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*Applying Science to Strengthen and Improve Systems*

# Improvement Methods Toolkit from the USAID ASSIST Project

**AUGUST 2020**

This toolkit was prepared by University Research Co., LLC (URC) for review by the United States Agency for International Development (USAID) and authored by the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project, drawing on content on improvement methods and tools developed by URC and published on the USAID ASSIST Project website. The USAID ASSIST Project was made possible by the generous support of the American people through USAID.

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USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project

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For more information on the work of the USAID ASSIST Project, please visit www.urc-chs.com/assist or write assist-info@urc-chs.com.

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## Acronyms

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|---|---|
| ASSIST | USAID Applying Science to Strengthen and Improve Systems Project |
| BTS | Breakthrough Series |
| CBT | Computer-based training |
| CME | Continuing medical education |
| HCI | USAID Health Care Improvement Project |
| IHI | Institute for Healthcare Improvement |
| ISO | International Organization for Standardization |
| ISQua | International Society for Quality in Health Care |
| IST | In-service training |
| KM | Knowledge management |
| MAQ | Maximizing Access and Quality |
| MOH | Ministry of Health |
| NCQA | National Committee for Quality Assurance |
| PBI | Performance-based incentive |
| QI | Quality improvement |
| UNICEF | United Nations Children's Emergency Fund |
| URC | University Research Co., LLC |
| USAID | United States Agency for International Development |
| WHO | World Health Organization |

# I. INTRODUCTION

The USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project (September 2012-June 2020) of the Office of Health Systems in the USAID Bureau for Global Health had as its goal to support health workers and service delivery institutions in USAID-assisted countries to develop sustainable capacity to achieve measurable improvements in care quality. USAID Missions and Ministries of Health in USAID-assisted countries demonstrated strong demand for ASSIST's technical support to institutionalize quality improvement capacity in priority programs and regions.

ASSIST sought to make quality improvement simpler by creating guidance in step-by-step, plain language manuals and developing a large body of tools and examples (codified improvement knowledge) to help others improve. ASSIST also demonstrated that using such tools results in faster uptake of improvement methods and better outcomes.

To achieve the goal of developing country capacity, ASSIST's country assistance programs drew on one or more evidence-based quality improvement approaches, as appropriate to the technical content of the requested assistance and the country context. The project focused on improving the effective implementation of high-impact interventions, taking into consideration the needs of marginalized and underserved populations and gender, age, and social differences that affect access to and utilization of care.

In each long-term country, the project applied an integrated design approach to explicitly define the evidence-based improvement strategies to be implemented to achieve the objectives set by USAID and the country.

The USAID ASSIST website was launched in 2014 to serve as a knowledge portal to provide guidance, tools, and resources to support the application of improvement methods to achieve measurable increases in service quality across all USAID priority health topics. In keeping with the project's knowledge management mandate, the website featured extensive content on QI methods and tools, including a QI Methods toolkit. This document consolidates the main QI methods and tools content from the USAID ASSIST website to make it available following the close of the website in September 2020.

# II. IMPROVEMENT METHODS TOOLKIT

Drawing on over 25 years of experience with health care improvement, the USAID ASSIST Project applied to health care the following core principles that underlie the science of improvement:

- The work of delivering health care happens in **processes and systems**. Understanding them and changing them in ways to produce better results is at the heart of improving health care.
- **Working in teams** of different health care providers involved in delivering care is key to making changes work and fostering ownership of the changes to enhance sustainability.
- **Testing changes** to determine whether they yield the desired results is at the heart of improvement. Data are used to analyze processes, identify problems, determine whether the changes have resulted in improvement, and help determine whether to abandon, modify, or implement the tested solution.
- Care should meet the **needs and expectations of patients, clients, and communities.**
- **Shared learning**, where multiple teams work on common aims and exchange information about what worked, what did not, how it worked, and why, is an essential part of improvement, producing better and faster results.

In the words of Paul Batalden *"Every system is perfectly designed to achieve exactly the results that it achieves."* Therefore, in order to achieve a different level of performance, we have to make changes to that system in ways that permit it to produce better results.

Improvement methods help us make systematic changes in the way health care is delivered to increase the likelihood that those changes will result in better care.

This toolkit describes the following mainstay improvement methods that have been widely use in low- and middle-income countries supported by USAID:

- Accreditation
- Audit and Feedback
- Certification
- Collaborative Improvement
- Licensing and Registration
- Organization of Work
- Performance-based Incentives
- Process Improvement and Redesign
- Reminders
- Standards and Evidence-based Guidelines
- Supervision
- Training

The toolkit also describes tools for presenting data for improvement and tools for analyzing systems or processes.

## A. Accreditation

### What is accreditation?

Accreditation[1] is a process by which a recognized body (governmental or nongovernmental) assesses and then recognizes that a health care facility meets pre-established performance standards. A committee of experts (e.g., medical associations, Ministries of Health, and non-governmental organizations) working with the accrediting body develop the standards for accreditation. They periodically revise standards to reflect advances in technology, treatment regimes, or policy changes.

To conduct accreditation of a health care facility, external surveyors evaluate the facility's achievement in providing services and goods to clients. The survey team then recommends whether the facility should be accredited or should implement further improvements and be re-evaluated in the future. Renewal of accreditation status is usually required every two to three years.

### How does accreditation improve health care quality?

Accreditation encourages facilities to improve by focusing on optimal or desirable, rather than minimum, standards of care. Through accreditation, health care organizations are encouraged to pursue increasingly higher levels of quality beyond the minimum needed for licensing. Traditionally, accreditation has been a voluntary process in which organizations choose to participate, rather than one required by government regulations. Recently, however, some countries have made participation of health care organizations in accreditation programs compulsory. Other countries, such as the United States, have tied accreditation systems to financing mechanisms, thereby creating a strong incentive to achieve and maintain accredited status.

The introduction of accreditation programs into developing country public sector health systems has resulted in recognition of the need to adapt traditional accreditation methodologies to the realities of the severe resource constraints and weak underlying performance of many health systems. Providing sufficient resources to effectively implement an accreditation program is also critical, since starting up an accreditation program without assuring its continued funding is likely to waste resources.

The International Society for Quality in Health Care (ISQua), a global network of organizations committed to promoting continuous improvement in the safety and quality of health care, offers an international accreditation program to accredit accrediting bodies. The ISQua website offers additional information about accreditation.

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[1] The monograph developed by the USAID-supported Quality Assurance Project in 1999, *Licensure, Accreditation, and Certification: Approaches to Health Services Quality*, provides a clear overview of accreditation. The monograph is available at: https://pdf.usaid.gov/pdf_docs/PNACF510.pdf.

## B. Audit and Feedback

### What are audit and feedback processes?

Audit and feedback process encompass a wide variety of interventions, including: performance review, supervisor assessment, medical record review, results generated by computerized information systems, self-assessment, and accreditation surveys. Audit and feedback is used to enhance health care professionals' performance and thereby improve the quality of health care.

### Types of audit and feedback processes

An audit and feedback intervention used widely in developing countries is supervisory audits using structured checklists to observe health worker performance or review records. Evidence from the Quality Assurance Project's work on Integrated Management of Childhood Illness in Niger suggests that supervisory audit can increase performance according to standards, particularly with respect to history-taking, physical examination, disease classification, treatment, and counseling.

A health care provider may conduct self-audit or self-assessment[2] to reflect on his or her own performance strengths and weaknesses and to identify learning needs and areas for improvement. A team, reviewing clinical records for a facility to measure performance across all providers in the facility, may also conduct self-assessment. Improvement collaboratives typically rely on monthly team self-assessment of compliance with standards to track the effects of changes made to improve care.

Peer review involves review of a provider's performance by other providers of the same profession. Peer reviewers may or may not be practicing in a different location. Audit and feedback interventions based on peer review and support rely on the major role that colleagues' judgment and beliefs play in an individual provider's evaluation and interpretation of new information. Peer review uses the influence and pressure of persons in the target practitioners' social network to affect individual performance. Peer-mediated strategies encompass a diverse group of interventions, including formal peer review, participatory guideline development, and team-based process improvement and problem solving. A study conducted by the Quality Assurance Project in Malawi found that peer review was more effective in changing practice routines when it was used as part of a broader quality improvement approach that included participatory development of criteria, quality circles, or group discussion and feedback.

Team-based peer review and support approaches may be more useful to achieve performance according to standards on an institutional rather than individual provider level.

### Effect of audit and feedback interventions

A 2010 review by the European Observatory on Health Systems and Policies about audit and feedback to improve health care quality and patient safety conducted by concluded, "*audit and*

[2] The USAID-supported Quality Assurance Project issues paper, *How Can Self-Assessment Improve the Quality of Healthcare?*, describes the evidence for self-assessment as a quality improvement method. It is available at: https://pdf.usaid.gov/pdf_docs/PNACN247.pdf.

*feedback may be effective in improving professional practice, but the effects are generally small to moderate....The benefits of audit and feedback measures are most likely to occur where existing practice is furthest away from what is desired, and when feedback is more intensive*."

## C. Certification

### What is certification?

Certification[3] is a voluntary process undertaken to demonstrate special capability or competence. To undergo certification, an established authority, such as a government agency, professional association, or specialty board, evaluates and recognizes either an individual or an organization as having met pre-determined criteria, such as expert knowledge, skills, and demonstrated competence in a specialty area.

### Certification of individual providers

Certification of health care providers shows that the he or she has successfully completed an approved educational program and evaluation process and possesses the knowledge, skills, and educational experience required to provide quality patient care in a specific field.

Health care provider certification through specialty boards often requires a re-certification after a defined period of time. This type of certification evaluates an individual provider on numerous levels, including experience, skills, professional standing, clinical performance, and even outcomes. Although certification is voluntary, an individual who does not meet re-certification requirements may not be legally able to deliver certain services if licensure for a specialty area is dependent on certification.

Professional societies in many countries often certify competence in their clinical specialty. Certification of professional nurse-midwives by the American College of Nurse Midwives, for example, requires graduation from an accredited teaching program, passing a national certification exam, continuing education, and, more recently, re-taking the certification exam every eight years.

Interest in provider certification or recognition has grown recently as part of pay-for-performance programs. The National Committee for Quality Assurance (NCQA), a non-profit, health care quality oversight organization in the United States, offers Physician Recognition Programs for specialists and primary care physicians that involve self-assessment and reporting of quality measures data. Health insurance plans and the United States Centers for Medicare and Medicaid Services now accept data reported through NCQA Physician Recognition Programs as evidence of eligibility for incentive payments to reward providers who demonstrate the highest levels of performance against evidence-based clinical standards.

### Certification of health care organizations

When applied to an organization or entire facility, certification usually implies that the organization has additional services, technology, or capacity beyond those found in similar

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[3] The monograph developed by the USAID-supported Quality Assurance Project in 1999, *Licensure, Accreditation, and Certification: Approaches to Health Services Quality*, describe certification in more detail. The monograph is available at: https://pdf.usaid.gov/pdf_docs/PNACF510.pdf.

organizations. Certification distinguishes the organization as capable of practicing or delivering services in a specialty area and may even grant the organization the legal authorization and funding to perform specialized activities. For example, a laboratory may pursue certification that allows specialized staff to conduct procedures and permits the use of specific equipment and materials. In many countries, certification of readiness to provide HIV care and treatment is a prerequisite for the facility to receive and be able to dispense antiretroviral drugs. Government authorities and insurance companies may create an incentive for organizations to seek certification as a requirement for reimbursement for specialized services.

UNICEF and WHO have used the certification model in their Baby-friendly Hospital Initiative, which recognizes health facilities that have met the ten steps to support breastfeeding with recognition as "baby-friendly".

In recent years, some countries have become interested in applying standards established by the International Organization for Standardization (ISO) to health sector processes and organizations to certify that they conform to the requirements specified in ISO standards. ISO 9001 standards for quality management systems have attracted particular interest of health care organizations that see the establishment of a quality management system as an opportunity to improve the quality of health care while reducing the costs. Similar to accreditation, ISO certification is resource-intensive because it requires periodic re-evaluation by external ISO-certified assessors.

## D. Collaborative Improvement

### What is collaborative improvement?

Collaborative improvement is a structured improvement approach that organizes a large number of teams or sites (i.e., “collaboratives”) to work together for 12- to 24-months to achieve significant improvements in a specific area of care. The collaborative approach combines traditional quality improvement methods of teamwork, process analysis, introduction of standards, measurement of quality indicators, training, job aids, and coaching with techniques based on social learning and diffusion of innovation theories.

### How do collaboratives work?

- In a collaborative, teams of health care providers from different health care facilities test out changes to improve health care delivery.
- Teams use a common set of indicators to measure the quality of the care processes the collaborative is trying to improve and, where possible, the desired outcomes.
- The collaborative organizes regular sharing of results among teams through learning sessions in which teams learn from each other about which changes were successful or not.

Collaboratives result in a dynamic improvement strategy in which many teams working on related problem areas can learn from each other to facilitate rapid dissemination of successful practices. In its emphasis on spread and scale-up of improvements, the improvement collaborative model offers a powerful tool in the arsenal of proven improvement methods.

**Experience with the improvement collaborative approach**

- The Institute for Healthcare Improvement (IHI) pioneered the improvement collaborative approach in 1995 to address a common problem in the health care system in the United States: while evidence existed for a particular standard of care, it was not routinely practiced. IHI designed the collaborative model to overcome obstacles to the consistent application of evidence-based practices and at the same time increase the pace and efficiency of improvement in health care, calling the approach the "Breakthrough Series" or BTS Improvement Collaborative.
- USAID has supported the widespread adaptation and application of the improvement collaborative approach in assisted countries since 2003. Since then, USAID has funded over 100 improvement collaboratives in developing and middle-income countries, mainly involving teams of public sector health care providers. These efforts, begun under the Quality Assurance Project and continued under the USAID Health Care Improvement Project, USAID ASSIST and other projects, made a number of adaptations to the BTS Improvement Collaborative model to accommodate government health system structures, introduce more content on quality improvement methods and measurement in learning sessions, and emphasize the role of coaches in guiding and motivating site teams[4]. Like the collaboratives supported by IHI in the United States and other countries, USAID-supported collaboratives have achieved rapid and significant improvements in the quality of diverse health care services and demonstrated that the gains made in quality of care through collaboratives could be maintained over time.
- USAID-supported collaborative improvement applications have found that shared learning among teams engaged in collaborative improvement accelerates the adoption and spread of evidence-based approaches across sites. Reviewing the process of service delivery allows teams to see what barriers and bottlenecks exist and need to be addressed. Data are a vital part of collaborative improvement, showing whether changes being tested/implemented have yielded the desired outcome.
- While collaborative improvement has been extensively applied to clinical care processes (both preventive and curative), it has also been applied to non-clinical areas like human resources management, information systems, supply management, community-based care for vulnerable children, and social services.

[4] A description of the collaborative improvement approach as adapted for low- and middle-income countries is presented in the 2008 USAID Health Care Improvement Project report, *The Improvement Collaborative: An Approach to Rapidly Improve Health Care and Scale Up Quality Services*, available at: https://pdf.usaid.gov/pdf_docs/PNADM495.pdf. The HCI Collaborative Evaluation Series report, *Results from Results of Collaborative Improvement: Effects on Health Outcomes and Compliance with Evidence-based Standards in 27 Applications in 12 Countries*, provides evidence of the results achieved by HCI-supported collaboratives. It is available at: https://pdf.usaid.gov/pdf_docs/PDACR710.pdf.

## E. Licensing and Registration

### What is licensing?

Licensing is a legal form of quality regulation of health care services where a governmental authority grants a license to a health care practitioner to engage in an occupation, or to a health care organization to operate and deliver services.

Licensing differs from other approaches to quality regulation in that it is mandatory and is performed uniquely by a government agency. Licensing standards are typically set at a minimum level, defined by the government as that needed to ensure health and safety in the country. For individual providers, licensing standards are usually defined in terms of training (e.g., completion of degree from an acceptable training institution) and demonstrated technical competence (e.g., passing of a licensing examination). Although licensure exams are the most common example of regulation through licensing, other regulatory programs related to licensing include the reciprocal granting of licenses to professionals of other countries, establishing standards for professional practice, and developing systems to investigate and punish professionals that violate professional license standards.

A critical requirement for achieving the intended impact of licensing is to build in mechanisms to ensure that the desired performance or competence is sustained over time. Licensing only at the point of entry into the health care market is insufficient to provide assurance to the public and to health sector institutions that providers maintain competency throughout the span of their careers.

Time-limited licenses and clear requirements for renewal are essential to create an incentive for providers to remain current through continuing education and for organizations to maintain physical infrastructure and capacity. A related issue is the need for enforcement of sanctions or consequences for loss or reversal of licensing status. This includes procedures for disciplinary action against licensees who fail to maintain the conditions of licensing as well as procedures for reporting and handling impaired or incompetent providers and facilities.

### What is registration?

Similar to licensing is registration, by which a provider is admitted into a registry recognized by the government as providers of health care services in the country. Registration may be a more effective mechanism for quality regulation than licensing, if registration requirements are based not only upon completion of educational requirements but also demonstrated technical competence, such as passing of a qualifying examination. Registration has the added advantage of enabling governments to create a database of information about health care professionals that are practicing or intending to practice their profession in a given country.

### Licensing and registration of health care facilities

Organizational licensing or registration is used in some countries to enable organizations to legally deliver health care services; granting of the license is often based on on-site inspection

to determine if minimum health and safety standards have been met.[5] The licensing of health care facilities differs from accreditation and certification in that it is mandatory, thus providing the government control over the entry and operation of facilities in the health sector[6]. However, in some countries, a new registration or licensing process has been proposed for existing health care facilities that more closely resembles accreditation in the sense that detailed standards covering various functional areas have been proposed, with initial and subsequent evaluation of compliance, and the possibility of assistance being provided to facilities to help them achieve the standards.

## F. Organizational Interventions

### What are organizational interventions?

Organizational interventions are those that either provide additional resources or equipment; introduce organizational changes, such as redistribution of tasks; or redesign processes to help improve performance. These interventions are often used to facilitate and reinforce health care performance in accordance with standards. Principal advantages of organizational interventions are that they are usually inexpensive and under the control of managers.

Increasing concern with preventable medical errors has fostered support for organizational interventions. The Institute of Medicine report on ways to reduce medical errors strongly advocated process redesign to simplify and standardize key health care processes and to design tasks in ways that ensure safety and facilitate correct performance. Key principles of such process redesign efforts are to avoid reliance on memory and use constraints or forcing functions to guide the health worker to do the right thing and make it harder to do the wrong thing.

Organizational interventions to improve work processes play a prominent role in much of health care quality improvement activities in low- and middle-income countries but have not often been subject to rigorous evaluations of their effectiveness.

### What organizational interventions can improve health care quality?

The USAID-supported Maximizing Access and Quality (MAQ) Initiative identified a set of guiding principles to improve the organization of health care delivery:[7]

- Use evidence-based practices to provide effective health care efficiently

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[5] For further discussion of licensing, see the monograph developed by the USAID-supported Quality Assurance Project in 1999, *Licensure, Accreditation, and Certification: Approaches to Health Services Quality*, available at: https://pdf.usaid.gov/pdf_docs/PNACF510.pdf.

[6] Further discussion of regulatory approaches applied to the health sector is available in the 2005 Quality Assurance Project report, Approaches to healthcare quality regulation in Latin America and the Caribbean: Regional experiences and challenges, available at: https://pdf.usaid.gov/pdf_docs/PNADE604.pdf.

[7] These principles are described in the MAQ Issue Paper, *Organizing Work Better*, published by the Johns Hopkins University Center for Communication Programs in 2004 and available at: https://pdf.usaid.gov/pdf_docs/PNADD046.pdf.

- Improve links with other services and delivery sites so that clients can obtain care appropriate to each level of the health care system
- Minimize paperwork and maximize information use
- Pay attention to the physical factors of service delivery, which include supplies, equipment, and workspace
- Tailor service hours and schedules to meet both clients' and providers' needs
- Examine client flow to make sure waiting times are minimized, giving more time for clients to interact with providers
- Define division of labor and job responsibilities to let staff know what is expected and to enable them to make decisions and take action
- Consider social factors, such as good supervision, to motivate and support staff and encourage skill development

## G. Performance-based Incentives

### What are performance-based incentives?

Performance-based incentives (PBI) include both monetary and non-monetary incentives to encourage health-related actions or achievement of performance targets.

*Supply-side PBIs* are used to improve the quality and availability of services. They are given to health care providers or managers at the facility, district, or national level, and are conditional on achieving service delivery or public health goals. Supply-side PBIs are now often being incorporated into national public health delivery systems, social insurance schemes, contracts with service delivery organizations, and safe motherhood schemes in low- and middle-income settings.

*Demand-side PBIs* encourage the demand for and access to essential health services. They are provided directly to households or patients in order to change certain health-related behaviors. One example of a commonly used PBI scheme is the conditional cash transfer program.

### How do PBIs improve health care?

Historically, performance-based incentives in low-resource settings have incentivized units of care, such as an attended birth, rather than performance measures linked to quality of care (that is, what was done in the care process). However, there is increasing recognition of the potential negative, unintended consequences of productivity-driven performance incentives on quality of care, as well as recognition of the potential benefits of quality performance measures in low-resource settings for improving delivery of best practices.

Providing incentives to motivate providers and organizations to participate in and maintain quality performance can be important, particularly in voluntary programs like accreditation. Financial incentives, such as linkages to payment systems, market advantage, reduction of liability insurance premiums, preferential reimbursement from private insurers, and quality bonuses can be powerful motivators to maintain quality programs, reward organizations' superior performance, and stimulate professional commitment. Symbolic rewards, including professional and public recognition through publicity or special awards, can also be highly

motivating, particularly if these are perceived to endow the provider or organization with a competitive advantage.

PBIs have become a potentially important and powerful tool to improve health in developing countries, with increasing interest in PBIs and results-based financing on the part of multi-lateral donors like the World Bank. While much experience has been gained over the last several years in a variety of approaches, more evidence is needed about the implementation and sustainability of PBI interventions in low- and middle-income countries.

## H. Reminders

### What are reminders?

Provider forgetfulness and/or lack of awareness, as opposed to deficiency in knowledge or skill, can be major barriers to performing according to standards. *Reminders* are prompts given either before or during a patient encounter that suggest a specific behavior should or should not be performed.

### How are reminders used in health care?

Reminders can include:

- a note in a patient's chart;
- a message appearing on a computer screen;
- a verbal cue from an assistant; or
- a checklist, wall poster, flowchart, or other paper- or computer-based job aid that guides the health provider through the appropriate steps in a process.

Several systematic reviews have concluded that reminders have been proven effective in increasing provider adherence to preventive care standards and prescribing guidelines. The effects of reminders often disappeared after the reminders were stopped; suggesting that to be effective, reminders must be applied continuously and incorporated into daily routines.

**Job aids** are a type of reminder that have been widely used in developing country settings, especially with non-physician health workers. Job aids are visual tools used by the provider during a health care activity that give direction on what actions to take and how. The purpose of the job aid is to reduce the amount of recall needed to correctly perform the task. Job aids are thought to be most appropriate when provider forgetfulness or lack of recall is an important barrier to performance, such as when the task to be performed is complex or infrequent.

Studies from the USAID Quality Assurance Project in Niger, Uganda, and Zambia found that job aids could be feasible and effective in hospital, primary care and community settings to prompt health workers to perform key tasks or communicate specific messages during patient counseling. The USAID Health Care Improvement Project's work in Benin demonstrated that job aids can contribute to help shift tasks from higher skilled to lower skilled health workers. The Quality Assurance Project Issue Paper, "The use of manual job aids by health care providers: What do we know?" provides a good overview of evidence related to effective use of job aids.

## I. Standards and Evidence-based Guidelines

### What are standards and evidence-based guidelines?

Standards communicate expectations for how a health care worker should perform a particular health care activity. They define, for both health workers and clients, the ingredients needed to produce quality services and outcomes. Standards are thus the cornerstone of most health care improvement approaches, including accreditation and other forms of external quality evaluation, collaborative improvement, and process improvement.

There are different forms of standards, including: procedures, clinical practice guidelines, treatment protocols, critical paths, algorithms, standard operating procedures, or statements of expected health care outcomes.[8]

**Standards are most effective if they are:**

- **Regularly updated, communicated to providers, and are "evidence based"**: In an evolving field such as health care – where new technologies, drugs, and procedures are continuously developed and an enormous body of scientific evidence is available to support clinical decision-making – it is critical to ensure that standards are regularly updated, communicated to providers, and are "evidence-based" to improve health care effectiveness and outcomes. Adherence to evidence-based standards is associated with improved health outcomes. Moreover, failure to provide clinical care in accordance with standards has serious negative effects on patient outcomes.
- **Clearly written, achievable, and available to health workers**: Many areas of health care have international evidence-based standards, including standards adapted to low-resource settings. For example, the U.S. Government's National Guideline Clearinghouse is a comprehensive, open-access database including over 2100 evidence-based diagnostic, surgical, and treatment guidelines, over 2000 disease or condition-related practice guidelines, and over 1400 drug-related guidelines.
- **Locally appropriate and reflect both the expected competencies of health care providers in that setting as well as the equipment, drugs, and supplies available to them.** But even when locally appropriate, evidence-based standards exist, health workers may not follow them routinely.

### Why is standards-based performance difficult to achieve and sustain?

A substantial body of research on guidelines implementation suggests many reasons why standards-based performance is often difficult to achieve and sustain. At the most basic level, health workers may simply not be familiar with standards because these have not been clearly communicated. In other cases, systemic factors such as lack of the necessary supplies or equipment to perform according to standards; delayed dissemination of standards from national to facility levels; poor monitoring and evaluation of guideline implementation; and lack of human

[8] See the 2001 report from the Quality Assurance Project, *Taxonomy of Health System Standards*, for a thorough discussion of these different ways of presenting standards. Available at: https://pdf.usaid.gov/pdf_docs/PNACN244.pdf.

resources can affect implementation of standards. Motivating and enabling health workers to perform according to standards is thus one of the biggest challenges to producing quality health care.

## J. Supervision

### What is supervision?

Supervision is the process of directing and supporting staff so that they may effectively perform their duties. Supervision may include periodic events, such as site visits or performance reviews, but it also refers to the ongoing relationship between a staff member and a supervisor. There is also an important human dimension to the supervisor-health worker relationship. In low-resource settings, where many health providers work alone or in small groups in remote sites, the supervisor may be the only link to the larger health system.

In health care settings, supervision often includes oversight and implementation of clinical and non-clinical tasks and activities that affect the organization, management, and technical delivery of health services. Supervisors may supervise work processes and systems, maintenance of facilities and infrastructure, and monitoring and improvement of system-wide performance.

### How does supervision improve health care quality?

Supervision has traditionally been viewed as a key approach to improving the quality of health care and the performance of health care providers, especially given the labor-intensive nature of health service delivery. This is particularly true in developing countries, where supervision remains one of the most direct ways for an organization to affect what its staff does. At the same time, adequate supervision is frequently not realized or sustained, and many supervisors lack the knowledge, skills, and tools for effective supervision.

Governments and donors have invested significant resources to strengthen supervision systems in low- and middle-income countries through supervisor training and supervisory tools and checklists. The Government of South Africa, for example, has made primary health care supervision as cornerstone of the national health care system. The Department of Health's Primary Health Care Supervision Manual contains guidelines for quality supervision, use of supervision support checklists, conducting in-depth technical program reviews, and tools for working with Primary Health Care Facility Committees.

International health agencies have reached consensus in recent years about the key functions of supervision: setting objectives, providing training and guidance, monitoring and evaluating performance, providing feedback, motivating staff, and providing support to solve problems.[9] At the same time, a growing body of experience from different settings suggests that broadening and enhancing how supervision functions can be performed—by involving health workers themselves, peers, and even communities. Evidence suggests that these alternative approaches achieve better health worker performance and outcomes than traditional

[9] The 2002 Maximizing Quality and Access Initiative issue paper, *Making Supervision Supportive and Sustainable: New Approaches to Old Problems*, explores how supportive supervision expands the scope of supervision methods by incorporating self-assessment and peer assessment, as well as community input. It is available at: https://pdf.usaid.gov/pdf_docs/PNACS924.pdf.

supervisory approaches, and some evidence indicates that these approaches may be more sustainable.

## K. Training

Health care professionals need to engage in educational opportunities in order to give them up-to-date knowledge and skills.

**Continuing medical education (CME)** in the form of in-service training (IST) for physicians, nurses, and other health care workers has traditionally employed short courses, conferences, seminars, medical rounds, small group sessions, workshops, tutorials, and other didactic methods to transfer clinical and other information to individuals and groups.

Numerous reviews, drawing primarily on studies in North America, have concluded that formal CME without support to enable or reinforce standards-based performance in actual practice has little or no impact on provider performance. However, when training events were complemented by other interventions to reinforce compliance, performance improvements were more likely to be demonstrated.

Despite the accumulated evidence pointing to the lack of effectiveness of traditional didactic training, expert-led teaching still prevails as the most common form of CME in developing as well as developed countries. However, the influence of adult learning theory on undergraduate and postgraduate medical education has recently resulted in increased interest in and application of experiential learning methods and alternative educational formats. These include inter-professional education, small group learning, learning contracts, telemedicine, and using the Internet to link isolated providers with university resources. For example:

- **Problem-based learning** emphasizes the study of clinical cases in small discussion groups, collaborative independent study, and the application of deductive reasoning as opposed to mastery of factual knowledge. Problem-based learning enhances the transfer of concepts to new problems, increases interest in the subject matter, and develops self-directed learning skills.
- **Computer-based training (CBT)** Computer-driven, interactive video can portray simulated real-life clinical scenarios that students experience in a setting that threatens neither the student nor the patient. CBT can also give students a “clinical” context to enhance recall later in actual clinical practice settings. Computers also have the advantage over traditional training of allowing self-pacing and repetition by individual learners.

USAID has invested considerable resources in improving the quality of IST for health care providers. The Human Resources for Health Global Resource Center offers extensive resources related to education and training of health workers, covering continuing education, distance education, in-service training, pre-service education, and training methodologies. The Global Improvement Framework for Health Worker In-service Training provides guidance to training program providers, professional associations and regulatory bodies on what practices are important to improve sustainability, effectiveness and efficiency of IST to develop and maintain health worker competencies. A related tool is the Training Evaluation Framework and Tools (TEFT) developed by I-TECH to help evaluators, implementers, and program managers at all levels plan successful evaluations of in-service training program outcomes.

# III. TIPS AND TOOLS FOR LEARNING IMPROVEMENT

To support capacity building in improvement, ASSIST developed in 2017 the series *Tips and Tools for Learning Improvement*, a set of competency-based materials to support targeted skill-building in key improvement competencies among health care providers, health care managers, Ministry of Health counterparts, and public health professionals who are new to improvement.

The materials can be used by an individual interested in improvement or can be used by improvement professionals as teaching tools during trainings or coaching visits to target and develop a specific skill. They are designed to complement improvement online courses and in-person trainings.

Each handout in the series is a self-contained, self-directed lesson with numerous competency-based exercises so that learners can practice the basic steps of improvement. An answer key is provided for each lesson, with additional information and commentary where appropriate. The topics in the series include:

- Aims for Improvement – Learn to identify a good improvement aim and practice developing an aim.
- Improvement Teams – Learn to choose members of an improvement team and practice creating a team.
- Flowcharts – Learn to use flowchart symbols and create and analyze a flowchart.
- Developing Changes – Learn to develop changes that address the root problems identified by improvement teams during the process of improving health care.
- Plan-Do-Study-Act (PDSA) Cycles – Learn to conduct a PDSA cycle and practice each part of the cycle.
- Measures for Improvement – Learn to develop and define measures for improvement.
- Measurement - Time Series Charts – Learn to create and plot data on a time series chart.
- Measurement - Variation vs. Improvement – Learn to calculate the median and analyze a time series chart.

Each handout was drafted in consultation with an instructional design consultant and then reviewed by other improvement experts. The materials were then tested by both ASSIST headquarters and field staff who were relatively new to improvement. The entire series of handouts and answer keys, consolidated in a single booklet, is available at: https://pdf.usaid.gov/pdf_docs/PA00WNZJ.pdf. The series in Spanish, called *Los Consejos y Herramientas para Aprender sobre el Mejoramiento*, is available at: https://pdf.usaid.gov/pdf_docs/PA00TBZ5.pdf.

# IV. TOOLS FOR ANALYZING A SYSTEM OR PROCESS

The following tools can facilitate the work of improvement teams in identifying and analyzing problems as well as solutions to those problems:

- Flowcharts
- System Modeling
- Cause-and-Effect Analysis

Many types of graphical data displays, such as bar and pie charts and histograms are also helpful to present data on the current situation in ways that led themselves to analysis of root causes of gaps found.

## A. Flowcharts

A flowchart is a graphic representation of how a process works, showing, at a minimum, the sequence of steps. Several types of flowcharts exist: the most simple (*high level*), a detailed version (*detailed*), and one that also indicates the people involved in the steps (*deployment or "swim lane" matrix*).

### When to Use a Flowchart

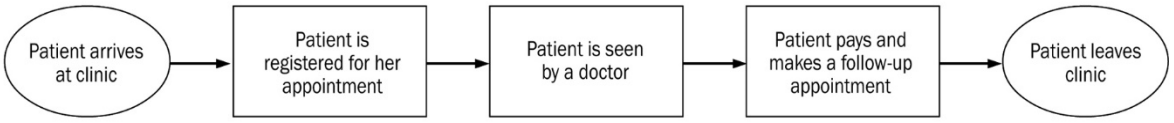
A flowchart helps to clarify how things are currently working and how they could be improved. It also helps in understanding the key elements of a process and where one process ends and the next one starts. Developing a flowchart stimulates communication among participants and establishes a common understanding about the process.

Flowcharts can also reveal steps that are redundant or misplaced. In addition, flowcharts can be used to identify appropriate team members, to identify who provides inputs or resources to whom, to establish important areas for monitoring or data collection, to identify areas for improvement or increased efficiency, and to generate hypotheses about causes. Flowcharts can also be used to examine processes for the flow of patients, information, materials, clinical care, or combinations of these processes. It is recommended that flowcharts be created through group discussion, as individuals rarely know the entire process and the communication contributes to improvement.

#### *High-Level Flowchart*

A high-level (also called *first-level* or *top-down)* flowchart shows the major steps in a process. It illustrates a "birds-eye view" of a process, such as the example in the figure below, "High-Level Flowchart of Prenatal Care" that shows the major steps that occur from the time a patient arrives at a clinic, until she leaves. It can also include the intermediate outputs of each step (the product or service produced), and the sub-steps involved. Such a flowchart offers a basic picture of the process and identifies the changes taking place within the process. It is significantly useful for identifying appropriate team members (those who are involved in the process) and for developing indicators for monitoring the process because of its focus on intermediate outputs.

**High-Level Flowchart of Prenatal Care**

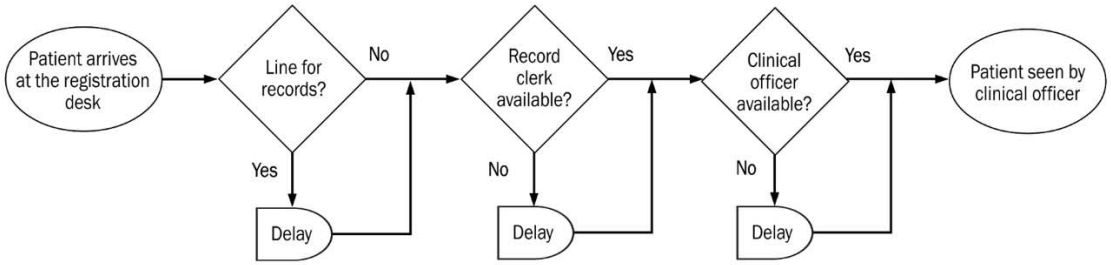



Most processes can be adequately portrayed in four or five boxes that represent the major steps or activities of the process. In fact, it is a good idea to use only a few boxes, because doing so forces one to consider the most important steps. Other steps are usually sub-steps of the more important ones.

### *Detailed Flowchart*

The detailed flowchart provides a detailed picture of a process by mapping all of the steps and activities that occur in the process. This type of flowchart indicates the steps or activities of a process and includes such things as decision points, waiting periods, tasks that frequently must be redone (rework), and feedback loops. This type of flowchart is useful for examining areas of the process in detail and for looking for problems or areas of inefficiency. For example, the "Detailed Flowchart of Patient Registration" reveals the delays that result when the record clerk and clinical officer are not available to assist clients.

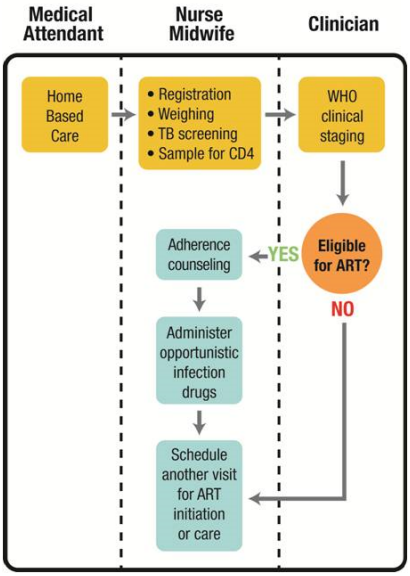
**Detailed Flowchart of Patient Registration**




### *Deployment or "Swim Lane" Flowchart*

A deployment flowchart maps out the process in terms of *who* is doing the steps. It is in the form of a matrix, showing the various participants and the flow of steps among these participants. It is mainly useful in identifying who is providing inputs or services to whom, as well as areas where different people may be needlessly doing the same task.

In the flowchart example at right, the tasks in seeing HIV patients at a health center are described for three different staff members at the facility: the medical attendant, the nurse midwife, and the clinician.



### When to Use Which Flowchart

Each type of flowchart has its strengths and weaknesses. The high-level flowchart addressing major steps is the easiest to construct but may not provide sufficient detail for some purposes. Detailed flowcharts include steps and activities and as well as decision points. Deployment flowcharts show persons involved in specific steps and activities.

**Type of Flowchart Indicated for Various Purposes**

| Purpose | High Level | Detailed | Deployment |
|---|---|---|---|
| To understand the process and determine team membership | +++ | | ++ |
| To gain group consensus about the process | +++ | +++ | +++ |
| To develop areas or indicators to be monitored for process information | +++ | ++ | |
| To find areas where efficiencies can be gained | | +++ | ++ |
| To identify who provides what to whom | ++ | ++ | +++ |
| To search for specific problem areas or steps that must often be redone | + | +++ | ++ |
| To allocate tasks | | | +++ |

+++ Very useful ++ Often useful + Sometimes useful

In choosing which type of flowchart to use, the improvement team should be clear on their purpose for flowcharting. The table below shows which type of flowchart is indicated for which type of purpose. If you are unsure which flowchart to use, start with the high-level one and move on to detailed and deployment. Note that creating detailed and deployment flowcharts can be time-consuming.

### How to Use a Flowchart

Regardless of which the type of flowchart you decide to use, there are several basic steps to its construction.

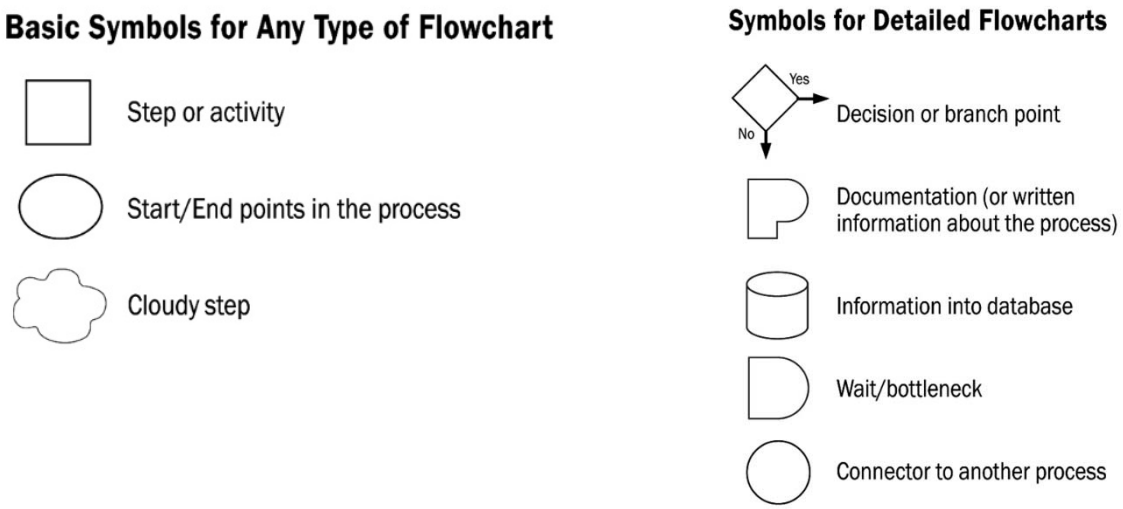
**Step 1.** Agree on the purpose of the flowchart and which format is most appropriate for the process you are analyzing.

**Step 2.** Determine and agree on the beginning and end points of the process to be flowcharted.

- What signals the beginning of this process? What are the inputs?
- What signals the end of the process? What is/are the final output(s)?

**Step 3.** Draw the flowchart for the process

List out the steps involved in the process in the first column of this table. Describe what happens at each step and what outcomes it leads to, and what next step must be taken as a result. Once all of your steps are listed, you can draw a simple flowchart using the basic symbols for any type of flowchart.



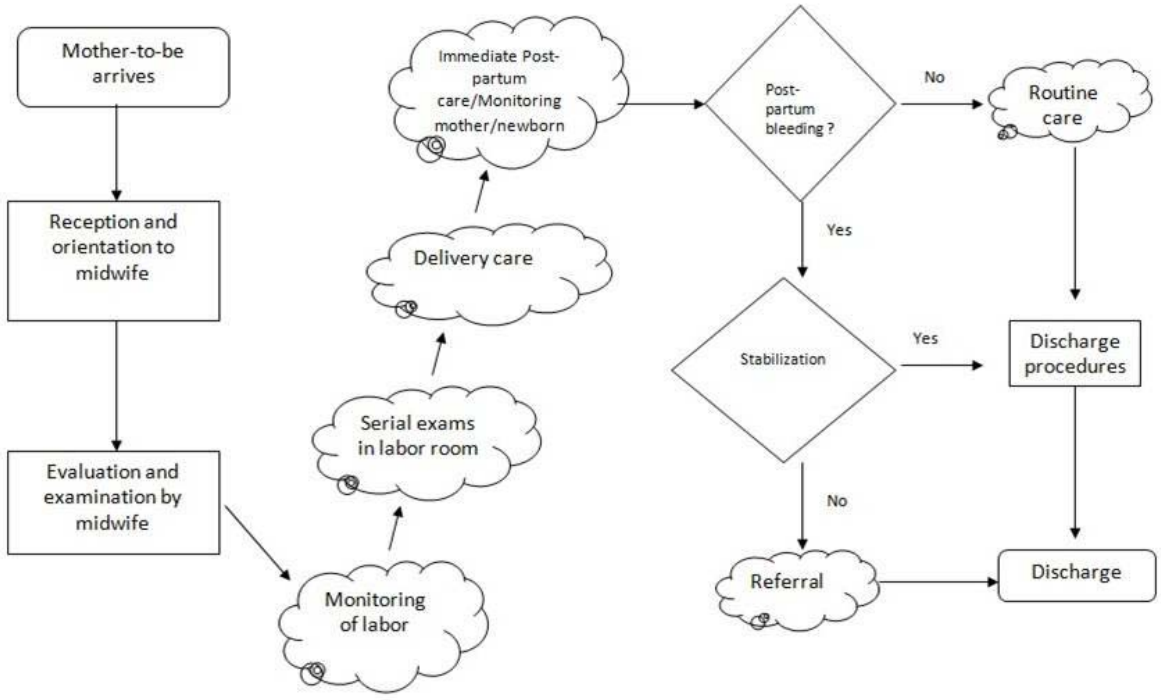

An example of the steps for a flowchart to analyze the labor and delivery process at a health center that addresses post-partum hemorrhage is provided below.

**Steps for a flowchart on labor and delivery at a health center**

| **What are the steps?** | **What happens at this step?** This may be clinical content, a management decision, a community action, or other. | **What are the possible outcomes from this step?** It may be a simple yes or no, it may be multiple possibilities, or it may be uncertain. |
|---|---|---|
| Reception and orientation | The mother-to-be is registered and introduced to the midwife | Proceeds to the next step |
| Evaluation and examination | Initial examination before going into the delivery room | Proceeds to the next step |
| Labor / delivery care | The mother-to-be is monitored, the delivery is attended, and the woman given care as needed if any complications arise | If post-partum bleeding occurs, then treatment is needed; otherwise, routine care is provided |
| Stabilization | Woman with post-partum hemorrhage is treated | Either she is stabilized or referred to the hospital |
| Routine care procedures and discharge | Routine care is provided to the woman and newborn | Woman and newborn are discharged from the clinic |

**Step 4.** Review the first draft of the flowchart to see whether the steps are in their logical order. Areas that are unclear can be represented with a cloud symbol, to be clarified later.

Below is a flowchart depicting the steps in the labor and delivery example shown in the table above.




**Step 5.** After a day or two, review the flowchart with the group to see if everyone is satisfied with the result. Ask others involved in the process if they feel it reflects what they do.

**Hints for Constructing Flowcharts**

Try to develop a first draft in one sitting, going back later to make refinements. Use the "five-minute rule": do not let five minutes go by without putting up a symbol or box; if the decision of which symbol or box should be used is unclear, use a cloud symbol or a note and move on.

To avoid having to erase and cross out as ideas develop, cut out shapes for the various symbols beforehand and place them on the table. This way, changes can easily be made by moving things around while the group clarifies the process.

Decision symbols are appropriate when those working in the process make a decision that will affect how the process will proceed. For example, when the outcome of the decision or question is YES, the person would follow one set of steps, and if the outcome is NO, the person would do another set of steps. Be sure the text in the decision symbol would generate a YES or NO response, so that the flow of the diagram is logical.

In deciding how much detail to put in the flowchart (i.e., how much to break down each general step), remember the purpose of the flowchart. For example, a flowchart to better understand the problem of long waiting times would need to break down in detail only those steps that could have an effect on waiting times. Steps that do not affect waiting times can be left without much detail.

Keep in mind that a flowchart may not need to include all the possible symbols. For example, the wait/bottleneck symbol may not be needed if the flowchart is not related to waiting times.

**Analyzing a Detailed Flowchart to Identify Problem Areas**

Once the flowchart has been constructed to represent how the process actually works, examine potential problem areas or areas for improvement using one or more of the following techniques.

- Examine each decision symbol: Does it represent an activity to see if everything is going well? Is it effective? Is it redundant?
- Examine each step or activity symbol: Is this step redundant? Does it add value to the product or service? Is it problematic? Could errors be prevented in this activity?
- Examine each documentation or database symbol: Is this necessary? Is it up to date? Is there a single source for the information? Could this information be used for monitoring performance and improving the process?
- Examine each wait symbol: What complexities or additional problems does this wait cause? How long is the wait? Could it be reduced?
- Examine each transition where one person finishes his or her part of the process and another person picks it up: Who is involved? What could go wrong? Is the intermediate product or service meeting the needs of the next person in the process?
- Examine the overall process: Is the flow logical? Are there unclear areas or places where the process leads nowhere? Are there parallel tracks? Is there a rationale for those?

**Points to Remember**

- Flowcharts for problem analysis should always reflect the actual process, not the ideal process.
- Involve people who know the process, either while developing the flowchart or as reviewers when the chart has been completed.
- Be sure that the flowchart really focuses on the identified problem or process.

## B. System Modeling

System modeling shows how the system should be working. Use this technique to examine how various components work together to produce a particular outcome. These components make up a system, which is comprised of resources processed in various ways (counseling, diagnosis, treatment) to generate direct outputs (products or services), which in turn can produce both direct effects (e.g., immunity, rehydration) on those using them and longer term, more indirect results (e.g., reduced measles prevalence or reduced mortality rates) on users and the community at large.

### When to Use System Modeling

By diagramming the linkages between each system activity, system modeling makes it easier to understand the relationships among various activities and the impact of each on the others. It shows the processes as part of a larger system whose objective is to serve a specific client need. System modeling is valuable when an overall picture is needed. System modeling shows how direct and support services interact, where critical inputs come from, and how products or services are expected to meet the needs in the community.

When improvement teams do not know where to start analyzing the problem they are facing, system modeling can help by showing the various parts of the system and the linkages among those parts. It can pinpoint other potential problem areas. System modeling can also reveal data collection needs: indicators of inputs, process, and outcomes (direct outputs, effects on clients, and/or impacts). Finally, system modeling can be helpful in monitoring performance.

### Elements of System Modeling

System modeling uses three elements: inputs, processes, and outcomes.

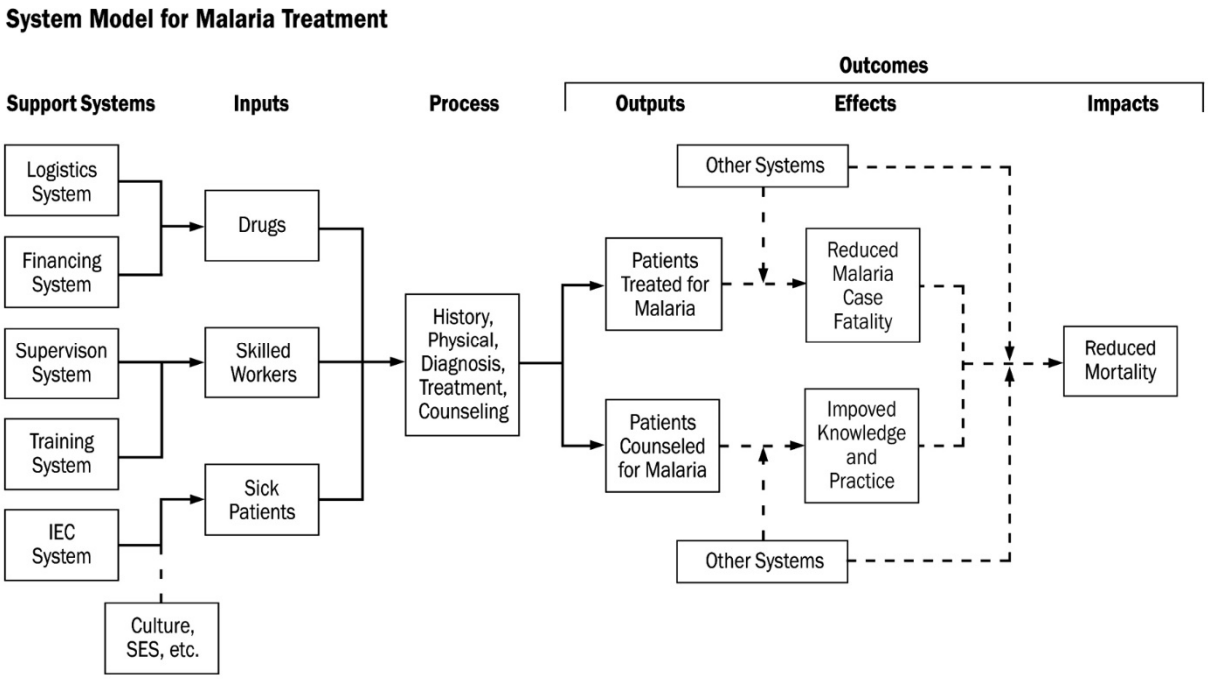
*Inputs* are the resources used to carry out the activities (processes). Inputs can be raw materials, or products or services produced by other parts of the system. For example, in the malaria treatment system, inputs include anti-malarial drugs and skilled health workers. Other parts of the system provide both of these inputs: the drugs by the logistics subsystem and the skilled human resources by the training subsystem.

*Processes* are the activities and tasks that turn the inputs into products and services. For malaria treatment, this process would include the tasks of taking a history and conducting a physical examination of patients complaining of fever, making a diagnosis, providing treatment, and counseling the patient.

*Outcomes* are the results of processes. Outcomes generally refer to the direct *outputs* generated by a process and may sometimes refer to the more indirect *effects* on the clients themselves and the still more indirect *impacts* on the wider community.

- *Outputs* are the direct products or services produced by the process. The outputs of the malaria treatment system are patients receiving therapy and counseling.
- *Effects* are the changes in client knowledge, attitude, behavior, and/or physiology that result from the outputs. For the malaria treatment system, this would be reduced case fatality from malaria (patients getting better) and patients or caretakers who know what to do if the fever returns. These are indirect results of the process because other factors may intervene between the output (e.g., correct treatment with an anti-malarial) and the effect (e.g., the patient's recovery).
- *Impacts* are the long-term and still more indirect effects of the outputs on users and the community at large. For malaria treatment, the impacts would be improved health status in the community and reduced infant and child mortality rates.

A system model for malaria treatment is shown below.




### How to Use System Modeling

**Step 1**. Identify the major process or "system" to be modeled and the need that system should be serving (desired impact). This can be done by starting with the PROCESS or IMPACT.

If starting with the PROCESS of interest, identify the part of the system to be modeled: a health care intervention (such as immunizations, malaria treatment, or hospital emergency services). It is also possible to focus system modeling on a support service, such as supervision or logistics. Next, identify the client needs that this PROCESS should be addressing (remember that support services meet the needs of internal clients).

If starting with the IMPACT, identify what the system is supposed to affect, e.g., what need in the community should the system meet? Then, identify what PROCESS is carried out to create the services or products (OUTPUTS) that would be expected to have appropriate EFFECTS on clients, which could in turn be expected to result in the desired IMPACT (meet that need).

**Step 2**. Draw and label the IMPACT and the PROCESS boxes.

**Step 3.** Work backwards through the OUTCOMES, beginning with the need (IMPACT), and determine what EFFECTS the product or services (OUTPUTS) must produce in the clients to achieve that desired IMPACT. Think about the various groups affected by the products and services. Draw and label the OUTCOMES box.

**Step 4**. Identify other factors that can affect the IMPACT: e.g., the economy or cultural factors, and add them to the model. No system operates in a vacuum, and the IMPACT will always be influenced by factors outside the system.

**Step 5**. Identify the specific OUTPUTS produced by the process that lead to the OUTCOMES just identified. In many instances, there will be more than one kind of OUTPUT. For example, a vaccination system should produce vaccinated children and informed mothers.

**Step 6**. Identify the major task categories in the PROCESS: e.g., taking the history, giving the physical, making a diagnosis, giving a treatment, and counseling. Write these in the PROCESS box. Review the OUTPUTS (e.g., patients treated for malaria, patients counseled) and make sure that there is an OUTPUT identified for each beneficiary of the major tasks.

**Step 7**. Identify the various INPUTS needed to carry out the process. These INPUTS should include workforce, materials, information, and financial resources. Draw boxes for the various INPUTS and label them. Determine which support systems (such as logistics, training, supervision) produce each of these INPUTS and write the sources in the boxes.

### Using the System Model for Problem Analysis

Review the various elements of the system. Determine what data are needed to know whether the system is sufficiently productive or adequately functioning to achieve the outcome and impact desired. Use these data to assess whether the system is performing the way it should be according to the system model you have drawn. Identify weak or missing components of the system by seeing where in the process quality falls short.

### Points to Remember

- Involve people who know the system being modeled, either while developing the model or as reviewers after it has been drafted.
- Be sure that the system model really addresses the identified problem.

## C. Cause-and-effect Analysis

A *cause-and-effect analysis* generates and sorts hypotheses about possible causes of problems within a process by asking participants to list all of the possible causes and effects for the identified problem. This type of analysis is often conducted by drawing cause-and-effect diagrams, which organize a large amount of information by showing links between events and their potential or actual causes and provide a means of generating ideas about why the problem is occurring and possible effects of that cause. Cause-and-effect analysis allows problem solvers to broaden their thinking and look at the overall picture of a problem. Cause-and-effect diagrams can reflect either causes that block the way to the desired state or helpful factors needed to reach the desired state.

### When to Use Cause-and-Effect Analysis

As a graphic presentation with major branches reflecting categories of causes, a cause-and-effect analysis stimulates and broadens thinking about potential or real causes and facilitates further examination of individual causes. Because everyone’s ideas can find a place on the diagram, a cause-and-effect analysis helps to generate consensus about causes. It can help to focus attention on the process where a problem is occurring and to allow for constructive use of facts revealed by reported events.

However, it is important to remember that a cause-and-effect diagram is a structured way of expressing *hypotheses* about the causes of a problem or about why something is not happening

as desired. It cannot replace empirical testing of these hypotheses: it does not tell which is the root cause, but rather possible causes.

There are two ways to graphically organize ideas for a cause-and-effect analysis. They vary in how potential causes are organized: (a) by category: called a *fishbone diagram* (for its shape) or *Ishikawa diagram* (for the man who invented it), and (b) as a chain of causes: called a *tree diagram.*

The choice of method depends on the team's need. A *fishbone diagram*, organized around categories of cause, will help the team think about groups of causes, such as those that are staffing-related, resource-related, facility-related, etc. A *tree diagram*, however, will encourage team members to explore the chain of events or causes.

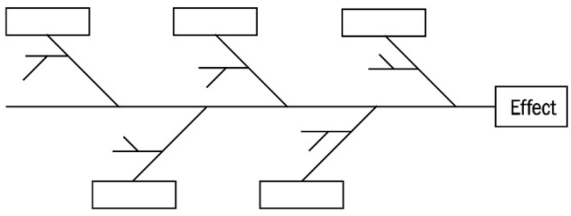
**Causes by Categories (Fishbone Diagram)**

The fishbone diagram (called so for its shape) helps teams to brainstorm about possible causes of a problem, accumulate existing knowledge about the causal system surrounding that problem, and group causes into general categories. The branches (labeled by the boxes at the top and bottom) represent main categories of potential causes that contribute to the origin or maintenance of the problem (labeled "Effect" at the head of the fishbone), such as issues that are staffing-related, patient-related, resource-related, facility-related, etc. The smaller lines coming off the main branches represent subcategories or specific causes within the category.

When using a fishbone diagram, several categories of cause can be applied. Some often-used categories are:

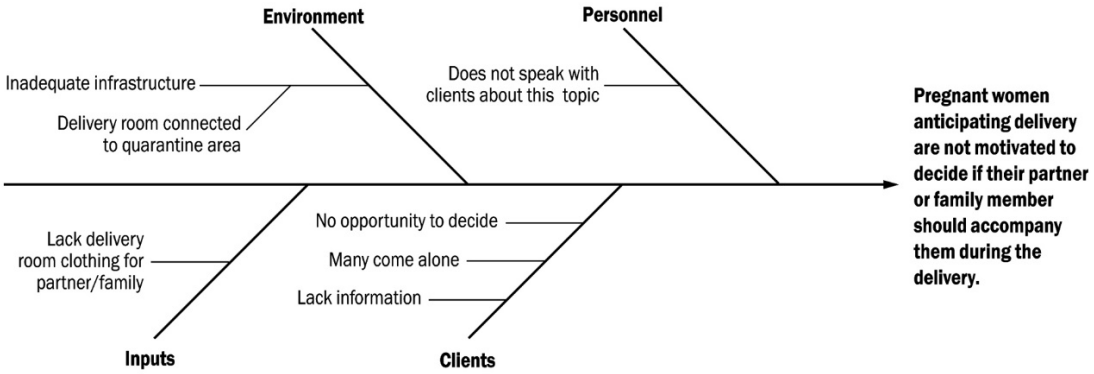
- Human resources, methods, materials, measurements, and equipment
- Clients, workers, supplies, environment, and procedures

**Fishbone Diagram Structure**



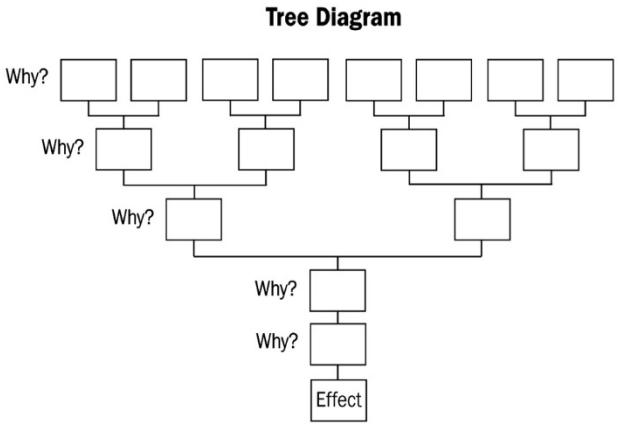

Categories for this type of cause-and-effect diagram vary widely, depending on the context. The group should choose those categories that are most relevant to them and feel free to add or drop categories as needed. A quality improvement team at a hospital in Bolivia developed this fishbone diagram to improve prenatal and delivery care:

**Fishbone Diagram Used at the San Carlos Hospital**



### A Chain of Causes (Tree Diagram) and the Five Why's

A second type of cause-and-effect analysis is a *tree diagram,* which highlights the chain of causes. It starts with the effect and the major groups of causes and then asks for each branch, "Why is this happening? What is causing this?"




The tree diagram is a graphic display of a simpler method known as the *Five Why's.* It displays the layers of causes, looking in-depth for the *root* cause. The Five Why's can be used alone or with any cause-and-effect diagram.

### Example of Applying the Five Why's to Analyze the Root Cause of Incorrect Treatment

*Effect:* The patient received the wrong medication.

*Question 1:* **Why** did the patient get the incorrect medicine?
*Answer 1:* Because the prescription was wrong.

*Question 2:* **Why** was the prescription wrong?
*Answer 2:* Because the doctor made the wrong decision.

*Question 3:* **Why** did the doctor make the wrong decision?
*Answer 3:* Because he did not have complete information in the patient's chart.

*Question 4:* **Why** wasn't the patient's chart complete?
*Answer 4:* Because the doctor's assistant had not entered the latest laboratory report.

*Question 5:* **Why** hadn't the doctor's assistant charted the latest laboratory report?
*Answer 5:* Because the lab technician telephoned the results to the receptionist, who forgot to tell the assistant.

***Solution:*** Develop a system for tracking lab reports.

### How to Use Cause-and-Effect Analysis

Although several ways to construct a cause-and-effect diagram exist, the steps of construction are essentially the same.

**Step 1.** Agree on the problem or the desired state and write it in the *Effect* box. Try to be specific. Problems that are too large or too vague can make it hard for the team to move forward.

**Step 2.** If using a tree or fishbone diagram, define six to eight major categories of causes. Or the team can **brainstorm** first about likely causes and then sort them into major branches. The team should add or drop categories as needed when generating causes. Each category should be written into a box.

**Step 3.** Identify specific causes and fill them in on the correct branches or sub-branches. Use simple brainstorming to generate a list of ideas before classifying them on the diagram, or use

the development of the branches of the diagram first to help stimulate ideas. Either way will achieve the same end: use the method that feels most comfortable for the group. If an idea fits on more than one branch, place it on both. Be sure that the causes as phrased have a direct, logical relationship to the problem or effect stated at the head of the fishbone.

Each major branch (category or step) should include three or four possible causes. If a branch has fewer, lead the group in finding some way to explain this lack, or ask others who have some knowledge in that area to help.

**Step 4.** Keep asking "Why?" and "Why else?" for each cause until a potential root cause has been identified. A *root cause* is one that: (a) can explain the "effect," either directly or through a series of events, and (b) if removed, would eliminate or reduce the problem. Try to ensure that the answers to the "Why" questions are plausible explanations and that, if possible, they are amenable to action.

Check the logic of the chain of causes: read the diagram from the root cause to the effect to see if the flow is logical. Make needed changes.

**Step 5.** Have the team choose several areas they feel are most likely causes. These choices can be made by **voting** to capture the team's best collective judgment.

Use the reduced list of likely causes to develop simple data collection tools to prove the group's theory. If the data confirm none of the likely causes, go back to the cause-and-effect diagram and choose other causes for testing.

**Points to Remember**

- Remember that cause-and-effect diagrams represent hypotheses about causes, not facts. Failure to test these hypotheses—treating them as if they were facts—often leads to implementing the wrong solutions and wasting time.
- To determine the root cause(s), the team must collect data to test these hypotheses. The "effect" or problem should be clearly articulated to produce the most relevant hypotheses about cause. If the "effect" or problem is too general or ill defined, the team will have difficulty focusing on the effect, and the diagram will be large and complex.
- It is best to develop as many hypotheses as possible so that no potentially important root cause is overlooked.
- Be sure to develop each branch fully. If this is not possible, then the team may need more information or help from others for full development of all the branches.

# V. TOOLS FOR DEVELOPING AND SELECTING SOLUTIONS

A number of tools can facilitate the work of improvement teams to generate and evaluate potential solutions to problems they have identified. These tools can be used alone or in combination to generate ideas, analyze the advantages and disadvantages of changes to test, and select changes to test or implement.

- Brainstorming
- Prioritization Tools
- Change Concepts
- Affinity Analysis
- TRIZ
- Client Window
- Benchmarking

## A. Brainstorming

Brainstorming is a way for a group to generate as many ideas as possible in a very short time by tapping into group knowledge and individual creativity. Brainstorming produces ideas by encouraging the participation of all group members through structured and unstructured thought processes on a given subject. It requires participants to be willing to express their ideas without evaluating them, remain open to new ideas, and refrain from criticizing suggestions. Brainstorming works best in an uninhibited environment where ideas are freely generated and built upon.

### When to Use Brainstorming

Brainstorming is particularly useful when trying to generate ideas about problems, areas for improvement, possible causes, other solutions, and resistance to change. By bringing out many creative ideas quickly and encouraging all group members to participate, this activity opens up people's thinking and broadens their perspectives. It allows ideas to build on one another, which would not occur if each team member were interviewed separately. Brainstorming is very simple to apply and is most productive with 6 to 15 people.

### How to Use Brainstorming

**Step 1**. Write the question or issue to be explored through brainstorming on a flip chart, blackboard, or any place where everyone can see it. Make sure that everyone is clear about the topic.

**Step 2.** Review the rules of brainstorming:

- Do not discuss ideas during the brainstorming
- Do not criticize any idea
- Be unconventional: every idea is acceptable
- Build on the ideas of others
- Quantity of ideas counts

**Step 3**. Gather ideas. Give people a few minutes to think of some ideas before starting. Brainstorming can be *unstructured* or *structured*. In unstructured brainstorming, each person voices ideas as they come to mind. This method works well if participants are outgoing

and feel comfortable with each other. In structured brainstorming, each person gives an idea in rotation (a person can pass if he or she doesn't have one at the moment). Structured brainstorming works well when people are unfamiliar with one another or are less talkative: the structure encourages everyone to speak.

**Step 4.** Write **all** ideas on a flip chart.

**Step 5.** After all the ideas have been generated (usually after about 30–45 minutes), review each one, clarify the idea if necessary, and combine related ideas.

**Step 6.** Agree on ways to judge ideas, and use data collection, voting, or prioritization matrices to choose among options. Groups often use voting techniques first to reduce the list to about six to 10 top ideas and then use other techniques to choose among this shorter list.

**Points to Remember**

- Brainstorming is a technique for generating ideas, but each idea will need elaboration.
- Discussing or judging ideas while brainstorming impedes the exercise and limits the flow of ideas. Save discussion until the end.
- If one or a few individuals dominate the discussion in an unstructured brainstorming session, shift to a structured brainstorming format.

## B. Prioritization Tools

Group methods for narrowing down and ranking a list of improvement ideas include *voting* and *prioritization matrices*. Both methods allow individuals to express their opinions or choices in reaching a group decision. *Voting* is a relatively unstructured technique where group members make a choice, using either implicit or explicit criteria. A *prioritization matrix* allows the improvement team to review the options against a set of explicit criteria.

### Voting

**When to Use Voting**

Voting is most useful when the improvement options are fairly straightforward or time is limited. It encourages equal participation of all team members by equalizing decision making between dominant and quiet participants.

Improvement teams can structure voting in several ways. *Straight* voting is the simplest, where each participant has one vote. *Multivoting* allows participants to vote more than once and is useful when the group wants to pick more than one item to improve or when the list of items is very long and needs to be reduced to two or more. (To reduce a list to one item, use straight voting.)

Multivoting can be repeated several times until the list is short enough to work with or a single priority stands out. This voting method increases the likelihood that everyone will have at least one of the items for which they voted on the reduced list.

*Weighting* can be added to multivoting to allow participants to indicate the strength of their preference by allotting more votes to the same option. Weighted voting allows a group to select options on the basis not only of how important each is to the group but also how strongly the group feels about their options. Weighted voting is helpful when team members hold strong but divergent ideas about how to proceed.

Regardless of the type of voting used, all group members should understand the various options being voted on before voting begins.

### How to Use Straight Voting

List all options and give each person in the group one vote. (All votes are weighted equally.) The option with the highest total is selected.

### Example of Straight Voting with 10 Participants

| Option | Vote | Total |
|---|---|---|
| Option 1 | **X X X** | 3 |
| Option 2 | **X X X X X** | 5 |
| Option 3 | **X** | 1 |
| Option 4 | **X** | 1 |
| Total votes | | 10 |

### How to Use Multivoting

List all options and allow each person to vote for a limited number of items (e.g., two to five). A general rule to determine the number of votes is:

- Up to 10 options = 2 votes
- 10–20 options = 3 votes
- 20–30 options = 5 votes

Add up the votes for each item; the one with the highest score is the group's top priority.

### Example of Multivoting with 10 Participants, Three Votes Each

| Option | Vote | Total |
|---|---|---|
| Option 1 | **X** | 1 |
| Option 2 | **X X X X X X** | 6 |
| Option 3 | **X X X X X X** | 6 |
| Option 4 | **X X X X X X X X** | 8 |
| Option 5 | **X X X** | 3 |
| Option 6 | **X X X X** | 4 |
| Option 7 | | |
| Option 8 | | |
| Option 9 | **X X** | 2 |
| Option 10 | | |
| | | 30 |

### How to Use Weighted Voting

List all options. Give each person a way to give more weight to some choices than to others. For example, give participants a fixed amount of hypothetical money, allowing each person to distribute it any way he or she wishes among the alternatives. If given $10, one could spend all $10 on a single item that he/she felt very strongly about, or he/she could distribute it evenly over five items, or any other combination. This method allows the voting to reflect each individual's conviction about the various choices.

Another way to organize weighted voting is to list all the options on the wall or a flip chart and give each participant an identical number of colored stickers or dots. Each sticker represents one vote. Ask the participants to allocate their stickers among the options according to their preferences. Count up the number of stickers placed by each option to determine the final votes.

### Example of Weighted Voting with 10 Participants

| Option | Team Member | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | | | | | | | | | | | 0 |
| 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 23 |
| 3 | 3 | 2 | | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 21 |
| 4 | 2 | 3 | 8 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 29 |
| 5 | | | | | | | | | 1 | 2 | 3 |
| 6 | 2 | 1 | | 1 | 2 | 1 | 1 | 2 | 1 | | 11 |
| 7 | | 2 | | 1 | | 1 | 1 | 1 | 1 | 1 | 8 |
| 8 | | | | | 3 | 1 | | | | 1 | 5 |
| 9 | | | | | | | | | | | 0 |
| 10 | | | | | | | | | | | 0 |

### Points to Remember

While equal participation in the process can contribute to the group spirit, a minority may feel disenfranchised by the result. That is, they may feel that they lost out. This can diminish the coherency of the group dynamics. To prevent this, engage in team-building exercises after voting activities.

## Prioritization Matrix

In each of the above voting options, each individual uses his or her own internal, unstated criteria to make a decision. A criterion is a measure, guideline, principle, or other basis for making a decision. Examples of criteria that are often used in health care settings are that activities must be affordable and safe. In teams, agreeing upon explicit decision-making criteria is a structured way of making a group decision.

Often in making decisions, people consider more than one criterion at the same time. For group decision making, it can be helpful for the group to discuss and agree upon the criteria by which each participant should base his or her vote or selection. A multiple criteria or prioritization matrix is a tool for evaluating options based on a set of explicit criteria the group has determined is important for making an appropriate, acceptable decision.

Criteria can be weighted and ranked to help in the decision-making process. Although the prioritization matrix is the method most likely to result in consensus, at times it can be time-consuming and complex.

**When to Use a Prioritization Matrix**

Matrices work best when options are more complex or when multiple criteria should be considered in determining priorities or making a decision. The matrix presented below displays the options to be prioritized in the rows (horizontal) and the criteria for making the decision in the columns (vertical). Each option is then rated according to the various criteria.

**Example of a Prioritization Matrix with Three Options and Four Criteria**

| **Options** | **Criteria** | | | | **Total** |
|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | |
| Option 1 | | | | | |
| Option 2 | | | | | |
| Option 3 | | | | | |

**How to Use a Prioritization Matrix**

**Step 1:** List the options or choices to be evaluated. Make sure that all team members understand what each option means.

**Step 2:** Set the criteria for making the decision. The group can choose these criteria using brainstorming and then voting to determine the most important/relevant ones. Be sure that everyone understands what the chosen criteria mean.

Criteria commonly used for choosing problems to work on include importance, support for change, visibility of problem, risks if nothing is done, and feasibility of making changes in this area. For choosing solutions, the following criteria are often applied: cost, potential resistance, feasibility, management support, community support, efficiency, timeliness, and impact on other activities. These are not the only possible criteria; the group should develop a list that is appropriate for its situation.

No minimum or maximum number of criteria exists, but three or four is optimal to keep the matrix manageable. One way to reduce the number of criteria is to determine if there are any criteria that all options ***must*** meet. Use this criterion first to eliminate some options. Then, list the other criteria to prioritize the remaining options.

Another way to make the matrix less cumbersome is to limit the number of options being considered. If the list of options is long (greater than six items), it may be easier to first shorten the list by eliminating some options.

**Step 3:** Draw the matrix and fill in the options and criteria.

**Step 4:** Determine the scale to use in rating the options against each criterion. Ways to rate options range from simple to complex. A simple rating scale sets a score based on whether the option meets a given criterion, e.g., Are trained staff already available? The answer (vote) "yes" would gain one point, while "no" would gain zero points.

Another common rating scale scores options according to how well one option meets the criterion, e.g., How much management support is there for this option? The answer of "high" would garner three points, "medium" two points, and "low" one point (see note in box for another example).

A complex rating scale assigns a different maximum score (weight) to each of the criteria, and each option is scored independently on each criterion, up to the maximum weight of that criterion.

**Example of Complex Rating Scale**

| Criteria | Maximum Points | Option 1 | Option 2 | Option 3 |
|---|---|---|---|---|
| Client acceptability | 50 | 25 | 35 | 50 |
| Feasibility | 35 | 30 | 20 | 28 |
| Low cost | 15 | 5 | 15 | 12 |
| Overall rating | 100 | 60 | 70 | 80 |

**Step 5:** Taking one option at a time, review each criterion and determine the appropriate rating, using the simple, common, or complex rating scale. This ranking can be done individually and then added up. Or, if the rating method is simple, it can be done by group discussion.

**Step 6:** Total the value for each option by adding the ranking for each criterion.

**Step 7:** Evaluate the results by considering the following questions:

- Does one option clearly meet all criteria?
- Can any options be eliminated?
- If an option meets some but not all criteria, is it still worth considering?

**Points to Remember**

- Make sure that everyone clearly understands the options under consideration and the definitions of the criteria.

## C. Change Concepts

All improvement requires change, but not every change is an improvement. *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance* (Langley GJ, et al., Jossey-Bass, 2009) is an excellent resource on how to enhance the performance of any organization. One of the ideas that the authors of the book develop is, what kinds of changes will lead to improvement?

The authors argue that people have a tendency to resort to common and often ineffective ways of developing change, such as adding more resources (money, time, people), adding more inspection or oversight/control, adding more procedures or defining them more rigorously, or

adding more restrictions. They note another pitfall is that people seek perfection when they are developing a change and never get around to implementing anything because they are too absorbed in building the perfect solution (also known as "letting the perfect be the enemy of the good").

Based on the authors' work as improvement advisors to many types of organizations and industries, they note that one effective strategy for developing change is to use generic ideas for change, what they call *change concepts*. These are general approaches that have been found to be useful in developing specific ideas for change when they are adapted to specific situations.

The book's appendix, **"A Resource Guide to Change Concepts",** contains a list of 72 generic change concepts that is a valuable source of ideas of how to change any process. The changes can be grouped in categories of changes to meet a certain objective, such as: eliminate waste, improve work flow, eliminate mistakes, change the work environment, address customer needs, and manage variation. The following table provides examples of the change concepts discussed in more detail in the book.

| Categories | Examples of change concepts |
|---|---|
| **Eliminate waste** | Evaluate the purpose of every step and eliminate those that don't add value; eliminate inputs that are not essential; eliminate multiple entry (e.g., recording the same information); reduce overkill; recycle or reuse; remove intermediaries |
| **Improve work flow** | Minimize handoffs; do tasks in parallel; move steps in a process closer together; use a coordinator/triage manager; change the order of steps; adjust to peak demand |
| **Eliminate mistakes** | Use reminders; standardize procedures; put in place constraints (things that prevent mistakes) and/or affordances (things that lead you to do the right thing); color code or mark similar things to differentiate them |
| **Change the work environment** | Give people access to information; reduce demotivating aspects of the work; provide training; emphasize natural consequences; develop alliances and cooperative relationships |
| **Address customer needs and problems** | Listen to customers; reduce waiting time; reach agreement on expectations; offer services whenever clients want them; offer services wherever clients want them |
| **Manage variation** | Standardize (create a formal process); develop contingency plans; adjust to peak demand; match the amount to the need |

### When to Use Change Concepts

Sometimes, changes that can improve health care services or outcomes are obvious. Many times, however, a change that will result in improvement is not obvious. In place of the common tendency to simply do more or add resources, consider making changes in the actual process of delivering care. Generic change concepts can provoke new thinking about how to improve a specific process and suggest changes that otherwise might not have been considered.

### How to Use Change Concepts

**Step 1.** Choose a category of change concept from the table above at random and discuss with the improvement team how generic concepts in the category could be applied to the health care process the team wants to improve. Change concepts can also be selected based on criteria such as “this change concept has never been considered before” or “this change concept has been used successfully in a similar setting.”

**Step 2.** Use brainstorming or another discussion technique to generate ideas of how to apply each change concept to the process of interest.

**Step 3.** After the generation of ideas is complete, evaluate or critique each idea using voting or another method to rank the ideas in order of preference for testing.

## D. Affinity Analysis

Affinity analysis is a process that helps groups gather a large amount of information and organize it on the basis of *affinities* (natural relationships). This technique allows participants find connections among ideas, rather than letting pre-determined categories determine or constrain the generation of ideas.

The affinity technique consists of two components—individuals first brainstorm on ideas and then organize them into natural categories. This process generates a lot of ideas and also organizes the overall picture of the issue (such as a problem) to understand its relationship to other areas. Like many other aspects of improvement, this process inspires feelings of ownership and participation for group members.

### When to Use Affinity Analysis

An affinity analysis can help an improvement team or group organize many different change ideas or items in a short period of time. Groups often use affinity analysis to generate ideas about problems or areas for improvement, causes, alternative solutions, and barriers to change. This type of analysis is mainly useful when issues appear too large or complex, when consensus is desired, or when creative ideas are needed. Because everyone’s idea is included and groupings of ideas are done by the team, it helps develop consensus. It is also useful for making sure that no ideas are lost.

### How to Use Affinity Analysis

**Step 1.** State the issue or question to be considered and assure that all participants are clear on what is being asked. Give participants a few minutes to think about their responses silently.

**Step 2.** Generate and record ideas. Ask each person to record each idea on a separate slip of paper or Post-it note or card. Each idea or item should be recorded on its own.

**Step 3.** Place the slips of paper in any order in a manner that allows everyone to see all of them (for example, posted on a wall, or laid on a large table).

**Step 4**. Ask team members to sort the individual ideas into relationships or categories by moving the slips of paper around; members should keep the discussion brief. After a while, the team members will stop moving items around.

- If the group is large, have the members work in groups of three or four to arrange the slips. Allow each group to work for a few minutes then call the next group of three or four. Let the groups continue in turns until they are no longer moving items around.
- Do not force an item into a category; it is fine to have categories with only a single item.
- If an item is constantly being moved back and forth between two categories, either clarify its meaning or make a copy and put it in both categories.

**Step 5.** Develop a name for each category that captures the essential meaning of all the items in the category. When doing this, look first among the items in the category. If no single item captures the idea clearly, create one that does. Write it on a slip of paper.

**Step 6.** Transfer the category titles and lists from all the slips of paper onto a sheet of paper; use lines to separate the categories.

**Step 7.** If needed, use prioritization tools to select from among categories.

**Points to Remember**

- Sorting should be done as silently as possible. Discuss the items on the slips of paper only for clarification.

## E. TRIZ

TRIZ is a creative thinking exercise that was developed for the engineering field. It was developed by the Soviet inventor and science fiction author Genrich Altshuller and his colleagues in the 1940s. In English, TRIZ is typically translated as "the Theory of Inventive Problem Solving." The full TRIZ process includes many problem-solving strategies, but a simplified version of the approach lends itself to improvement work.

**When to Use TRIZ**

TRIZ can help an improvement team think creatively about how to solve a problem or improve a complex process by thinking about the *opposite* of the desired result. TRIZ encourages participants to think outside the usual solutions by envisioning what would be the perfect system to prevent the desired result from occurring. By focusing on how to ensure that the opposite occurs, characteristics that may be preventing the desired result from happening are more easily identified and can then be addressed. As a structured creativity exercise, TRIZ works best in a small group (5-8 participants), but can be used in larger groups by applying the technique in several small groups working in parallel and then bringing pairs or trios of groups together to share and integrate their insights.

**How to Use TRIZ**

**Step 1.** Think of a difficult and complex problem that the team needs to solve or a complex process to improve. Examples of such can be found on the TRIZ website.

**Step 2**. Describe as many of the key elements of the desired result or outcome of improving that process/solving the problem. Be as specific as possible.

**Step 3.** Design a comprehensive system that makes it absolutely impossible to get that result. What policies, practices, and ways of operating would make it 100% certain that there is no way any of the desired results can happen. List the key elements of the perfect system to prevent the desired result from occurring.

**Step 4.** Compare the list to the current situation to identify what aspects of the system are actually in place now.

**Step 5**. For each element of the "perfect system to prevent the desired outcome" that is similar to the current situation, identify what it would take to eliminate the similarities. Use these insights to design specific changes to make in the current process/system.

More techniques like TRIZ can be found in the resource guide, *Engaging Everyone with Liberating Structures Handbook*.

## F. Client Window

A client window is a tool for gaining feedback from actual clients about the services they use. It differs from a client survey in that a survey asks clients about product or service's performance, based on the survey designer's ideas about what clients want and need. A client window asks questions in very broad terms, letting the clients express what they need, expect, like, and dislike in their own terms and from their own point of view.

### When to Use a Client Window

A client window can be used to get information from clients or patients, in their own terms, about what they want or what they like about the current health service they are receiving. However, this is really only one step in understanding what is most important to clients. Not all things listed will be of equal weight, and further discussion with clients may be needed to find which areas are true priorities. A client window can be used by itself, or as groundwork for more formal data collection through surveys; using it in this way can help design more relevant survey questions. Client windows can also be used when designing solutions, getting information that will make it easier to avoid repeating past mistakes in planning.

### How to Use a Client Window

**Step 1.** Determine the service or area for which feedback is desired. Frame what kind of feedback is being sought. Is feedback desired on the whole range of services provided? Is the team more interested in specific areas? For example, clients could be asked to provide feedback on all health services they receive, or the team may want to focus on specific services, such as care for chronic conditions.

**Step 2.** Gather information from clients by asking them to respond to the following questions:

1. What are you getting that you want? What are you getting that is meeting your needs and expectations? (Cell #1 of the client window)
2. What are you getting that you really don't want or need? (Cell #3 of the client window)
3. What do you wish you were getting that you are not? (Cell #2 of the client window)
4. What needs do you expect in the future? (Cell #4 of the client window)
5. What suggestions do you have for how we can improve our products or services for you?

**Client Window Framework**

| | Getting | Not Getting |
|---|---|---|
| Want | Getting what you want (#1) | Want, but not getting (#2) |
| Don't want | Getting, but not wanted (#3) | Don't want, not getting (#4) (anticipated needs for the future) |

There are two ways to administer the client window: to a group of clients or to clients individually.

*Group:* Prepare a large client window framework on a flip chart or wall. When the clients are gathered, explain that the goal of this activity is to get honest feedback about how their needs and expectations are being met. Write the areas of focus on the flip chart or wall. Ask them to write individually the answers to the above questions on the client window. (It is best to leave the room at this point so that the clients have privacy to answer as honestly as possible.)

*Individual:* In this mode, ask each client to fill out the client window and return the responses (no names required). Prepare instructions, including how their feedback will be used, the areas of focus, how to fill out the client window, and where and when to return it. Clients write their responses to the above questions directly on the client window form.

**Step 3.** Compile the information. If the client window was administered in a group, record the answers on a separate sheet of paper as they were written for each section of the window. Review the answers and count how often the same feelings were expressed by several people. If the client window was administered individually, place all individual responses on a master sheet, and then count how frequently similar responses were given.

## G. Benchmarking

*Best practices benchmarking* is a systematic approach for gathering information about process or product performance and then analyzing why and how performance differs between business units. In other words, benchmarking is a technique for learning from others' successes in an area where the team is trying to make improvements. The term *benchmarking* means using someone else's successful process as a measure of desired achievement for the activity at hand. Some sources of information for benchmarking include: literature reviews, standard-setting organizations, professional organizations, universities, or staff or customer interviews. A 2000 Quality Assurance Project paper about benchmarking within health care provides ideas for how to organize a benchmarking activity.

### When to Use Benchmarking

Benchmarking is most useful when trying to develop options for potential solutions. When trying to develop solutions, improvement teams often have difficulty generating new ideas. People frequently do not know what others nearby are doing regarding the same problem the team is facing. Benchmarking helps stimulate creativity by gaining knowledge of what has been tried. It can also be used to identify areas for improvement by seeing what level of quality is possible.

### How to Use Benchmarking

**Step 1.** Identify other groups, organizations, or health facilities that serve a similar purpose and that appear to work well. They do not need to be doing exactly what the team does, as long as the issue at hand can be compared. For example, if the team is dealing with problems in hospital laundry services, the team could learn from hotels and dormitories that provide similar services, although they are not in the same field and/or do not provide exactly the same service.

**Step 2.** Visit these sites and talk to managers and workers, asking them what they are doing, if they have similar problems, what they have done about it, and what levels of performance they have achieved. Ask as well what obstacles they have run into and how they have dealt with them.

**Step 3**. As a team, review how the situation and constraints for the process in question are similar to or different from that of these other groups. Based on the information collected, identify promising ideas that could be tested.

### Points to Remember

- Be sure to understand fully how the process in question works before looking at the processes of others.
- Be sure that the other process is fully understood before adopting or adapting it to the process in question.

# VI. TOOLS FOR PRESENTING DATA

Graphs can help you to quickly and more clearly understand data, draw inferences about data patterns, and see whether changes have led to improvement. When creating graphic displays of data, it is important to keep in mind what you are trying to communicate and to pay attention to labeling key information that will help others to understand the data. Disaggregating data by important factors, such as sex, age, or location, can also help to show key differences and patterns that need to be addressed in improvement work.

The type of data you are working with will determine what types of graphs you may want to use to illustrate your data. *Discrete* data can be counted or classified in a finite number of categories, for example the percentage of children whose well-being score was “good”, “bad”, or “fair”. *Continuous data* are measurements on a continuum or scale, such as time, cost, length, weight, or temperature. A particular set of continuous data has a minimum and a maximum value that define the range of possible values.

A number of data presentation tools can facilitate the work of improvement teams and are useful at different points in an improvement effort. The table below describes different purposes of data displays and which data display tools may be most appropriate for each purpose.

**Considerations for choosing data display tools**

| **Purpose is to show:** | **Display tool to use:** | **Data needed to use the tool:** |
|---|---|---|
| **Frequency of occurrence** | Bar chart<br>Pie chart<br>Pareto chart | Tallies by category (data that can be put into categories or continuous measurement data divided into categories) |
| **Trends over time** | Time series chart | Measurements shown in chronological order (either counts or percentages) |
| **Distribution of a single variable (variation not related to time)** | Histograms | Measurements on a continuous scale |
| **Association between two things** | Scatter diagrams | Paired data (that is, two pieces of information about the thing being analyzed), each on a continuous scale |

## A. Bar and Pie Charts

Bar and pie charts use pictures to compare the sizes, amounts, quantities, or proportions of various items or groupings of items.

### When to Use Bar and Pie Charts

Bar and pie charts can be used in defining or choosing problems to work on, analyzing problems, verifying causes, or judging solutions. They make it easier to understand data because they visually present data, highlighting the results in ways that may be easier for team members, managers, and other stakeholders to understand.

Bar and pie charts present results that compare different groups. They can also be used with variable data that have been grouped. Bar charts work best when showing comparisons among categories. Pie charts can be used when you want to compare parts to a whole. Pie charts are used for showing relative proportions of various items in making up the whole (how the "pie" is divided up).

**Selecting a Type of Bar Chart**

Teams may choose from three types of bar charts, depending on the type of data they have and what they want to stress:

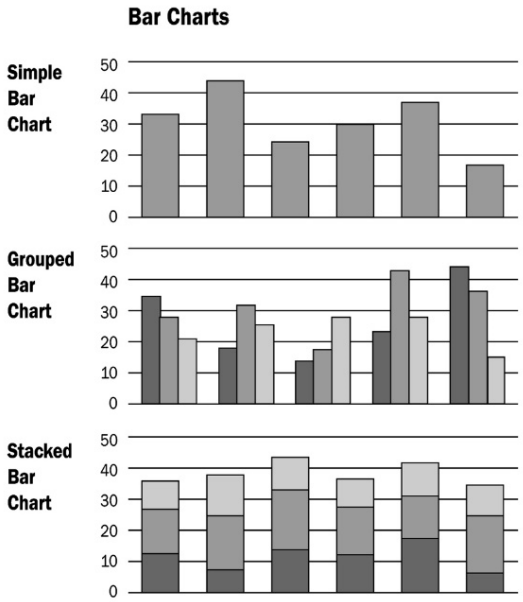
*Simple bar charts* sort data into simple categories.

*Grouped bar charts* divide data into groups within each category and show comparisons between individual groups as well as between categories. (It gives more useful information than a simple total of all the components.)

S*tacked bar charts,* which, like grouped bar charts, use grouped data within categories, except that the bars representing the subgroups are placed on top of each other to make a single column, or side by side to make a single bar. They make clear both the sum of the parts and each group's contribution to that total. Stacked bar charts that sum to 100% can also be used to show the contribution of parts to a whole, similar to pie charts.

**How to Use a Bar Chart**

**Step 1.** Choose the type of bar chart that stresses the results you want people to focus on. Grouped and stacked bar charts will require at least two classification variables (for example, Performance of sites on MOH quality standards as "good", "fair", or "poor"). For a stacked bar chart, the data within each category are tallied into combined totals before creating the chart.




**Step 2.** The vertical axis represents the values of the variable of comparison (e.g., number, percent).

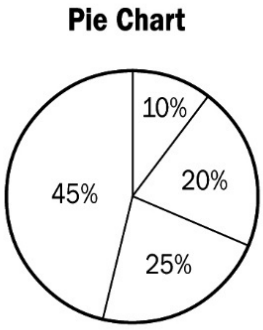
**Step 3.** The number of bars you will use will equal the number of categories for simple or stacked bar charts. For a grouped bar chart, the number of bars will equal the number of categories multiplied by the number of groups.

**Step 4.** Each item's bars should be of equal width. Be sure to label each category on the horizontal axis, and if applicable, the groups. Provide a title for the graph that indicates the sample and the time period covered by the data.

**How to Use a Pie Chart**

**Step 1.** Create a pie chart only if the sum of all categories is meaningful (for example for proportions). Each category will represent the contribution of each category to the whole (100%).

**Step 2.** Provide a title for the pie chart that indicates the sample and the time period covered by the data. Label each segment with its percentage or proportion (e.g., 25%, 75% etc.) and with what each segment represents (e.g., people who returned for a follow-up visit; people who did not return). Remember, in a pie chart, all parts need to be mutually exclusive, with no overlap between parts. All parts need to add up to 100%. If there are more than five to seven parts, or if you want to compare parts to each other rather than parts to a whole, use a different type of graph.




**Points to Remember**

- Be careful not to use too many notations on the charts. Keep them as simple as possible and include only the information necessary to interpret the chart.
- Do not draw conclusions not justified by the data. For example, determining whether a trend exists may require more statistical tests and probably cannot be determined by the chart alone. Differences among groups also may require more statistical testing to determine if they are significant.
- Whenever possible, use bar or pie charts to support data interpretation. Do not assume that results or points are so clear and obvious that a chart is not needed for clarity.
- To ensure that charts do not mislead, follow these guidelines:
  - Scales must be in regular intervals
  - Charts that are to be compared must have the same scale and symbols
  - Charts should be easy to read

## B. Pareto Charts

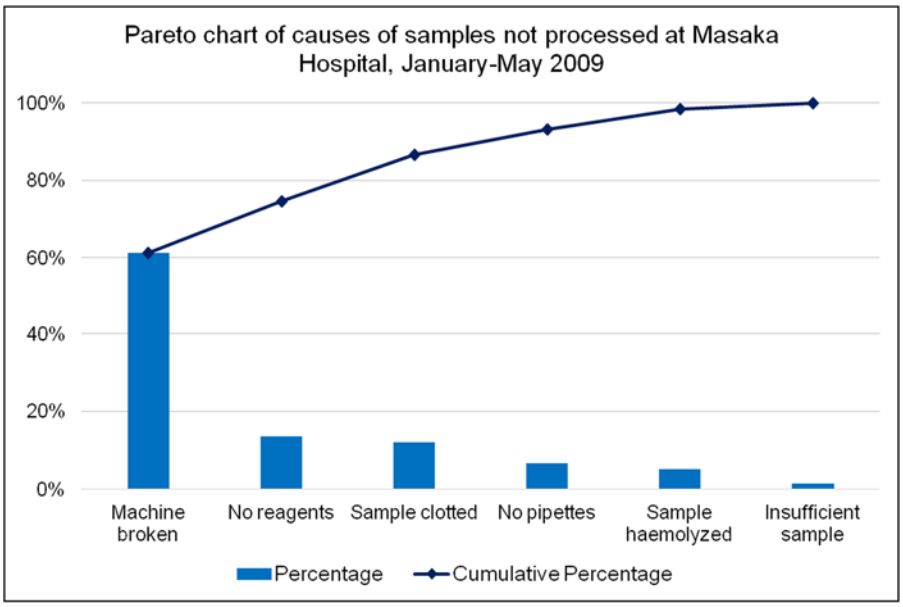
A Pareto chart provides facts needed for setting priorities. It organizes and displays information to show the relative importance of various problems or causes of problems. It is essentially a special form of a vertical bar chart that puts items in order (from the highest to the lowest) relative to some measurable effect of interest: frequency, cost, time. The chart is based on the *Pareto* principle, which states that when several factors affect a situation, a few factors will account for most of the impact. The Pareto principle describes a phenomenon in which 80 percent of variation observed in everyday processes can be explained by a mere 20 percent of the causes of that variation. Pareto charts help improvement teams identify the most important causes of variation.

Placing the items in descending order of frequency makes it easy to discern those problems that are of greatest importance or those causes that appear to account for most of the variation. Thus, a Pareto chart helps teams to focus their efforts where they can have the greatest potential impact.

**When to Use a Pareto Chart**

Pareto charts help teams focus on the small number of really important problems or causes of problems. Pareto charts are useful in establishing priorities by showing which are the most critical problems to be tackled or causes to be addressed. Comparing Pareto charts of a given situation over time can also determine whether an implemented solution reduced the relative frequency or cost of that problem or cause.

Here is an example of a Pareto chart:




**How to Use a Pareto Chart**

**Step 1.** Develop a list of problems, items, or causes to be compared.

**Step 2.** Develop a standard measure for comparing the items.

- How often it occurs: frequency (e.g., utilization, complications, errors)
- How long it takes: time
- How many resources it uses: cost

**Step 3.** Choose a time frame for collecting the data.

**Step 4.** Tally, for each item, how often it occurred. Then add these amounts to determine the grand total for all items. Find the percent of each item in the grand total by taking the sum of the item, dividing it by the grand total, and multiplying by 100.

**Tallying Items in a Compilation Table**

| Causes for sample not processed | Number of Occasions | Percentage |
|---|---|---|
| No pipettes | 9 | 7 |
| No reagents | 18 | 13 |
| Sample clotted | 16 | 12 |
| Insufficient sample | 2 | 1 |
| Sample haemolyzed | 7 | 5 |
| Machine broken | 82 | 61 |
| | | 100 |

**Step 5.** List the items being compared in decreasing order of the measure of comparison: e.g., the most frequent to the least frequent. The cumulative percent for an item is the sum of that

item's percent of the total and that of all the other items that come before it in the ordering by rank.

**Arranging Items in a Compilation Table**

| Causes for sample not processed | Number of Occasions | Percentage | Cumulative Percentage |
|---|---|---|---|
| Machine broken | 82 | 61 | 61 |
| No reagents | 18 | 13 | 75 |
| Sample clotted | 16 | 12 | 87 |
| No pipettes | 9 | 7 | 93 |
| Sample haemolyzed | 7 | 5 | 99 |
| Insufficient sample | 2 | 1 | 100 |
| | | 100 | 100 |

**Step 6.** The horizontal axis of a graph should have columns for all the items listed from highest to lowest. Label the left vertical axis with the items, then label the right vertical axis with the cumulative percentages (the cumulative total should equal 100 percent).

**Step 7.** The cumulative percentages are illustrated by a line graph. The first point on the line graph should line up with the top of the first bar.

**Step 8.** Analyze the diagram by identifying those items that appear to account for most of the difficulty. Do this by looking for a clear breakpoint in the line graph, where it starts to level off quickly. If there is not a breakpoint, identify those items that account for 50 percent or more of the effect. If there appears to be no pattern (the bars are essentially all of the same height), think of some factors that may affect the outcome, such as day of week, shift, age group of patients, home village. Then, subdivide the data and draw separate Pareto charts for each subgroup to see if a pattern emerges.

**Points to Remember**

- Try to use objective data instead of opinions and votes.

## C. Histograms

A histogram displays a single variable in a bar form to indicate how often some event is likely to occur by showing the pattern of variation (distribution) of data. A pattern of variation has three aspects: the center (average), the shape of the curve, and the width of the curve. Histograms are constructed with continuous data—such as time, weight, temperature—and are not appropriate for discrete data.

**When to Use a Histogram**

All data show variation; histograms help interpret this variation by making the patterns clear. They tell a visual story about a specific case in a way that a table of numbers (data points) cannot. Histograms can be used to identify and verify causes of problems. They can also be used to judge a solution, by checking whether it has removed the cause of the problem.

**How to Use a Histogram**

**Step 1.** From the raw numbers (the data), find the highest and lowest values. This is the range.

**Step 2.** Determine the number of bars to be used in the histogram. If too many bars are used, the pattern may become lost in the detail; if too few are used, the pattern may be lost within the bars. The table below provides guidance for choosing an appropriate number of bars.

| Number of Data Points | Number of Bars |
|---|---|
| < 50 | 5–7 |
| 50–100 | 6–10 |
| 101–250 | 7–12 |
| > 250 | 10–20 |

**Step 3.** Determine the width of each bar by dividing the range by the number of bars. Then, starting with the lowest value, determine the grouping of values to be contained or represented by each bar.

**Step 4**. Create a frequency table like the one below and fill in the boundaries for each grouping.

**Histogram Frequency Table**

| Bar | Boundaries | Tally | Total |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

**Step 5.** Fill in the frequency table by counting the number of data points for each bar and calculating the total number of data points in each bar.

**Step 6**. Create the horizontal and vertical axes, and label them

**Step 7**. Create the bars to correspond with the totals from the frequency table

**Step 8**. Identify and classify the pattern of variation. The figure below presents the possible shapes and their interpretation.

**Types of Histograms**

*Bell Shaped:* The normal pattern

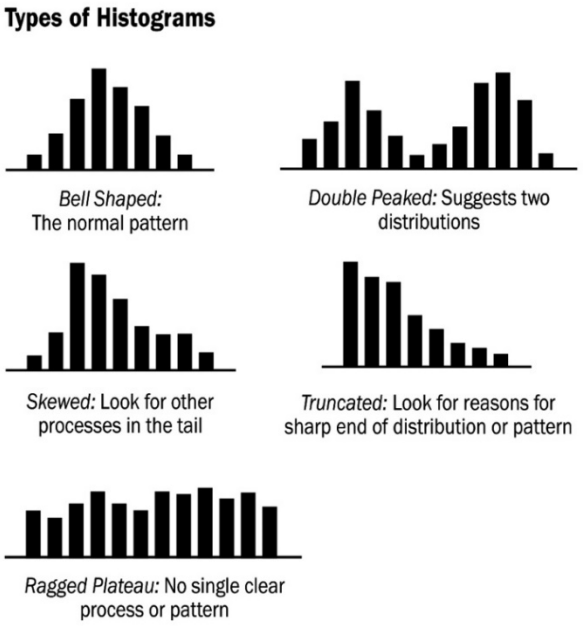
*Double Peaked:* Suggests two distributions

*Skewed:* Look for other processes in the tail *Truncated:* Look for reasons for sharp end of distribution or pattern

*Ragged Plateau:* No single clear process or pattern

**Points to Remember**

- Simple daily observations often do not tell enough about a process, and averages or ranges are not adequate summaries of the data. The potential pitfall of a histogram is not using one: it is a useful, necessary tool.
- If variation is small, the histogram may not be sensitive enough to detect significant differences in variability or in the peaks of the distribution, especially if using a small-sample data set. There are advanced statistical tools that can be used in such situations.




## D. Time Series Charts

A time series chart is a line graph which plots the indicator of interest on the Y (vertical) axis and the time interval over which the data are displayed on the X (horizontal) axis, using any interval of time (e.g., minute, hourly, daily, weekly, monthly, quarterly, yearly, etc.). Common types of indicators plotted on the Y axis are percentages (e.g., percent of patients receiving care according to standards), rates (e.g., case fatality rate), time (e.g., waiting time), quantities (e.g., stock levels), or numbers (e.g., weight).

Time series charts help us understand if the changes we are making are leading to a change in improving the quality of care from some initial level to a consistently sustained higher level. They are a simple yet effective tool to track the performance of a process over time and document the story of improvement work. They make trends or other non-random variation in the process easier to see and understand. With the understanding of patterns and trends of the past, groups can then use time series charts to help predict future performance.

Guidance developed by the USAID Health Care Improvement Project explains how to create and label (see **Appendix 1**) and how to analyze and interpret a time series chart (see **Appendix 2**).

**When to Use a Time Series Chart**

Time series charts portray indicator data over time. While most graphs are like a photo that captures a point of time, the time series chart is like video rolling over time. The ongoing monitoring of an indicator through a time series chart is particularly valuable in quality improvement as it allows us to track when specific changes were introduced, see their impact on a process, and tell whether improvement is sustained over time. The more data points that can be plotted, the better the understanding that can be gained about the process over time.

An important element in construction of a time series chart is to calculate the *median* value of the data. The median represents the middle value in a set of data. Creating a horizontal line through the median of a data set allows you to detect shifts or changes in the tendency of the

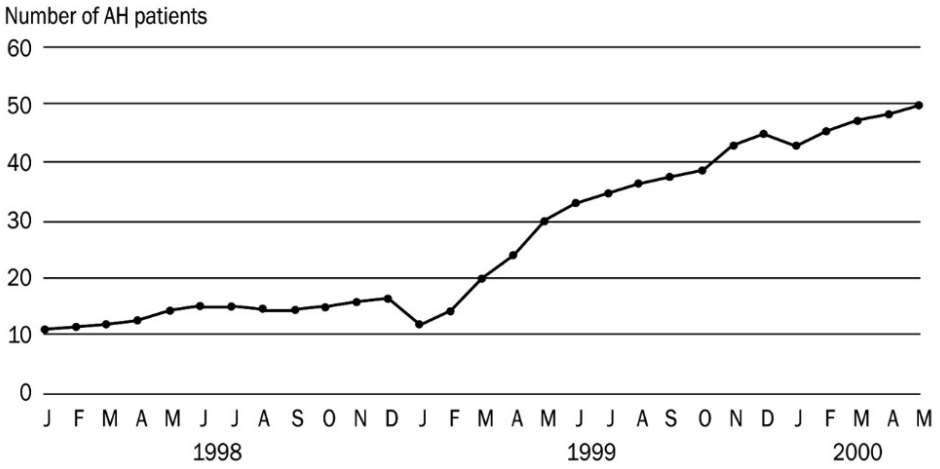
indicator on a time series chart. At minimum, 10 data points are needed to calculate and plot the median of a set of data.

**How to Use a Time Series Chart**

Time series charts are often referred to as “run charts” because the term *run* means a consecutive series of points running either above or below the median or center line of the data set. The points in a run chart mark the single events (how much occurred at a certain point in time). A run is broken once it crosses the center line. Values on the center line are ignored: they do not break the run, nor are they counted as points in the run.

Here is an example from Russia.

**Run Chart of Arterial Hypertension Patients under Observation (per 1,000) in Tula Oblast, Russia**




The basic steps in creating a time series chart follow.

**Step 1.** Collect at least 25 data points (number, time, cost), recording when each measurement was taken. Arrange the data in chronological order.

**Step 2.** Determine the scale for the vertical axis as 1.5 times the range. Label the axis with the scale and unit of measure.

**Step 3.** The horizontal axis marks the measure of time (minute, hour, day, shift, week, month, year, etc.). Make sure the axis is labeled as such.

**Step 4.** Plot the points and connect them with a straight line between each point. Be sure to include a center line for the median value of all the data points.

The following rules guide the interpretation of a time series chart:

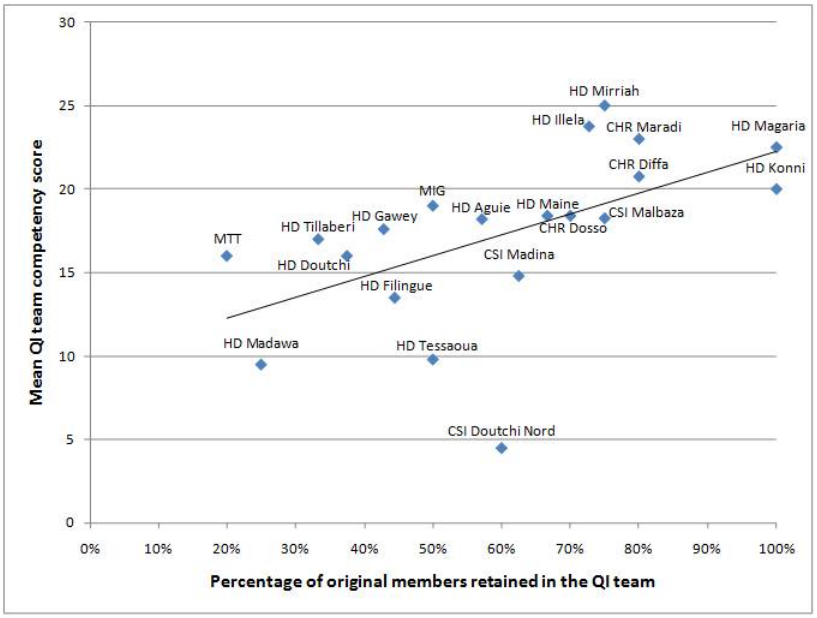
- Five consecutive increasing (or decreasing) points suggest a trend
- Six consecutive points above (or below) the median line suggest a statistically significant shift in the process
- Fourteen successive points alternating up and down suggest a cyclical process

**Points to Remember**

- Be careful not to use too many annotations on a time series chart. Keep it as simple as possible and include only the information necessary to interpret the chart.
- Do not draw conclusions that are not justified by the data. Certain trends and interpretations may require more statistical testing to determine if they are significant.
- When interpreting data points, the variation in the denominator can influence patterns and conclusions. Two common sources of variation in denominator size are: 1) changes in service utilization by clients, and 2) for pooled data, variations in the number of sites contributing (reporting) data.
- To ensure that the time series chart does not mislead, take care to present scales in regular intervals.

## E. Scatter Diagrams

The scatter diagram is another visual display of data. It shows the association between two variables acting continuously on the same item. The scatter diagram illustrates the strength of the *correlation* between the variables through the slope of a line. This correlation can point to, but does not prove, a *causal* relationship. Therefore, it is important not to rush to conclusions about the relationship between variables as there may be another variable that modifies the relationship. For example, analyzing a scatter diagram of the relationship between weight and height would lead one to believe that the two variables are related. This relationship, however, does not mean causality; for instance, while growing taller may cause one to weigh more, gaining weight does not necessarily indicate that one is growing taller. The scatter diagram is easy to use but should be interpreted with Points to Remember as the scale may be too small to see the relationship between variables, or confounding factors may be involved.




At right is an example from Niger showing the association between mean competence score and quality improvement team stability from a sample of 20 teams.

**When to Use a Scatter Diagram**

Scatter diagrams make the relationship between two continuous variables stand out visually on the page in a way that the raw data cannot. Scatter diagrams may be used in examining a cause-and-effect relationship between continuous measurement data. They can also show relationships between two effects to see if they might stem from a common cause or serve as surrogates for each other. They can also be used to examine the relationship between two causes.

### How to Use a Scatter Diagram

Scatter diagrams are easy to construct using programs such as Excel or Stata.

**Step 1.** Collect at least 40 paired data points: "paired" data are measures of both the cause being tested and its supposed effect at one point in time.

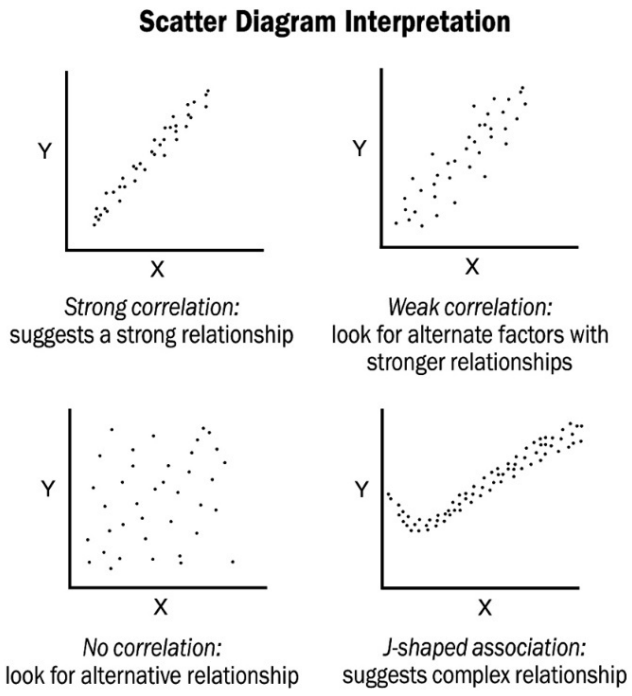
**Step 2.** Create a grid, with the "cause" on the horizontal axis and the "effect" on the vertical axis.

**Step 3.** Determine the lowest and highest value of each variable and mark the axes accordingly.

**Step 4.** Plot the paired points on the diagram. If there are multiple pairs with the same value, draw as many circles around the point as there are additional pairs with those same values.

**Step 5.** Identify and classify the pattern of association using the graphs at right showing possible shapes and interpretations.

### Points to Remember




- Stratifying the data in different ways can make patterns appear or disappear. When experimenting with different stratifications and their effects on the scatter diagram, label how the data are stratified so the team can discuss the implications.
- Interpretation can be limited by the scale used. If the scale is too small and the points are compressed, then a pattern of correlation may appear differently. Determine the scale so that the points cover most of the range of both axes and both axes are about the same length.
- Be careful of the effects of confounding factors. Sometimes the correlation observed is due to some cause other than the one being studied. If a confounding factor is suspected, then stratify the data by it. If it is truly a confounding factor, then the relationship in the diagram will change significantly.
- Avoid the temptation to draw a line roughly through the middle of the points. This can be misleading. A true regression line is determined mathematically. Consult a statistical expert or text prior to using a regression line.
- Scatter diagrams show relationships, but do not prove that one variable causes the other.

# APPENDICES

## Appendix 1: Norms for Presentation of Time Series Charts (September 2008)

### Why do we need data presentation norms?

During the "*Measuring our Results in HCI"* session at the December 2007 USAID Health Care Improvement Project (HCI) Launch Week, HCI staff identified the need to develop specific and consistent expectations or norms for presenting data (results) across the project. This need was based on the Quality Assurance Project's past experience, in which time series charts displayed during presentations (Quarterly Review meetings and other presentations) were often difficult to interpret for those viewing them, because they did not have sufficient information on them.

### Purpose of these norms

- To ensure that all HCI-generated time series charts contain adequate information for those viewing them to understand and interpret what is being presented

### Norms for Data Presentation

Norms are presented below in three categories: a set of norms valid for any chart and then additional specifications for charts of individual QI team data and for charts of aggregated data across sites. These norms should be built into the way charts are automatically generated by EXCEL and adhered to for any data presentation (e.g., paper presentation or electronic; at a learning session, an in-country presentation, a Quarterly Review Meeting, etc.). Following the norms below are several graphs which as examples of the norms applied to both site level and aggregated data for a variety of indicator types.

All time series charts should have:

1. **A clear, well-defined title:** A clear and well-defined title that expresses who, what, when, and where. *The title should describe the key message that the graph is meant to convey.*
2. **Labeled X- and Y-Axis:** Axes should include a "scale" such as 0 – 100% and a "label" which describes what variable or indicator is being represented on the axis. In most cases, the Y-axis label should contain the indicator itself, with an expanded definition if needed (see norms 3. and 4. below).
3. **Denominator definition**: The criteria for being counted in the denominator.
4. **Numerator definition**: The criteria for being counted in the numerator. When the graph is presenting count data (instead of a percentage or rate), the description of the indicator should clearly indicate whether this is a count of new cases or a cumulative value over time.
5. **Denominator values:** If the indicator being shown is a percentage, the number of cases counted in the denominator for each measurement period should be presented. If this will unduly crowd the chart, a note of the average sample size of the denominator should be labeled on the graph.

6. **Data source:** A brief description of the source of data should be included (i.e., all births recorded in the maternity register, selected maternal charts for review, direct observations, etc.)
7. **Sampling strategy:** If data for the denominator come from a sample, rather than all cases that fit the denominator definition in that period, state how sampling was done (e.g., systematic sample of 10 records).
8. **Legend:** Use a legend to distinguish between multiple graph lines if more than one indicator or study group is shown on a single graph.

Time series charts showing data for one site or one QI Team should *also:*

9. **Annotate key tested changes:** Annotations can be of two categories: (1) *key* changes implemented as part of QI interventions and (2) *key* events within the context where data was collected that may explain changes in results over time. Key changes represent QI interventions which relate to substantial changes in the value of the indicator (positive or negative). Although not required, substantial changes which were ineffective may also be annotated to highlight learning of what did not work.

Time series charts showing aggregated data across multiple sites should also include:

10. **Number of sites reporting for each measurement period:** For each point on the graph, the total number of sites included in the aggregated measure should be presented.

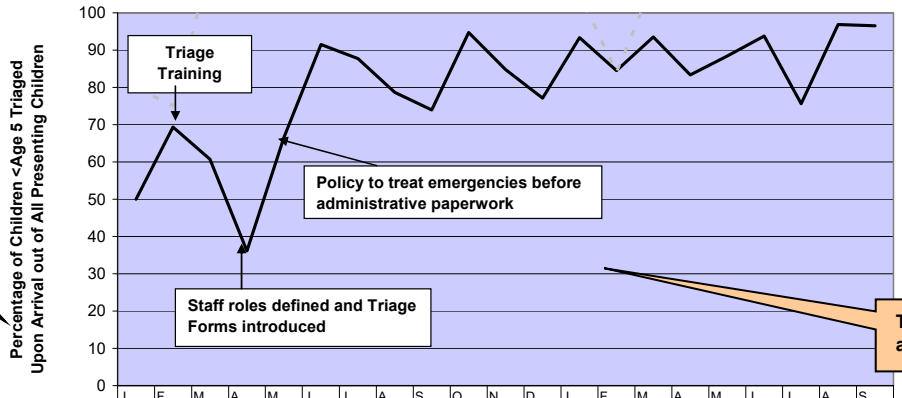
**Examples of Presentation Norms**

Shown below are examples of presentation norms for five types of graphs: (1) Percentage indicator for 1 site or QI team; (2) Count indicator (multiple teams, but un-aggregated data); (3) Percentage indicator for aggregated data across multiple sites; (4) Percentage indicator for comparison of multiple groups; and (5) Use of multiple indicators on one graph.

## Example 1: Presentation Norms using % Indicator for One Site or QI Team

Well-defined title that includes what is presented, where, and when

### Increasing Triage of Children <5 upon Arrival at Kollo Hospital, Niger (2006-2007)




Y- and X-axes have clear "scale" and includes indicator "label"

Denominator values shown for each month

Tested changes are annotated

| | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 | | | | | | | | | | | | 2007 | | | | | | | | |
| % of children <5 triaged at arrival | 50 | 69 | 61 | 36 | 67 | 91 | 88 | 79 | 74 | 95 | 85 | 77 | 93 | 85 | 94 | 83 | 88 | 94 | 76 | 97 | 96 |
| # of children <5 coming to the hospital | 80 | 75 | 112 | 119 | 150 | 164 | 130 | 159 | 184 | 170 | 177 | 131 | 105 | 84 | 108 | 120 | 112 | 160 | 623 | 256 | 114 |
| # of children <5 triaged (U,P,NP) at arrival | 40 | 52 | 68 | 43 | 100 | 150 | 114 | 125 | 136 | 161 | 150 | 101 | 98 | 71 | 101 | 100 | 99 | 150 | 471 | 248 | 110 |

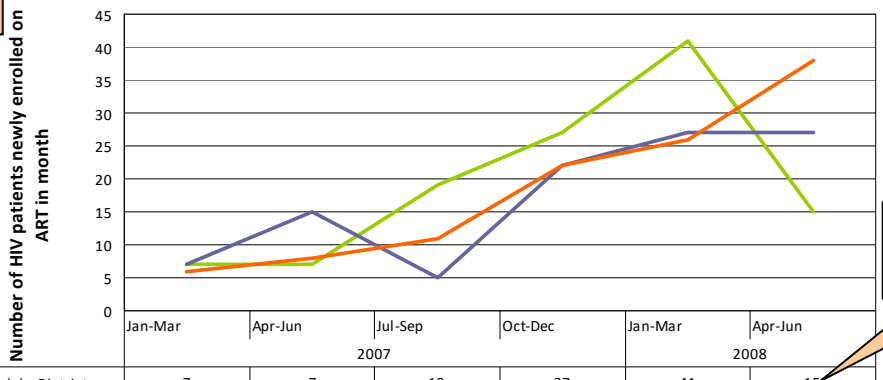
**Numerator Definition:** number of children <5 years of age who were triaged monthly U=urgent, P=priority, NP=not priority [Source: *Triage forms* ]
**Denominator Definition:** number of children <5 years of age that arrived for a consultation at the hospital [Source: *Hospital Register* ]
**Sampling Strategy -->** data are not a sample.

Numerator and denominator definitions are provided, including information on data source and sampling strategy

## Example 2: Presentation Norms using Count Indicator and Multiple Sites

Y-Axis with scale and label for "count indicator

### Increased Number of HIV Patients enrolled on ART in 3 Districts of St. Petersburg (2007-2008)



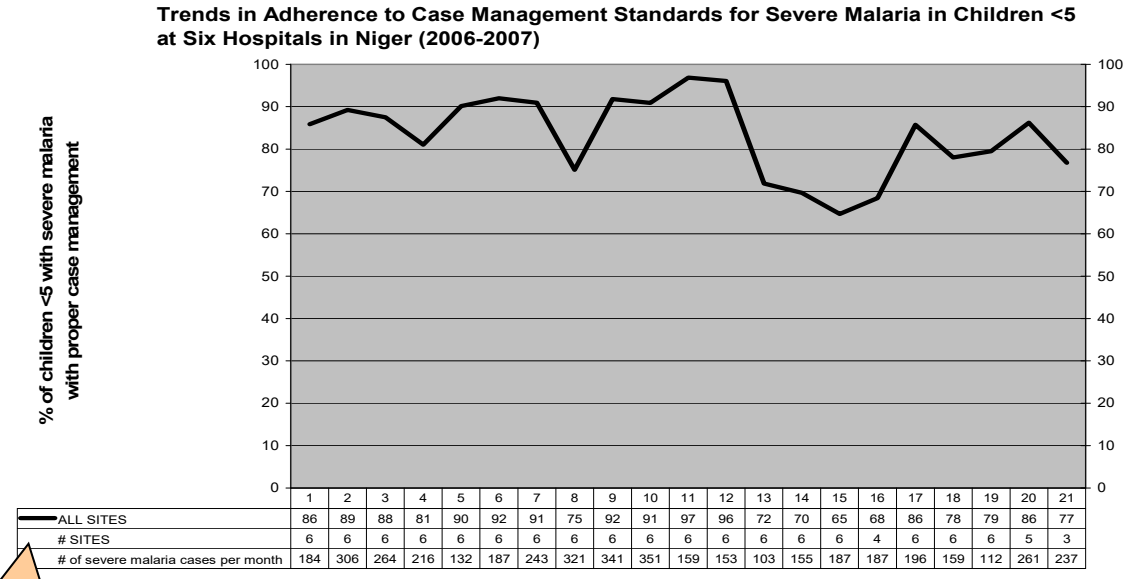

Legend indicating labels for each line on the graph

Shows only values of numerator (because no denominator)

| | Jan-Mar | Apr-Jun | Jul-Sep | Oct-Dec | Jan-Mar | Apr-Jun |
|---|---|---|---|---|---|---|
| | 2007 | | | | 2008 | |
| Krasnoselsky District | 7 | 7 | 19 | 27 | 41 | 15 |
| Krasnogvardeisky District | 7 | 15 | 5 | 22 | 27 | 27 |
| Frunzensky District | 6 | 8 | 11 | 22 | 26 | 38 |

Time Since the Beginning of Scale Up in January, 2007

## Example 3: Presentation Norms using % Indicator for Aggregated Data across Multiple Sites or QI Teams

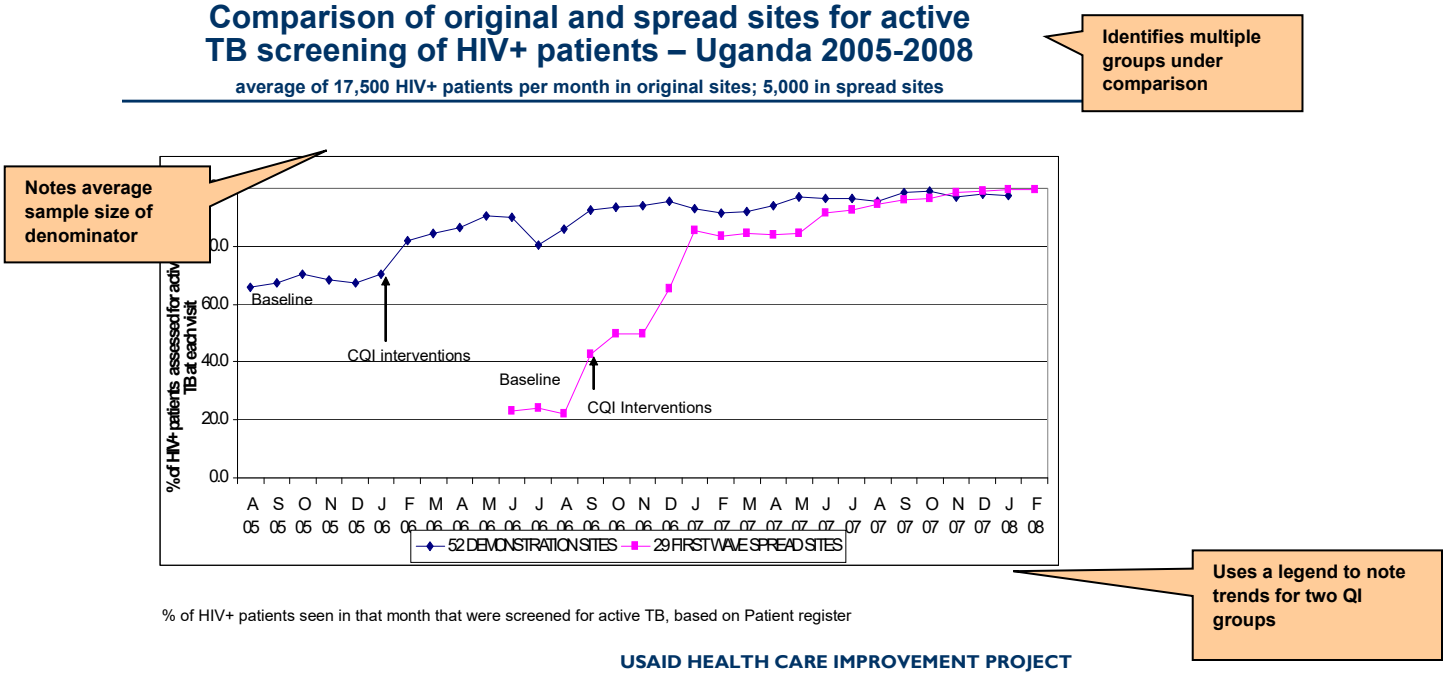



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALL SITES | 86 | 89 | 88 | 81 | 90 | 92 | 91 | 75 | 92 | 91 | 97 | 96 | 72 | 70 | 65 | 68 | 86 | 78 | 79 | 86 | 77 |
| # SITES | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 | 6 | 6 | 6 | 5 | 3 |
| # of severe malaria cases per month | 184 | 306 | 264 | 216 | 132 | 187 | 243 | 321 | 341 | 351 | 159 | 153 | 103 | 155 | 187 | 187 | 196 | 159 | 112 | 261 | 237 |

Additionally indicates number of sites reporting for each measurement period

**Numerator: # of cases reviewed of children <5 in which all 10 critieria for correct case management were met**
**Denominator: # of clinical records reviewed of children <5 admitted to hospital for severe malaria**
***Data source: medical record review***

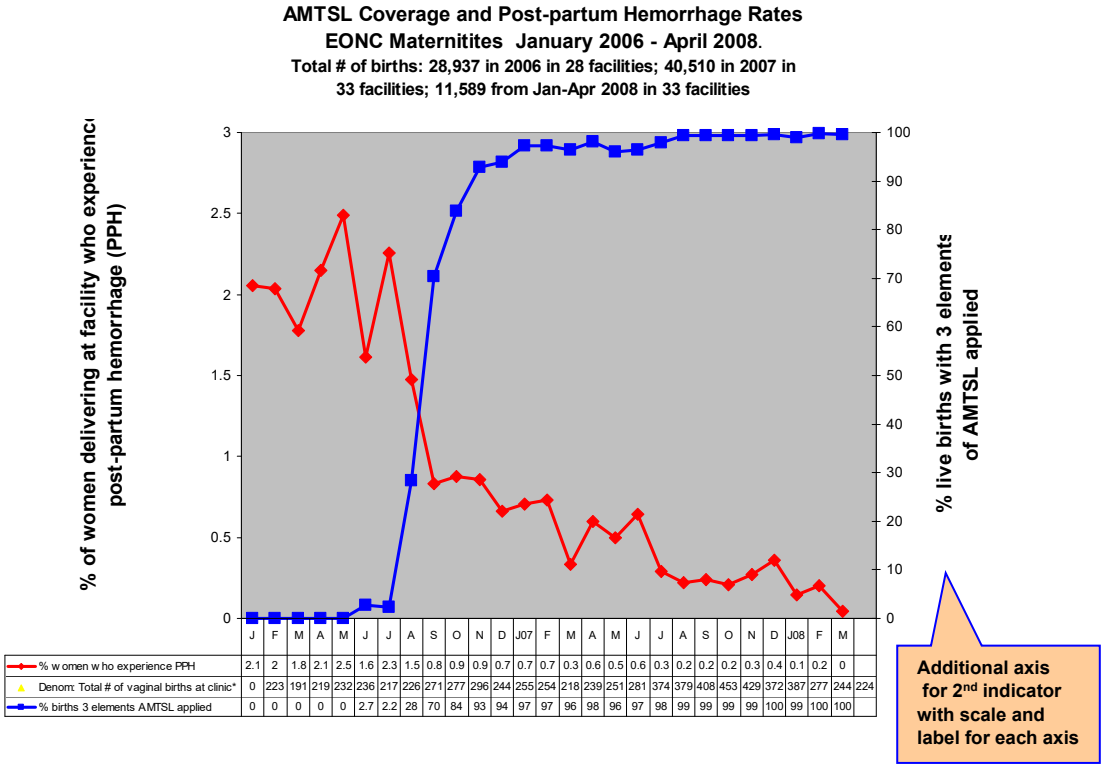
## Example 4: Presentation Norms using Percent Indicator for Comparison of Multiple Groups




% of HIV+ patients seen in that month that were screened for active TB, based on Patient register

USAID HEALTH CARE IMPROVEMENT PROJECT

## Example 5: Presentation Norms using Multiple Indicators on a Single Graph




Numerator: # of women with live births at maternity who experience post-partum hemorrhage; # women with live births as maternity who receive oxytocin 1 minutes after delivery, controlled cord traction and uterine massage: Denominator : (identical for both indicators) # women delivering a live birth at the maternity

Data Source: Partograph Sampling: all women delivering at facility during month

## Appendix 2: Guidance for Analyzing Quality Improvement Data Using Time Series Charts (September 2010)


### 1. WHY USE A TIME SERIES CHART?

The crux of quality improvement is answering the question, how will we know that a change yields improvement? Without data, or the skills to graph and interpret them, we are unable to know. The key to answering this question is the time series chart, a line or run chart that displays a key indicator over a regular unit of time.

Time series charts help us understand if the changes we are making are leading to a change in improving the quality of care from some initial level to a consistently sustained higher level. They are a simple yet effective tool to track the performance of a process over time and document the story of improvement work.

**Box 1: What is a time series chart?**

The time interval is displayed on the X (horizontal) axis and can be any interval of time (e.g., minute, hourly, daily, weekly, monthly, quarterly, yearly, etc.). The indicator being tracked is plotted on the Y (vertical) axis. Common types of indicators plotted on the Y axis are percentages (e.g., percent of patients receiving care according to standards), rates (e.g., patient satisfaction rates), time (e.g., waiting time), quantities (e.g., stock levels), or numbers (e.g., weight).

We use time series charts to portray and analyze our indicator data over time because they provide a dynamic follow-up of indicators over time. While most graphs are like a photo that captures a point of time, the time series chart is like video rolling over time. This ongoing monitoring of an indicator through a time series chart is particularly valuable in quality improvement as it allows us to track when specific changes were introduced, see their impact on a process, and tell whether improvement is sustained over time. The time series is a simple and effective tool that can be completed as easily using paper and pencil as with a computer.

Using this guidance regularly will allow you to:

- Analyze data without complicated formulas or computers, but with statistical rigor if enough data points are available
- Identify and react to statistically significant change in a process as quickly as possible
- Develop aims by identifying which processes are consistently underperforming over time
- Determine if improvements are sustained over time

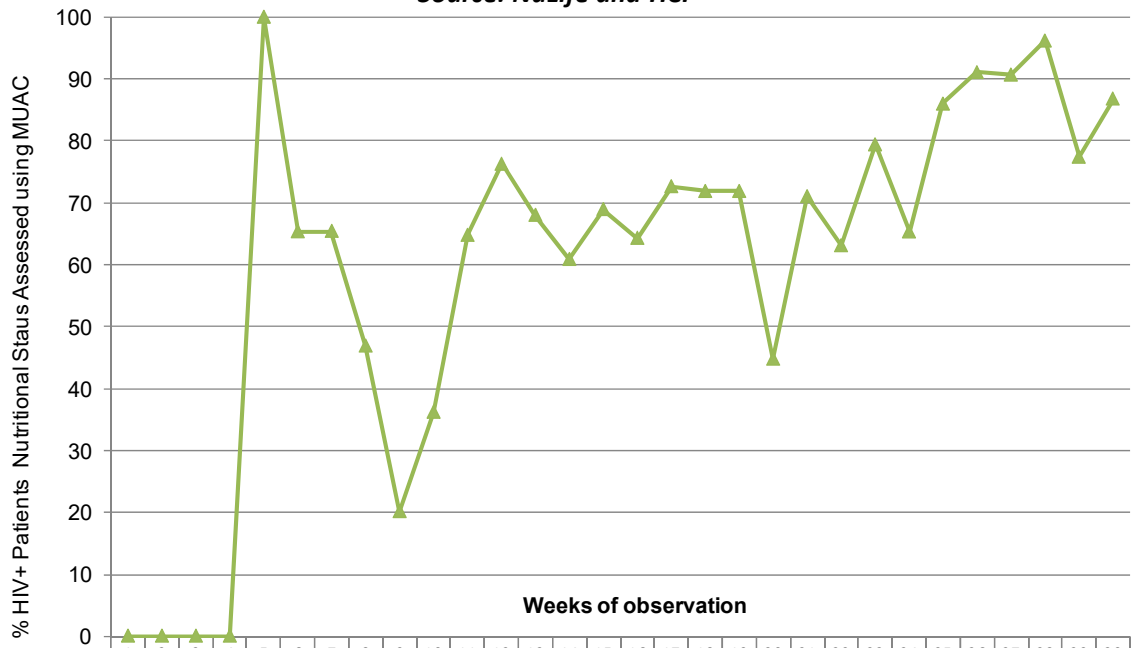
SEPTEMBER 2010

This guidance was prepared by Karen Askov Zeribi and Lynne Miller Franco of University Research Co., LLC (URC) for review by the United States Agency for International Development (USAID). The USAID Health Care Improvement Project (HCI) was made possible by the generous support of the American people through USAID and is managed by URC under Contract No. GHN-I-01-07-00003-00. This guidance does not reflect the official policy of USAID or of the United States Government.

**Figure 1** presents a time series chart illustrating the work of one quality improvement (QI) team at Kamuli Mission Hospital in Uganda. This team, assisted by the Food and Nutrition Interventions for Uganda (NuLife) and HCI projects, sought to increase the percent of HIV-positive patients assessed for nutritional status using mid-upper arm circumference (MUAC) for the purpose of identifying those needing therapeutic food. Graphing the data over time like this helps the team track their progress and demonstrates that improvement is not always linear.

**Figure 1. % HIV-positive patients for whom nutritional status was assessed using Mid Upper Arm Circumference (MUAC), Kamuli Mission Hospital, Uganda**

***Source: NuLife and HCI***




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | | | | May | | | | June | | | | July | | | | | August | | | | Sept | | | | | October | | | |
| % assessed | 0 | 0 | 0 | 0 | 100 | 65 | 65 | 47 | 20 | 36 | 65 | 76 | 68 | 61 | 69 | 64 | 73 | 72 | 72 | 45 | 71 | 63 | 79 | 65 | 86 | 91 | 91 | 96 | 77 | 87 |
| Nb. seen | 0 | 0 | 0 | 0 | 86 | 75 | 159 | 64 | 159 | 94 | 122 | 80 | 125 | 92 | 103 | 98 | 190 | 103 | 103 | 105 | 176 | 130 | 97 | 98 | 171 | 67 | 107 | 78 | 168 | 53 |

Time series charts can also be used to plot results across multiple health facilities (such as those participating in a collaborative) by pooling and plotting their data collectively. Although the chart may be labeled to reflect this pooling of data, the rules for interpretation would remain the same.

This guidance is divided into sections. If you are new to time series charts, please read Section 2 carefully, which lays out the essential features of time series charts and explains how to calculate the median value. Section 3 presents two important rules for analyzing time series charts, with examples. Section 4 outlines some important considerations for time series charts, and Section 5 summarizes how they can be used to detect effective changes. The **Appendix** provides step-by-step instructions on how to make a time series chart by hand.

## 2. ESSENTIAL FEATURES OF TIME SERIES CHARTS FOR ANALYZING IF CHANGES YIELD IMPROVEMENTS

Time series charts can be used to track any indicator over regular time intervals. Good time series charts facilitate the analysis of whether changes yield improvements by including clear labeling and definitions, a median line, and annotation.

### Clear labeling and definitions

Time series charts should be easy to read and interpret, such that anyone could interpret the chart without explanation from the person who actually drew it. To accomplish this clarity, time series charts need to have clear titles, labels for X and Y axes, definitions of the numerator and denominator, denominator values, data sources, sampling strategy, and a legend (see **Box 2**). These are described in detail in the project's *Norms for Presentation of Time Series Charts.*

**Box 2: Appropriate labeling of a time series chart**

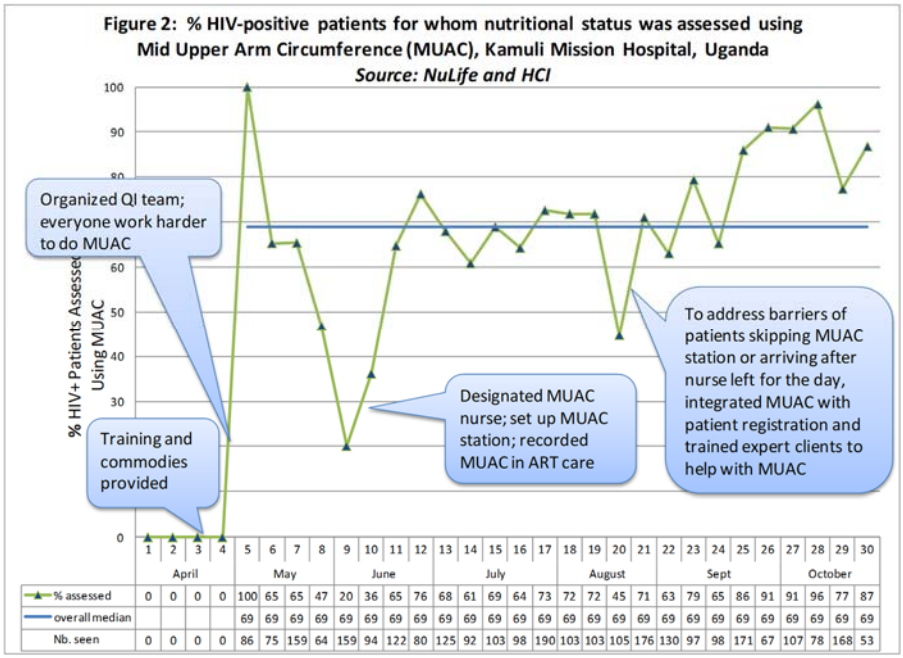
Time series charts should include:

- A title that describes the indicator charted
- Labels on both the horizontal and vertical axes
- Definitions of the components of the indicator (e.g., numerator and denominator)
- Data table; if data are pooled, the data table should also show the number of sites contributing to the pooled values

### Annotation

Annotation is the process of adding commentary or explanatory notes to a time series chart. Annotating when changes were implemented on a time series chart connects the numerical results (the data displayed in the graph) with the changes introduced by quality improvement teams; it also can provide context about other possible explanations for the data. Annotating a time series chart involves simply drawing small text boxes (by hand or on a computer) next to a data point with a brief explanation of what change was introduced or key event occurred that may have affected results. Annotation allows you to see if variations in results are linked in time with changes made to the process. Though it seems simple, annotation is very important as it provides a succinct and easy way to document changes over time and communicate the story of improvement to internal and external stakeholders. Teams should annotate their time series charts each time that they plot new data points.

Referring back to **Figure 1**, we can see that use of MUAC seems to be improving over time, but this version of the chart does not tell us about what the quality improvement team did to achieve these results. It also does not help the team from Kamuli Mission Hospital determine which changes are most effective, nor does it convey learning to other interested stakeholders. In contrast, **Figure 2** shows the same time series chart but with annotation about specific changes introduced. This annotated version is more helpful than the version in **Figure 1**, as it clearly documents what and when the team tried different interventions.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | | | | May | | | | June | | | | July | | | | | August | | | | Sept | | | | | October | | | |
| % assessed | 0 | 0 | 0 | 0 | 100 | 65 | 65 | 47 | 20 | 36 | 65 | 76 | 68 | 61 | 69 | 64 | 73 | 72 | 72 | 45 | 71 | 63 | 79 | 65 | 86 | 91 | 91 | 96 | 77 | 87 |
| overall median | | | | | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| Nb. seen | 0 | 0 | 0 | 0 | 86 | 75 | 159 | 64 | 159 | 94 | 122 | 80 | 125 | 92 | 103 | 98 | 190 | 103 | 103 | 105 | 176 | 130 | 97 | 98 | 171 | 67 | 107 | 78 | 168 | 53 |

### Calculating the median

The median represents the middle value in a set of data. Drawing a horizontal line through the median of a data set (see **Box 3**) allows you to detect shifts or changes in the tendency of the indicator on a time series chart. You will need a minimum of ten data points to plot the median[10] of your data.

If you have fewer than ten data points, it is still useful to plot the data even without the median. It is possible to detect a trend without a median line. The more data points you have, the better understanding you can gain about your process over time. If you would like to draw conclusions sooner about your process, consider collecting data more frequently (e.g., daily or weekly instead of monthly).

**Figure 2** includes this median line (shown in blue). The median line enables you to apply the rules discussed below to assess the effectiveness of interventions. The version of the chart in **Figure 2** gives enough information to apply the rules discussed in the next section to determine if the changes have resulted in significant improvement.

## 3. RULES FOR DETECTING TRENDS AND SHIFTS IN TIME SERIES CHARTS

This section of the guidance will provide you with information to detect the two most commonly used rules for analyzing time series chart data: 1) *trends* (at least five consecutive points moving in the same direction, discussed in section 3a), and 2) *shifts* (at least six points on one side of the median line, discussed in section 3b). These rules have been published in the quality improvement literature (please see the references for the most applicable literature specific to health care) and are commonly applied. There are additional rules, but these two are

[10] For time series charts, the median is the preferred measure of central tendency, as it is not as sensitive to extreme values as is the mean, which is more affected by extreme values.

the easiest to understand and the best suited for determining if a change is yielding improvement or not.

Using these rules will help you avoid drawing any premature conclusions about your results while helping to identify significant changes, even when they are not immediately obvious. These rules are based on probability theory, which means that the likelihood of meeting the criteria for any one of these rules is less than 5% without any significant change made to the process (Provost and Murray 2007). In other words, if any of the following rules are detected in your data, it is 95% likely that there was statistically significant change to the process you are studying. This means that the patterns you are seeing in your data are not due to chance, but something real happening. You need apply only one rule to determine if a significant change has occurred in the process that you are studying, however, it is possible that both of these rules will appear in the same data set.

**Trends**

A trend is continued movement in a single direction, either up or down (see **Box 4**). When examining if a change is yielding improvement, we are looking for movement in our data. Identification of a trend requires at least five consecutive data points moving in the same direction. The median is not required to detect trends. If you have more than ten data points, it is recommended that you still calculate the median to provide greater perspective on the data.

**Box 4: Trends at a glance**

- No median required
- A minimum of five data points continuously increasing or decreasing (see **Table 1**)
- If more consecutive data points are equal, only one counts towards the trend

When counting the number of consecutive points for determining a trend, if two or more consecutive data points in the series are the same, only one of these points is counted (and the others ignored) to determine if there are enough (i.e., at least five) consecutive points to detect the presence of a trend. **Table 1** provides the exact requirements for the number of data points required to determine a trend, based on the total number of data points available.

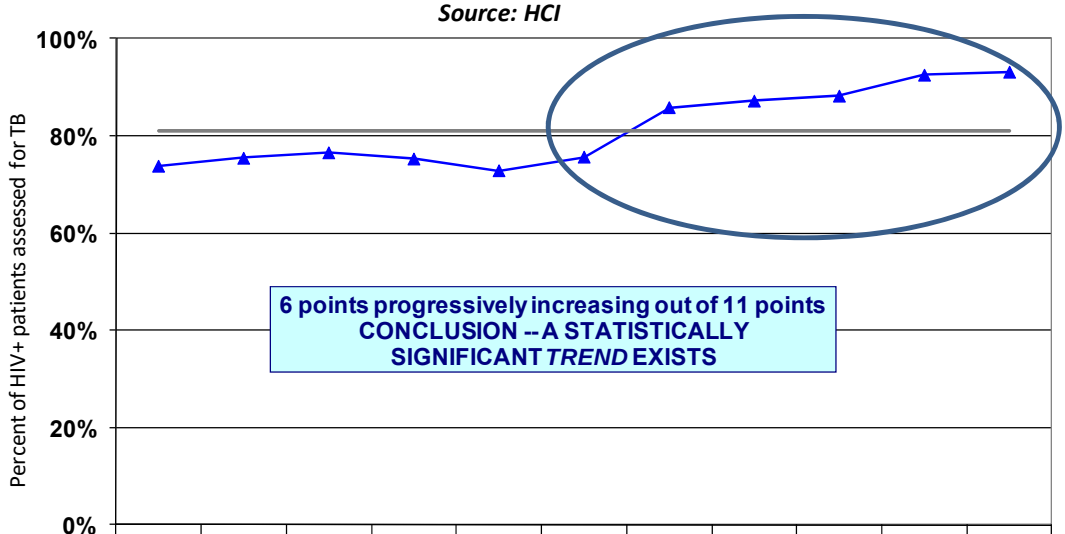
**Table 1: Number of points required to identify a trend**

| Number of data points available | Number consecutively increasing or decreasing points required for a trend |
|---|---|
| ≤8 data points | 5 data points |
| 9-20 data points | 6+ data points |
| 21+ data points | 7+ data points |

Source: Lloyd R. 2004.

**Figure 3** demonstrates this rule applied to data from Uganda. Unlike the data in **Figures 1** and **2**, which represent a single site, data in **Figure 3** are pooled across multiple sites working together in a collaborative. These sites were able to identify a trend (six points which are progressively increasing) after only 10 data points. These six data points in a row, each one higher than the previous point, indicate that this pattern is not due solely to chance. This time series chart also has a median line, as there were ten data points; although it is helpful, the median is not necessary to see this trend.

**Figure 3: Uganda - Percent of HIV-positive patients assessed for active TB, August 2005-June 2006**
***Source: HCI***




| | AG | SE | OC | NO | DE | JA | FE | MR | AP | MY | JN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| denominator | 9755 | 10578 | 10653 | 11878 | 11339 | 13259 | 13707 | 15505 | 16021 | 17198 | 17755 |
| PERCENT | 74% | 75% | 77% | 75% | 73% | 76% | 86% | 87% | 88% | 92% | 93% |
| n sites | 23 | 23 | 24 | 24 | 24 | 25 | 24 | 31 | 31 | 32 | 33 |
| median | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% |

## Shifts

A shift is a pattern indicating that a process or outcome measure in question has now moved to a different level, and that this shift is statistically significant. In fact, in quality improvement, this pattern is what we are hoping to achieve when we make changes in the process of how we do our work. The median for all available data points is necessary to identify a pattern as a shift, and a shift requires at least six points on one side (above or below) the median line (see **Box 5**).

**Box 5: Shifts at a glance**

- A median is necessary
- At least six data points above or below the median
- Data points that fall on the median are not counted

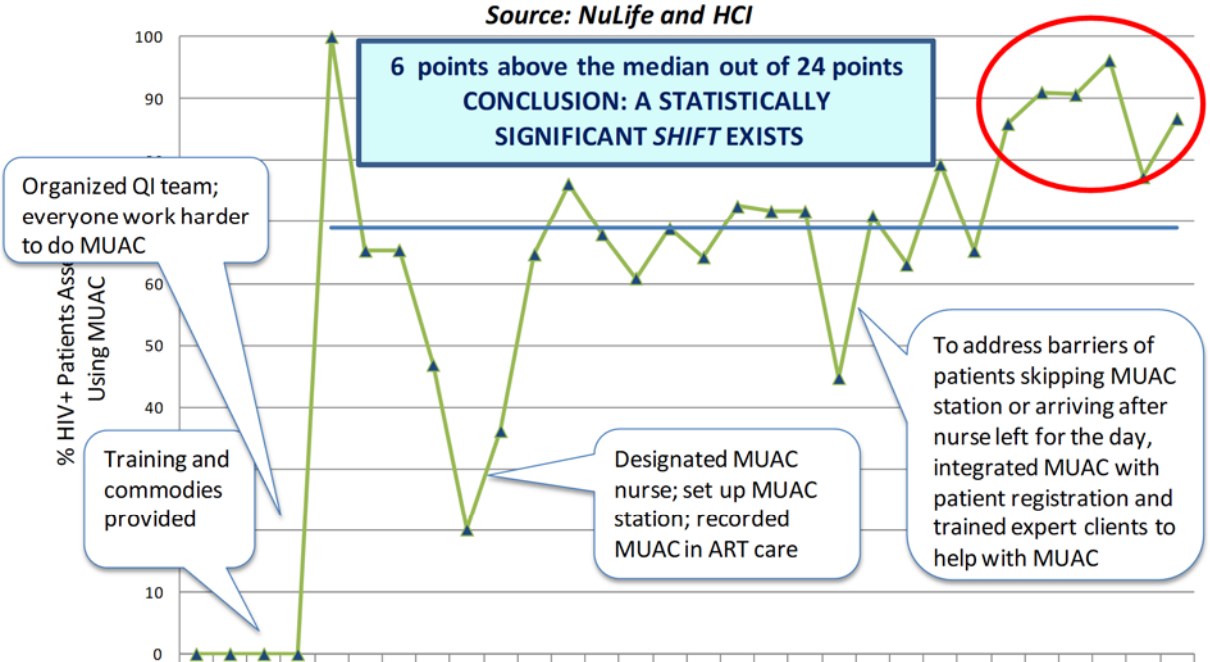
If there are points which fall on the median line, these cannot be counted as part of the six points needed to detect a shift. It should be noted that it is possible to find a trend embedded in a shift, if five consecutive points of these six are ascending or descending and fall consistently above or below the median.

**Figure 4** is a continuation of the data set displayed in **Figures 1** and **2**, with enough information on the time series chart, we can now interpret the chart using the rules. The last six data points are clearly above the median, constituting a shift; with the annotated chart, we can see that this shift indicates that the nurse's new schedule and use of a trained expert resulted in a significant increase in the percent of HIV-positive patients assessed using MUAC.

Going back to **Figure 3** for active screening for TB among HIV-positive patients in Uganda, no shift was yet evident in the data, but there was a trend. **Figure 5** shows this same data set, except with an additional seven months of data. With this additional data, we are able to identify a shift. At this point, the upward trend of HIV-positive patients screened for TB (from **Figure 3**) has now developed into a shift, showing a statistically significant increase in the level of compliance with this standard.

**Figure 4: % of HIV-positive patients for whom nutritional status was assessed using Mid Upper Arm Circumference (MUAC), Kamuli Mission Hospital, Uganda**

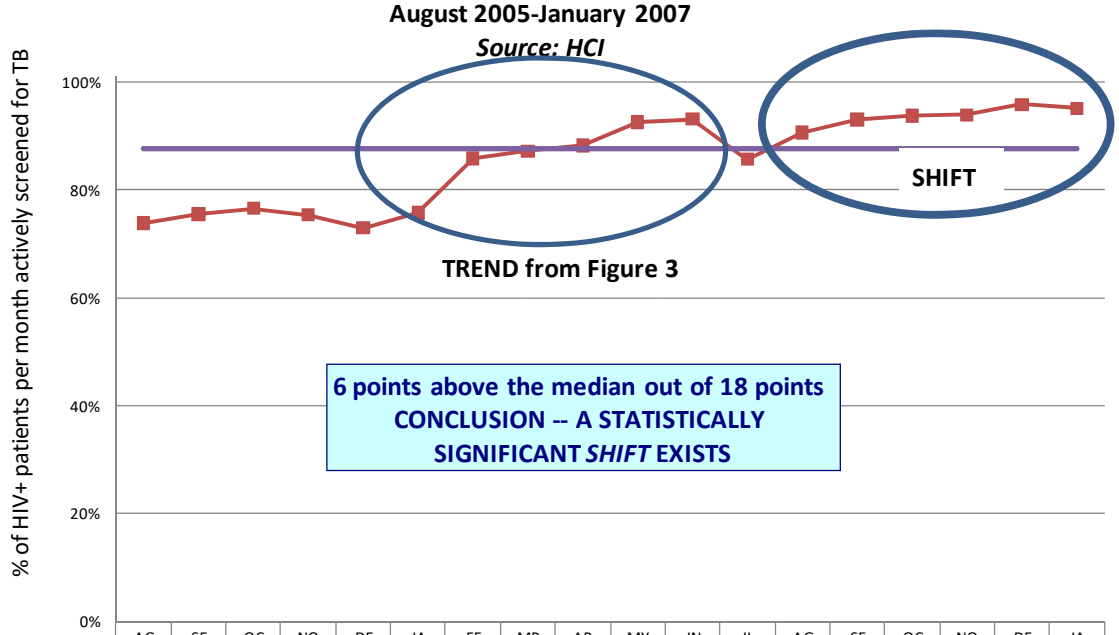
***Source: NuLife and HCI***




| | April | | | | May | | | | June | | | | July | | | | | August | | | | Sept | | | | | October | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| % assessed | 0 | 0 | 0 | 0 | 100 | 65 | 65 | 47 | 20 | 36 | 65 | 76 | 68 | 61 | 69 | 64 | 73 | 72 | 72 | 45 | 71 | 63 | 79 | 65 | 86 | 91 | 91 | 96 | 77 | 87 |
| overall median | | | | | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| Nb. seen | 0 | 0 | 0 | 0 | 86 | 75 | 159 | 64 | 159 | 94 | 122 | 80 | 125 | 92 | 103 | 98 | 190 | 103 | 103 | 105 | 176 | 130 | 97 | 98 | 171 | 67 | 107 | 78 | 168 | 53 |

**Figure 5: Uganda - Percent of HIV-positive patients assessed for active TB, August 2005-January 2007**

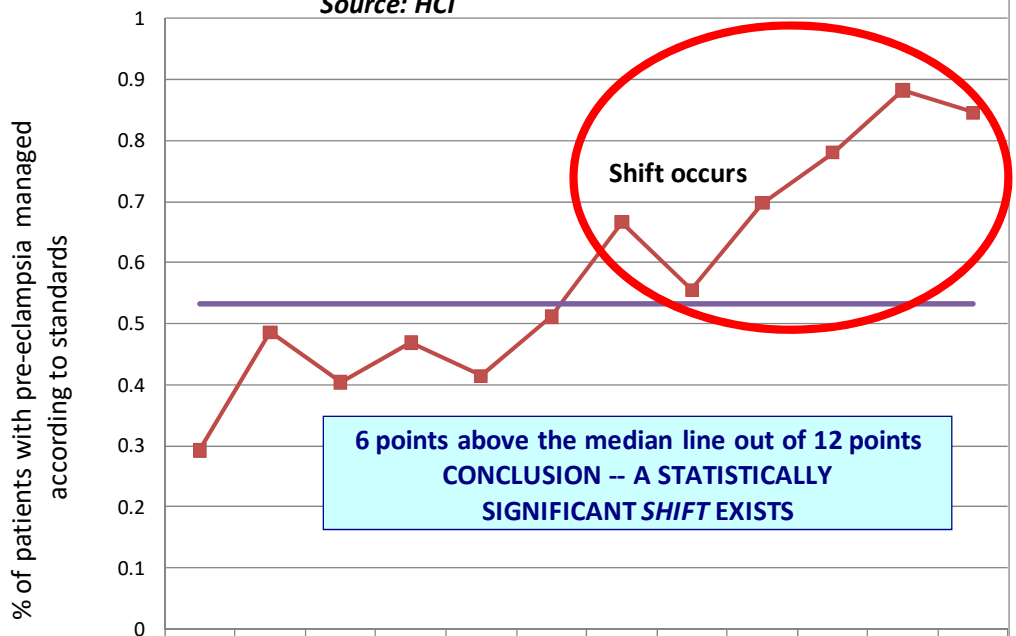
***Source: HCI***




| | AG | SE | OC | NO | DE | JA | FE | MR | AP | MY | JN | JL | AG | SE | OC | NO | DE | JA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERCENT | 74% | 75% | 77% | 75% | 73% | 76% | 86% | 87% | 88% | 92% | 93% | 86% | 91% | 93% | 94% | 94% | 96% | 95% |
| denominator | 9755 | 10578 | 10653 | 11878 | 11339 | 13259 | 13707 | 15505 | 16021 | 17198 | 17755 | 17854 | 22795 | 19274 | 21103 | 22146 | 21639 | 21023 |
| median | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% | 88% |
| n sites | 23 | 23 | 24 | 24 | 24 | 25 | 24 | 31 | 31 | 32 | 33 | 34 | 34 | 38 | 41 | 42 | 42 | 41 |

**Figure 6** provides another example of a shift with data from Ecuador on the management of pre-eclampsia. This graph displays a clear shift in the management of patients with pre-eclampsia after only 12 data points.

**Figure 6: Ecuador - Management of pre-eclampsia in 6 hospitals**
**January-December 2007**
***Source: HCI***



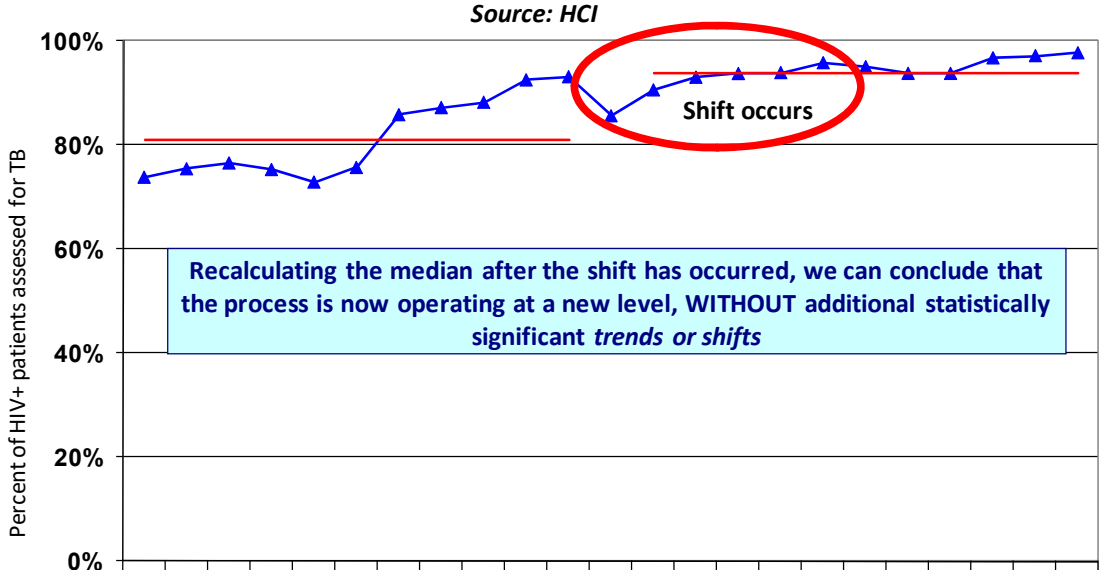

| | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| demoninator | 41 | 37 | 42 | 32 | 41 | 43 | 33 | 36 | 43 | 41 | 34 | 26 |
| % Preeclampsia patients correctly managed | 29% | 49% | 40% | 47% | 41% | 51% | 67% | 56% | 70% | 78% | 88% | 85% |
| Sites reporting | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Median | 53% | 53% | 53% | 53% | 53% | 53% | 53% | 53% | 53% | 53% | 53% | 53% |

### Calculating a new median after a shift

Once your process is generating results at a new level (after you have detected a shift), it is often useful to analyze results at that new level to see how your process is performing. When you have at least 10 data points after a shift has occurred, you can recalculate the median. **Figure 7** shows an example of two medians calculated using the data from Uganda on active TB screening. With more data available, it appears that the curve is stabilizing at a new level. By calculating a new median line based on values at that new level, we can see that the pattern has stabilized and does not appear (at least as of yet) to be experiencing further significant improvements. The first median line (at 81%) includes the data points that identified the trend, while the second median line (at 94%) includes the data points starting at the shift.

To determine when to recalculate the median, examine your graph and see when a new pattern appears to be taking shape, after the shift has started. Use the rules for analyzing time series charts with this new median to see if a new, stable pattern has emerged (that is, with no significant trends or shifts). You will need at least ten points for calculating each of the medians, so at least 20 data points in all. To recalculate the median values, cluster your data into the two groups (before the shift and at least ten data points after the shift), and using the instructions in **Box 3**, calculate the median for each group separately.

**Figure 7: Uganda - Percent of HIV-positive patients assessed for active TB, August 2005-June 2007**
***Source: HCI***




| | AG | SE | OC | NO | DE | JA | FE | MR | AP | MY | JN | JL | AG | SE | OC | NO | DE | JA | FE | MR | AP | MY | JN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| denominator | 9755 | 10578 | 10653 | 11878 | 11339 | 13259 | 13707 | 15505 | 16021 | 17198 | 17755 | 17854 | 22795 | 19274 | 21103 | 22146 | 21639 | 21023 | 20747 | 20904 | 22310 | 25301 | 22642 |
| PERCENT | 74% | 75% | 77% | 75% | 73% | 76% | 86% | 87% | 88% | 92% | 93% | 86% | 91% | 93% | 94% | 94% | 96% | 95% | 94% | 94% | 97% | 97% | 98% |
| n sites | 23 | 23 | 24 | 24 | 24 | 25 | 24 | 31 | 31 | 32 | 33 | 34 | 34 | 38 | 41 | 42 | 42 | 41 | 39 | 37 | 37 | 37 | 35 |
| median | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | | 94% | 94% | 94% | 94% | 94% | 94% | 94% | 94% | 94% | 94% | 94% |

**Figure 8** presents another example of shifting medians for post-partum hemorrhage data from Niger. This example shows how these rules also apply to negative trends or shifts. In this case, a dramatic downward shift in the percent of post-partum hemorrhage among women with normal deliveries was apparent after 17 months of data. When more data had been collected (another 18 months), two median lines were calculated. In this case, the new pattern emerging started after the shift, and the new median was calculated well after the shift was detected. From this analysis, we can see that the process is now consistently operating at a new, lower level.

## 4. IMPORTANT CONSIDERATIONS FOR TIME SERIES CHARTS

This section discusses two additional considerations for time series charts: 1) how annotation also applies to grouped data (such as collaborative databases), and 2) the importance of comparable denominators across time periods.

**Annotation of time series charts:** Annotation is useful for all time series charts, whether they are charts for individual health facilities or pooled table from multiple health facilities (such as collaborative level databases). Annotating time series charts for pooled data creates some challenges, as not all sites will be implementing changes at the same time. However, indications of changes that were broadly implemented helps explain the patterns in results seen. **Figure 9** is an example from Nicaragua of interventions introduced throughout the course of a collaborative in the 33 participating health facilities and demonstrates a shift following certain changes. The annotation on this time series not only shows the specific interventions, but also useful contextual information about missing data at the baseline. Other examples of useful contextual information include other events that explain the results (positive or negative), such as strikes, movement of personnel, or stock-outs.

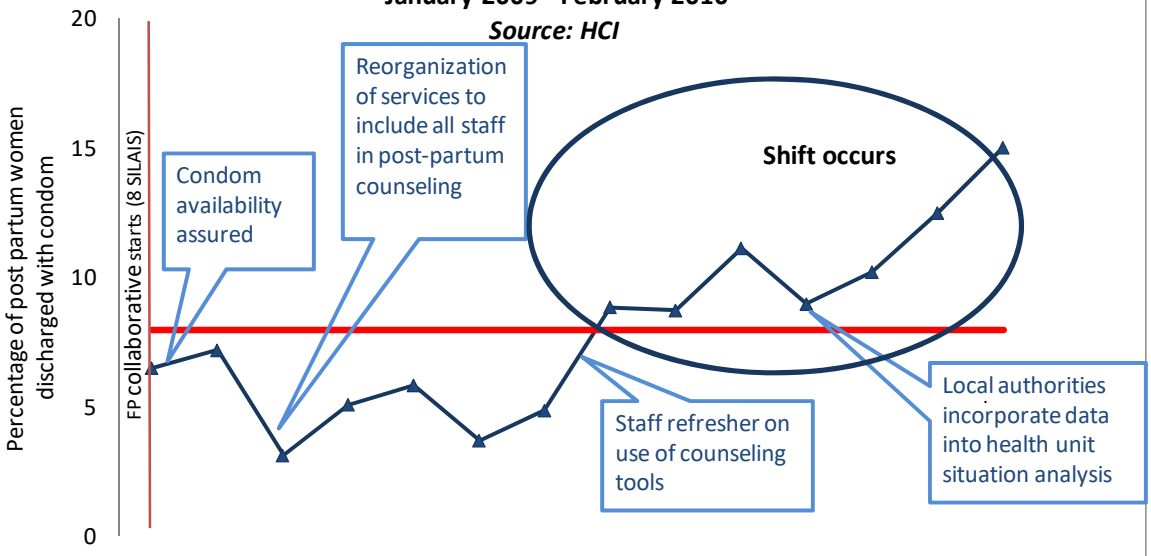
**Figure 8: Niger - Proportion of normal deliveries with post-partum hemorrhage in 33 facilities, 2006-2008**

***Source: HCI***


| | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| denominator | 223 | 191 | 219 | 232 | 236 | 217 | 226 | 271 | 277 | 296 | 244 | 255 | 254 | 218 | 239 | 251 | 281 | 261 | 257 | 274 | 292 | 273 | 247 | 255 | 247 | 236 | 264 | 272 | 300 | 270 | 282 | 300 | 310 | 301 | 261 | 269 |
| % of normal deliveries with PPH | 2.1 | 2.0 | 1.8 | 2.1 | 2.5 | 1.6 | 2.3 | 1.5 | 0.8 | 0.9 | 0.9 | 0.7 | 0.7 | 0.7 | 0.3 | 0.6 | 0.5 | 0.6 | 0.1 | 0.1 | 0.2 | 0.1 | 0.0 | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.1 | 0.0 | 0.2 |
| median | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |

**Figure 9: Nicaragua - Condom use as a contraceptive method post-obstetric event in 13 hospitals and 20 health centers January 2009 - February 2010**

***Source: HCI***




| | Jan-09 | Feb-09 | Mar-09 | Apr-09 | May-09 | Jun-09 | Jul-09 | Aug-09 | Sep-09 | Oct-09 | Nov-09 | Dec-09 | Jan-10 | Feb-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 6 | 7 | 3 | 5 | 6 | 4 | 5 | 9 | 9 | 11 | 9 | 10 | 12 | 15 |
| N | 117 | 116 | 58 | 99 | 104 | 65 | 101 | 189 | 227 | 354 | 291 | 311 | 339 | 242 |
| D | 1802 | 1615 | 1862 | 1949 | 1785 | 1762 | 2082 | 2136 | 2603 | 3181 | 3245 | 3048 | 2714 | 1611 |
| Median | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

N: Numerator: Number of post-partum women discharged with condom
D: Denominator: Total of post-partum women discharged

**Comparable data points:** When interpreting data points, the variation in the denominator can influence patterns and conclusions. Two common sources of variation in denominator size are: 1) changes in service utilization by clients, and 2) for pooled data, variations in the number of sites contributing (reporting) data. When this variation is greater than 25% of the median value for the denominator, you will need to think about what this may mean.

**Variations related to client population:** The rules described above for analyzing time series charts for trends and shifts are based on an assumption that denominator values are roughly consistent within a range of ± 25% across time periods. For example, a hospital working on loss to follow-up rates needs to examine the indicator's denominator—the number of HIV-positive patients enrolled in care and treatment—over time. For example, this denominator may typically be an average of 500 patients per month, but some months it may be 375 (25% lower) and others months it could be 625 (25% higher). If the denominator value goes beyond this 25% range and is not due to a data collection error, this should be annotated on the chart so that the chart can be interpreted within this context. For example, if there are changes in performance levels corresponding to variations in denominator size, it would be important to understand if this might be related to having a smaller or larger number of patients to manage.

**Consistency in reporting sites for group data:** When denominators from multiple health facilities are pooled together into a single database (as in collaborative databases), a common source of variation in denominators is the number of sites reporting. As with case load, the key question is whether this change in the number of sites reporting is influencing the results seen. For example, if sites that are doing poorly are not reporting in a specific month, the indicator value may appear higher than it should. In this case, one can limit the analysis of data to those sites for which data are available for the whole period, or wait to interpret the data until data are available from more sites. Again, it is important to annotate this information on the chart, not only for external stakeholders that view your time series charts, but also for your own team to keep an accurate record for future reference.

## CONCLUSION

A time series chart is a simple tool for quality improvement requiring only a pencil, paper, and accurate data. Yet, with the consistent application of some simple rules and best practices (see **Box 6**), these charts provide rigorous evidence of the effect of improvement efforts, with the ability to detect changes in a process within 95% statistical probability. Interpreting time series charts is an essential skill for managers, coaches, quality improvement teams, and stakeholders to understand improvement data and properly interpret the results of their work. Teams applying these simple rules can detect significant trends and shifts. The rules can also be applied at different times to determine how patterns in their data are changing.

**Box 6: Best practices for using time series charts**

- ✓ Do not wait to create the chart: start plotting and annotating with your first data point.
- ✓ Plot and annotate the data on an ongoing basis to build the habit of using data regularly and enable the data to drive your improvement effort.
- ✓ Remember to calculate the median after 10 data points and clearly define and label the key elements of the chart.
- ✓ Seeing a trend or shift by itself does not tell you *why* it occurred. Annotating the time series charts with interventions and/or contextual information could explain the trend or shift.

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## APPENDIX: HOW TO MAKE A TIME SERIES CHART

Making a time series chart is simple and can be completed using paper and pencil as easily as with a computer. Making a time series charts can be broken down into four major steps:

1. Organize your data.
2. Draw and label your chart.
3. Plot and annotate your data.
4. Analyze your chart.

If you have access to a computer, the USAID Health Care Improvement Project has a template that will plot your chart with a median line as you enter your data; you can download this template at: http://www.hciproject.org/node/1274. Whether making your chart by hand or on the computer, please refer to the USAID Health Care Improvement Project's *Norms for Presentation of Time Series Charts,* available at http://www.hciproject.org/node/1523, for more complete guidance on constructing time series charts.

### 1. Organize your data.

The first step is to figure out the indicator that you will be tracking and clarify if this is a chart of a single facility, or pooled results across a number of health facilities (e.g., will the chart show the work of a single hospital, or data grouped from 10 hospitals?). If you don't have the data yet, you will need to make a plan to start collecting the data. If you already have some data points for the indicator, organize the data chronologically (e.g., Week 1, Week 2, Week 3, etc.).

Once you have your data, start by writing some basic information:

- A brief but descriptive title at the top of the page
- The data source
- A brief description of how sampling was done (if applicable)
- A legend if there is more than one indicator or group on a single chart

### 2. Draw and label your chart.

Now you will set up the basic structure for your chart (see the HCI *Norms for Presentation of Time Series Charts*):

- Draw a straight horizontal line for the X axis and a straight vertical line on the left side of the page for the Y axis.
- Create a data table underneath the X axis (horizontal) that lists the data points together chronologically. If you are tracking a percent, include the numerator and denominator for each measurement point. If the time series chart will show grouped data from multiple health facilities, make sure to include in the data table the number of sites reporting for each data point.
- Divide and clearly label the X axis into equal time intervals based on how often your team is collecting and plotting the data (e.g., daily, weekly, monthly, etc.). Make sure to leave enough room to plot future data.
- Create the scale for the Y axis (vertical).

- If you are just starting to collect data, you can start with a scale from 0 to 100% to encompass all values.
- If you already have at least 15 data points, you can customize the scale by subtracting 20% of the smallest value and adding 20% to the largest value in the data set (IHI 2004).

*Example*: Let's use the example of a team tracking infection rates, where the range of values in the data is between 1% and 5%. To figure out the upper end of the scale, you would take 20% of 5, which is 1; therefore, upper range of the scale would be 6% (5+1). To figure out the lower end of the scale, you would subtract 20% from the smallest value in the data set, 1%. Since 20% of 1 is .2, the lower end of the range would be 0.8% (1-0.2).

- Divide the axis into equal intervals.
- Label the Y-axis with a descriptive name of what is being measured (e.g., percent of women tested for HIV in antenatal care, minutes clients wait until receiving care). If the measure is a percentage, include a definition for the numerator and denominator with criteria for what was counted.

**Plot and annotate your data.**

Now that you have the structure for your chart, you can start to plot and annotate your data points.

- Plot the actual values on the chart according to when they occurred in time (horizontal X axis). Connect the dots together with a line.
- Annotate the time series chart with additional useful information that will help tell the story over time, such as:
  - Quality improvement interventions (changes implemented)
  - Any other key events that occurred during the time period that would explain changes in the results over time (e.g., stock-outs of drugs, loss of staff, strikes, changes in other government policies that affect the facility, etc.)
  - The aim for the quality improvement work

**Analyze your chart.**

For this stage in developing your time series chart, refer to the text in Section 3 of this document.

- If you have at least 10 data points, calculate the median and plot it on the chart. If you have fewer than 10 data points, do not add the median yet. Please see Box 3 for instructions on calculating the median.
- Use the rules to look for trends and shifts on your chart.
- Pay attention to any variation in denominator values or number of sites reporting that need to be taken into account in your interpretation of results.

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