ABSTRACT  In response to the Institute of Medicine’s *To Err Is Human* report on the prevalence of medical errors, the Leapfrog Group, an organization that promotes hospital safety and quality, established a voluntary hospital survey assessing compliance with several safety standards. Using data from the period 2002–07, we conducted the first longitudinal assessment of how hospitals in specific cities and states initially selected by Leapfrog progressed on public reporting and adoption of standards requiring the use of computerized drug order entry and hospital intensivists. Overall, little progress was observed. Reporting rates were unchanged over the study period. Adoption of computerized drug order entry increased from 2.94 percent to 8.13 percent, and intensivist staffing increased from 14.74 percent to 21.40 percent. These findings should not be viewed as an indictment of Leapfrog but may reflect various challenges. For example, hospitals faced no serious threats to their market share if purchasers shifted business away from those that either didn’t report data or didn’t meet the standards. In the absence of mandatory reporting, policy makers might need to act to address these challenges to ensure improvements in quality.

In 1999 the Institute of Medicine published its landmark report, *To Err Is Human: Building a Safer Health System*, which estimated that up to 100,000 people die annually in US hospitals from preventable medical errors.¹ These findings generated responses from virtually every organized health care stakeholder group, including private and public health care purchasers, who provide insurance benefits to employees, retirees, or program beneficiaries. In 2000 these purchasers—at the time representing twenty-six million covered lives and $45 billion of annual expenditures—formed the Leapfrog Group, with a mission of improving quality of care in hospitals and correcting the safety deficiencies documented in the report and other studies.²

The Leapfrog Group’s operational strategy was based on several principles, including the identification of evidence-based standards, or “leaps,” that hospitals could implement to improve safety. One such standard was using computerized drug order entry systems in hospitals to automate prescription drug ordering and distribution, including software that checks drug orders for common prescribing errors. A second standard was staffing hospital intensive care units with intensivists, who are physicians trained in critical care medicine. A third was making evidence-based hospital referrals, which direct patients requiring complex surgeries and treatments to experienced hospitals meeting certain structural and process requirements.

Researchers affiliated with the Leapfrog Group
estimated that if all three of these standards were implemented in all nonrural US hospitals, as many as 65,400 deaths could be avoided and as many as 907,600 serious medication errors could be prevented annually, with an associated annual cost savings of $41.5 billion. There is substantial evidence that the use of intensivist staffing and computerized drug entry is associated with improvements in a variety of patient safety measures and broader health outcomes, although several studies have called this conclusion into question.

To promote hospitals’ adoption of these standards, the Leapfrog Group employed a multifaceted strategy of public reporting and transparency, pressure from local purchasers, and the use of incentives and rewards for hospitals that met the standards. Specifically, Leapfrog relied on self-insured purchasers, for example, large employers; business health coalitions; health plans; and other stakeholders to pressure hospitals to both publicly disclose their status and adopt these safety measures. Employers and health plans were asked to modify benefit designs to promote the use of hospitals meeting the safety standards.

To make sure there was sufficient demand-side pressure on hospitals, Leapfrog embarked on its regional rollout strategy, in which specific cities and states were selected, and all nonrural hospitals within these regions (the “targeted” hospitals) were asked to complete Leapfrog’s hospital survey. Originally Leapfrog started with eighteen regions, but this number has expanded over time. Dennis Scanlon and coauthors presented a formal “logic model” for the Leapfrog Group in 2008, describing in greater detail how these efforts were expected to play out in local communities across the United States.

Leapfrog is arguably the first and largest coordinated attempt by private and public health care purchasers in the United States to influence hospital safety through the use of voluntary public reporting and incentives. And although additional activities have emerged since the establishment of the Leapfrog Group, the impact of Leapfrog’s efforts over its ten-year history is instructive for understanding the likely impact and limitations of voluntary reporting and market-based purchasing efforts aimed at improving the quality and safety of the health care system.

In this article we examine the degree to which hospitals in the original regions have publicly disclosed their status on these safety measures and have met or made progress on two of the three standards described above—specifically, intensivist staffing and computerized drug entry systems. Ours is the first study that uses longitudinal data to track the progress of the initially targeted Leapfrog hospitals over time. Other studies have looked at hospital reporting and compliance at a point in time, and some studies have correlated hospitals’ Leapfrog status with other outcomes. However, we are unaware of another study that has measured progress over time among the originally targeted Leapfrog hospitals.

We focused on these two standards because implementing them can be accomplished by all hospitals without giving up business in specific clinical areas. We excluded the evidence-based hospital referral standard because hospitals might be faced with the difficult decision of having to exit a particular clinical area of activity.

Specifically, we address the following questions: Has the Leapfrog Group’s effort led to greater public disclosure regarding hospitals’ safety infrastructure? Have hospitals that have been continuously targeted by the Leapfrog Group implemented or made progress toward implementing these two key safety measures? Was there regional variation in hospitals’ response to the Leapfrog Group? Did hospitals meet self-imposed deadlines for adopting the safety standards?

**Study Data And Methods**

**STUDY DATA** Data for this study came from the Leapfrog Group’s voluntary hospital survey, which any hospital in the United States is free to complete. In contrast to other hospitals, those in the Leapfrog Group’s regional rollout effort are specifically asked to complete the survey, and the Leapfrog Group discloses results on its website, along with a list of hospitals that failed to complete the survey.

The survey has been administered online by an outside vendor since 2001 and has been refreshed on approximately an annual basis. Hospitals were asked to actively report their status toward meeting the safety standards at the beginning of the survey period and were expected to update their entry when their status changed.

In our study we used six rounds of survey data from July 2001 to March 2008. The six rounds encompassed more than six calendar years because the first round included responses received between July 2001 and April 2003, and subsequent rounds were based on nine-to-twelve-month reporting periods extending across calendar years. Because the majority of round 1 responses were received in 2002, and the majority of round 6 responses were received in 2007, we treated 2002 as our baseline and 2007 as our endpoint.

In total, 1,869 US hospitals reported data at
any point, with hospitals reporting an average of 3.74 times during the study period. To examine hospital responses to Leapfrog over a roughly five-year period, we restricted attention to the 1,170 hospitals that were included in the first round of data collection, and we imposed a series of sample restrictions, depicted in Appendix Exhibit 1. These restrictions yielded samples of 849 and 794 continuously targeted hospitals for computerized drug order entry and intensivist staffing, respectively.

Of the initial 1,170 hospitals, 236 were in regions not targeted by the Leapfrog Group. We excluded these hospitals from our sample because, in addition to not being subject to the full set of Leapfrog incentives, they might have chosen to submit a response because they were already performing well or because they anticipated improvement. This left us with 934 hospitals in regions targeted for the first round of the survey.

We dropped an additional 85 hospitals that closed, merged, or were misclassified over the subsequent 5 rounds of data collection, thus restricting our analytic sample to 849 hospitals across the 18 regions that were continuously targeted by the Leapfrog Group between 2002 and 2007 and that were in continuous operation as independent entities during that period.

All hospitals in the sample were included in our analysis of computerized drug order entry. A total of 794 were included in the intensivist staffing analysis, because 55 hospitals either opened or closed an intensive care unit during the study period and thus did not meet the sample criteria of having continuously operated an intensive care unit across all 6 rounds of the survey.

Appendix Exhibit 2 compares the observable characteristics of Leapfrog hospitals that did and did not respond to the survey in 2002. Based on unpaired t-tests, there were significant ($p < 0.05$) differences across the two groups in ownership type, system membership, and annual admissions but not in teaching status, occupancy rates, or net income per admission. In addition, eight of the eighteen targeted regions were represented to statistically different degrees among reporting and nonreporting hospitals.

**Methods** We tabulated the percentage of hospitals that responded to Leapfrog’s survey at both the first (2002) and sixth rounds (2007) and calculated the percentage of hospitals that reported fully meeting the computerized drug order entry and intensivist staffing standards in 2002 and 2007. We tested for significant changes in reporting and adoption rates between 2002 and 2007 using standard t-tests.

The Leapfrog survey also measured where hospitals stood in terms of progress toward meeting the safety standards. For hospitals responding to the survey, a four-point progress scale was used: does not meet, assigned a value of 1; good early progress, assigned a value of 2; good progress, assigned a value of 3; and fully meets, assigned a value of 4.

We calculated the mean values of these progress measures for each hospital that reported in both 2002 and 2007 and tested for significant changes over the 2002–07 period using standard t-tests. To determine whether there were regional differences in hospitals’ adoption of the safety standards, we calculated the percentage of targeted hospitals within each region that reported fully meeting each standard at the time of the baseline survey in 2002 and at the close of the sixth round in 2007. Again, we used standard t-tests to determine whether the change in each region was significant.

One of the unique aspects of the Leapfrog Group’s survey was that it asked hospitals not fully meeting the safety standards to disclose whether they had plans to meet them. These questions asked whether the hospital had a dedicated staff person leading the implementation efforts and whether the hospital board had approved a dedicated budget. When hospitals answered these questions affirmatively, they were asked to indicate the year in which they expected each standard to be fully implemented.

Since adopting the safety standards can take time, the answers to these questions were used to gain partial credit on the scale used by Leapfrog to classify and publicly report on hospitals, with the assumption that hospitals planning to meet the safety standards were further along than those with no concrete plans to do so. However, because of concerns about the accuracy of these self-reported implementation dates, the Leapfrog Group eventually limited the number of consecutive years in which a hospital could receive partial credit.

To determine the extent to which hospitals accurately forecast how long it would take to fully comply with the safety standards, we calculated the mean and median of the anticipated implementation dates for each of the six survey rounds (2002–07) and tested for the presence of a significant time trend by regressing the mean and median implementation dates on a linear time trend using, respectively, ordinary least squares and median regression.

**Limitations** Our study had five primary limitations. First, as illustrated by Ashish Jha and coauthors in the *Joint Commission Journal on Quality and Patient Safety*, compared to other hospitals in the United States, the hospitals targeted by Leapfrog were, on average, larger, more...
likely to be teaching hospitals, and more likely to be located in an urban area.\textsuperscript{15}

Second, where available, data sets capturing hospitals’ safety practices use definitions and measures that are not comparable to those used by Leapfrog, which makes it difficult to construct a valid control group. As a result, our analysis should not be construed as a causal evaluation of the Leapfrog initiative. However, because the most plausible counterfactual scenario is one in which some progress would have occurred even in the absence of pressure from Leapfrog, our estimates probably provide an upper bound on the causal impact of the Leapfrog Group’s efforts.

Third, longitudinal data on our sample of the originally targeted Leapfrog hospitals were not publicly available after 2008, which precluded us from extending our study period. Fourth, the voluntary nature of the Leapfrog survey raises the possibility that high-performing hospitals, or those anticipating improvement, might have been more likely than others to respond. This is not an issue when studying reporting itself, and we sidestep possible sample selection bias when examining full adoption of the safety standards by focusing on reported adoption rates using the full sample of targeted hospitals. The potential for reporting bias is larger when using the Leapfrog four-point progress scale, because that analysis is based on a self-selected sample of hospitals that chose to respond to the survey in both 2002 and 2007.

Finally, because we had data only on hospital characteristics for a single pre-Leapfrog year, we were unable to extend to a longitudinal setting the regression analysis conducted by David Cutler and colleagues in their 2005 Health Affairs article on the determinants of computerized drug order entry at baseline. That analysis is based on a self-selected sample of hospitals that chose to respond to the survey in both 2002 and 2007.

| SOURCE | Authors’ calculations using data from rounds 1–6 of the Leapfrog Hospital Survey. Note The intensivist staffing sample contains fifty-five fewer hospitals because the intensivist staffing standard applies only to hospitals that had an intensive care unit in continuous operation between 2002 and 2007. \textsuperscript{a}p < 0.05 change from 2002 to 2007 based on an unpaired t-test. |
Collectively, the results suggest that although there was improvement in the overall percentage of hospitals that met the safety standards, the overall percentage of hospitals meeting these standards was low, and certainly less than the Leapfrog Group had hoped for.\(^2\)

**REGIONAL VARIATION** As depicted in Exhibit 3, most of the communities targeted as part of Leapfrog’s regional strategy saw an increase in the percentage of hospitals reporting full adoption of computerized drug order entry. Among the regions with large numbers of hospitals targeted by Leapfrog, Minnesota and central Florida experienced the largest increases, with gains of 27.78 and 20.83 percentage points, respectively, in the fraction of hospitals reporting full adoption. Because of the smaller numbers of hospitals at the regional level, only two of the eighteen regions—Minnesota and central Florida—exhibited a change that was statistically significant at conventional levels (\(p < 0.05\)).

A similar picture is found when considering intensivist staffing. In this case, several communities with substantial numbers of targeted hospitals, including New Jersey and Kansas City, experienced no change in the percentage of hospitals using intensivists, although other communities experienced large increases (California, Colorado, and Massachusetts) and still others a decrease (Minnesota, New York City metropolitan area, and St. Louis) (Exhibit 3). Again, only two of the regions—in this case, California and Massachusetts—exhibited a significant change in adoption rates (\(p < 0.05\)).

When one is considering these comparative rates of change across communities, it is important to consider two issues. First, communities with relatively high baseline rates had less opportunity for improvement. Second, the percentages are calculated based on different numbers of hospitals in each community, which makes it difficult to compare changes in smaller and larger markets.

**ACCURACY OF HOSPITAL PROJECTIONS** Because Leapfrog’s survey asked hospitals to report when they expected to meet the safety standards, it was possible to examine, retrospectively, whether hospitals’ forecasts were accurate. Exhibit 4 lists the mean and median projected implementation dates for full adoption of each safety standard among hospitals making a projection in each round of the survey.

Among hospitals that weren’t fully compliant at baseline, both the mean and median projected implementation dates increased by approximately one year annually for both safety standards. These trends were found to be significant (\(p < 0.05\)) when the implementation dates were regressed on a linear time trend using ordinary least squares and median regression.

**Discussion**

Our examination of Leapfrog’s data on targeted hospitals’ reporting over six rounds of its hospital survey suggests that progress on key outcomes has been limited, from 2.94 percent adoption of computerized drug order entry in 2002 to 8.13 percent in 2007 and from 14.74 percent adoption of intensivist staffing in 2002 to 21.40 percent in 2007. Given those results, it is important to understand why the Leapfrog Group’s efforts did not have more of an impact and what the results mean for public policy aimed at improving quality and safety. Not having access to the rich qualitative data that would be required to fully explain why the progress observed was limited, we draw on a priori knowledge and the research of others to generate hypotheses regarding the findings and their implications for policy.

Incomplete public reporting and the slow adoption of the safety standards call into question the effectiveness of voluntary hospital disclosure and reporting programs when hospitals do not also face substantial threats to their market share if purchasers shift business away from hospitals that don’t report or don’t meet the standards. Even though Leapfrog benefited from the participation of some large self-funded Fortune 100 employers, the covered lives that these employers represented were still a small proportion of the overall hospital market in most regions, resulting in little market-share threat.

Moreover, few of the participating purchasers or insurance plans changed their benefit designs to favor hospitals that reported to Leapfrog or that met its safety standards. As Robert Galvin...
and coauthors noted in a 2005 Health Affairs article, absent widespread purchaser backing, including support from public-sector purchasing programs such as Medicare and Medicaid, the impact of Leapfrog was likely to be small.2

Prior work has documented that many hospitals questioned the evidence base for the Leapfrog safety standards.13 This was more true for computerized drug order entry than for intensivist staffing. For example, many hospitals pointed to multiple challenges to implementing computerized drug order entry systems. These included high investment costs and limited product selections from vendors, with many products being beta versions incompatible with existing hospital information technology.

### Exhibit 3

<table>
<thead>
<tr>
<th>Region</th>
<th>Computerized drug order entry</th>
<th>Intensivist staffing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of hospitals</td>
<td>Difference, 2002–07</td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>23</td>
<td>8.70</td>
</tr>
<tr>
<td>California</td>
<td>288</td>
<td>2.77</td>
</tr>
<tr>
<td>Central Florida</td>
<td>24</td>
<td>20.83*</td>
</tr>
<tr>
<td>Colorado</td>
<td>28</td>
<td>7.14</td>
</tr>
<tr>
<td>Dallas/Fort Worth, TX</td>
<td>47</td>
<td>2.13</td>
</tr>
<tr>
<td>East/Mid TN</td>
<td>20</td>
<td>0.00</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>24</td>
<td>0.00</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>66</td>
<td>10.60</td>
</tr>
<tr>
<td>Memphis, TN</td>
<td>16</td>
<td>0.00</td>
</tr>
<tr>
<td>New York City metro area</td>
<td>131</td>
<td>3.06</td>
</tr>
<tr>
<td>Minnesota</td>
<td>36</td>
<td>27.78*</td>
</tr>
<tr>
<td>New Jersey</td>
<td>76</td>
<td>1.31</td>
</tr>
<tr>
<td>Rochester, NY</td>
<td>4</td>
<td>25.00</td>
</tr>
<tr>
<td>Savannah, GA</td>
<td>3</td>
<td>0.00</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>25</td>
<td>8.00</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td>30</td>
<td>0.00</td>
</tr>
<tr>
<td>Wichita, KS</td>
<td>3</td>
<td>33.33</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>5</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Source:** Authors’ calculations using data from rounds 1–6 of the Leapfrog Hospital Survey. **Note:** The intensivist staffing samples often contain fewer hospitals because the intensivist staffing standard applies only to hospitals that had an intensive care unit in continuous operation between 2002 and 2007. “p < 0.05 change from 2002 to 2007 based on an unpaired t-test.

### Exhibit 4

<table>
<thead>
<tr>
<th>Year</th>
<th>Computerized drug order entry</th>
<th>Intensivist staffing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hospitals making a projection</td>
<td>Mean projected date</td>
</tr>
<tr>
<td>t-statistic H0: linear trend = 0</td>
<td>–*</td>
<td>52.55</td>
</tr>
<tr>
<td>p value</td>
<td>–*</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Source:** Authors’ calculations using data from rounds 1–6 of the Leapfrog Hospital Survey. **Note:** We obtained a t-statistic for testing the null hypothesis of “no linear time trend” by regressing the mean and median projected implementation dates on a linear time trend using, respectively, ordinary least squares and median regression. “Not applicable.
In addition, the high-profile case of Cedars-Sinai Hospital in California, which implemented a computerized drug order entry system but later removed it because of physician pushback,18 made many hospitals anxious about being early adopters. Finally, other drug safety tools, such as bar-coding medication administration systems, were being promoted as substitutes for computerized drug order entry. But it is important to note that Leapfrog viewed these alternatives as being less comprehensive than computerized drug order entry systems.19,20

There were similar concerns about the evidence for intensivist staffing. However, key issues for hospitals in meeting this standard related to the availability of intensivists, in short supply during our study period, and Leapfrog’s strict requirements for demonstrating compliance, such as the minimum number of days and hours intensivists had to be available on call and the maximum time deemed acceptable for responding to a page. As in the case of computerized drug order entry, there were also some substitutes that hospitals could consider and still meet the Leapfrog standard, such as intensivist staffing from remote locations using video and telehealth technology.

Following the release of the Institute of Medicine report mentioned above, hospitals also faced public reporting initiatives from the Centers for Medicare and Medicaid Services, various state and local governments, and a myriad of proprietary health care rating organizations such as HealthGrades. For example, Wisconsin had at least four different entities simultaneously producing public reports of hospital quality during this time period.

Many hospitals used these other efforts to explain their failure to respond to the Leapfrog Group’s survey as well as their lack of prioritization of the Leapfrog standards relative to what these other reporting entities reviewed.11 To reduce the “noise” from these multiple efforts, many hospitals suggested that purchasers, both private and public, needed to coordinate on sending a clear signal regarding what should be prioritized.

Policy Implications
We believe that our findings provide several lessons for policy makers and health care purchasers. First, although it is desirable to “move the needle” in terms of expectations of health care providers, it is also important that the evidence base for proposed quality improvement interventions be well documented and ready for scaled implementation. With computerized drug order entry and intensivist staffing, there was some disagreement about both.

Second, given the composition of hospitals’ revenues across payers, it seems essential that any major purchasing effort have the backing of the Medicare and Medicaid programs. Without the support of these major payers, hospitals perceive less of a potential market-share threat and thus have less incentive to comply, particularly for costly interventions or interventions with an ambiguous evidence base.

Third, uniform expectations regarding priorities for the quality and safety agenda would provide a clearer signal for hospitals and other health care providers. Since Leapfrog’s inception, entities like the National Quality Forum have emerged in an attempt to set national priorities. Nonetheless, a high degree of variation still exists across both the quality and safety measures and the interventions being advocated.

Fourth, mandated public reporting of progress on safety standards might yield more complete information than voluntary public reporting. However, as some researchers point out,21 the evidence on optimal disclosure design is not clear and depends on many factors. For example, our results suggest that hospitals either might have been naïve in their forecasts or might have strategically chosen to err on the optimistic side when forecasting implementation dates to receive partial credit on the Leapfrog Group’s public reports. If either conjecture were true, such actions by hospitals would raise concerns about providing partial credit on public reports based on self-reported future plans.

The Affordable Care Act addresses several of these areas, although in ways that are still being determined as final decisions regarding implementation of health reform are made. For example, the Centers for Medicare and Medicaid Services is charged with establishing a hospital value-based purchasing program, which might serve to better align Medicare’s efforts with those of private purchasers, and thus effectively address the issue of limited purchasing power. The Affordable Care Act also charges the federal government with increasing the availability and transparency of measures related to patient safety and quality.

When considering the policy implications of these findings, readers should not view our study as an indictment of the Leapfrog Group. Prior research has documented several tangible contributions that the Leapfrog Group has made to hospital patient safety. These studies have highlighted the contributions of Leapfrog in areas such as assisting chief quality officers of hospitals with securing resources for quality and safety budgets,13 as well as linking Leapfrog...
reporting with better scores on the Hospital Quality Alliance measures.\textsuperscript{15}

**Conclusion**

In summary, our study highlights the complexity of improving the quality and safety of health care in the United States through reliance on purchaser pressure and public disclosure, both of which feature prominently in the Affordable Care Act. We hope that the lessons learned from the Leapfrog Group’s experience will help purchasers and policy makers design better systems for promoting transparency, quality, and safety.

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**NOTES**

17. To access the Appendix, click on the Appendix link in the box to right of the article online.
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Dennis Scanlon is a professor of health policy and administration at the Pennsylvania State University College of Health and Human Development. He serves as principal investigator for the Robert Wood Johnson Foundation’s Aligning Forces for Quality evaluation and is a consultant on an Agency for Healthcare Research and Quality study, “Assessing a Statewide Multi-Stakeholder Chronic Care Model Implementation.” Scanlon also serves on the editorial board of several journals, including BMC Health Services Research, International Scholarly Research Network Public Health, Health Services Research, American Journal of Managed Care, and Medical Care Research and Review. In 2002 he received the John D. Thompson Prize for Young Investigators, given annually by the Association of University Programs in Health Administration to an outstanding young investigator in the field of health services research. Scanlon earned a master’s degree in economics from the University of Pittsburgh and a doctorate in health services organization and policy from the University of Michigan.

In this month’s Health Affairs, John Moran and Dennis Scanlon report on their longitudinal study of the effects of a Leapfrog Group initiative to advance hospital quality and safety. Drawing on data from the period 2002–07, they found that hospitals in specific cities and states selected by Leapfrog made little progress, either in adopting standards requiring the use of computerized drug order entry and hospital intensivists, or in reporting on their compliance with these standards. The authors offer possible explanations for the lack of progress and suggest that policy makers may need to address them to ensure improvements in quality.