SECTION 3: CASE STUDIES

Improving Care Through Collaboration

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ABSTRACT. The opportunity to improve health care using existing scientific knowledge is immense. Much is known that is not being used in routine care, leading to a large gap between knowledge and practice. Collaborative improvement models bring health care professionals together to focus on this gap and to accelerate the pace of improvement in their organizations. This article describes one such model, the Institute for Healthcare Improvement’s Breakthrough Series Collaborative model. Lessons are drawn to help inform future collaborative efforts that focus on the improvement of care. Pediatrics 1999;103:384–393; collaboration, quality of care, improvement, cooperation, outcomes.

ABBREVIATIONS. MI, myocardial infarction; IHI, Institute for Healthcare Improvement; BTS, Breakthrough Series; ICU, intensive care unit; LGH, Lawrence General Hospital; CHW, Children’s Hospital of Wisconsin; PICU, pediatric intensive care unit; NNE, Northern New England Cardiovascular Disease Study Group.

“...that there shall develop a final, cosmopolitan system of medicine which will combine the best elements to be found in all countries.” —Charles H. Mayo, MD, 1930, Mayo Clinic

“Our future as clinicians will depend on our ability to work together and to lead the continuous improvement of health care.” —William Nugent, MD, 1996, Chief of Cardiothoracic Surgery, Dartmouth-Hitchcock Medical Center

Collaboration—it literally means laboring together. The word raises visions of intention—people working together toward some worthy goal. There is a sense of purpose, of collegiality, of sweat, and of joint learning. The word feels like hard yet rewarding work. For most in health care, it feels familiar.

A MEDLINE search on collaboration gives references on: 1) research collaboratives such as the AIDS Clinical Trial Groups, 2) interpersonal collaboration discussing the need for professionals to work together, and 3) improvement collaboratives where cross-functional teams from different departments or organizations join together to improve the care they provide. In this article, I will discuss the latter—using collaboration to improve health care quality, satisfaction, and finances.

This article is about collaborative improvement methods that accelerate the rate of diffusion of existing science into clinical practice. It is about improving care based on what is already known using multi-institutional or multi-site work groups. The opportunity to do so is immense.

Given the nature of clinical medicine, one would anticipate that collaboration is a central operating principle in our profession. Instead, health care is a study of contrasts regarding collaboration.

On one hand, health care is steeped in collaborative experiences. As individuals, we often work closely together—physician and nurse, nurse and pharmacist, one physician and another consulting physician. Indeed, the very nature of caring implies a collaborative relationship between health professionals, patients, and their families. The full gamut of patient care is rarely achieved by a single individual acting alone.

On the other hand, our difficulty with collaborative relationships is exemplified daily in Harvard’s Center for Medical Simulation and other such simulated environments. The Center is a mock operating room where anesthesiologists, surgeons, and nurses come together to simulate patient care. Established scenarios are played out using a computerized patient and crises evolve that require intensive team interactions to resolve. Sessions are videotaped and subsequently reviewed by the caregivers. Failure is common—the “patient” frequently expires.

When analyzing tapes of these sessions, it is clear that cooperation and collaborative behaviors are often lacking. Information is not shared; help is not requested (often pride prevents us from asking for help); communication skills are poor; anger is not uncommon. These experiences demonstrate the need for improved knowledge and use of cooperative and collaborative behaviors in health care. The Center also simulates critical care units, emergency departments, and other situations with similar results.

Beyond the level of individual interactions, the necessary knowledge and opportunities for groups or organizations to work effectively together is also rare. To an extent, this construct is embedded in health care’s culture. Physicians are generally trained to be fully independent in thought and action—they often do not view themselves as being dependent on others in the provision of care. Physician culture leads toward independent action, not toward group improvement activities where intensive sharing of information is the norm. They think and act in singular—my patient, my office, my actions. This insu-
lar nature of clinical medicine is compounded by the lack of detailed information on current clinical practice that challenges existing attempts to improve the provision of clinical care.\(^2\)

Health care lacks a robust understanding of collaborative improvement. The content of our interactions speaks loudly on this issue. Although we speak about technical aspects of patient care, rarely do we discuss details of the provision of care. For example, it is common to hear a conversation between physicians on optimal care of patients after a myocardial infarction (MI). One of the elements of that conversation would undoubtedly focus on the use of aspirin for secondary prevention. In contrast, it would be distinctly unusual to hear clinicians discuss methods of assuring that all eligible patients receive aspirin post-MI. This is not so much a conversation about decision-making and prescribing care as it is a conversation about creating systems that automatically provide the highest quality care. The concept of systems is a crucial one. It moves away from a focus on the individual and toward the essentials of how care is provided.

The lack of collaborative opportunity is exacerbated in the current environment of heated competition and productivity pressures; little time and few opportunities are available for providers to meet each other on common clinical grounds.

However, I believe that this is neither a normal or natural state—human beings, in general, and health care workers, in specific, will collaborate toward the improvement of care if given the proper environment and opportunity.\(^3\) As health care has begun to focus on quality, the desire for, and advantages of, collaborative behavior are becoming clear as demonstrated by several recent collaborative efforts to improve care.\(^2,4,5\)

Other industries, even those more competitive than health care, take advantage of collaborative opportunities. Consider semiconductor manufacturing, for instance, where competition and the pace of innovation is extraordinary, and where brief lapses in technological edge can lead to corporate demise. Nonetheless, 10 of the largest US semiconductor manufacturers including Intel, Motorola, Texas Instruments, Digital, Advanced Micro Devices, and others have joined forces to perform applied research together in a company called Semanteck (Austin, TX). They understand the win-win dynamic established by an atmosphere of collaboration.

As discussed below, powerful motivators for collaboration (see Table 1) in clinical care do exist. It was in this light that the Institute for Healthcare Improvement (IHI) developed a series of collaborative projects in 1995 called the Breakthrough Series (BTS). The vision of IHI is to be an integrative force in health care—to bring people and organizations together to work towards its continual improvement. It is in this spirit of cooperation and collaboration that the BTS was born.

In this article, the motivating factors behind numerous collaborative improvement efforts will be examined. IHI’s BTS will be used as a model for collaborative improvement and examples from several participating organizations will be provided. Lastly, general lessons pertaining to collaborative improvement initiatives will be discussed. In the end, this article aims to provide a deeper understanding and stimulate a broader use of collaborative improvement methods.

**MOTIVATIONS FOR COLLABORATIVE IMPROVEMENT MODELS**

When existing collaborative improvement efforts are examined, the driving forces behind them are remarkably similar. These forces will be explored in this section.

First, a substantial gap exists between current knowledge and the actual provision of care. In other words, there is a great deal of knowledge that is simply not being used. For example, much is known about caring for asthmatic patients including when and how to use inhaled steroids, yet this knowledge often goes unused in the routine care of those who could benefit from it.\(^6,7\) Likewise, despite numerous clinical trials demonstrating the beneficial effects of antenatal steroid treatment in premature infants, the use of this treatment remains suboptimal.\(^8\) A 1996 analysis showed that 25% of 196 neonatal intensive care units treated <56% of infants weighing between 501 to 1500 g.\(^9\) The diffusion of proven findings is unacceptably slow in health care. Collaboration helps to expose these gaps and accelerate the diffusion of existing knowledge into practice.

Second, broad variation exists in the provision of care for comparable patient populations. This variation includes the use of diagnostic tests, surgical procedures, and pharmaceutical agents that cannot be explained by differences in population demographics or risks.\(^10\) Like the gap between knowledge and practice, collaboration exposes variation and reduces it as practices gravitate toward higher performance standards.

Third, examples of improved practices exist but are often poorly described and disseminated to other organizations. Despite abundant literature describing practices that should or should not be done, little is written about *how* to do or not to do these things. Knowing that one should do something is not equivalent to knowing *how* to do it. Although this seems obvious, it is more evasive in reality. Most clinicians know that aspirin should be given to patients after a MI, yet its use remains unacceptably low.\(^11,12\) Therefore, the challenge lies in understanding and disseminating the knowledge of “*how to*”—application or *improvement knowledge* that helps assure that patients receive the best possible care.

There is a science of improvement rooted in statistics and theories of adult learning that is generally unknown in health care.\(^13-17\) This science uses the

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**TABLE 1. Motivators for Collaborative Improvement**

| 1. | A substantial gap exists between knowledge and practice |
| 2. | Broad variation in practice is pervasive |
| 3. | Examples of improved practices and outcomes exist |
| 4. | Existing professional boundaries inhibit improvement |
| 5. | Outcomes are the results of systems of care, not just individuals |
scientific method, systems theory, real-time performance measurement, psychology, and methods for the diffusion of innovations to improve care.18–21 Collaboration fosters an environment where improvement knowledge can be learned and used.

Fourth, health care professionals, physicians in particular, have not been trained to, and often do not, work well across professional boundaries.22 Physicians often have a poor understanding of other professions and often undervalue the intellectual contribution of nurses, physical therapists, and others. Health care leaders have relegated pharmacists to behind-the-counter drug dispensation instead of using them for their clinical pharmaceutical expertise. Collaboration provides opportunities for professionals with diverse yet synergistic skills to work together to solve difficult clinical problems. Collaboration enables the synergism.

Fifth, although physician culture is defined by fierce independence, no health care provider is solely responsible for patient outcomes. A single physician cannot manage patients in a neonatal intensive care unit without the help of nurses, laboratory technicians, respiratory therapists, consulting physicians, pharmacists, and others. We are all parts of complex systems and it is these systems of care that produce health outcomes, not just individuals. To optimize outcomes, we must, therefore, focus on systems. Collaborative projects remove us from our silos and provide a much clearer picture of the overall system. They change our focal plane.

Collaboration is an understanding that improvements in patient care are achieved more effectively by working together and focusing on systems than they would be by working independently and focusing on individuals. The vision is of doctors, nurses, pharmacists, and managers working together across departmental or institutional boundaries to improve their systems of care: nursing units meeting to share information; institutions working jointly toward common improvement aims; and, crossing industry boundaries to learn from each other. The benefits of collaboration are clear. When we work together:

- Our total knowledge and understanding is greater than when we work separately.
- We increase the probability of successfully discovering solutions to problems.
- Solutions focus on systems of care and not on individuals.
- Solutions are more integrative.
- Participation in problem-solving processes increases acceptance of the solutions.17
- Meaningful relationships are built and are the key to future improvement.22

Most clinicians are aware of the value of immunizations, of the lack of utility in treating most upper respiratory tract infections with antibiotics, and of the lack of utility of using H₂-blockers and proton pump inhibitors simultaneously. Unfortunately when common practice is examined, we find that this basic knowledge is often not being put into effective action. Yet most health care providers are highly motivated to provide the highest quality care possible. How can this contrast exist? It exists in large part because of the insularity of health care professionals and their failure to understand and use the science of improvement. To address this contrast, health care professionals must change the way they work. One powerful way of doing so is through collaborative experiences.

THE IHI'S BTS: A COLLABORATIVE IMPROVEMENT MODEL

The BTS is an improvement method that relies on the spread and adaptation of existing knowledge to multiple, similar sites to accomplish common aims. The BTS model is shown in Fig 1. Each BTS Collaborative consists of 20 to 40 organizations working together for approximately 6 to 12 months on a specific topic and utilizes three 2-day Learning Sessions. Thus far, more than 450 teams have participated from more than 300 organizations. Table 2 lists completed, ongoing, and upcoming Collaboratives. Some topics are being repeated.

In addition to addressing the issues outlined in the previous section, the BTS seeks to: 1) find, describe, and diffuse best practices throughout Collaborative organizations; 2) improve outcomes in participating organizations by understanding their systems of care and changing them rapidly, yet safely; 3) develop health care expertise in the science of improvement within each topic area; and 4) disseminate and deploy knowledge gained during the Collaboratives as

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**Fig 1.** IHI’s BTS model. LS indicates Learning Session; PDSA indicates Plan-Do-Study-Act Cycles.
TABLE 2. IHI BTS Topics

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<td>• Reducing Delays and Waiting Times (I &amp; II)</td>
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<td>• Reducing Cesarean Section Rates While Maintaining Maternal and Fetal Outcomes (I &amp; II)</td>
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<td>• Improving Asthma Care</td>
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<td>• Reducing Adverse Drug Events (I and II)</td>
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<td>• Improving Prescribing Practices</td>
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<td>• Improving Care at the End of Life</td>
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<td>• Reducing Waits and Delays and Improving Patient Satisfaction in the Emergency Department (I)</td>
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<td>• Reducing Adverse Drug Events (II)</td>
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<td>• Improving Efficiency and Access to Care in Physician Offices and Clinics</td>
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<td>• Improving Service in Health Care (I)</td>
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<td>• Reducing Costs and Improving Outcomes in Adult Intensive Care (II)</td>
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<td>• Reducing Costs and Improving Outcomes in Adult Cardiac Surgery</td>
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Ongoing

|                                                                 |                                                                 |
| • Improving Care for Chronic Conditions—Diabetes and the Frail Elderly (I) |                                                                 |
| • Reducing Waits and Delays and Improving Patient Satisfaction in the Emergency Department (II) |                                                                 |
| • Improving Care for Chronic Conditions—Diabetes and Congestive Heart Failure (II) |                                                                 |
| • Improving Care for Patients Approaching the End of Life with CHF and COPD |                                                                 |

Upcoming

|                                                                 |                                                                 |
| • Reducing Waits and Delays and Improving Patient Satisfaction in the Emergency Department (II) |                                                                 |
| • Improving Care for Chronic Conditions—Diabetes and Congestive Heart Failure (II) |                                                                 |
| • Improving Care for Patients Approaching the End of Life with CHF and COPD |                                                                 |

broadly as possible to others in the health care community.

The following is a brief description of the key components of the BTS.

1. Identifying Topics for Collaborative Improvement

“Ripe” topics for improvement are selected using four criteria: 1) sound scientific evidence suggests improved approaches compared with prevailing practices (ie, a “gap” exists between knowledge and prevailing practice); 2) at least a few systems or practitioners are performing at a higher level using this knowledge; 3) both organizations and patients would benefit from “closing the gap;” and 4) national tension for improvement exists in the topic area. In a prior article, Berwick suggested several such topics. Using the criteria above, it is easy to identify many more.

2. Identification and Consolidation of Relevant Knowledge

The challenge in identifying and consolidating knowledge for improvement is that is goes beyond typical knowledge found in the medical literature. Not only must you understand what to do (scientific knowledge), you must also understand how to do it (improvement knowledge). To achieve this, researchers familiar with the topic, along with practitioners who have achieved documented cutting-edge performance, are invited to join an expert Planning Group whose role is to clarify the nature of the gap and to consolidate the scientific and improve knowledge. For example, the Planning Group for the Collaborative on Reducing Cesarean Section Rates While Maintaining Maternal and Infant Outcomes included an obstetrician from Green Bay, Wisconsin, where rates had been reduced successfully from 18% to 8% in slightly over 3 years.

Chaired by an individual with national prominence in the field, each such Planning Group establishes numerical goals that could be achieved if the best available science were used. They identify knowledge that is ready for wider deployment and testing. Sources of knowledge “ripe for testing” include clinical trials, extensive data-based practice experience, expert opinion, analysis of one’s own past performance, or solid scientific theory. Planning Groups also explore and suggest measurement systems specific to the topic.

Concepts used in the Collaborative on Improving Asthma Care included, for example, “develop organizational agreement on a standardized asthma assessment tool,” “increase use of inhaled anti-inflammatory agents,” and “streamline crisis management.” For BTS Collaborative on Reducing Adverse Drug Events, concepts derived from human factors engineering and related sciences included “reduce reliance on short-term memory,” “reduce handoffs,” and “standardize.”

As such concepts are identified, improvement knowledge is used to put these concepts into practice. In the treatment of asthma, for example, it is necessary but not sufficient to know that the use of inhaled anti-inflammatory agents should be increased. Improvement demands that we know how to apply this concept—how to establish systems that assure appropriate use of these agents. The Planning Group elaborates in detail on concepts like these in lectures, conference calls, written materials, and coaching sessions.

It is the synergy between scientific knowledge and improvement knowledge that enables improvement to occur at the patient level.

3. Recruitment and Preparation of Collaborative Participants

For each topic, IHI issues a national call for participants—organizations serious about making demonstrable improvements at an unprecedented rate. Interested organizations must complete an application, show evidence of senior executive commitment to the aim, and be willing to contribute to the budgetary requirements of the Collaborative. Once an application has been accepted, IHI sends preparatory work and arranges an initial conference call. IHI works with each organization to establish specific organizational goals that are clearly stated, data-based, numerical, and grounded in the knowledge developed by the Chair and Planning Group.

Critical to success is the ability of an organization to identify the right individuals to participate in this work, and to secure the time and resources necessary to achieve the aim. Individuals should be chosen based on their knowledge of the system and interest in the aim. Teams vary in size and composition from organization to organization, but each should have representation from three different domains: system leadership, technical expertise, and day-to-day leadership.

A system leader is someone with enough clout in the organization to leverage resources and change
policy when necessary. When a change is suggested, this person should have the authority to get it done. When time and resources are necessary, this individual should have the authority to allocate them. Examples of a system leader include a vice president, chief of medical staff, or a division head.

A technical expert is a subject matter expert—someone who knows the subject intimately, is trusted by other clinicians in the organization, and understands the processes of care. This individual should be an opinion leader in the institution—someone that others respect and seek for advice. Additional technical expertise may be provided by an improvement expert who can help a team understand what needs to be measured, design simple, effective measures, and collect, display and interpret data. Examples of a technical expert include a highly respected intensivist if the Collaborative topic is on improving care in the critical care unit, or the head of obstetrics if the topic is reducing cesarean section rates.

A day-to-day leader is a person who works in the process on a daily basis and who will be persistent in assuring that the necessary work is completed. This individual will be the critical driving component of the team, assuring that tests of change are performed and data are collected. Examples of a day-to-day leader include a nurse manager of the labor and delivery floor if the topic is reducing cesarean section rates, or a pharmacist if the topic is reducing adverse drug events.

All teams should have at least one active physician champion. The greater this individual’s influence with other clinicians, the more effective they will be in engaging them in the process of change.

4. The Collaborative Process

For a period of up to 12 months, participants engage in a series of structured activities designed to advance their improvement work as rapidly as possible. Participating organizations meet together at three 2-day “Learning Sessions” during this period where they learn from the Planning Group, clarify the science, plan their own tests of change, and learn from each other’s efforts. The term “Learning Session,” although now fixed in our jargon, can be deceptive. The participants not only learn from the experts, but work closely with them and with each other to refine the science of improvement in each topic. Jointly laboring in this process, participants grow in knowledge and understanding together, and they become bound in the act of improvement.

Between Learning Sessions, the collaborative experience is sustained. Participants remain linked with each other through weekly conference calls (often involving experts on specific topics, such as anesthesia practices in labor, or proper analgesia in the intensive care unit [ICU]), e-mail “listserv” discussion groups, and monthly exchange of printed reports. They visit other Collaborative institutions, examining firsthand differences in systems of care—an extremely powerful and underutilized learning and motivating experience.

Throughout the Collaborative the focus is on results with a strong, early emphasis on establishing performance measurement systems within participating institutions. Results depend on the performance of numerous planned, structured tests of change while collecting data to learn from those tests. Such tests of change are not equivalent to clinical trials; the changes tested are not the turf for institutional review boards. The ideas being tested are, in general, already proven in the literature, successfully used elsewhere, and supported by experts in the field.

The purpose of testing change is iterative inductive-deductive learning about, and change in, our systems of care to achieve documented improvements in outcomes. Several thorough descriptions on the topic of testing change and using the scientific method in clinical care recently have been published.26–33

5. The Deployment of Knowledge

Each Collaborative concludes with a public “National Congress” where participants become faculty and national experts on improvement of the topic. Others working on improvement in the field outside of the Collaborative are also invited to present. The most useful scientific and improvement knowledge, measurement methodologies, lessons, and results are also consolidated into a monograph Guide to Improvement and articles are prepared for publication in peer-reviewed journals.26–33

Other Features of the BTS Model

Two additional features of the BTS model are worth exploring to give insight into future collaborative designs. First, BTS Collaboratives are limited in time (6 to 12 months) and focused on using joint learning to foster rapid, intraorganizational improvement. This creates tension for change. Participants set difficult goals and must work hard to achieve them in a limited amount of time. This necessitates close interaction within and between organizations.

Second, each organization collects and maintains its own data. Because each organization can choose to work on those issues most important to them, common data collection is not performed. Our emphasis is on building the internal capabilities of participants to collect, analyze, and display data beyond the lifetime of the Collaborative.

CASE STUDIES OF ORGANIZATIONAL IMPROVEMENT

This section will provide examples of successful improvement resulting from the BTS Collaborative process. Because any one of the following case studies could have occurred outside of the Collaborative environment, what does collaboration add? Collaboration makes it possible for subject matter and improvement experts to understand each others’ terrain and to package knowledge so that it is actionable—allowing front-line caregivers to put the science into practice.26–30,33 Collaboration accelerates the pace of improvement by exposing individuals and organizations to each other in an intellectually safe environ-
ment where sharing is the norm. This creates tremendous motivation for improvement.34

Reducing Cesarean Section Rates While Maintaining or Improving Maternal and Fetal Outcomes

The cesarean section rate in the United States has escalated from <10% to 24.5% over the last 25 years with no substantial evidence of improved maternal or fetal outcomes.33 Other industrialized countries currently achieve substantially lower rates with good outcomes.

Lawrence General Hospital (LGH), Lawrence, Massachusetts, entered the BTS Collaborative on Reducing Cesarean Section Rates with an aim of reducing their cesarean section rate by 30% in 12 months while maintaining or improving maternal and infant outcomes. LGH helps deliver approximately 1600 babies annually. Their measurement system captured data pertinent to their aim including total, primary, and repeat cesarean section rates, admissions for false labor, use of epidural anesthesia, fetal Apgar scores, and more. Data were summarized monthly (see Fig 2.)

The LGH team included obstetricians, anesthesiologists, labor and delivery nurses, senior management, and others. The following are examples of changes tested by this team and supported by the literature.33

Hospital admission for women in false or very early labor can lead to anxiety and a feeling that something should be done to accelerate the process. When unnecessary or early admission occurs, or when labor is proceeding slowly, there is a tendency toward increasing intervention that often cannot be justified by the literature and can increase the likelihood of unnecessary cesarean section. Examples of such interventions include electronic fetal monitoring, the use of induction agents such as Pitocin, and use of epidural analgesia. Other factors that can increase the probability of cesarean sections include a fear of litigation, poor management of the labor process, undue patient expectations, and a false belief that vaginal delivery is contraindicated after a previous cesarean section.30

After a rapid analysis of their processes and outcomes, the staff at LGH developed a policy for reducing admission for false labor and for low-risk patients with <4 centimeters of cervical dilation. To improve the appropriateness in the use of Pitocin, a protocol including criteria for use was developed, tested, and instituted. They standardized the concentration of Pitocin, but left dosing orders up to individual physicians.

To manage expectations regarding the safety and desirability of vaginal birth after a previous cesarean section, an educational program for patients and providers was developed. This program provides support to women early rather than later in pregnancy. Last, provider performance data were distributed to each obstetrician allowing them to learn from their differences with their colleagues.

The use of performance feedback to lower cesarean section rates is discussed elsewhere in this issue.35

Reducing Costs and Improving Outcomes in Adult Cardiac Surgery

Wide disparity exists in the provision of care for cardiac surgery patients. For example, some hospitals maintain median postsurgical ventilator times of <6 hours with excellent outcomes while others keep patients ventilated for over 12 to 24 hours. Although there is no scientific evidence to suggest that longer ventilation times are beneficial, there are substantial theoretical reasons to seek reduced ventilator times. Shorter ventilation times reduce the risk of nosocomial infections, improve postoperative ambulation, reduce the need for sedation, reduce overall ICU stays, and reduce patient anxiety and discomfort.36

At Covenant Health System’s Parkwest Medical Center in Knoxville, Tennessee, ventilator times were successfully reduced from a median of 20 hours to 12 hours between 1993 and 1996. On entering the IHI’s BTS Collaborative on Reducing Costs and Improving Outcomes in Adult Cardiac Surgery, staff from Covenant quickly appreciated the advantage of reducing ventilator times more dramatically. One of their aims was to reduce median ventilation time for all coronary artery bypass patients to <6 hours.

Their measurement system included time from ICU admission to extubation, reintubation rates, number of arterial blood gases performed per case, number of hours on mechanical ventilation, and more. They used these data in conjunction with the IHI’s bundle of care to lower their ventilation times.

Fig 2. Cesarean section rates, LGH, Lawrence, Massachusetts—approximately 400 deliveries per quarter; baseline cesarean section rate = 23% in the first quarter of 1995.
pulmonary complications, and length of stay in the ICU. Data were collected on all patients without exclusions (see Figs 3 and 4.)

After studying the procedures and data of other organizations in the Collaborative, the Covenant staff determined that three changes were central to rapid and safe postoperative extubation.

1. Alterations in anesthesia can insure that patients are spontaneously ventilating and ready to extubate within several hours after surgery. The traditional use of high intraoperative doses of narcotics and sedatives lead to prolonged sedation and is unnecessary. Likewise, neuromuscular blockers can be titrated and reversed at the end of the procedure allowing for early spontaneous ventilation.

2. Small, frequent doses of narcotics can be used to manage postoperative pain instead of traditional large doses that lead to prolonged sedation and respiratory depression. More rapid extubation itself affords pain reduction through relief of the anxiety associated with intubation.

3. Nurses and respiratory therapists are capable of using weaning protocols to assess and move patients toward extubation. Once sufficiently trained, they can proceed with extubation and ongoing respiratory monitoring. The key components of an effective postoperative weaning protocol include a well-trained staff and clearly defined weaning criteria that must be met before extubation.

Improving Prescribing Practices

Despite the value of nutrition in critically ill patients, nutritional concerns often go overlooked in busy ICUs. Poor nutrition can increase susceptibility to infection and make ventilator weaning more difficult. Staff at Children’s Hospital of Wisconsin (CHW) assessed nutritional practices in their pediatric ICU (PICU) as a part of IHI’s BTS Collaborative on Improving Prescribing Practices and realized the gap between current knowledge and their practices. They established an aim of placing at least 75% of PICU cardiovascular patients on enteral feedings within 24 hours of meeting criteria.

To achieve this aim, CHW tested and then instituted several changes. They developed an algorithm for automatic assessment and initiation of nutrition unless specific exclusion criteria were met. CHW dietitians began rounding in the PICU. They revised the nursing flow sheets to include “initiation of enteral feedings.” And, academic detailing was conducted to discuss nutrition with clinicians in face-to-face meetings.

Their results were shared openly and were impressive. The percentage of patients receiving feedings within 24 hours of meeting criteria rose from 50% to 90%, average overall days from admission to feeding in the PICU decreased from 12 to 4, and the overall incidence of infection was reduced almost 50%. (See Figs 5 and 6.)

LESSONS FOR COLLABORATIVE IMPROVEMENT EFFORTS

Limited duration, organizational ownership of data, and a focus on action and results are intentional features of the BTS. The BTS is designed as an improvement collaborative and not a research collaborative in its traditional sense. Our “research” concerns topics such as organizational change, effective
leadership, and methods of data collection as opposed to traditional clinical or epidemiologic research.

An examination of existing collaborative efforts reveals a spectrum of purpose and design worth exploring to inform future collaborative efforts. At one end of this spectrum exists the pure improvement collaborative and at the other end lies clinical epidemiology. By clinical epidemiology, I refer to those joint efforts where data collection and analysis are the primary activities, although improvement is the goal. This does not include clinical investigative projects such as the AIDS Clinical Trials Groups because their purpose is to perform clinical studies. Nor does this scheme include pure benchmarking efforts that only seek to provide comparative data analyses for similar organizations.

The BTS falls solidly on the improvement side of this spectrum with little emphasis on epidemiology while other efforts fall toward the pure epidemiology side. Still other collaborative efforts exist somewhere along the spectrum. In fact, a collaborative’s emphasis can vary with time, depending on the needs and availability of existing knowledge as a basis for action.

The purpose of epidemiology-focused collaboratives is investigation—leveraging increased patient and data availability from multiple organizations or sites to develop new clinical knowledge. The emphasis is on data that is standardized across organizations and often extracted by project personnel. The intent is dissemination of newly developed knowledge through publication. Several problems exist with the pure epidemiology-focused efforts. Although they create new scientific knowledge, the details of application of this knowledge are often not established. Epidemiologic knowledge is often divorced from an understanding of the systems of care. Knowledge dissemination is often slow. Internal capacity of participating organizations to use the knowledge to drive improvement locally may not be developed.

In contrast, collaboratives with a pure improvement focus generally seek action—making rapid, demonstrable improvements in participating organizations. They do so by leveraging increased application knowledge that results when multiple organizations or sites work together to understand and compare their systems of care. They then use this understanding together with existing scientific information to improve clinical outcomes. Data are collected and managed by individual organizations and are not standardized across the collaborative sites; individual sites collect data pertinent to their aims. It is pragmatic science—understanding the application of existing scientific knowledge. Improvement collaboratives build the internal capacity of participating organizations to improve beyond the life of the collaborative.

Several existing collaboratives exemplify a mix of these purposes—performing epidemiology while simultaneously seeking to improve systems of care. These intents need not exist in exclusion. At times these efforts place a stronger emphasis on improvement, at other times they focus on epidemiology. In fact, when properly designed, these ends inform each other.

The Northern New England Cardiovascular Disease Study Group (NNE) is one such example. Begun in 1988, the NNE was an innovative, visionary, and novel approach to both epidemiology and improvement. They began on mastering data collection and demonstrating variation in care in the five participating cardiac surgery centers. This step was necessary to gain the confidence of surgeons and hospitals. Beginning in 1991, NNE organizations...
shifted their focus toward improvement with a concerted effort to reduce cardiac surgical mortality.\textsuperscript{2,49}

Since that time, the group has used its epidemiology abilities to inform essential improvement opportunities. Examples include: 1) an exploration of the determinants of patients at high-risk for surgical mortality, then a concerted effort to address those determinants; and 2) an exploration of the utility of perioperative Swan Ganz catheters and the subsequent development of a decision rule used to optimize their use. With common data collection, a series of structured visits to other NNE sites, three meetings a year, and other routine communication, the NNE has proven that such a model can flourish over time by simultaneously performing very high-quality research while also achieving important improvement objectives.

Although the potential synergy between improvement and epidemiology is tremendous, a word of caution is advisable. Health care tradition is deeply rooted in our existing scientific paradigm. The science of improvement, the science of application, is distinct from this paradigm in its intent and methodologies. Health care’s understanding and application of improvement sciences, while growing rapidly, is in its infancy.

Because of our history, when an option exists, health care professionals tend to fall back into the familiar terrain of traditional science. In doing so, data collection tends to dominate the mindset and familiar terrain of traditional science. In doing so, health care professionals tend to fall back into the back seat. Even when a situation and available knowledge demand immediate action, our tendency remains in the direction of more study.\textsuperscript{23} If collaborative efforts are designed to perform both epidemiology and improvement, participants must clearly understand the aims of the effort, and then make sure that the unfamiliarity with improvement does not give way to a dominance of epidemiologic investigation.

Although I support future efforts to combine these two, it is true that the sheer volume of existing scientific knowledge not only warrants an intensive focus on improvement, but also supports efforts that focus only on improvement.

\textbf{CONCLUSION}

The BTS is a collaborative improvement model that seeks to use existing scientific knowledge. Clinicians and health care leaders intent on rapid improvements can use the basic elements of this model—clear aims, repeated exchanges among teams, precise measurement systems, input from established experts, rapid tests of change, and an enabling social climate—to design widespread improvement efforts.

Collaborative improvement efforts move beyond the current insular nature of our industry and open up doors that energize health care professionals. Collaboration liberates health care professionals to lead the improvement of systems of care instead of feeling powerless to make the changes they know are necessary. When we work together, we overcome the barriers currently impeding the broad use of existing knowledge for the improvement of patient care.

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