease management, and integrated care. The Wagner chronic disease model is a useful of chronic disease management.

Six Sigma Improvement System

Six Sigma[5,6] was developed by Motorola in the 1970s. This system assesses critical customer requirements using defined methodology. Measurement of process defects that affect important user requirements forms the first phase of the improvement process. This is followed by analysis to determine possible improvement areas. The improvement phase is followed by a control phase using statistical process control (SPC) tools. Sigma is a statistical measure of standard deviation from the mean in a Gaussian distribution; one sigma represents a tolerance of 790,000 errors per million opportunities. Six sigma tolerates 3.5 defects per million.

It is noteworthy that's health care does not reach six sigma. (Table 3). A zero defects approach, advocated by Cassin[8,9], advocates the use of six sigma in health care. Drug prescription may be amenable to this approach as it is a defined process that can be monitored and that has a high throughput; both attributes are pre-requisites for success. Computerised prescription systems have been shown to reduce the error rate significantly, at least in the hospital setting[6,7].

Making Six Sigma work

- *Black belts.* To develop the process Sigma, large numbers of technical personnel are trained as "black belts" to lead teams in applying the statistically-based methodology. As expected, most black belt training programs focus heavily on these advanced statistical techniques.
- *Champions, master black belts and green belts.* High level executives are appointed as "champions" to drive the Six Sigma Program within their segment of the company. Master Black Belts coach black belts and coordinate Six Sigma projects. Some companies provide basic process improvement training to Six Sigma project team members and refer to them as "green belts." Black belts and / or teams are assigned process improvement projects with specific performance improvement goals.
- *External facilitation*. To reduce the workload on their key personnel, to lessen the need for extensive training, and to minimize costs, small organizations (and some large ones, too) obtain external facilitation and statistical methods support.

The Balanced Scorecard

Performance management system

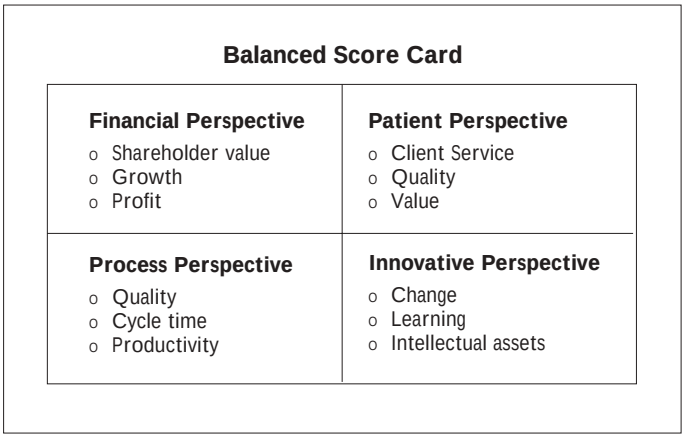
Kaplan and Norton (1992, 1993, 1996) developed an approach for a business report card called the balanced scorecard. The premise behind the balanced scorecard is that senior management must have a balanced set of measures that describes the critical aspects of the organization. This balance is achieved by developing measures from four different perspectives: financial, patient, process, and innovative (Figure 12).

Table 3. Selected Health Care Quality Problems Viewed As Defects Per Million Compared with Quality Performance In Selected Industries.

Sigma level	Defects per million	Selected heath care examples	Selected industrial examples
6	3.4	-	Allied Signal: 3 model factories Publishing: one misspelled word in all the books in a small library
	5.4	Deaths caused by anaesthesia during surgery	-
	10.8	-	2 Siebe plants in Italy and United Kingdom, making temperature controls for refrigerators
5	230	-	Airline fatalities
4	6210	-	Airline baggage handling. Restaurant billing
	10,000	1% of hospitalized patients injured by negligence	-
3	66,800	-	Publishing: 7.6 misspelled words per page in a book
	210,000	21% of ambulatory antibiotics for colds	-
2	308,000	-	-
	580,000	58% of patients with depression not detected or treated adequately	-
1	690,000	-	-
	790,000	79% of eligible heart attack patients who fail to receive beta-blockers	

Source: Cassin, 1998.

Figure 12. Four Perspectives



A balanced score care is a performance management system that can be used to:

- Align vision and vision with stakeholder requirements and day to day work
- Manage and evaluate business strategy
- Monitor efficiency improvements
- Build organizational capability
- Communicate progress to all stakeholders.

Healthcare organizations should no longer look at a one-dimensional report card (e.g., their financial statements) or at a limited two-dimensional report card (e.g., clinical outcomes and costs). Healthcare organizations need to develop a balanced score card that includes measures of business value (e.g., return on investment, equity), employee value (e.g., service value), and patient value (e.g. health care value, satisfaction). Healthcare organizations need also to add to the balanced scorecard the fourth dimension recommended by Kaplan and Norton (1992, 1993, 1996): learning and growth measures (Figure 13).

Figure 13. A Sample Balanced Scorecard For A Healthcare Organisation

Patient-Value Added (Patient Perspective) o New healthcare services o Access o Community partnerships o Preventive medicine o Clinical outcomes o Patient and family satisfaction	**Employee-Value Added (Internal Perspective)** o Employee well-being o Employee development o Employee retention o Employee satisfaction o Patient-focused integration
Business-Value Added (Learning Perspective) o Quality improvement o Percentage of new services from patients o Process-cycle time efficiency o Learning-cycle time efficiency o Time to develop new services	**Business-Value Added (Financial Perspective)** o Activity-based costing if feasible o Cost-of-quality databases o Value-added analyses o Organization cycle time o Return on investment o Cash flow o Litigation avoidance

Source: Value-Based Cost Management for Healthcare: Linking Costs to Quality and Delivery, by K. Castañeda-Méndez, 1996, New York: Quality Resources, Inc. Copyright 1996 by K. Castañeda-Méndez.

Objectives and key performance indicators (KPI)

The main purpose of a Balanced Scorecard is to connect employee behavior to the organization's mission. This is accomplished by translating an organization's strategy into a collection of objectives and performance indicators for financial, customer, internal business processes, and learning and growth. Each of these perspectives should be linked in a chain of cause-and-effect relationships that conveys the organization's vision and strategy.

A good Balanced Scorecard should form a chain of objectives and performance measures that are linked based on cause-and-effect relationships (Figure 14). For example, highly skilled employees should provide quality customer service, which should cause customer satisfaction to improve, which should affect financial performance positively. This chain of performance measures should communicate the company's goals and objectives to all members of the organization.

Figure 14. Performance Measures in the Balanced Score Card

Financial Perspective	Patient census Unit profitability Funds raised for facility improvements
Customer Perspective	Patient satisfaction (survey) Patient retention Patient referral rate
Internal Process	Perspective weekly patient complaints Employee turnover rate
Learning & Growth Perspective	Employee satisfaction Training hours per caregiver Patient loads

Review of performance

Management should review the Balanced Score Card periodically to evaluate and take corrective and preventive action on planned actions that do not contribute to the strategy. Lack of contribution can range from actions that are not progressing as planned to actions that are proving ineffective. Senior management audits its progress annually by reviewing the organizationwide balanced scorecard and by performing another assessment. This annual audit is feedback to the strategic planning process, which senior management uses to repeat the cycle, to take corrective action, and to redirect the organization.

The Chain of Effect Model

Systems change is at the heart of the improvement in service delivery. Every system is perfectly designed for the results it gets[1]. To have a better performance there is a need to change the system. For the improvement of health care quality to take effect, many system components need to change. The Institute of Medicine has championed patient safety as quality to be realized for health care. To achieve this there is a need for system change in an interconnected way, namely, the chain of effect that must take place (Figure 15). There is a need for a common vision of unity for health, with all stakeholders working together.

Figure 15. Crossing the Quality Chasm

The Chain of Effect in Improving Health Care Quality

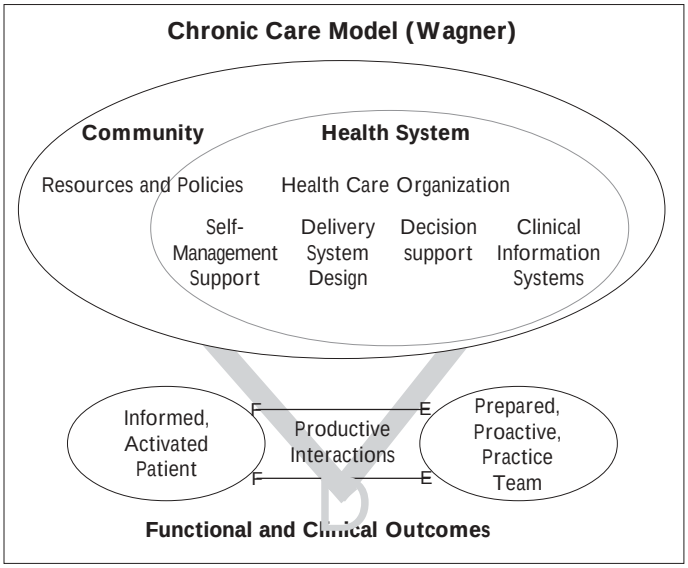
Patient and Community	Experience	Aims (safe, effective, patient-centered, timely, efficient, equitable
Micro-system	Process	Simple rules / Design Concepts (knowledge-based, customized, cooperative)
Organizational Context	Facilitator of Processes	Design Concepts (HR, IT, finance, leadership)
Environmental Context	Facilitator of Facilitators	Design Concepts (financing, regulation, accreditation, education)

Berwick, 2003

Chronic Care Model

Figure 16 shows the 6 components that must be addressed in improving the chronic disease management of patients[10,11,12].

Figure 16. The 6 Components of the Chronic Care Model



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USEFUL WEBSITES

1. IHI Tools. URL: http://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/Tools/ (accessed Jul 06 2007)
2. Quality assurance project. URL. http://www.qaproject.org/pubs/pubsmonographs.html (accessed Jul 06 2007)
3. What is clinic audit? Principles for Best Practice in Clinical Audit (2002) URL: http://www.ubht.nhs.uk/ClinicalAudit/what_is_clinical_audit.htm (accessed Jul 06 2007)

LEARNING POINTS

- **Quality improvement (QI) tools are at the heart of any QI activity.**
- **To help us in the QI journey, there are now many tools that have been developed and also numerous websites that try to provide repositories of such tools and know-how about the use of these tools.**
- **The basic QI tools can be categorised into the information gathering tools, the seven process analysis tools (or statistical process control tools), the documentation tools, and the meeting tools.**
- **The QI concept models can also be regarded as quality improvement tools. These are: the Model of Improvement which incorporates the PDSA Cycle, the Six Sigma Improvement System, the Balanced Score Card, the Chronic Care Model, and the Chain of Effect.**