Topic 7: Introduction to quality improvement methods

Why students need to know about quality improvement methods

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Students will be familiar with the term evidence-based medicine and the randomized controlled trial, which has enabled medicine to establish if a particular treatment is validated by evidence or merely one that rests on belief of the practitioners. Research methods such as the randomized controlled trial measure clinical effectiveness. But such methods do not measure contextual components or the process of care. The problems in health systems are significantly affected by the processes of care and a randomized controlled trial will not measure the problems nor fix them. Students need to be aware that process measures require different methods. The science of improvement is new to medicine and as a result there has been debate about whether the measures of quality improvement are rigorous enough. Berwick has captured this debate in a paper published in 2008 where he argued that both research methods are necessary to improve health-care research for improving clinical evidence and research for improving processes of care [1].

Quality improvement methods are designed to study processes and have been successfully used for decades in other industries. In health care, students will be familiar with the goal of scientific research, which is to discover new knowledge but they will be less familiar with quality improvement, which is to change performance [2]. Students are encouraged to observe or join a team undertaking an improvement activity. Medical students can begin to understand the role of quality improvement methods by:

- asking about measures that improve quality and safety;
- recognizing that good ideas can come from anyone;
- being aware that the situation in the local environment is a key factor in trying to make improvements;
- being aware that the way people think and react is as important as the structures and processes in place;
- realizing that the spread of innovative practices is a result of people adopting new processes and not the other way around.

Most quality improvement methods are based on the application of continuous quality improvement theory developed by the manufacturing industry. The principle underpinning quality improvement was that quality was not something controlled at the end of the line, but rather throughout the entire work process. This topic explains some of the underlying theory.

Traditional attempts to persuade and influence clinicians to change behaviour, such as compliance with a protocol or vigilance in regard to drug interactions in the interest of improving the quality of patient care, have by and large failed. There have been thousands of recommendations by hundreds of committees and peer groups for improving the safety and quality of patient care over decades, yet there is little evidence that clinicians have changed their practice because of them. The publication of evidence in peer reviewed journals, does not necessarily lead in of itself , to clinicians' changing their practice. Many articles outline best practice and make urgent recommendations for changes as a result of new information [3].

Quality improvement methods have successfully addressed this gap and provide clinicians with the tools to: (i) identify a problem; (ii) measure the problem; (iii) develop a range of interventions designed to fix the problem; and (iv) test whether the interventions worked.

Tom Nolan, Brent James, Don Berwick and others have applied quality improvement principles in

developing quality improvement methods for health clinicians and managers. The identification and examination of each step in the process of health-care delivery is the bedrock of this methodology. When students examine each step in the process of care they begin to see how the pieces of care are connected and measurable. Measurement is critical for safety improvement.

A range of quality improvement methods have been designed. Below are some more common examples:

- clinical practice improvement (CPI);
- root cause analysis to retrospectively examine what went wrong;
- failure modes and effects analysis to prospectively consider what might go wrong.

Keywords

Quality improvement methods, PDSA cycle, change concepts, continuous improvement methods, variation, CPI, root cause analysis, flowcharts, Cause and effect diagrams (Ishikawa/fishbone), Pareto charts, histograms, run charts.

Learning objective

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The objectives of this topic are to describe the principles of quality improvement and to introduce students to the basic methods and tools for improving the quality of health care.

Learning outcomes: knowledge and performance

This topic is an important one for students to understand because improvement will only be achieved and sustained through continuous measurement. However, it will also be one of the most difficult because many hospitals and clinics do not measure the processes of their care. An effective way for students to understand the benefits of using quality improvement methods is to apply the principles and use the tools to undertake their own improvement project.

What students need to know (knowledge requirements):

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- the science of improvement;
- the quality improvement model;
- change concepts;
- two examples of continuous improvement methods;
- methods for providing information on clinical care.

What students need to do (performance requirement):

4

- know how to perform a range of improvement activities and tools.

WHAT STUDENTS NEED TO KNOW (KNOWLEDGE REQUIREMENTS)

The science of improvement

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W Edwards Deming, the father of improvement theory, described the following four components of knowledge that underpin improvement: [4]

- appreciation of a system;
- understanding of variation;
- theory of knowledge;
- psychology.

Deming stated that we do not need to understand these components in depth to apply the knowledge. An analogy used by improvement leaders (e.g. Langley; Nolan [4,5]) is that we can drive a car without understanding how it works. Students beginning their medical careers only need a basic understanding of the science of improvement. It is more important to be familiar with the methods used to improve the processes of care.

Appreciation of a system

In applying Deming's concepts to the health care, we need to remember that most patient care outcomes or services result from a complex system of interaction between health-care professionals, treatment procedures and medical equipment. Therefore, it is important that medical students understand the interdependencies and relationships among all of these components (doctors, nurses, patients, treatments, equipment, procedures, theatres and so on) thereby increasing the accuracy of predictions about any impact that changes may have on the system.

Understanding of variation

Variation is the differences between two or more similar things such as different rates of success for appendectomies in two different parts of the country. There is extensive variation in health care and patient outcomes can differ from one ward to another, from one hospital to another and one region to another. Variation, though, is a feature of most systems. Shortages of personnel, drugs or beds can lead to variations of care. Deming urges people to ask questions about variation. Students can get into the habit of asking their clinical supervisors what their outcomes are for a particular treatment or procedure. Do the three patients returned to theatres after surgery indicate a problem with surgery? Did the extra nurse on duty make a difference with patient care or was it a coincidence? The ability to answer such questions and others like them is part of the reason for undertaking improvement activities.

Theory of knowledge

Deming says that the theory of knowledge requires us to make predictions that any changes we make will lead to an improvement. Predicting the results of a change is a necessary step to enable a plan to be made even though the future is certain. Many students will have experience of such predictions, having written study plans predicting what is necessary to pass exams. Those with specific experiences may be better at focused predictions. For example, health professionals who work in particular health-care settings such as a rural clinic may be better at predicting the results of a change in this environment. Because they have more knowledge about these clinics and the way they function or should function and the way the change will impact on the patients and their families. When health professionals have experience and knowledge of the area they wish to change it is more likely that the change will result in an improvement. Comparing the results with the predictions is important learning. Deming says that building knowledge by making changes and measuring the results or observing the differences is the foundation of the science of improvement.

Psychology

The last component is the importance of understanding the psychology of how people interact with each other and the system. Making a change whether it is small or large will have an impact and knowledge of psychology helps to understand how people might react, and why they might resist change. A medical ward, for example, includes a number of people who will vary enormously in their reactions to a similar event such as introducing an incident monitoring system. The potential different reactions must be factored in when making an improvement change.

Deming stresses that successful improvements can only be achieved when all four components are addressed; he calls this the system of knowledge underpinning improvement. Deming says it is impossible for improvement to occur without the following action: developing, testing and implementing changes.

The role of measurement in improvement

Quality improvement activities require health professionals to collect and analyse data generated by the processes of health care. For example, a student cannot study the change in his study habits without obtaining some information about his current study habits and the environment in which he lives and studies. He first needs the data to see if he has a problem with study habits and, second, he needs to decide what information he requires to measure whether he has made any improvements.

In this analogy, the aim of the improvement project is to make a change in the study habits of the student leading to improved success in leading to improved success his examinations, rather than simply identifying students with poor study habits.

Measurement is an essential component of quality improvement because it forces people to look at what they do and how they do it. Most activities in health care can be measured, yet currently they are not. There is strong evidence to show that when people use the appropriate measures to measure change, significant improvements can be made. All quality improvement methods rely on measurement. The medical student will only know he has improved his study habits by measuring the before and after situation.

Medical students will be familiar with measurement in the basic sciences; the measures in quality improvement are different from those used in formal medical research. The IHI has produced the following chart (see Table 15) to distinguish between the two measures. 6

Table 15. Institute for Healthcare Improvement: different measures

	Measurement for research	Measurement for learning and process improvement
Purpose	To discover new knowledge	To bring new knowledge into daily practice
Tests	One large “blind” test	Many sequential, observable tests
Biases	Control for as many biases as possible	Stabilize the biases from test to test
Data	Gather as much data as possible, “just in case”	Gather “just enough” data to learn and complete another cycle
Duration	Can take long periods of time to obtain results	“Small tests of significant changes” accelerates the rate of improvement

Three main types of measures

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Outcome measures

Examples of outcome measures include patient satisfaction surveys and other processes that capture the patients' and their families' views about their health care. This includes surveys and other methods such as interviews that seek to ascertain peoples' perceptions or attitudes to the service and their level of satisfaction with the hospital or clinic.

Some specific examples include:

- access: time waiting for surgery
- critical care: number of deaths in the emergency department;
- medication systems: the number of medication dosing or administration errors.

Process measures

Process measures refer to measurements about the workings of the system. These measures are usually used when a clinician or manager wants to find out how well a part or aspect of a health service or system is working or being performed.

Some specific examples:

- access: number of days the ICU is full and has no spare beds;
- surgical care: number of times swab count completed.

Balancing measures

This measure is used to ensure that any change does not create additional problems. It seeks to examine the service or organization from a different perspective. If a medical student makes a change to his study habits that leaves no time for him to see his friends that may have an impact on his well-being.

A specific example is:

- reducing the length of stay in hospital: ensure readmission rates are not increasing.

The quality improvement model

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The quality improvement model is a combination of building and applying knowledge to make an improvement by asking three questions and using the PDSA (plan, do, study,act) cycle developed by Deming.

The questions are:

1. What are we trying to accomplish?
2. How will we know whether a change is an improvement?
3. What changes can we make that will result in an improvement?

Deming stresses that the questions can be asked and answered in any order. This model takes the simple concept "trial and error" and transforms it into the PDSA model that can be used to make improvements for all sorts of problems, both big and small.

What are we trying to accomplish?

The idea behind this question is to guide and focus the efforts of the health-care team doing the improvement. It is important that the team agrees that a problem exists and that it is worthwhile fixing.

Does everyone agree that the infection rate in patients who have had a knee operation is too high?

Confirmation that there is a problem requires that supporting evidence (qualitative or quantitive) exists indicating the extent of the problem.

Do we have the figures indicating the high infection rate?

It is not a good idea to put a lot of effort into something that only one person thinks is a problem.

The person who said the infection rate was high had only worked one shift in three and had a patient who had an infection-is this a significant problem?

Many countries will have national and international databases for specific disease indicators that are

useful, particularly for benchmarking. These data are important because it allows the team to focus on the right area. In some cases, there might not be much available to help answer the question; however, irrespective of the extent of information, the simple rule is to keep the answer short and concise.

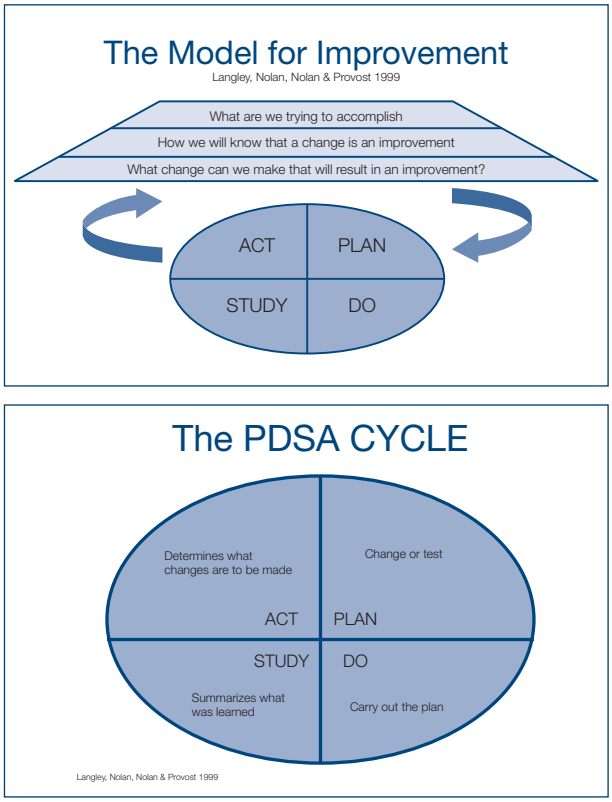
How will we know that a change is an improvement?
An improvement can only be confirmed when the measures show things were improved over time.

What changes can we make that will result in an improvement?
This last question involves the team testing the different interventions used to make the improvements. PDSA is a method designed to assist testing a range of ways to see if an intervention worked.

Using the improvement model developed by Langley, Nolan and others, the IHI has created a PDSA template to assist health-care practitioners implement PDSA cycles to improve health-care services or processes (see Figure 4). The model for improvement, promoted by the IHI was developed by Associates in Process Improvement. Their version of quality improvement is different from other change models in that it seeks to accelerate improvement. Hundreds of health-care organizations have successfully used the model to improve health-care processes and outcomes.

Plan-do-study-act cycle 9 10

Figure 4 Model for improvement



IHI has summarized a range of quality improvement methods, which can be accessed on their web site at http://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/Tools/ accessed May 2008.

One of the rules of quality improvement is regular testing of any changes introduced because unexpected things may happen. The cycle begins with a plan and ends with an action. The study section is designed to build new knowledge. This is an important step in improvement science because the new knowledge allows better predictions about the impact of changes. The application of the model can be simple or complex, formal or informal. It can be used to improve waiting times in the clinic or decrease surgical infection rates in theatres. A formal improvement activity may require detailed

documentation, more complex tools for data analysis or more time for discussion and team meetings. The PDSA model depends on a format that repeats steps over and over until an improvement has been effected and sustained.

The IHI model has two parts:

- three fundamental questions, which can be addressed in any order (as set out by Deming);
- the PDSA cycle to test and implement changes in real work settings—the PDSA cycle guides the test of a change to determine if the change is an improvement.

Forming the team
Including the right people on a process improvement team is critical to a successful improvement effort. Teams vary in size and composition. Each organization builds teams to suit its own needs. For example, if the improvement project is to improve discharge planning than the team should have people who know about discharge-nurses, doctors, patients, primary care physicians and nurses.

Setting aims and objectives
Improvement requires setting aims and objectives. Objectives should be time-specific and measurable and should also define the specific population of patients that will be affected. This helps keep the team focused on the project.

Establishing measures
Teams use quantitative measures to determine if a specific change actually leads to an improvement.

Selecting changes
All improvement requires making changes, but not all changes result in improvement. Organizations, therefore, must identify the changes that are most likely to result in improvement.

Testing changes
The PDSA cycle is shorthand for testing a change in the real work setting—by planning it, trying it, observing the results and acting on what is learnt. This is the scientific method used for action-oriented learning.

Implementing changes
After testing a change on a small scale, learning from each test and refining the change through several PDSA cycles, the team can implement the change on a broader scale—for example, for an entire pilot population or on an entire unit.

Spreading changes
Successful implementation of a change or package of changes for a pilot population or an entire unit can permit the team or managers to spread the changes to other parts of the organization or in other organizations.

Change concepts

Many people intuitively use change concepts in their daily lives such as asking what changes can be made to improve a particular situation—improved study habits, tension with a family member, a teacher or difficulties at work. They ask: “What can I do to make the situation better—to make an improvement?” A change concept in quality improvement is a general notion (a good idea, an approach) that has been found useful in developing specific ideas for change that will result in improvement.

Nolan and Schall [5] defined a change concept as a general idea, with proven merit and sound scientific or logical foundation, that can stimulate specific ideas for changes that lead to improvement.

They identify a number of sources for thinking about possible changes: critical thinking about the current system, creative thinking, observing the

process, a hunch, an idea from the literature, a patient suggestion or an insight gained from a completely different area or situation. A health-care team that wants to improve patient care takes a concept and moulds it to fit their local environment, situation or the task they are trying to improve. This is an important step because it engages the local team in the process. Team members will be more committed to the improvement project and it caters for the particular variations that can occur in different settings. Langley and his colleagues have developed 70 change concepts that have been grouped into the following nine general categories listed in their 1996 landmark book on improvement, *The improvement guide: a practical approach to enhancing organizational performance*. [12]

1. *Eliminate waste*
Look for ways of eliminating any activity or resource in the hospital or clinic that does not add value to patient care.

2. *Improve workflow*
Improving the flow of work in processes is an important way to improve the quality of patient care delivered by those processes.

3.*Optimize inventory*
Inventory of all types is a possible source of waste in organizations; understanding where inventory is stored in a system is the first step in finding opportunities for improvement.

4. *Change the work environment*
Changing the work environment itself can be a high-leverage opportunity for making all other process changes more effective.

5. *Enhance the health provider/patient relationship*
To benefit from improvements in quality and safety of health care, the health-care professionals and patients must recognize and appreciate the improvements.

6. *Manage time*
An organization can get more achieved by reducing the time to deliver health care, develop new ways of delivering health care, reducing waiting times for services and cycle times for all services and functions in the organization.

7. *Manage variation*
Reducing variation improves the predictability of outcomes and helps reduce the frequency of adverse outcomes for patients.

8 *Design systems to avoid mistakes*
Organizations can reduce errors by redesigning the system to ensure that there is redundancy i.e. multiple checks and balances to combat human error.

9. *Focus on the product or service*
Although many organizations focus on ways to improve processes, it is also important to address improvement of products and services.

Example: change concept

A health-care team may want to adhere to the WHO protocol *Clean hands are safer hands*. Infection control is a good idea and the WHO guidelines are based on evidence, expert opinion and the literature. One could predict that if the guidelines were implemented then an improvement would be made, i.e. a decrease in the transmission of infection via hands. Implementing a guideline is an example of an abstract concept.

The team is required to then make more specific statements about implementing the guideline in their workplace. This process will move the abstract change concept to a practical aim. If the

change concept is abstract as opposed to practical then it should be backed by literature and evidence-based medicine.

As the concept becomes more local and practical it should be increasingly concrete, logically connected and sensitive to the local situation. One of the benefits of lists such as the 70 change concepts described by Langley et al. is that they can speed up the process by not having to duplicate long searches for ideas to test using the PDSA cycle.

A number of catalogues have been published covering topics such as medical errors, waiting time, delays, intensive care and asthma.

Two continuous improvement methods

There are a number of examples of quality improvement methods in health care but the two most relevant to medical students are:

- CPI (Clinical practice improvement) methodology;
- root cause analysis.

Clinical practice improvement Slides 13 14

CPI methodology is used by health-care professionals to improve the quality and safety of health care. It does this through a detailed examination of the processes and outcomes in clinical care. The success of a CPI project depends on the team covering each of the following five phases. An example of a completed CPI project is provided in the second part of this topic and in the Case Study Bank in Appendix 1.

Project phase: The team needs to ask themselves what it is they wish to fix or achieve. They do this by developing a mission statement or objective that describes what it is they wish to do in a few sentences. This is the time to select the team members who should be selected on the basis of their knowledge about the problem.

Patients should always be considered as appropriate members of the team rather than as an after thought. At this stage the team should consider the type of measures they may use.

Diagnostic phase: Some problems are annoying yet may not be worth fixing because of the little benefit they add. Therefore, the team needs to ask if the problem they have identified is worth solving. The team should establish the full extent of the problem by gathering as much information about the problem as possible. A brainstorming exercise by the team will generate possible changes that could lead to an improvement. A decision about how to measure the improvement needs to be resolved during this phase.

The following activities will assist the team to complete the diagnostic phase.

1. Team members collect and analyse quantitive and qualitative data of the process being investigated to establish causes of and potential solutions.
2. Members discuss the different causes interact to produce the problems.
3. Members identify solutions using the following activities.
    - process flowchart;
    - brainstorming;
    - consumer focus groups;
    - nominal group technique;
    - tally chart.

Members organize and prioritize information by using the following tools.

- cause and effect diagram;
- affinity diagram;
- Pareto chart.

Members prepare graphs of current data-run chart, statistical process control chart.

Intervention phase: By now, the team will have worked out what the problems are and their

possible solutions. Each of the solutions have to be tested through a trial and error process by using the PDSA cycles to test changes, observe them and keep the bits that work.

[15] [16] [17] [18]

Impact and implementation phase: This is the time to measure and record the results of the trials of the interventions. Did they make any difference? [19]

All changes are required to be measured for impact so that the change can be said to truly have made a difference rather than a coincidence or a one-off effect. The goal is to introduce a change that has sustained improvement. The data showing the evidence of the change are displayed using run charts and statistical process control. Using the study habits of a student as an example, we can say that the student has improved his study habits if he has maintained his improved study habits for a period of months and not returned to the old habits.

Sustaining and Improvement phase: The final phase requires the team to develop and agree upon a monitoring process and plans for continuous improvement. Improvements made now will become failures in the future if there are no plans to sustain the improvements. [20]

This may involve:

- standardization of existing processes and systems for undertaking work activities;
- documentation of relevant policies procedures protocols and guidelines;
- measurement and review to enable the change to become routine;
- training and education of staff.

Root cause analysis [21]

Many hospitals and health services are now using a process called root cause analysis to determine the underlying causes of adverse events or incidents. A root cause analysis is used after an incident has occurred to uncover the primary possible causes. As such, it focuses on the particular incident and the circumstances surrounding it. However, there are many lessons to be gained from this retrospective process that may prevent similar incidents in the future.

A root cause analysis is a defined process that seeks to explore all of the possible factors associated with an incident by asking what happened, why it occurred and what can be done to prevent it from happening again.

Health-care workers require training in this method as they do in CPI methodology. Many countries have introduced training programmes for staff to develop skills in conducting root cause analyses. The Veteran Administration in the United States has adapted root cause analysis to investigate adverse events; their model has become a prototype for health-care organizations the worldwide.

It will be very difficult for a team of health-care professionals to conduct a root cause analysis without the support of the organization because the process requires resources to be effective—people, time, support from the managers and clinicians and the chief executive. Yet, the benefits are real and can lead to improvements of the system as a whole. An effective root cause analysis requires the following components.

- multidisciplinary team:
  - of no more than six people;
  - including lay people, particularly those that may bring a patient's perspective;
  - in which no one on the team has had an actual involvement in the event under review;

  - composed of people who can add value because of their knowledge, position in the organization or unique perspective they bring;
  - made up of some members who have been trained in root cause analysis, who can guide the rest of the team with just-in-time training about the root cause analysis process, wider system issues and factors that may be associated with the event;
  - who will be committed to meeting weekly for two to four hours at a time over a period of five to six weeks;
- root cause analysis effort is directed towards finding out what happened:
  - documentation and review (medical records, incident forms, hospitals guidelines, literature review, letters from the patient or their family or carer);
  - site visit—the team will benefit from visiting the environment in which the event occurred to examine the equipment, the surroundings and observe the relationships of the relevant staff;
- event flowchart is a key part of the investigation as it:
  - helps to form a common understanding of what happened;
  - allows the team to develop problem statements to enable a cause and effect diagram to be developed;
  - outlines the story and defines what happened chronologically;
- the team develops a problem statement that:
  - clearly states the problem to be addressed;
  - focuses deeply about the problem(s) and not the solutions;
- establishing the contributing factors or root causes are accomplished through:
  - a brainstorming process of all possible factors;
  - the development of an event flowchart of the events including documenting the process of questions about each event and expanding the chart on the basis of the information:
    - *environmental factors:* e.g. the work environment and its attention to safety; the type of culture in the unit or locality; medico-legal issues;
    - *organizational factors:* e.g. staffing levels; quality and attention to policies; morale of staff; workload and fatigue; access to essential equipment; administrative support, attitudes to patients and their families;
    - *team staff factors:* e.g. supervision of junior staff; quality and effectiveness of communication between professional groups; availability of senior doctors;
    - *individual staff factors:* e.g. level of knowledge or experience; fatigue and stress; expectations of staff;
    - *task factors:* e.g. existence of clear protocols and guidelines; system in place for obtaining test results; definition and description of tasks;
    - *patient factors:* e.g. distressed patients; communication and cultural barriers between patients and staff; multiple co-morbidities.

The VA root cause analysis process has developed a guide to staff about the possible areas and questions they might ask to uncover the possible factors involved in an incident.

- *communication:* Was the patient correctly identified? Was information from patient assessments shared by members of the treatment team on a timely basis?
- *environment:* Was the work environment designed for its function? Had there been an environmental risk assessment?
- *equipment:* Was equipment designed for its

intended purpose? Had a documented safety review been performed on the equipment?
- *barriers:* What barriers and controls were involved in this? Were they designed to protect patients, staff, equipment or environment?
- *rules, policies and procedures:* Was there an overall management plan for addressing risk and assigning responsibility for risk? Had a previous audit been done for a similar event, were the causes identified and were effective interventions developed and implemented on a timely basis?
- *fatigue/scheduling:* Were the levels of vibration, noise and other environmental conditions appropriate? Did personnel have adequate sleep?

Other activities involved in the root cause analysis process include:
- cause and effect diagrams:
  - a cause and effect diagram helps the team to stay focused on all of the possible causes rather then fixate on the one cause. The cause and effect diagram or fishbone diagram begins with a few problem statements and shows how these may have been caused by a few actions and many latent (underlying) conditions;
- root cause statements:
  - root cause statements should only be made at the end of the process—the VA process provides the following guidance to staff in writing root cause statements;
- the cause and effect relationship must be explicit and:
  - avoid negative value statements;
  - identify a preceding cause in each human error;
  - each procedural deviation must have a preceding cause;
  - failure to act is only causal when there was a pre-existing duty to act;
- preventing a reoccurrence:
  - many root cause analyses fail at this stage because they have not paid sufficient attention to the feasibility and practicality of the recommendations—if there is no senior engagement and commitment to implementing the recommendations then a root cause analysis process can wither before it blooms;
  - once the root cause analysis is completed the team should come up with recommendations that aim to either eliminate it (requires action), control it (requires action) or accept. They should be very focused and not too general and certainly not only about more resources.

All recommendations should be realistic and:
- address the root cause of a problem;
- be specific and concrete;
- be easily understood;
- be possible to implement;
- define roles and responsibilities for implementation;
- define a timeframe for implementation.

WHAT STUDENTS NEED TO DO (PERFORMANCE REQUIREMENTS)

Know how to use a range of improvement activities and tools.

Quality improvement tools

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The following tools are commonly used in quality improvement efforts to improve health care. They are simple to use and can be used by everyone in the organization. Most hospitals and clinics routinely collect and use data about the health services being delivered and many will statistically analyse the data to report to the health authorities or head of the health service. The following tools are commonly known as the seven tools of TQM (total

quality management). Four of these are listed below.

- flowcharts;
- cause and effect diagrams (Ishikawa/fishbone);
- Pareto charts;
- run charts.

Experience from other industries and quality improvement experts such as Ishikawa demonstrate that 9 out of 10 operational problems may be solved by one of the tools described in this section. In health care that means a health service problem can usually be solved by applying some or all of these tools.

The following case example of a CPI project will assist students to understand the tool and how it is used in the improvement process. The case used below is a real case and was undertaken during the CPI programme conducted by the Northern Centre for Healthcare Improvement (Sydney, New South Wales, Australia). The name of the hospital and the participants are de-identified, the title of the project is accelerated recovery colectomy surgery (ARCS).

The first thing that needs to be done is to identify exactly what it is that needs fixing. Is the length of stay for patients having colectomy surgery too long and outside best practice? A mission statement is developed that captures the aim of the project. Participants are encouraged to aim high, to develop stretch goals. The following mission statement was agreed upon.

The mission statement:

To reduce the length of stay for patients having colectomy surgery from 13 days to 4 days within 6 months at the base hospital.

The next thing to do is to make sure that the right team has been selected to undertake this project. The team members must have the fundamental knowledge.

Guidance team members:

- Health service manager;
- Executive officer for the hospital;
- Director of nursing for the hospital;
- Area clinical nurse consultant pain management;
- Visiting medical officer surgeon.

Project team members:

- Area clinical nurse consultant pain management (team leader);
- General surgeon;
- Anaesthetist;
- Acute pain nurse;
- Peri-operative clinic;
- Surgical ward registered nurses;
- Physiotherapist;
- Dietician;
- Patient.

Is this a problem?

This group of health-care workers decided that there was a problem with the length of stay and wanted to reduce the time patients were in hospital

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Flowcharts 24

The next step is to understand the steps involved for patients having colectomy surgery. A flowchart is a pictorial method for showing all the steps or parts of a process that makes up the system. Health care is so complex and before we can fix a problem we need to understand how the parts fit together and how they function. A range of people construct and contribute to a flowchart. It would be very difficult to only have a doctor draw a flowchart because he may not know the wide range of actions that occur in a particular situation or have access to the documentation of the service. Flowcharts are good for setting out what people actually do at work rather than what others think they do.

Even though the actions described may differ from the organization's view, it is important to draw in the flowchart what actually happens because this provides a common reference point and shared language that all members of the team can share. Constructing a flowchart enables a "real" and actual portrayal of the process.

The IHI has assembled a range of tools on the Institute's web page that is available to help people with improvement projects.

There are two levels of flowcharts:

- high-level flowchart:
  - there are only 6-12 steps described that gives an overview of a process;
  - these show any major blocks of activity, or the major system components, in a process;
  - they are especially useful in the early phases of a project.
- detailed flowchart:
  - there are many steps described and is a close-up view of the process;
  - it can identify loops and allows complex causes of errors to be identified;
  - these are often shown using the cloud symbol as shown in the slide below (flowchart of process);
  - detailed flowcharts are useful after teams have pinpointed issues or when they are making changes in the process.

Using a flowchart has a variety of benefits:

- it explains the processes involved in health-care delivery;
- it identifies the steps that do not add value to the health-care service including delays; needless storage and transportation; unnecessary work, duplication and added expense; breakdowns in communication;
- it helps health-care workers get a shared understanding of the process and use this knowledge to collect data, identify problems, focus discussions and identify resources;
- it serves as a basis for designing new ways to deliver health care;
- health-care workers who document the process also gain a better understanding of each other's role and functions.

Not all flowcharts look the same. Slide 24 shows the flowchart developed by the team who want to reduce colectomy patient length of stay from 13 days to 4 days within 6 months.

The team also wants to understand the expectations of the participants. 25

A cause and effect diagram is a tool for solving problems. This diagram is also called an Ishikawa or fishbone diagram. The diagram is used to explore and display the possible causes of a certain effect. The content on each arm of the diagram is generated by members of the team in a brainstorm about possible causes. The fishbone diagram in slide 26 is the result of a brainstorm by a team of health-care professionals working on reducing length of stay post-colectomy. 26

A cause and effect diagram has a variety of benefits:

- it identifies multiple causes that may contribute to an effect;
- it graphically displays the relationship of the causes to the effect and to each other;
- it focuses the team to the areas for improvement.

Continuing with the CPI project conducted by the team at the base hospital who were trying to reduce length of stay post colectomy, the Pareto chart identifies the factors that they saw as contributing to the current time patients stayed in hospital. 27

Pareto charts

In the 1950s, Dr Joseph Juan used the words "Pareto principle" to describe a large proportion of quality problems being caused by a small number of causes. The principle that a few contributions account for the majority of the effect is employed to determine where to focus the effort in attempting to fix a problem. This is done by prioritizing problems, highlighting the fact that most problems are affected by a few causes and indicating which problems to solve and in what order.

A Pareto diagram is a bar chart in which the multiple factors that contribute to the overall effect are arranged in descending order according to the magnitude of their effect. The ordering is an important step because it helps the team concentrate its efforts on the factors that have the greatest impact. It also assists them to explain the rationale for concentrating on particular areas.

Slides 26 and 27 come from the IHI tool Pareto diagram. Slide 26 describes a sample data table setting out the types of errors discovered during surgical setup and Slide 27 is a bar chart depicting in descending order the magnitude of the contributing factors.

Implementation of plan-do-study-act cycles

28

A team can brainstorm a number of possible interventions.

Run chart example

29

Slide 29 is a run chart produced by the base hospital team that tracks over time the improvements. Run charts or time plots are graphs of data over time. A run chart helps the team know if a change is an improvement over time or just a random fluctuation wrongly interpreted as significant improvement. Run charts help identify if there is a trend. A trend is formed when a series of seven consecutive points continually fall or rise.

The benefits of using run charts include:

- helping the team judge how a particular process is performing;
- helping the team to identify when a change is truly an improvement by plotting a pattern of data that one can observe as the changes are made.

Strategies for sustaining improvements

30

Making the improvement is not the end; the improvement needs to be sustained over time. This means continuous measuring and making adjustments through PDSA cycles. Slide 30 describes the strategies for sustaining improvement and this is where we leave our team. They have successfully reduced the length of stay for patients having colectomy surgery at their hospital. In doing so they have saved the hospital a significant amount of money as well as decreased the chance of a patient receiving an infection. Even so, they need to sustain these improvements. The above strategies were identified by the team to monitor and measure the length of stay on a monthly basis.

Summary

There is overwhelming evidence that patient care improves and errors are minimized when clinicians use quality improvement methods and tools. Only then will the efforts of the team be rewarded by real sustained improvements to health care. This topic set out the methods for quality improvement and described a range of tools that are used in quality improvement.

HOW TO TEACH THIS TOPIC

Teaching strategies/formats

Teaching quality improvement methods to students can be challenging because it requires clinicians who have had real experience with the tools and know the benefits. The best way to

teach this topic is to get the students to use the quality improvement tools and arrange for individualized coaching in quality improvement methods. Students should be encouraged to join existing projects to experience the team approaches and how patient outcomes are significantly improved with such methods.

This topic can be delivered in a number of ways.

An interactive/didactic lecture

This topic contains a lot of underpinning and applied knowledge that is suitable for an interactive didactic lecture. Use the accompanying slides as a guide, covering the whole topic. The slides can be PowerPoint or converted to overhead slides for a projector.

Panel discussions

Invite a panel of health professionals who have done a root cause analysis or a CPI project to talk about the process and whether the methods gave them insights they would not have had except for the root cause analysis or CPI.

Small group discussion session

The class can be divided up into small groups with three students in each group asked to lead a discussion about the benefits of quality improvement methods—root cause analysis and CPI and when they might be used.

Simulation exercises

Different scenarios could be developed for the students: practising the techniques of brainstorming; designing a run chart, cause and effect diagram or histogram.

Teaching and learning activities

This topic is best taught by getting the students to practise the tools and techniques used in quality improvement methods by undertaking their own personal quality improvement project.

Examples of self-improvement projects:

- develop better study habits;
- spend more time with family;
- give up smoking;
- lose or put on weight;
- perform more housework.

Students can implement the PDSA cycle to suit their own personal circumstances and obtain a better understanding of the process so they can apply it in their professional work as medical students or members of a health-care team. Following the steps set out above in the case example, students can begin to experiment with the tools and see how to use them and whether they helped them in their project.

Another activity, if available, is for students to ask their clinical supervisors or other health professionals if the hospital undertakes quality improvement. If so, they could ask to observe a root cause analysis process of a CPI project.

After these activities students should be asked to meet in pairs or small groups and discuss with a tutor or clinician what they observed and whether the features or techniques being observed were present or absent, and whether they were effective.

TOOLS AND RESOURCES

WWW Web-based resources

Root cause: *Root cause analysis*. US Department of Veteran Affairs National Center for Patient Safety, 2007 (http://www.va.gov/NCPS/rca.html, accessed May 2008).

Flowchart: *Flowchart.* Institute for Healthcare Improvement Boston, 2004 (http://www.ihi.org/NR/rdonlyres/9844A3FD-9F2F-44D7-A423-81F81891F19E/651/Flowcharts1.pdf, accessed May 2008).

Improvement methods: *Improvement Methods.* Institute for Healthcare Improvement, Boston (http://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/Tools/, accessed May 2008).

Root cause: *Ask "why" five times to get to the root cause.* Institute for Healthcare Improvement, Boston (0htt10p://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/ImprovementStories/AskWhyFiveTimestoGettotheRootCause.htm, accessed May 2008).

Clinical improvement guide: Easy guide to clinical practice improvement: a guide for health professionals. New South Wales Health Department, 2002 (http://www.health.nsw.gov.au/quality/pdf/cpi_easyguide.pdf, accessed May 2008).

Health care improvement: Northern Centre for Healthcare Improvement (http://www.nchi.org.au/www/html/443-documentation.asp, accessed May 2008).

There are many good examples of completed CPI projects.

Resources

Langley GL et al. *The improvement guide: a practical approach to enhancing organizational performance*. Institute for Healthcare Improvement. San Francisco, Jossey-Bass Publishers, 1996.

Mozena JP, Anderson A. *Quality improvement handbook for healthcare professionals*. Milwaukee, ASQC Quality Press,1993.

HOW TO ASSESS THIS TOPIC

A range of assessment methods are suitable for this topic including:

- complete and write up a self-improvement project;
- write a reflective statement about an observation of the root cause analysis or CPI process;
- participate in a root cause analysis or CPI project.

HOW TO EVALUATE THIS TOPIC

Evaluation is important in reviewing how a teaching session went and how improvements can be made. See the Teacher's Guide (Part A) for a summary of important evaluation principles.

References

1. Berwick D. The science of improvement. *Journal of American Medical Association*, 2008, 299(10):1182–1184.
2. Davidoff F, Batalden P. Toward stringer evidence on quality improvement: draft publication guidelines: the beginning of a consensus project. *Quality & Safety in Heath Care*, 2005, 14:319–25.
3. Lundberg G, Wennberg J A. JAMA theme issue on quality in care: a new proposal and a call to action. *Journal of the American Medical Association,* 1997, 278(19):1615–1618.
4. Langley GL et al. *The improvement guide: a practical approach to enhancing organizational performance*. San Francisco, Jossey-Bass Publishers, 1996.
5. Nolan TW et al. *Reducing delays and waiting times throughout the healthcare system*, 1st ed. Boston, Institutue for Healthcare Improvement, 1996.

SLIDES FOR TOPIC 7: INTRODUCTION TO QUALITY IMPROVEMENT METHODS

Didactic lectures are not usually the best way to teach students about patient safety. If a lecture is being considered, it is a good idea to plan for student interaction and discussion during the lecture. Using a case study is one way to generate group discussion. Another way is to ask the students questions about different aspects of health care that will bring out the issues contained in this topic such as the blame culture, nature of error and how errors are managed in other industries.

The slides for topic 7 are designed to assist the teacher deliver the content of this topic. The slides can be changed to fit the local environment and culture. Teachers do not have to use all of the slides and it is best to tailor the slides to the areas being covered in the teaching session.