ABSTRACT  America’s health care systems have not achieved the desired level of quality and safety. This may be due, in part, to the lack of clear and robust approaches for institutions to follow. Denver Health, an integrated, public safety-net institution, developed a multifaceted, structured approach to quality and safety improvement that has produced positive outcomes. For example, in 2010 Denver Health ranked first of 112 US academic medical centers in terms of actual mortality observed relative to the national mortality rate. Given these results, we argue that regulatory bodies should refocus their oversight to consider an institution’s overall structured approach to quality improvement and safety, instead of monitoring individual small outcomes, such as a patient’s receipt of antibiotics for pneumonia within six hours of arriving in the emergency department.

PATIENT AND PROVIDER SATISFACTION
Patient safety and quality have been important objectives for American health care for more than a decade. Although gains have been made in some focused areas, such as compliance with hospital discharge protocols for patients with a myocardial infarction, widespread improvements have eluded our health care system. One factor that could inhibit quality improvement efforts is the lack of a defined and replicable approach for health care systems to follow to achieve institutional quality and safety.

It seems unlikely that either aspiration or a series of uncoordinated efforts can improve health care quality. We describe a structured, multifaceted approach to quality and safety at one safety-net institution, Denver Health. The efficacy of such an approach may have health policy implications, because it could move regulatory bodies away from measuring individual processes and outcomes and toward assessing the robustness and aggregate nature of an institution’s approach to quality and patient safety.

The Organization
Denver Health is a public, academic health system and Colorado’s principal safety-net institution. The system includes an emergency paramedic system; an acute care hospital; all eight of Denver’s federally qualified health centers; twelve school-based clinics; the city’s public health department; a health maintenance organization; a 100-bed nonmedical detoxification unit; correctional care; and a call center that includes a poison center, a help line staffed by nurses, and centralized appointment and translation services. The system serves one-third of Denver’s adults and 40 percent of the city’s children. Almost half of the system’s patients are uninsured.

Although Denver Health’s structured approach to quality and safety began approximately seven years ago, a number of foundational elements were already in place, including an integrated health care system. We believe that this integrated system is the foundation for quality and safety because it provides people with geographically convenient access...
to care; seamless continuity of care across a person’s life and health care needs; and the right care, at the right time, with the right provider.

Another foundational element is that the system is staffed by 265 employed and salaried physicians, all of whom have academic appointments at the University of Colorado School of Medicine. This employed-physicians model promotes the alignment of goals across the enterprise and helps implement quality and safety interventions. There is no salary incentive plan that provides higher payments for more procedures, and that may reduce the overuse of resources and the use of unnecessary high-cost procedures.

An employed-physician model is not unique to Denver Health; such a model is used in academic health centers, many safety-net institutions, and other organizations. Moreover, although such an arrangement promotes the alignment of many goals and initiatives, there is nothing in Denver Health’s structured approach that depends on salaried employment.

The delivery of safe, high-quality, and efficient health care depends on the provider’s having comprehensive patient care information at the point of care. Denver Health is an advanced user of health information technology. The technology is also being used in other health care systems and will become more widespread in response to incentives in the Health Information Technology for Economic and Clinical Health (HITECH) provisions in the American Recovery and Reinvestment Act of 2009.

This foundation of an integrated system, employed academic physicians, and health information technology provided a springboard for Denver Health’s structured approach to health care quality and patient safety. At the same time, as a safety-net institution, Denver Health faces clear disadvantages compared to other health systems.

These barriers include limited resources coupled with a population of socially disadvantaged and clinically complex patients. For example, in 2009 the Denver Health system provided more than $100 million of care to patients classified as homeless. In 2010 the system provided approximately $382 million of uncompensated care to patients with no insurance. Denver Health has been in the black every year since 1991, but its 2009 operating margin was only 0.4 percent, leaving few resources for quality and safety initiatives.

Although characteristics of the health care system are important in achieving high-quality, safe, and efficient care, health is the result of mutual efforts by the patient and the care system. A safety-net institution’s patients are often society’s most vulnerable, including the poor, the mentally ill, and many non-English-speaking members of minority groups. For example, the majority of Denver Health’s patients have incomes below 185 percent of the federal poverty level. Three-quarters of the system’s patients are ethnic minorities, and one-third do not speak English. These patient characteristics embody health care disparities that impede the intended outcomes of a system’s quality and safety interventions.3

Denver Health’s leadership was inspired to begin a quality improvement journey in part because of these substantial challenges that it faced as a safety-net institution. The system’s leaders saw an opportunity to address the problem, and they were aware of new approaches that could be applied to health care.

**The Structured Approach**

Denver Health’s quality improvement approach involved four steps: creating a comprehensive approach to patient care; appointing a person or creating a department to take responsibility for quality and safety; creating programs to manage high-risk and high-opportunity clinical situations; and implementing systems to reduce variability in patient care processes and outcomes.

This quality-of-care and patient safety initiative was embedded in the framework of an existing comprehensive patient care approach that began seven years ago with a grant from the Agency for Healthcare Research and Quality. Denver Health called this effort “Getting It Right: Perfecting the Patient Experience.”4 Initially there were five linked components: the right environment for providing high-quality care; the right people to provide it; the right communication among providers and between patients and providers; the right reward for teams that took steps to address a financial or quality issue; and the right process. More recently, “right service” was added to reflect the need to consider the patients’ perception of their care. Each component contained elements that advanced patient safety and care quality.

**Right Environment** The “right environment” component focused on developing patient care spaces built for safety, quality, and efficiency. Examples include identical patient room layouts to avoid confusing the caregiver, particularly in an emergency; rooms to accommodate family members, including sleeping areas, to enable family involvement in patient care decisions; and distinct environments for high-risk, behavioral health, and correctional care patients.

**Right People** The “right people” component
focused on using talent-based hiring tools to select employees with values and work styles reflective of high performers. These tools have been validated by large, successful companies in their hiring processes. However, these tools are not widely used in health care, which is an industry that tends to focus on specific education and skill sets such as having a nursing, physical therapy, or medical degree along with specific experience. Denver Health uses a company that relies on talent-based screening tools to hire its employees; only 22 percent of that company’s clients are in health care.

**RIGHT COMMUNICATION** The “right communication” component focused on structured communication such as a clearly outlined set of reasons for escalation and detailed processes for escalation; checklists; and so-called geographic clustering of similar patient types. As an example of escalation, a nurse who did not get a timely reply to a question from a senior resident would be encouraged to contact the chief resident or the staff attending physician.

The technique of geographic clustering represents a change from typical hospital practice. In the majority of hospital settings, patients are seen at different times by nurses, doctors, pharmacists, and others. With geographic clustering, coupled with “team rounding,” the caregivers visit each patient as a team, which facilitates interdisciplinary communication. In addition, an anonymous online patient incident reporting system for reporting errors and near misses—occasions when a patient’s safety was almost endangered—was implemented. The system made it possible to track trends or system issues that were creating barriers to quality and safety.

**RIGHT REWARD** The “right reward” component featured monetary awards given to teams that substantively addressed a financial or quality issue. Of the 133 cash awards given to date, 57 were given for quality initiatives. These payments underscored that quality and safety were important, along with financial outcomes.

**RIGHT PROCESS** The “right process” component relied on the wide dissemination of the lean or Toyota Production Systems approach throughout the enterprise. Lean is a philosophy and tool set that focuses on reducing waste from the customer perspective. It is built on a philosophy of respect for people and continuous improvement, and it thus has a direct impact on organizational culture. The use of lean can dramatically improve and standardize processes and result in higher-quality, lower-cost care.

The implementation of the lean approach at Denver Health relied on 8 full-time facilitators and 225 internally trained “lean black belts”—people trained to lead process-improvement projects. There were sixteen areas of focus, called “value streams,” across Denver Health, including recently added clinical processes such as those that focused on cancer screening and the prevention of blood clots in hospitalized patients. More than 300 “rapid improvement events”—mechanisms for making radical changes to current processes and activities within a very short time frame—occurred in these focus areas during the past five years.

This comprehensive, broad, and multifaceted approach to “perfecting the patient experience” created the physical spaces and a culture on which specific quality and safety efforts could be built. Having the right people, and having them focused on doing work in the right manner to support each other and the patients, nurtured a culture of respect and commitment to improvement and quality.

**Identifying Quality And Safety Leaders**

The next step in Denver Health’s approach to creating high-quality care and patient safety was to identify a responsible person and department to lead this effort (see the Appendix Exhibit). Although decentralizing and integrating these strategies into every clinical department is important, we saw the need for a centralized and distinct department of patient safety and care quality to facilitate the application of a broad array of changes in process, organization, and teamwork. An associate medical director position was created, with the responsibility of developing goals and leading the department. This arrangement drew on the quality improvement literature, which demonstrates the association between developing broad and shared improvement goals and achieving substantial quality improvement, through the provision of
administrative support to mine data fields for quality improvement purposes, having strong physician leadership, and using credible and timely data feedback. Key new personnel appointed included a manager of regulatory compliance, a director of medical biostatistics and data warehousing, and a director of medical education, as well as additional infection control personnel. The manager of regulatory compliance played a central role in the overall quality effort by focusing on linking regulatory standards to patient safety and quality initiatives. The director of medical biostatistics also served a vital function in meeting the need to constantly measure, monitor, and report the outcomes of interventions. Objectively comparing valid, consistent, timely, and transparent measurements with established benchmarks enabled quality initiatives to spread and be sustained throughout Denver Health’s system.

The inclusion of a director of medical education within Denver Health’s Department of Patient Safety and Quality reflected the deep need for oversight of medical education in bringing about improvement in health care quality. Physicians-in-training are at the hub of care delivery systems, especially in safety-net hospitals and academic medical centers; thus, they must work in concert with evidence-based quality initiatives. This coordination has been facilitated at Denver Health by team rounding, checklists, and computerized physician order entry with standard order sets. (Standard order sets are similar to checklists used to ensure the accuracy and completeness of prescriptions, standardize patient care, and guarantee clarity when communicating medical orders.)

The inclusion of infection control in the Department of Patient Safety and Quality reflected a growing recognition of the severity of hospital-acquired infections. An infectious disease physician with epidemiology training was appointed to head infection control and was supported by qualified nurses. The new appointments placed within this department fostered the implementation of interventions in the high-risk areas discussed below.

**Managing High-Risk And High-Opportunity Areas**

The third element in Denver Health’s approach to creating high-quality care and patient safety included a set of programs to manage high-risk and high-opportunity areas. This reflected the notion that safety is not only freedom from injury or damage but also freedom from the risk of injury or damage. Some of the high-risk and high-opportunity areas identified in the relevant clinical literature were also identified at Denver Health (Exhibit 1). Each is discussed below.

**FAILURE TO RESCUE** “Failure to rescue” refers to failure to identify patients who are deteriorating and to intervene in a timely manner to prevent their deterioration. The recent study of postoperative mortality by Amir Ghaferi and coauthors stressed “failure to rescue,” rather than the number of complications, as the key variable in explaining differences in mortality rates across hospitals.

We were aware of hospitalized patients at Denver Health who gave evidence of clinical deterioration long before substantive interventions were activated. Thus, we opted to institute a rapid response system to identify such patients and intervene in their care. Given that the literature shows only modest evidence of success for common rapid response team approaches, we opted for a variation on those approaches.

We reviewed the literature and defined our own “clinical triggers.” For example, a systolic blood pressure of less than 90 mm Hg would activate the response system. Our system did not involve a separate team of responders. Instead, it used the patient’s intern and resident teams, who were called by the patient’s nurse in response to the presence of a clinical trigger.

**EXHIBIT 1**

<table>
<thead>
<tr>
<th>High risk/high opportunity</th>
<th>Approach</th>
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</thead>
<tbody>
<tr>
<td>Failure to rescue</td>
<td>Clinical triggers/rapid response system</td>
</tr>
<tr>
<td>Medical problems on surgical services</td>
<td>Hospitalist co-management or consultation</td>
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<tr>
<td>Antibiotic overuse or misuse</td>
<td>Antibiotic stewardship program</td>
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<tr>
<td>Central-line infection</td>
<td>Checklists/posting of results</td>
</tr>
<tr>
<td>Venous thromboembolism</td>
<td>CPOE-embedded prophylactic therapy guidelines</td>
</tr>
</tbody>
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**SOURCE** Denver Health internal document. **NOTE** CPOE is computerized physician order entry.
team members were expected to evaluate the patient at his or her bedside within ten minutes of the nurse’s call.

Using this new rapid response system, Denver Health reduced its cardiopulmonary arrest rate from a median of 5.9 per 1,000 discharges to 2.2 per 1,000 discharges ($p < 0.001$). The number of patients who required transfer back to the intensive care unit within forty-eight hours after being moved to hospital floor units also decreased significantly, from 4.62 to 3.27 per 100 intensive care unit transfers ($p = 0.03$).

Hospitalist Co-Management We instituted hospitalist co-management or consultation for all patients on the orthopedic service, patients on low-volume inpatient surgical specialty services such as oral maxillofacial and urology, and patients on the psychiatric ward with concurrent medical conditions. This arrangement promoted the care of these patients’ medical problems, such as diabetes or cardiac disease, by providers whose expertise was in these areas.

Antibiotic Stewardship Another Denver Health initiative was related to infectious disease care. Antibiotic use is considered one of the most important aspects of infection control. Overuse and underuse of antibiotics have been deemed by the Joint Commission to be an important barrier to quality improvement.

Almost 60 percent of Denver Health’s inpatients were being treated with an antibiotic during their hospital stay. Therefore, a formal and robust antibiotic stewardship program was established to provide careful oversight and guidance to our clinical services. This approach spawned new programs, including mandatory infectious disease consultation for certain common and serious infections; concurrent and timely feedback to a prescribing team when multiple antibiotics were used for the same patient; new rules-driven guidelines embedded within our computerized physician order entry system for common inpatient infections such as pneumonia and cellulitis; and formal weekly infectious disease consultant rounds with intensive care unit teams.

As a result, Denver Health’s antibacterial drug use, in days of therapy per 1,000 patient days, was the lowest of thirty-five US academic health centers reporting through the University HealthSystem Consortium. Moreover, proper treatment has increased and adverse consequences from illness have decreased for the highly prevalent Staphylococcus aureus bacteremia.

Catheter Checklists Nationally, central-line (intravenous catheter) infection is a common and costly hospital-acquired condition, which is associated with the deaths of 31,000 patients annually in the United States. The use of checklists has been demonstrated to dramatically affect this complication, and it therefore was a measure that Denver Health instituted. The use of checklists, strict measurement, and consistent posting of infection rates resulted in a dramatic decline in the rate of central line–associated bloodstream infections in all of the system’s intensive care units. A median infection rate of zero was sustained for many consecutive months.

Reducing Postoperative Blood Clots Another high-risk hospital-acquired condition is venous thromboembolism, or blood clots occurring after surgery. These blood clots are the most common preventable cause of hospital deaths, and each blood clot that is prevented avoids $25,000–$40,000 in medical costs.

A lean rapid improvement event team focused on the proper and cost-efficient use of prophylactic anticoagulation—use of blood-thinning medication—with high-risk inpatients. Low-molecular-weight heparin, a medication used to prevent postoperative blood clots, had become the most costly line item in the hospital pharmacy’s budget. Yet our incidence of these postoperative blood clots was much worse than national benchmarks.

The team produced an evidence-based risk-assessment tool and a clinical practice guideline, which were embedded into admission order sets in the computerized physician order entry system. Compliance with the guideline is now approaching 100 percent, the overall use of low-molecular-weight heparin has decreased more than 60 percent, and the occurrence of these blood clots has decreased in frequency. Our performance in preventing venous thromboembolism is now in the top 10 percent of outcomes nationwide.

Targeting Outpatients For Quality Improvement

The aforementioned interventions have all focused on hospitalized patients. Improving ambulatory care poses unique challenges. Despite the fact that there are currently 900 million outpatient visits annually in the United States, compared to 35 million hospital discharges, there has been less effort directed toward improving the quality of outpatient care.

However, with the growing focus on medical homes and health reform’s emphasis on accountable care organizations, it is crucial that high-quality care is also delivered to outpatients. Denver Health has embarked on outpatient quality initiatives using its integrated health information technology system, along with a robust data warehouse and dynamic patient registries.
The system now has a mature immunization registry that enables Denver Health to achieve an 88 percent immunization rate among one-year-old patients. The health system was awarded the prestigious Codman Award by the Joint Commission for this effort. There are similar registries for asthma, trauma, cancer screening, hypertension, diabetes, anticoagulation, and obstetric care.

These registries trigger improved quality by providing aggregated point-of-care (care delivered during an office visit) performance data by specific clinic site and specific clinician to make the data available for audit and feedback. The cancer registries’ patient-specific data serve as a visual prompt to the physician during a patient encounter, reminding the physician to encourage the patient to comply with recommended breast, cervical, and rectal cancer screening. These registries are also tools for proactive management and outreach to patients between visits. As a result, 70 percent of patients with hypertension have their blood pressure controlled, and more than 50 percent of diabetic patients have their low-density lipoprotein cholesterol, or “bad” cholesterol, values at the target level.

**Focusing On Process For Better Care**

The fourth element in Denver Health’s approach was more uniformity in patient care processes, such as the administration of preoperative antibiotics. This was achieved through both the meaningful use of health information technology and the implementation of lean’s core concept of standard work, which states that there is one consistent way to do a process.

Despite the usefulness of computerized physician order entry systems, only 17 percent of health care institutions have implemented them, and even fewer are using these systems with decision support—reminders and links for physicians about guidelines and best practices. Denver Health has had computerized physician order entry systems for almost five years and has linked these systems with standard order sets to enable evidence-based care as the standard approach. Computerized physician order entry systems eliminate handwriting errors; enable pharmacies to check doses, allergies, and drug interactions; and produce clinician alerts. Approximately 250,000 inpatient orders are entered each month into the Denver Health system.

As a result of this structured approach to quality and safety, Denver Health was ranked first of 112 academic medical centers, with the lowest (0.55) observed-to-expected mortality ratio—the ratio of actual deaths at Denver Health compared to national death trends—in the 2010 University HealthSystem Consortium’s Quality and Accountability Aggregate Score. In 2008 Denver Health was ranked twenty-eighth in this indicator. (The consortium is an alliance of academic medical centers and their affiliated hospitals, representing approximately 90 percent of US nonprofit academic medical centers.)

This improvement in the observed-to-expected mortality ratio occurred despite a progressive and sustained increase in Denver Health’s case-mix index, which measures the severity and acuity of patients’ medical conditions.

In addition, in January 2011 the Colorado Department of Public Health and Environment released the most current (2007–09) risk-adjusted trauma inpatient mortality for all level 1 trauma facilities in Colorado. The mortality rate for Denver Health was the lowest in the state, with a mortality odds ratio of 0.74. This means that the mortality rate at Denver Health was 26 percent lower than would be expected for a hospital in Colorado with its case-mix. Also, Denver Health’s cesarean section rate has been the lowest of all consortium hospitals for two years, with no unexpected full-term fetal mortality. Moreover, the success of Denver Health’s quality quest is evident in a marked reduction in the number of annual sentinel events (the most serious and preventable). In 2010 Denver Health had only two sentinel events across the entire system. In 2009 it had nine, and in 2008 it had thirteen.

**Conclusion**

The Denver Health experience demonstrates that care quality and patient safety can be advanced within America’s health care institutions, even in organizations challenged by lack of resources and by socially disadvantaged patients. Denver Health demonstrates one pathway. Its integrated system of care, employed medical
staff, and strong health information technology infrastructure has allowed the creation of a structured approach to patient safety and quality of care.

Our approach includes the designation of a responsible person and department for quality and safety that focuses on high-risk clinical areas, uses standardized care based on rigorous scientific evidence, and is supported by transparent and robust real-time performance data that can be used for peer comparisons. The Denver Health experience suggests that regulatory entities might achieve the substantial results in quality improvement that they desire by increasingly focusing their assessments on an institution’s or organization’s overall structured approach to improving quality and on broad outcomes, rather than by focusing on narrower outcomes related to the care of individual patients.

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NOTES

8 To access the Appendix, click on the Appendix link in the box to the right of the article online.