Integrating Six Sigma and Lean Into the Improvement Toolkit

Features

**Performance Improvement**
- Optimizing the Process Quality Improvement Toolkit
- Guiding Inpatient Quality Improvement: A Systematic Review of Lean and Six Sigma
- Pediatric HIVQUAL-T: Measuring and Improving the Quality of Pediatric HIV Care in Thailand, 2005–2007
- Kaiser Permanente’s Performance Improvement System, Part 2: Developing a Value Framework

**Patient and Family Involvement**
- Twelve Evidence-Based Principles for Implementing Self-Management Support in Primary Care

**Department**

**Tool Tutorial**
- Infection Preventionist Checklist to Improve Culture and Reduce Central Line–Associated Bloodstream Infections

---

*Health systems that have done the hard work of developing a systematic approach to process improvement . . . will incorporate methodologic advances into their toolkit when it makes sense in the service of their overall process improvement activities.*
—VanKooy (p. 532)
Performance Improvement

Pediatric HIVQUAL-T: Measuring and Improving the Quality of Pediatric HIV Care in Thailand, 2005–2007


Following the United Nations General assembly meeting on HIV/AIDS in 2006, 147 countries agreed to work toward the goal of "universal access to comprehensive prevention programs, treatment, and care and support" by 2010. During the past few years, many countries have improved access to antiretroviral treatment (ART) and HIV care. In Thailand, in 2007 an estimated 610,000 people—including 14,000 HIV-infected children—were living with HIV/AIDS. The Thai government began a national ART program in 2000, and by 2007 approximately 143,539 persons—including 6,687 children—were receiving ART.

As pediatric care expands, there has been an increased need for a hospital-based quality improvement (QI) system for HIV care. Because pediatric HIV is an increasingly treatable chronic disease, improving the quality of pediatric HIV care should help ensure that HIV–infected children receive standard HIV care and will be able to survive to become healthy adults.

Pediatric HIVQUAL-T was initiated in Thailand in 2005 as a pediatric HIV/AIDS care and treatment QI initiative designed to support ongoing improvement in the quality of pediatric HIV care through the use of HIV care performance data from hospitals. As in other countries, comprehensive pediatric HIV care includes not only disease-specific management but well-child care and coordination of other subspecialty and supportive services. In pediatric HIVQUAL-T, the performance of hospitals is measured using indicators based on national guidelines for pediatric HIV care. QI activities are aimed at areas identified by performance measurement data which show need for improvement. Then, performance is remeasured in an annual cycle.

Thailand is the second country to implement the HIVQUAL framework for quality management. The Thai model was adapted from the New York State Department of Health AIDS Institute HIVQUAL model, which has been...
applied to a national network of ambulatory HIV care programs in the United States with support from the U.S. Health Resources Service Administration (HRSA). Beginning in 2003, the Thailand Ministry of Public Health (MOPH)–U.S. Centers for Disease Control and Prevention Collaboration (TUC) helped adapt and implement HIVQUAL to fit the Thai national guidelines, resources, and health care system. Examples include the involvement of Thai providers to prioritize indicators that were derived from national HIV treatment and care guidelines, and the linkage of HIV QI activities to the structure and processes of the Thai hospital system QI program through IHQIA. The adult model was first adapted and then rapidly expanded from a 12-hospital pilot in 2003 to a national HIV QI program in 2008.

No QI program has been undertaken specifically for pediatric HIV care in Thailand. The pediatric HIVQUAL-T model was first used in 5 pilot-site hospitals (Table 1, above) in 2005 and was expanded to include an additional 15 tertiary care hospitals in 2010 for representation in a total of 15 of Thailand’s 76 provinces. These 20 hospitals, as participants in the national accreditation program, are required to apply total quality management principles, to self-assess performance, and to demonstrate quality assurance and customer-focused continuous quality improvement. Accordingly, most of the hospital staff were assumed to be familiar with basic QI concepts. In this article, we describe how quality of pediatric HIV care services was successfully improved using a pediatric HIVQUAL-T model in the five pilot-site tertiary care hospitals in Thailand.

### Methods

**WORKING GROUP**

A pediatric HIVQUAL-T working group was established in 2005 in Thailand by physicians and nurses working in pediatric HIV care, representatives from TUC, and the MOPH—BATS (Bureau of AIDS, Tuberculosis [TB], and Sexually Transmitted Infections [STIs]). The working group defined core and optional indicators for the pediatric HIVQUAL-T program on the basis of national guidelines for children’ (Table 2, page 543).

![Table 1. Demographic Data of the Five Hospitals](https://example.com/table1.png)
### Table 2. Pediatric HIVQUAL-T Indicators and Definitions, Thailand, 2005–2007*

<table>
<thead>
<tr>
<th>Indicator name</th>
<th>Indicator definition: Proportion of eligible HIV–infected children who received the service as recommended in the Thai national HIV treatment and care guidelines during the review period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical status monitoring</td>
<td>HIV–infected children should receive clinical staging (WHO or CDC staging) at least annually.</td>
</tr>
<tr>
<td>CD4 monitoring</td>
<td>HIV–infected children should receive a CD4 test (% for children aged &lt; 6 years old or count for children aged &gt; 6 years old) at least once a year.</td>
</tr>
<tr>
<td>Viral load monitoring</td>
<td>HIV–infected children who receive ART should have a viral load test at least once a year.</td>
</tr>
<tr>
<td>Growth assessment</td>
<td>HIV–infected should receive a weight and height assessment at least once a year.</td>
</tr>
<tr>
<td>PCP prophylaxis</td>
<td>Trimethoprim-sulfamethoxazole for PCP prophylaxis is recommended for the following: –All HIV–infected children aged &lt; 1 year</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged ≥ 1 year and CD4 &lt; 15%</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged ≥ 6 year and CD4 &lt; 200 cell/mm³</td>
</tr>
<tr>
<td>Clinical TB screening</td>
<td>HIV–infected children should be screened for history of TB contact, TB signs and symptoms (chronic cough, prolonged fever, weight loss, night sweats) at least once a year (2005–2006) or every six months (2007).</td>
</tr>
<tr>
<td>Antiretroviral treatment</td>
<td>Eligibility criteria for initiation of ART therapy according to Thai national HIV treatment and care guidelines include the following: –HIV–infected children aged &lt; 1 year and either CDC clinical staging B, C or WHO staging 3, 4 or CD4 &lt; 25%</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged 1–3 years and either CDC clinical staging C or WHO staging 3, 4 or CD4 &lt; 20%</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged &gt; 3 years and either CDC clinical staging C or WHO staging 3, 4 or CD4 &lt; 15%</td>
</tr>
<tr>
<td>Antiretroviral adherence monitoring</td>
<td>All HIV–infected children who are on ART should receive adherence assessments by patient interview and either pill counts or review of an antiretroviral calendar at every visit or at least at each of the last 3 visits.</td>
</tr>
<tr>
<td>Mycobacterium avium complex (MAC) prophylaxis</td>
<td>MAC prophylaxis and CMV retinitis screening are recommended for HIV–infected children who meet eligibility criteria: –HIV–infected children aged &lt; 1 year with CD4 &lt; 750 cells/mm²</td>
</tr>
<tr>
<td>Cytomegalovirus (CMV) retinitis screening</td>
<td>–HIV–infected children aged 1–2 years with CD4 &lt; 500 cells/mm³</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged 2–6 years with CD4 &lt; 75 cells/mm³</td>
</tr>
<tr>
<td></td>
<td>–HIV–infected children aged ≥ 6 years with CD4 &lt; 50 cells/mm³</td>
</tr>
<tr>
<td>Immunization history assessment</td>
<td>HIV–infected children should be assessed for immunization history. Children with incomplete immunizations who had no contraindication for vaccination should receive vaccine according to National Immunizations program: –BCG (at birth; contraindication: symptomatic children)</td>
</tr>
<tr>
<td></td>
<td>–DTP, OPV at 2, 4, 6, 18 months and 4–6 years</td>
</tr>
<tr>
<td></td>
<td>–Hepatitis B vaccine at 0, 1–2, 6 months</td>
</tr>
<tr>
<td></td>
<td>–MMR at 9 months and 4–6 years (contraindication: children with clinical staging C or immunologic category 3)</td>
</tr>
<tr>
<td></td>
<td>–JE vaccine at 18 months (2 doses apart) and 30 months</td>
</tr>
<tr>
<td></td>
<td>–DT at 13 years old</td>
</tr>
<tr>
<td>Oral health assessment</td>
<td>Oral health should be assessed by medical doctor or dentist or nurse at least once a year. Children with abnormal oral health should be referred to dental clinic.</td>
</tr>
<tr>
<td>Developmental assessment</td>
<td>Developmental assessment can be done by history, physical examination, and assessing developmental milestones. Children aged &lt; 5 years should be assessed for gross motor, fine motor, speech, and social skills.</td>
</tr>
<tr>
<td>Secondary sexual characteristic assessment</td>
<td>Children aged &gt; 10 years should be assessed for secondary sexual characteristics (Tanner staging) and should receive sexual and reproductive health information</td>
</tr>
<tr>
<td>HIV disclosure to child</td>
<td>HIV–infected children aged &gt; 10 years should be aware of their HIV status.</td>
</tr>
</tbody>
</table>

*WHO, World Health Organization; CDC, Centers for Disease Control and Prevention; ART, antiretroviral therapy; PCP, *Pneumocystis jiroveci* pneumonia; TB, tuberculosis; BCG, bacille Calmette-Guérin; DTP, diphtheria-tetanus-pertussis; OPV, oral polio vaccine; MMR, measles-mumps-rubella; JE, Japanese encephalitis; DT, diphtheria-tetanus vaccine.
Pilot-Test Sites

Five tertiary care hospitals with high patient case loads were selected as pilot-test sites (Table 1). All five hospitals have pediatric patient care teams—multidisciplinary teams composed of physicians, nurses, pharmacists, social workers, and psychologists who meet regularly (usually monthly) to review patient care issues. For the pediatric HIVQUAL-T initiative, multidisciplinary pediatric HIV QI committees were established at each hospital as subcommittees of existing patient care teams. These committees meet regularly, usually before or after pediatric HIV clinic sessions, to review patients’ clinical issues, pediatric HIVQUAL-T performance data, and QI plans. They also communicate HIV QI plans and performance results to the hospital QI committee.

DATA COLLECTION

Staff at participating hospitals received one-day training on the pediatric HIVQUAL-T software used for performance data collection and on the basic QI process, which drew on the Plan-Do-Study-Act (PDSA) cycle.

HIV clinic performance data were collected from January 1, 2005, to December 31, 2005. After quality improvement projects were initiated, performance data were collected from January 1, 2006, to December 31, 2006, and for the same period in 2007. Hospitals’ data for 2006–2007 were compared with 2005 baseline data. Data from the five pilot hospitals in 2007 were also compared with the

---

Figure 1. HIV clinic performance data were collected from January 1, 2005, to December 31, 2005. After quality improvement projects were initiated, performance data were collected from January 1, 2006, to December 31, 2006, and for the same period in 2007.

Steps for Pediatric HIVQUAL-T Data Collection and Use, Thailand, 2005–2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of eligible HIV-infected children from 5 hospitals</td>
<td>1,119</td>
<td>1,183</td>
<td>1,341</td>
</tr>
<tr>
<td>Total number of eligible patients sampled for chart abstraction</td>
<td>460</td>
<td>435</td>
<td>418</td>
</tr>
<tr>
<td>&lt; 10 years cases</td>
<td>294</td>
<td>166</td>
<td>106</td>
</tr>
<tr>
<td>10–14 years cases</td>
<td>166</td>
<td>228</td>
<td>207</td>
</tr>
<tr>
<td>Data entered into pediatric HIVQUAL-T software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediatric HIVQUAL-T reports automatically generated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data presented to pediatric HIV quality improvement committee and quality improvement plans developed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
baseline pediatric HIVQUAL data from six tertiary care hospitals that started implementing pediatric HIVQUAL in 2007.

In addition, data were compared among hospitals as part of a regional workshop conducted at the end of each fiscal year to share QI strategies. Topics discussed included pediatric antiretroviral adherence and disclosure to children—areas in which few of the hospitals had extensive experience. Different types of counseling, use of other members of the patient care teams (for example, persons with HIV/AIDS were assigned to assist in antiretroviral assessment [pill counts] in the clinics), and tools and materials were shared among hospitals.

**PERFORMANCE MEASUREMENT**

**Eligibility Criteria.** Eligibility criteria for performance measurement were as follows:

- HIV infection
- Age 2–14 years (2005–2006) or 6 months–14 years (2007)
- Receipt of HIV care in a participating hospital, with a minimum of two outpatient visits in at least three months during the one-year review period

Children younger than two years of age were excluded from the pediatric HIVQUAL-T review in 2005–2006 because the standard diagnostic testing guideline to confirm HIV diagnosis for infants born to HIV-positive mothers during the study period was to test at 18 months of age. A policy of universal free access to DNA PCR (polymerase chain reaction) testing for HIV–exposed infants at 1–2 and 4–6 months of age was launched in 2007. Some indicators, including disclosure of HIV status and assessment of secondary sexual characteristics and growth and development, are age specific and were only applied to the subset of children meeting age criteria. Patients who had only one outpatient visit during the calendar year or who died during the calendar year were listed separately and were reviewed as part of loss to follow-up and mortality case reviews.

**Sampling.** A line listing of eligible patients seen during a specified period at each hospital was entered into the pediatric HIVQUAL-T software program. This program selects a random sample from the line listing. Sampling was stratified by age group to ensure sufficient numbers to measure age-specific indicators. Sample size was calculated to achieve 90% confidence intervals with a precision range of +/– 8% for each performance indicator. There is no requirement for a minimum sample size.

All patients were selected if the sample size was < 16. Review of up to 140 patients per hospital was required to assess performance on age-specific indicators. After the random sample was selected, any patient found to be ineligible for chart abstraction or for whom the medical chart could not be located was replaced from the line list with the next eligible patient in the same age group.

Annually, the hospital staff generated a sample and abstracts indicator data from selected patient records. These data were entered into the pediatric HIVQUAL-T software program. Two to seven staff per hospital, including nurses, data managers, and physicians, collected and entered data (Table 1). The time required to develop a hospital case list varied from 30 to 120 minutes, depending on the complexity of the hospital database. The time required for chart abstraction was 12–25 minutes/case when done manually and 5–10 minutes/case when done electronically. Standard reports without identifiers were generated after data entry was complete.

**DISSEMINATION OF REPORTS**

**QI Functions.** Data reports were provided to the hospital pediatric HIV QI committees for development of QI activities. The committee reviewed performance measurement data, identified areas for improvement, selected improvement priorities, and planned activities (see examples in Appendix 1, available in online article). The clinic teams designed improvement strategies to address different elements of the Chronic Care Model, including information systems to organize patient data for efficient and effective care; self-management support to empower patients to manage their health and health care; organization of services to create a culture and mechanisms that promote safe, high-quality care; delivery-system activities that ensure the delivery of effective, efficient clinical care and self-management support; and decision-support approaches to promote clinical care that is consistent with scientific evidence and patient preferences.

QI activities were evaluated by assessing performance on various indicators over time (Table 2).

**Workshops and Benchmarking.** Pediatric HIVQUAL-T data reports were provided at annual workshops and sent to the MOPH for benchmarking. The annual HIVQUAL-T workshop allowed hospitals to learn from one another by sharing performance data and lessons learned from QI activities. Median proportion and range of performance data were determined across all hospitals. Benchmarking was used to compare performance across hospitals and in each hospital by year. Hospitals evaluated their service delivery and QI strategies in relation to other hospitals and shared tools and materials for QI activities. This process allowed hospitals to make improvements and adopt best practices from other hospitals. For example, one
hospital shared a clinical record form that captured all pediatric HIVQUAL-T indicators, and another hospital adopted this record form for routine use (Appendix 1, available in online article).

**DATA ANALYSIS**

For each indicator, the proportion of patients meeting the indicator definition was determined, with the unit of analysis being the hospital. The median proportion was determined across all hospitals. The nonparametric test, an extension of the Wilcoxon Rank-Sum test, was used to assess the trend in median proportion across hospital groups, and the Wilcoxon Rank-Sum test was used to test differences of median proportion between the five pilot hospitals and six new hospitals that began implementing HIVQUAL in 2007. The chi-square test for trend or Cochran-Armitage trend test was used to test differences in performance at individual hospitals during the three-year period.

**ETHICAL REVIEW**

The protocol for this project was reviewed at the U.S. Centers for Disease Control and Prevention (CDC), which determined that as a program evaluation the project did not require Institutional Review Board approval.

**Results**

**PATIENT SAMPLE**

A total of 1,119 HIV–infected eligible children in 2005, 1,183 in 2006, and 1,341 in 2007 received care at the five hospitals; 460 (41%), 435 (37%), and 418 (31%), respectively, were selected for chart abstraction (Figure 1).

**INDICATORS**

As shown in Table 3 (page 547), > 95% of the eligible children received the essential elements of pediatric HIV treatment in 2005 as specified in the Thai national HIV care and treatment guidelines, including clinical status monitoring, annual CD4 count monitoring, ART, antiretroviral adherence monitoring, and growth assessments. The median performance scores for PCP prophylaxis were 86% and 82% in 2005 and 2006, respectively, with an increase to 100% in 2007. The median score for clinical TB screening increased from 86% in 2005 to 98% in 2006 and then decreased in 2007 when the indicator was changed, requiring more frequent screening. Performance for viral load assessments, *Mycobacterium avium* complex (MAC) prophylaxis, cytomegalovirus (CMV) retinitis screening, immunization history assessments, developmental assessments, secondary sexual characteristic assessments, and HIV disclosure was 60% in 2005; most of these indicators showed improved performance by 2007, but MAC prophylaxis and CMV retinitis screening remained at 60%.

Indicators with a decrease in median scores from one year to the next included viral load assessments from 2005 to 2006, clinical TB screening from 2006 to 2007, CMV retinitis screening from 2006 to 2007, and oral health assessments from 2006 to 2007 (Table 3).

**IMPROVEMENT PROJECTS AND EFFECT ON INDICATOR SCORES**

Improvement projects, which were chosen by the hospitals on the basis of their respective results, were implemented for the following 10 of the 15 indicators: *Pneumocystis jiroveci* pneumonia (PCP) prophylaxis; MAC prophylaxis; TB and CMV retinitis screenings; HIV disclosure; and assessments of antiretroviral adherence, oral health, immunization history, secondary sexual characteristics, and development.

All hospitals launched projects for more than one indicator in 2006. Improvements were implemented in different areas of the clinic system, which are grouped into the categories of the Chronic Care Model (Appendix 2, available in online article). Most of the changes were made in information systems, such as designing new forms and using different sources for information. Changes in the delivery of services included changes in history-taking and improved referrals. Changes in self-management and organization of services were also common, including a variety of patient education strategies, specific reminders for patients, an oral-health “beauty contest” to engender friendly competition in oral health, reassignment of functions among staff, and the implementation of multidisciplinary team meetings for staff. Various decision-support strategies were implemented, mostly consisting of provider education, but in at least one instance, this also included review of the QI plan with the entire provider team to encourage team participation in the activities and to foster transparency. None of the facilities engaged community providers or tapped other community resources in their improvement work.

Hospitals with low performance scores for any of the indicators used these results to guide the development of QI activities, and hospitals with increased or high scores shared strategies to improve performance at the annual meeting. For example, all hospitals except Hospital A scored > 90% on antiretroviral adherence monitoring (Figure 2a, page 548). After the hospital implemented QI activities in 2005, the score increased to > 90% in 2006 and 2007 (Appendix 3). Similarly, although the
median score for PCP prophylaxis was < 90% in the first two
years, the hospitals’ subsequent QI activities resulted in an
increase in the median score to 100% in 2007 (Table 3). The
median score for clinical TB screening also improved from 86%
to 98% following QI activities in 2006.

Benchmarking of performance across hospitals demonstrated
a wide range of performance and variable improvement over
time for each indicator. Some hospitals showed little improve-
ment from 2005 to 2006 but by 2007 noted increases in their
scores (Appendix 2). For example, all hospitals improved on
antiretroviral adherence monitoring for each year, and all hos-
pitals except Hospital E had low scores for immunization his-
tory assessments in 2005 (Figure 2a and Figure 2b, page 548).
Hospital E was able to improve its performance in 2006 (Table
3 and Appendix 2) following selection of this area for QI in
2008 (Figure 2b).

The median performance scores of various indicators of the
six tertiary care hospitals that started implementing pediatric
HIVQUAL in 2007 were significantly lower when compared
with the five pilot hospitals, including CD4 monitoring; viral
load monitoring; clinical TB screening; MAC prophylaxis; and
assessments of immunization history, oral health, development
of secondary sexual characteristics, and HIV disclosure (Figure
3, page 549).
Discussion

The results from this pilot of pediatric HIVQUAL-T demonstrate that pediatric HIVQUAL-T can facilitate data use at the local level to improve the quality of pediatric HIV care services. This improvement is consistent with other reports of QI in care of adults with HIV.²,¹⁰,¹¹ This article—the first report of QI in pediatric HIV care—demonstrates the adaptability of a pediatric HIVQUAL model for use in developing countries such as Thailand.

Benefits of Pediatric HIVQUAL-T

Although HIV data are collected routinely as part of the national HIV monitoring program in Thailand, those data are primarily used and analyzed at the national level; data analysis and use rarely take place at the local level, which is a prerequisite for implementation of QI activities at that level. From the perspective of the HIV program, benchmarking serves to identify which hospitals are performing well or improving and which are not, allowing the HIV program representatives at each governmental level (national, regional, and provincial) to provide necessary coaching and technical assistance. From the perspective of the individual hospital, benchmarking enables it to compare its performance with that of other hospitals and to learn best practices from hospitals with strong performance rates. We found that hospitals that started HIVQUAL implementation later had poorer performance, as compared with hospitals with earlier initiation of HIVQUAL and QI activities, suggesting that performance improvement may be attributed to QI activities.

The pediatric HIVQUAL-T software program helped reduce the burden of medical record review through the use of random samples with simple and systematic data entry screens. The work load for implementing pediatric HIVQUAL-T varied depending on the sample size for each hospital, the completeness of medical records, and the number of staff involved in the HIVQUAL-T process. Data abstraction was faster in 2006 and 2007, when providers were familiar with the process and the data record system had been improved on the basis of lessons learned from the initial year. Data abstraction was also faster in hospitals with good data management systems and clearly designated team roles.

Implementation of HIVQUAL-T has yielded a number of additional benefits. Pediatric HIVQUAL-T indicators, as based on Thai national HIV care and treatment guidelines, reinforce the implementation of pediatric HIV care standards. Performance measurement relies on the completeness and accessibility of medical records; deficiencies in recordkeeping identified through initial HIVQUAL-T data collection can lead to improvements in medical record forms and documentation processes. Finally, HIVQUAL data have been used by Thailand’s national HIV program to identify care providers needing additional technical assistance and by the national health care payor to document the quality of services purchased.

Figure 2. The percentages of eligible patients who received services for (a) antiretroviral adherence monitoring and (b) immunization history assessment are shown.
Our data show that most HIV-infected children received most of the essential elements of pediatric HIV treatment as defined by the Thai national guidelines. High rates of compliance with the pediatric HIV treatment indicators reflect the national financial and program support for antiretroviral medications, CD4 count monitoring, and training on HIV care and treatment,12 as well as providers’ compliance with national guidelines. Initially low performance scores (<60%) on some indicators are attributable to a variety of reasons. Viral load monitoring was not part of the national AIDS program benefit package during 2005–2006, and performance consequently varied according to whether the hospital had external research support for this activity. However, even after viral load monitoring was included in the national AIDS program benefit package in 2007, performance remained low, highlighting it as an area for improvement in 2008. MAC prophylaxis was also not included in the national AIDS program benefit package in 2005–2006—but was added in 2010.7 One possible reason for low ratings of CMV retinitis screening may be that ophthalmologists could not be accessed to perform screening. Recommendations for immunization history assessments or secondary sexual characteristic assessments, disclosure of a child’s HIV status to the patient, and clinical TB screening were included in the national guidelines, but the guidelines did not include details about how to perform assessments or screening frequency.7 Despite these challenges, many hospitals were able to improve performance significantly through the QI process by focusing on the implementation processes for these guidelines and introducing improvements in the systems.

Possible reasons were considered for low performance scores. In the area of screening of clinical TB, awareness of the high TB burden in this population led the pediatric HIVQUAL-T working group in 2007 to change the recommended screening frequency from annually to every six months—which was followed by a decrease in screening rates, as shown in retrospective review of charts from January through December 2007. Annual screening had identified an unexpectedly high number of TB cases and contacts, but the poorer performance in 2007 highlighted clinical TB screening as an area for improvement for 2008. Hospital E’s QI activity to address CMV retinitis screening was followed by a decrease in performance, which was attributed to limited availability of ophthalmologists. As a result, there were long intervals between referral and receipt of an ophthalmologic examination. The decrease in oral health assessments in 2007 may be attributable to Hospital C’s inability to sustain a successful QI activity of dental health education at a camp for HIV–infected children in 2006.
hospitals were able to learn from these declines in performance rates, and they developed new QI activities in the subsequent years.

The data indicate that relatively high median scores can be improved if the hospitals set more challenging goals and implement QI activities in those areas. Without QI activities, performance of HIV services generally did not change significantly.

**LIMITATIONS OF PEDIATRIC HIVQUAL-T**

The Pediatric HIVQUAL-T program relied on medical records, which varied in terms of completeness and other aspects of quality, for performance measurement. Low performance scores may have reflected poor documentation, including incomplete records or records stored in separate locations for different types of services. Improvements in medical records made during the first two years of the project made this less of an issue in 2007.

In addition, pediatric HIVQUAL software only allows assessment of the quality of services delivered during the review period; it is not designed to monitor treatment outcomes or follow patients longitudinally. Therefore, we did not attempt to link care with clinical outcomes. However, several indicators have clearly demonstrated benefits for clinical outcomes. For example, ART has been shown in numerous studies to decrease mortality. Studies suggest that children who know their HIV status have higher self-esteem than children who do not, and parents who have disclosed the status to their children experience less depression. The benefit of other treatment and care indicators is less clear. Further research to confirm that all of these quality indicators actually translate into better clinical outcomes is needed.

**SUCCESS FACTORS**

Factors that may have contributed to the success of pediatric HIVQUAL-T include the fact that clinics were organizationally prepared for QI, with the support of hospital and clinic leadership. At the clinic level, staff appreciation of the value of data for QI and benchmarking, a learning culture, implementation of simple and sustainable QI activities, and adequate staffing likely all contributed to the success of this initiative. The one-day pediatric HIVQUAL and QI training was found to be sufficient in introducing the concepts of HIVQUAL and continuous QI. External experts also provided ongoing consultation and coaching in 2005–2006 and were helpful in facilitating understanding of the HIVQUAL concepts. Clinic staff from the five pilot hospitals have now become consultants for other hospitals while continuing to learn through the annual HIVQUAL-T workshop.

**NEXT STEPS**

Maintenance and expansion of the Pediatric HIVQUAL-T program will be facilitated by hospital leaders with an institutional vision for QI of HIV care and through endorsement by a wide range of national and provincial stakeholders. Long-term sustainability may be achieved with hospital-level ownership of the QI process and integration with the national adult HIV care program and with capacity building of staff at the MOPH, the national hospital accreditation body, and the national health care payor office. Expansion to an additional 15 provinces (for a total of 30 provinces) is scheduled for completion by December 2010; the government is funding project expansion to all voluntary provincial hospitals by 2014. The pediatric HIVQUAL model has also been adapted to other countries.

**Summary and Conclusion**

Pediatric HIVQUAL-T facilitates the delivery of comprehensive pediatric HIV care services, highlighting areas of care where improvement is needed. Through QI activities, it facilitates integration of missing services into comprehensive care. The model is simple and requires minimal resources because it uses a sampling methodology for data collection and is implemented through existing hospital-based programs. Benchmarking and annual HIVQUAL-T workshops allow hospitals to learn from each other and adopt best practices. This pediatric HIVQUAL model is adaptable from one country to another, adjusting for differences in guidelines, resources, and health care models.

For their important contributions to this work, the authors gratefully acknowledge Philip Mock (Thailand Ministry of Public Health [MOPH]–U.S. Centers for Disease Control and Prevention [CDC] Collaboration and Dr. Peeramon Ningsanond and Chuenkamol Setthabut (Bureau of AIDS, Tuberculosis, Sexually Transmitted Infections). They also express their gratitude to all health care providers and staff in the pediatric HIV clinics of Chiang Rai Regional Hospital, Queen Sirikit National Institute of Child Health, Siriraj Hospital, Sappasitthipasong Hospital, and Bamrasnaradura Institute for their support in project implementation. This work was funded by the Thailand MOPH and the U.S. CDC.
References


Appendix 1. Examples of Quality Improvement Projects

a. Example: QI Activity to Increase Assessment of Immunization History

**Problem:** Immunization history assessment among HIV-infected children in 2005 was lower than 10%.

**Aim:** To improve immunization history assessment and provide immunizations to HIV-infected children according to EPI program

**Plan:**
- Provided immunization guidelines to health providers
- Assigned roles and responsibilities to team members
  - *Nurses and social workers:* reviewed immunization history in the outpatient department (OPD) card at registration desk and wrote down findings in the OPD card for doctor
  - A caretaker who forgot history of immunizations: gave an appointment card to the caretaker to bring vaccination book in the next clinic visit
  - *Doctors:* reviewed immunization history in clinical record form (page AP-2) and provided immunizations based on EPI program and provided proper management for each patient
  - *Nurses:* reviewed OPD card that all immunizations data are entered properly

**Do:** Implemented the plan for 2 months and assigned a nurse to review OPD card of children who visited clinic during the last 2 months.

**Study:** Analyzed data. The nurses found that uptake of immunization assessment was only 50%. She reported findings to the pediatric QI committee at routine meeting.

**Act:** The nurse reminded all stakeholders about the process of immunization history assessment and asked for cooperation. Repeat cycles and measurement.

(continued on page AP2)
Appendix 1. Examples of Quality Improvement Projects (continued)

* Provided courtesy of Siriraj Hospital, Bangkok, Thailand.
Appendix 1. Examples of Quality Improvement Projects (continued)

b. Example: QI Activity to Increase Dental Health Assessment

**Problem:** Only 40% of HIV-infected children who had oral health problems were receiving proper oral care.

**Aim:** To improve oral health assessment and provide proper oral care for HIV-infected children.

**Plan:**
- Invited dentist’s assistant to hold dental education class on weekly pediatric HIV clinic day.
- Assigned clinic staff to develop educational materials for the clinic.
- Arranged to have a dentist providing monthly oral health examination at HIV clinic.
- Informed doctors to refer children with caries to dental clinic and give fluoride to children.

**Do:** Implemented the plan. At weekly post-clinic meeting, multidisciplinary team reviewed OPD card of individual child who did not receive oral check up.

**Study:** Discussed results and barriers of oral health assessment and oral care during the post-clinic meeting.

**Act:** Integrated into routine services.
## Appendix 2. Quality Improvement (QI) Activities and Related Performance Measurement (PM) Data for Related Indicators by Hospital, Thailand, 2005–2007

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Indicator (Year of QI Activity)</th>
<th>QI Activity Examples (QI Category*)</th>
<th>2005 % (n/N)</th>
<th>2006 % (n/N)</th>
<th>2007 % (n/N)</th>
<th>p value for Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Antiretroviral adherence monitoring (2006)</td>
<td>■ Develop antiretroviral adherence record form for the clinic (IS) ■ Develop antiretroviral adherence measurement tools (IS) ■ Teach patients how to use watch (SM) ■ Review PM results in weekly HIV staff meeting (OS)</td>
<td>66 (21/32) 91 (29/32) 94 (67/71)</td>
<td></td>
<td></td>
<td>p = .02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = .51</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Developmental assessment (2006)</td>
<td>■ Add developmental variable to medical record form (IS)</td>
<td>7 (1/14) 57 (4/7) 94 (68/72)</td>
<td></td>
<td></td>
<td>p = .01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = .001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cytomegalovirus CMV retinitis screening (2007)</td>
<td>■ Screen visual acuity for HIV–infected children with CD4 count &lt; 15% (DS) ■ Refer children with abnormal visual acuity to ophthalmologist (DS) ■ Review PM results in weekly HIV staff meeting (OS)</td>
<td>0 (0/2) 0 (0/5) 40 (2/5)</td>
<td></td>
<td></td>
<td>p = 1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = .048§</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immunization history assessment (2007)</td>
<td>■ Add immunization variable to medical record form (IS) ■ Develop reminder card for patients to bring vaccine book to the clinic (SM) ■ Review PM results in weekly staff meeting (OS)</td>
<td>5 (3/63) 13 (10/79) 58 (42/72)</td>
<td></td>
<td></td>
<td>p = .10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p &lt; .001</td>
</tr>
<tr>
<td></td>
<td>Immunization according to national immunization program (2007)</td>
<td>■ Train health care providers on recommendations for immunization for HIV–infected children (DeS)</td>
<td>N/A 30 (3/10) 67 (28/42)</td>
<td></td>
<td></td>
<td>p = N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = .03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Immunization history assessment (2006)</td>
<td>■ Ask patients to bring vaccine book to clinic (SM) ■ Assign health providers to assess vaccine history (DS) ■ Obtain history from provincial health office report for patients without vaccine books (IS)</td>
<td>1 (1/141) 55 (72/131) 80 (82/102)</td>
<td></td>
<td></td>
<td>p &lt; .001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p &lt; .001</td>
</tr>
</tbody>
</table>

(continued on page AP5)
### Appendix 2. Quality Improvement (QI) Activities and Related Performance Measurement (PM) Data for Related Indicators by Hospital, Thailand, 2005–2007 (continued)

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Indicator (Year of QI Activity)</th>
<th>QI Activity Examples (QI Category*)</th>
<th>2005 % (n/N)</th>
<th>2006 % (n/N)</th>
<th>2007 % (n/N)</th>
<th>p value for Trend</th>
</tr>
</thead>
</table>
| B        | Developmental assessment (2006) | □ Add developmental variable to medical record form (IS)  
□ Develop process in clinic to assess child development (DS) | 10 (1/10) | 57 (4/7) | 76 (76/100) | < 0.001‡ |
|          |                                 | □ Add developmental variable to medical record form (IS)  
□ Develop process in clinic to assess child development (DS) | p = .04 | p = .27 | | |
|          | Secondary sexual characteristic assessment (2007) | □ Add secondary sexual characteristic assessment to medical record form (IS) | 0 (0/85) | 27 (19/71) | 71 (49/69) | < 0.001† |
|          |                                 | □ Add secondary sexual characteristic assessment to medical record form (IS) | p < .001 | p < .001 | | |
| C        | Immunization history assessment (2006) | □ Meet patient care team to review problems (OS)  
□ Develop medical record form for vaccine (IS)  
□ Educate patients and caretakers during pre-clinic group education about importance of immunization (SM) | 74 (67/90) | 87 (70/80) | 71 (47/66) | 0.80‡ |
|          |                                 | □ Meet patient care team to review problems (OS)  
□ Develop medical record form for vaccine (IS)  
□ Educate patients and caretakers during pre-clinic group education about importance of immunization (SM) | p = .03 | p = .01 | | |
|          | Immunization according to the national program (2006) | □ Assess immunization history by doctor and nurse at every visit (DS)  
□ Train providers to give vaccines according to recommendation (DeS/DS) | 5 (3/67) | 67 (47/70) | 89 (42/47) | < .001‡ |
|          |                                 | □ Assess immunization history by doctor and nurse at every visit (DS)  
□ Train providers to give vaccines according to recommendation (DeS/DS) | p < .001 | p = .006 | | |
□ Refer patients with abnormal dental health to dentist (DS) | 73 (66/90) | 100 (80/80) | 74 (49/66) | .42† |
|          |                                 | □ Conduct oral health education and assessment in a camp for HIV–infected children (SM)  
□ Refer patients with abnormal dental health to dentist (DS) | p < .001 | P < .001‡ | | |
|          | Antiretroviral adherence monitoring (2007) | □ Develop antiretroviral adherence record form for the clinic (IS)  
□ Develop antiretroviral adherence measurement tools (IS)  
□ Analyze outcomes of antiretroviral adherence (IS)  
□ Review PM results in weekly HIV staff meeting (OS) | 97 (66/68) | 97 (35/36) | 100 (61/61) | .32† |
|          |                                 | □ Develop antiretroviral adherence record form for the clinic (IS)  
□ Develop antiretroviral adherence measurement tools (IS)  
□ Analyze outcomes of antiretroviral adherence (IS)  
□ Review PM results in weekly HIV staff meeting (OS) | p = 0.96 | p = .37§ | | |

(continued on page AP6)
## Indicator QI Activity Examples 2005 2006 2007  

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Indicator (Year of QI Activity)</th>
<th>QI Activity Examples (QI category*)</th>
<th>2005 % (n/N)</th>
<th>2006 % (n/N)</th>
<th>2007 % (n/N)</th>
<th>p value for Trend</th>
</tr>
</thead>
</table>
| D        | Immunization history assessment (2006) | ■ Add immunization variable in medical record form (IS)  
■ Develop reminder card for patients to bring vaccine book to the clinic (SM)  
■ Assign healthcare provider to review vaccine book (IS)  
■ Review PM results in weekly staff meeting (OS)  | 8 (8/96) | 100 (56/56) | 100 (97/97) | $p < .001^\dagger$ |
|          |                                 |                                    |             |             |             | $p = 1.00$      |
|          | CMV retinitis screening (2006)    | ■ Discuss QI plan with providers at pediatric HIV and ophthalmology clinics (DeS)  
■ Review eligibility criteria for CMV retinitis screening according to national guidelines (DeS)  
■ Refer eligible patients to visit ophthalmology clinics on the same day as HIV clinic (DS)  | 0 (0/7) | 67 (2/3) | 100 (5/5) | $< .001^\dagger$ |
|          |                                 |                                    |             |             |             | $p = .07^§$    |
|          |                                 |                                    |             |             |             | $p = .38^§$    |
|          | HIV disclosure to child (2006)    | ■ Review history and plan for HIV disclosure to child in a weekly meeting with psychologist and nurses (DeS)  
■ Train staff on counseling techniques for HIV disclosure to child (DeS)  
■ Add HIV disclosure variable to medical record form (IS)  | 26 (9/35) | 69 (20/29) | 73 (41/56) | $< .001^\ddagger$ |
|          |                                 |                                    |             |             |             | $p = .001$     |
|          |                                 |                                    |             |             |             | $p = .68$      |
|          | Clinical tuberculosis (TB) screening (2006) | ■ Add TB screening variable to medical record form (IS)  
■ Develop system in clinic to assess history of TB contact and TB symptoms (DS)  
■ Review history of TB screening for each child before clinic day (OS)  | 84 (79/94) | 98 (55/56) | 99 (96/97) | $< .001^\ddagger$ |
|          |                                 |                                    |             |             |             | $p = .007$     |
|          |                                 |                                    |             |             |             | $p = .69$      |
|          | Secondary sexual characteristic assessment screening | ■ Add secondary sexual characteristic assessment to medical record form (IS)  
■ Develop Tanner staging and picture card for clinic (DeS)  
■ Ask HIV–infected patients > 10 years old to identify their Tanner staging on the Tanner staging card (SM)  | 29(10/35) | 83 (24/29) | 100 (56/56) | $< .001^\dagger$ |
|          |                                 |                                    |             |             |             | $p < .001$     |
|          |                                 |                                    |             |             |             | $p = .004^§$   |

(continued on page AP7)
### Appendix 2. Quality Improvement (QI) Activities and Related Performance Measurement (PM) Data for Related Indicators by Hospital, Thailand, 2005–2007 (continued)

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Indicator (Year of QI Activity)</th>
<th>QI Activity Examples (QI Category*)</th>
<th>2005 2006 2007</th>
<th>p value for Trend</th>
</tr>
</thead>
</table>
■ Develop educational materials for the clinic (DeS)  
■ Arrange to have a dentist providing monthly oral health examination at HIV clinic (DS) | 90 (63/70) 100 (90/90) 100 (81/81) | < .001† |
|          |                                 | | p = .003§ | p = 1.00 |
■ Give fluoride to children (DS)  
■ Conduct “teeth beauty contest” in HIV clinic twice a year (SM) | 41 (12/29) 100(45/45) 100(50/50) | < .001† |
|          |                                 | | p < .001§ | p = 1.00 |
|          | Secondary sexual characteristic assessments (2006–2007) | ■ Inform stakeholders to assess Tanner staging for children > 10 years old (DeS)  
■ Post a reminder card on outpatient card to remind providers for Tanner staging assessments (IS) | 33 (14/43) 50 (21/52) 68 (32/47) | < .001‡ |
|          |                                 | | p = .43 | p = .006 |
|          | Clinical TB screening (2006)    | ■ Add TB screening variable into routine clinical form (IS)  
■ Create opportunistic infection (OI) prophylaxis forms to remind providers about eligibility of patients for OI prophylaxis (IS) | 47 (33/70) 100(90/90) 97.5(79/81) | < .001† |
|          |                                 | | p = .001§ | p = .22§ |
|          | PCP prophylaxis (2007)          | ■ Create opportunistic infection (OI) prophylaxis forms to remind providers about eligibility of patients for OI prophylaxis (IS) | 43 (15/35) 43 (9/21) 100(14/14) | .002† |
|          |                                 | | p = 1.00 | p < .001§ |
|          | MAC prophylaxis (2007)          | ■ Assign specific roles and responsibilities to pediatric HIV clinic staff for screening patients who are eligible for OI prophylaxis (OS)  
■ Conduct a meeting among providers to review forms (OS) | 0 (0/6) 33 (1/3) 33 (1/3) | .41† |
|          |                                 | | p = .13 | p = 1.00 |
|          | CMV retinitis screening (2007)  | ■ Conduct a meeting among providers to review forms (OS) | 17 (1/6) 67 (2/3) 0 (0/3) | 1.00† |
|          |                                 | | p = .13 | p = .08 |

*QI categories: IS, information systems; SM, self-management; DS, delivery of services; DeS, decision support; OS, organization of services.
† Cochran-Armitage Trend test.
‡ Test for trend.
§ Fisher Exact test.