Measurable Outcomes of Quality Improvement in the Trauma Intensive Care Unit: The Impact of a Daily Quality Rounding Checklist

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Objective: **The use of "care bundles" in the prevention of ventilator-associated pneumonia (VAP) and other intensive care unit (ICU) complications have been increasingly used in critical care practice. However, the effective implementation of these strategies represents a challenge in a busy Level I trauma ICU. We devised a daily "Quality Rounds Checklist" (QRC) tool for use in the ICU to increase compliance with these prophylactic measures and identify areas for improvement in quality of care.**

Methods: **A prospective before-after design was used to examine the effectiveness of the QRC tool in promoting compliance with 16 prophylactic measures for VAP, deep venous thrombosis or pulmonary embolism, central line infection and other ICU complications. Compliance was assessed for 1 month before institution of the QRC. On daily analysis, the QRC was then applied by the ICU fellow to assess compliance. Any deficiencies were actively corrected in real time. Compliance was assessed by a multidisciplinary team for the next 3 months and compared with the pre-QRC compliance rates.**

Results: **Implementation of the QRC tool facilitated improvement of all measures not already at >95% compliance. Compliance with VAP prevention measures of head of bed elevation >30 degrees (35.2% vs. 84.5%), sedation holiday (78.0% vs. 86.0%), and prophylaxis for both peptic ulcer disease (76.2% vs. 92.3%) and deep venous thrombosis (91.4% vs. 92.8%) were all increased. A decrease in central line duration >72 hours (62.4% vs. 52.8%) and ventilator duration >72 hours (74.0% vs. 61.7%) was also noted. Additionally, a decrease in mean monthly rates per 1,000 device days of VAP (16.3 vs. 8.9), central line infection (11.3 vs. 5.8) and self-extubation (7.8 vs. 2.2) was demonstrated.**

Conclusion: **Introducing a daily QRC tool facilitated improved compliance rates for 16 clinically significant prophylactic measures in a busy Level I trauma ICU. The daily use of this tool, requiring just a few minutes per patient to complete, results in a sustainable improvement in patient outcomes.**

Key Words: **Injury, Wounds and injuries, Trauma, Outcome assessment, Quality assessment.**

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The Institute for Healthcare Improvement (IHI) issued a challenge to the medical industry in 2004: save 100,000 lives by June 2006 through the implementation of evidence-based interventions in six specific clinical areas.[1] The areas proposed for inclusion in the IHI "100,000 Lives Campaign" included deployment of rapid response teams, delivery of reliable evidence-based care for acute myocardial infarction, prevention of adverse drug events by implementing medical reconciliation, and implementation of scientifically grounded steps to prevent central line infections, surgical site infections and ventilator-associated pneumonia (VAP). Several groups, including the Centers for Disease Control (CDC)[2] and the American Thoracic Society,[3] have joined the IHI in emphasizing the importance of preventative measures in improving patient outcomes. Particularly in the intensive care unit (ICU) setting, where the complexity of care is commonly the most pronounced, these groups have produced evidence-based consensus statements designed to provide guidelines for the maintenance of these preventative efforts.

A major hurdle, however, remains the effective implementation of these evidence-based best practices.[4,5] This challenge is magnified in a busy high-volume trauma center. The objective of this study was to assess the effectiveness of the implementation of a cost-effective and efficient "Quality Rounds Checklist" (QRC) tool to improve compliance with the VAP bundle recommendations and 12 other beneficial prophylactic measures at a high-volume Level I trauma center.

METHODS

A QRC tool (Fig. 1) was developed to quantify compliance with 16 recommended prevention measures. The preventative measures to be quantified were chosen after a comprehensive review of best-practices data by a multidisciplinary team of care providers that included intensivists,

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MR#	Age	Gender	ICU Day	PUD Prophylaxis	DVT/PE Prophylaxis	Central Line Day	Sedation Holiday	Glucose Control Type	Low Blood Glucose Level for 24 hr	High Blood Glucose Level for 24 hrs	Vent Day	Intubation Method	Low Tidal Volume	Assessed for Weaning Protocol	Gross Contamination of Respirator Circuit	Continuous Subglottic Suctioning	Code Status	HOB at least 30 degrees	Nutrition Evaluated	Antibiotic need / Culture Evaluation	Invasive Device Need Considered

Fig. 1. *LAC + USC daily quality rounding checklist.*

trauma surgeons, nursing staff, and a biostatistician. Selected measures targeted VAP prevention, glucose control, line-sepsis, and sedation. An ICU fellow not directly involved in patient care then used this tool during a 1-month period to determine baseline compliance before intervention. During the initial 1-month preliminary survey, nursing and clinical staff were blinded to the use of the tool. During the following 3 months, the tool was used actively by the on-duty trauma ICU fellow and the ICU team to note episodes of noncompliance. All deficiencies in evidence-based practices noted during this time frame were highlighted for immediate correction.

Reported data included basic demographic information and compliance with each of 16 rapidly discernable prophylactic compliance measures for each patient day surveyed. Data were reported in percent compliance and mean values for the respective data points. An ongoing monthly review of deficiencies by a multidisciplinary team of intensivists, trauma surgeons, nursing staff, and a biostatistician resulted in the highlighting of those measures most clearly requiring more focused effort. Discussion of systemic approaches and unique solutions to improvement of these deficiencies were then designed and implemented.

RESULTS

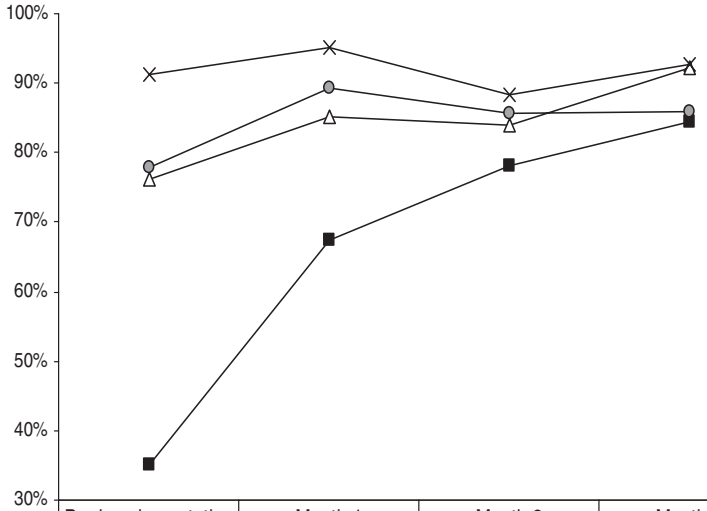
During the study period, daily survey information was collected for 810 patient days. The demographic characteristics of the ICU patients surveyed remained constant between the observational and implementation phases (Table 1). Compliance rates for the four components of the VAP bundle were significantly impacted by the utilization of our bedside tool. Before the implementation of this device, the rates of head of bed elevation (HOB) >30 degrees, daily interruption from continuous sedation (SEDHOL), PUD prophylaxis and DVT prophylaxis were 35.2%, 78.0%, 76.2%, and 91.2%, respectively (Fig. 2). Significant initial improvement in the respective compliance rates was noted in the first month of tool use (HOB, 67.6%; SEDHOL, 89.2%; PUD, 84.0%; DVT, 95.1%). These gains were sustained or further improved with continued use of the tool during the first full 3 months of use (HOB, 84.5%; SEDHOL, 86.0%; PUD, 92.3%; DVT, 92.8%). The p value of the trend of improvement for HOB, PUD and SEDHOL was <0.05. An improvement in DVT prophylaxis compliance, already at 91.2% in the pre-implementation phase, was also noted but did not prove statistically significant ($p = 0.3$).

Table 1 **Demographics**

	Preimplementaton	Mo 1	Mo 2	Mo 3
ICU patient days surveyed	244	185	188	193
Mean age	41.1	41.0	41.6	40.3
Male (%)	73.0	76.8	67.0	78.9
Mean ISS	17.3	20.9	15.0	16.1

In our ICU, pain assessment, restraint need, oral care utilization, and daily central venous catheter site evaluation are documented through routine daily nursing assessments. Compliance of the nursing staff in the completion of these measures is ensured by the monitoring of a unit nurse manager through a previously established quality assurance pathway. To examine the effectiveness of this pathway, the compliance rates for these measures were also assessed using the daily tool. Evaluation of this information revealed compliance rates in excess of 95% with each of these individual measures. Data collected from the tool were also used to quantify the frequency with which other existing protocols achieved their stated goals. For example, examination of our daily mean high blood glucose levels and insulin administration routes highlighted the need for improvement in our unit glucose control regimen.

Based on our findings, one to two measures were selected monthly for primary focus and process improvement during the following month. In the first month of implementation, HOB >30 degrees and Code Status documentation were selected for emphasis. Possibilities for process improvement were discussed and novel ideas to facilitate increased compliance devised and implemented. For the improvement of our HOB >30 degrees compliance, nursing and staff education were undertaken. Additionally, laminated flyers were placed at the exit of every room (Fig. 3) to serve as a visual reminder. To address the code status deficiency, a simple card system of documentation for the front of the chart was developed and similar nursing and staff education un-



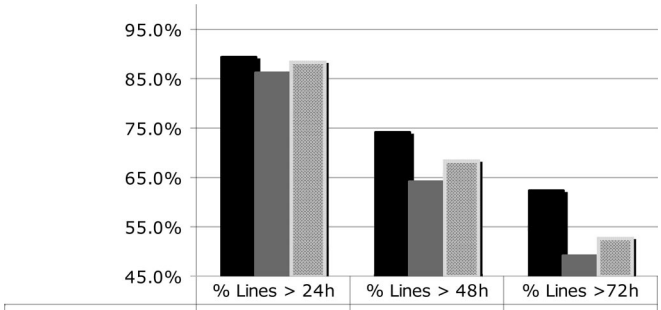
	Pre-impelementation	Month 1	Month 2	Month 3
HOB ≥ 30	35.2%	67.5%	78.2%	84.5%
PUD Prophylaxis	76.2%	85.2%	84.0%	92.3%
DVT Prophylaxis	91.2%	95.1%	88.3%	92.8%
No Cont Sed / Holiday	78.0%	89.2%	85.6%	86.0%

Fig. 2. *Compliance rates with VAP prevention measures before and after implementation of LAC + USC quality improvement rounding tool.* p *value for trend for HOB, PUD and SEDHOL <0.05.* p *value for trend for DVT = 0.3.*

dertaken. Both of these measures were simple and easy to implement, but resulted in significant improvement in compliance. After 1 month of emphasis, the percentage of patient days with documented HOB >30% rose from 35.2% to 67.6%, and continued to improve to 84.5% during the span of the initial 3 months. The improvement in code status documentation was even more dramatic, rising from 0% to 100% over just 2 months of emphasis. In the second month of our implementation phase, we focused our efforts on the improvement of our existing insulin regimen. As previously outlined, a simple strategy of education and protocol revision resulted in significant improvement in glucose control. These efforts resulted in a decrease in our mean blood glucose level from 137.7 mg/dL to 125.4 mg/dL ($p < 0.05$) during the subsequent 2 months of implementation.

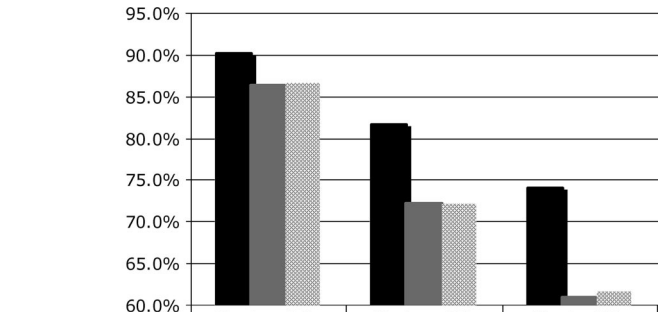
Fig. 3. *Example of educational flyer placed in each ICU room to reinforce head of bed elevation initiative.*

With the implementation of the QRC, several clinically significant improvements in patient outcomes were noted. Central venous catheters routinely used at our facility are antimicrobial-coated (ARROWgard Blue PLUS Multi-lumen CVC, antimicrobial surface–coated using chlorhexidine, chlorhexidine acetate, and silver sulfadiazine) and placed directly or through an introducer (ARROW percutaneous sheath introducer kit 8.5 Fr). All routine catheters are placed using full barrier precautions, and catheters placed in emergency situations where the use of full precautions is not documented are removed within 24 hours. This protocol has been an active component of our efforts to decrease line sepsis rates at our institution, and pre-dates the study period. After QRC implementation, we noted that efforts to decrease line sepsis rates were further augmented by a decrease in the percentage of central venous catheters remaining in places for durations longer than 24, 48, and 72 hours (Fig. 4). This sustained decrease was noted at both 1 month and 3 months after the initiation of QRC use. A similar, sustained decrease in the percentage of patients undergoing prolonged mechanical ventilation was also observed during the same time period (Fig. 5).



	% Lines > 24h	% Lines > 48h	% Lines >72h
Pre-implementation	89.4%	74.1%	62.4%
One month	86.2%	64.1%	49.1%
Three Month	88.4%	68.4%	52.8%

Fig. 4. *Central venous catheter durations before and after implementation of LAC + USC quality improvement rounding tool.*



	Vent > 24h	Vent > 48h	Vent >72h
Pre-implementation	90.1%	81.7%	74.0%
One month	86.4%	72.2%	60.9%
Three Month	86.7%	72.2%	61.7%

Fig. 5. *Mechanical ventilation durations before and after implementation of LAC + USC quality improvement rounding tool.*

Infectious complications were also decreased as a result of QRC implementation. At our facility, all potential nosocomial infections, central line-related infections and VAP are diagnosed by the hospital epidemiology service based on CDC definitions. For the diagnosis of central line-related infection: positive blood cultures with a recognized pathogen without evidence of alternative septic source must be documented, and the catheter must have been in place for >48 hours. The diagnosis of VAP requires: a purulent sputum, associated with systemic evidence of infection (WBC >11,000 or <4,000 per mL; fever >100.4°F); and two or more serial chest radiographs with new or progressive and persistent infiltrate, consolidation, or cavitation. When compared with the 3 months before implementation, the 3 months during which our tool was used to reinforce the VAP bundle compliance, minimize continuous sedation and enforce daily central line evaluation resulted in a decrease in both VAP rates (16.3 vs. 11.3 per 1,000 ventilator days) and central line-related infections (8.9 vs. 5.8 per 1,000 device days). Additionally, the minimization of continuous sedation and daily weaning assessment was associated with a decrease in self-extubation rates (7.8 vs. 2.2 per 1,000 ventilator days) (Table 2).

Table 2 Outcome Comparison Before and After Quality Improvement Tool Implementation

	Mean Monthly VAP Rate	Mean Monthly Central Line Associated BSI	Self-Extubation Rate
3 mo before QI tool use	16.3	11.3	7.8
3 mo of active QI tool use	8.9	5.8	2.2

All rates per 1,000 device days.

VAP, ventilator associated pneumonia; BSI, blood stream infection.

DISCUSSION

The birth of quality improvement principles has been attributed to the 1920s and the development of high volume manufacturing in the United States. During this period, industrial pioneers such as Henry Ford, Harvey Firestone, and Albert Champion saw the need to critically examine and improve their manufacturing process to minimize product defects and yet streamline production to meet the growing demand for their products. Successful adaptation of these principles by the Japanese industrial movement of the 1950s and 1960s gave greater structure to these efforts, and by the 1970s, such innovators of quality improvement as W. Edwards Demming and Dr. Joseph Juran were actively proposing quality improvement measures for the world of manufacturing and business.

The need for quality improvement in health care has become increasingly apparent. Health care costs in the United States are approximately 40% higher than the next most expensive nation. In addition, it is estimated that 44,000 to 98,000 Americans die in hospitals each year due to errors in their care.[6,7] Appropriate utilization of prophylactic measures are paramount in improving on this situation. Central line sepsis, with an attributable mortality of 4% to 20%, is associated with a cost of $3,700 to $29,000 dollars per blood stream-related infection.[8,9] VAP represents another significant risk, increasing the mortality by 14% over ventilated patients who avoid these infections,[10] adding an estimated $40,000 in cost to a hospital admission.[11] Effective measures to minimize these occurrences will result in decreased financial and workload burden on the healthcare system and significant morbidity and mortality benefit to patients.

In 2002, the Surviving Sepsis Campaign introduced the concept of "care bundles" through which the consensus recommendations of several international organizations could be applied to the improvement of outcomes in the management of sepsis. The science supporting the individual practices included in bundles, although based on levels of evidence varying from randomized prospective control trials to professional consensus, nonetheless represent standard of care practices that individually improve care. When applied together, the collective application of these "bundled" interventions result in an even substantially greater improvement in care. The 100K campaign recommended four primary prophylactic

components be included in a "VAP Bundle": elevation of the head of the bed between 30 degrees and 45 degrees, daily "sedation vacation" and daily assessment of readiness to extubate, peptic ulcer disease prophylaxis, and deep venous thrombosis prophylaxis unless contraindicated. The application of this bundled approach for the prevention of VAP has been demonstrated to be effective by several institutions with excellent results.[12–15] The successes achieved with the 100,000 lives initiative has inspired the IHI to build upon these efforts through the Five Million Lives Campaign, designed to protect patients from five million incidents of medical harm before the end of December 2008. In doing so, they aim to enlist at least 4,000 U.S. hospitals in a renewed national commitment to improve patient safety faster than ever before.[1] Several groups have already demonstrated the benefit of effectively bundled patient care improvement strategies. Berriel-Cass and associates at St. John Hospital Medical Center in Detroit found that implementation of bundled improvement measures resulted in decreases in catheter-related blood stream infections and VAP of more than 50%.[12] Recent reports have supported these findings, as bundled care initiatives have demonstrated similar improvements in VAP rates in various populations.[14,16]

Despite the consensus agreement that bundled measures for VAP prevention are beneficial, critical examination of current practices reveals persistent difficulties with the implementation of these strategies.[17] Several barriers to these positive changes exist in a busy ICU.[4] These include need for additional staff education and training, inadequate staffing levels, and lack of appropriate support entities and technologies. The cost-effectiveness of various VAP prevention strategies, while clearly proven by numerous authors,[18–20] also represents a special concern in their development and implementation. Finally, while many of the individual interventions are as simple to initiate as they are effective, the successful utilization of bundled approaches requires the dedicated efforts and coordination of a multidisciplinary team of dedicated individuals.

Cocanour et al.[13] at the University of Texas Medical School at Houston demonstrated that the daily audit of compliance with a modified VAP bundle and weekly feedback reporting of these results to caregivers was associated with a statistically significant decrease in VAP rates and improved glucose control. They additionally noted an associated decrease in nursing turnover, utilization of agency nursing personnel and ICU cost after implementation of this quality improvement mechanism. Cocanour used practitioners from their infection control department for the daily auditing compliance rates, which were then reported on a weekly basis to provide insight into areas for improvement.

Our approach differed in that it used Surgical Critical Care fellows to act as what Dr. Donald Craven termed "champions" of daily prophylaxis.[4] The use of our daily checklist tool provided for a cost-effective and efficient strategy with real-time opportunities for intervention, while the monthly reported results of the compliance alterations provided our Multidisciplinary Trauma and Surgical Critical Care Quality Improvement Committee the opportunity to critically examine areas for broader systemic improvements. The subsequent efforts in education, training, implementation of new protocol strategies, and improvement of existing approaches resulted in further improvements in both compliance rates and patient outcomes.

The use of the quality improvement tool seemed to have less impact on compliance rates with established nursing protocolized aspects of patient care, which already exceeded 95% compliance before implementation of the tool. For each of the other prophylactic measures, however, the QRC tool served to assess compliance and act as a daily reminder, while also allowing for the identification of specific deficiencies in current protocols and reassessment after changes made to address these issues. For example, after the analysis of blood glucose results and insulin utilization practices, an improvement strategy was developed in a multidisciplinary setting. Feedback regarding the previous glucose control policy was collected from providers at all levels and carried back to the committee for discussion. Revision of the protocol was undertaken to remove identified barriers to implementation and educational sessions were conducted for staff physicians, residents and nursing staff caring for patients in our ICU. The resulting improvements in glucose control and insulin utilization were then appraised using the quality improvement tool for ongoing quality improvement after these interventions.

The initial time required for the daily completion of the tool and institution of corrective changes averaged approximately 1 hour per day. As familiarity with the tool increased during the first few weeks of use, the time required for completion decreased to 20–30 minutes daily. This time investment equated to approximately an additional 2 minutes per patient and represented little additional burden on the rounding fellow. Future challenges include continuing reassessment and improvement of the existing tool as new evidence based practices arise and the introduction of new technologies to facilitate the use of this or similar tools.

CONCLUSION

Our study demonstrates that a simple rounding tool can make an impact not only in the rates of compliance with standard of care prophylactic measures, but also in the improvement of outcomes in a busy ICU at a Level I trauma center. This was accomplished though the use of a simple checklist device which required minimal additional effort by the clinical fellow on duty in the ICU. The use of our physician-driven tool did not significantly alter nursing workloads, and given the resulting improvements in compliance rates and improved clinical outcomes, the use of this tool proved an excellent investment of the bedside clinician's time.

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DISCUSSION

Dr. Christopher P. Michetti (Falls Church, Virginia): Dr. DuBose and colleagues at USC/LA County Medical Center have attempted to address the significant challenge of ensuring that routine, standardized and evidence-based care is delivered to every patient in the ICU every day.

Their quality rounds checklist is a simple, commonsense tool that prompts this care instead of relying on our imperfect human memory to do so.

We have been using a similar checklist which we call the Critical Care Blueprint in our trauma ICU at the Inova Fairfax Hospital for over a year and it has been enormously helpful in achieving the goals previously stated.

I have just a few questions for the authors. The study period is relatively short, only a few months. Were your good results simply a Hawthorn effect where the staff knew they were being monitored? Or do you think the checklist will have a sustained impact over time?

A years' worth of data before and after implementation of the checklist would be useful in this regard. Why did you choose such a short study period?

You showed a significant decrease in the number of central lines removed early, with only 52.8 percent of lines still in place longer than 72 hours by the third month of your study.

But how necessary are those lines in the first place if half of them can be removed within three days of admission to the ICU? One may consider your results a reflection of unnecessary line placement in the trauma bay as much as from attentive ICU care.

Given the high rate of DVTs from large bore central lines, can you further explain your liberal use at your center? And when you say the central line duration was decreased, do you mean they were completely removed or exchanged over a guide wire?

As far as catheter infections go, our catheter related BSI rate in all of our ICUs at my hospital has dropped to almost zero with implementation of the IHI guidelines but also by using antimicrobial catheters. Are you using antimicrobial central lines?

And, finally, I would love to know how you are accomplishing sedation holidays on such a large majority of your patients since this has been extremely difficult for us to implement in our trauma ICU.

Brain injury patients are not good candidates and it seems very labor-intensive for the nurses who basically have to sit at the bedside to watch for agitation and self-extubation. What's your secret?

I enjoyed this paper very much because it lends evidence to something that I think makes intuitive sense. You have shown that implementation of an ICU checklist can have a measurable and direct effect on patient care.

And I also believe it will have the additional benefit of nurse, resident and student education about the standards of surgical ICU care.

My only suggestion would be to consider having each member of your multidisciplinary team sign the checklist each day. The Joint Commission requires documentation that we are doing multidisciplinary rounds in the ICU and a signed checklist would satisfy this requirement.

Dr. Steven R. Shackford (Burlington, Vermont): Who filled out the checklist? Was it the same person who was assigned for that all the time? What were the costs of tracking this data and analyzing it?

Dr. David A. Spain (Stanford, California): It leads to my question, Joe. I think we as a group have been poor about taking credit for the good we do.

You've reduced your VAP rate by about 33%. That's an enormous cost savings. The average cost of a ventilator associated pneumonia is about $55,000.

What credit are you getting from your hospital for achieving these good results?

Dr. Frank L. Mitchell III (Kansas City, Missouri): I want to make some comments related to this. The verification review committee looks at about 130 different hospitals each year for the verification process.

I can tell you that the variability of utilization of bundles and other guidelines is certainly out there.

And we've had some preliminary discussions related to how we can encourage through the verification process some of these bundles and some other guidelines that would improve the level of care. And I think this is right on with that.

And hopefully we will come up with some things that we can encourage, potentially require, trauma centers throughout the country because of the variability that we do see in the verification process.

Dr. Robert Kurtz (Brooklyn, New York): We're using very similar checklists and we've been using it for about two years now. And I would issue a challenge to the authors and anyone else in the room that wanted to take it up.

The New York City Health and Hospitals Corporation, which is the grouping that contains the eleven city hospitals in New York of which Kings County is a part, started posting the results of exactly this checklist on its Website last Friday so that we're public with all the information you guys have collected, bloodstream catheter infection rate, ventilator associated pneumonia, and so forth, as well as a bunch of other medical measures.

Five of the hospitals involved are Level I trauma centers. I think that using the checklist, following these goals, and doing the larger publicity ambit under the aegis of Mayor Bloomberg and our Health Commissioner Dr. Tom Frieden provides a positive incentive to all of us to try to keep on doing this improvement.

We actually have lowered our bloodstream catheter infection rate from years ago up in the 30s per thousand patient catheter days long before these programs started to zero for 12 of the last 14 months, and likewise for ventilator associated pneumonia rates.

I think those are feasible goals. I think if we can do it, anybody can do it. And I hope that others keep on working along these lines.

Dr. Amy Koler (Las Vegas, Nevada): This is a great idea for utilization in the ICU but what happens when the patients move to the floor and a lot of this care needs to continue?

I think checklists are a great idea and maybe this is something, a good option for our nurse well-physician extenders to keep a checklist on our floor patients.

Dr. Joe DuBose (Los Angeles, California): I would like to thank Dr. Michetti for his kind review and Drs. Spain, Shackford, and the others for their excellent questions. I will do my best to address each of them briefly.

With regard to Dr. Michetti's question regarding the relatively short study interval utilized, this is our initial report after the first 3 months of our checklist utilization. We continue to use the checklist daily on an ongoing basis, and hope to have a further report of our results at the 1-year interval very shortly, but we are encouraged by the initial results.

Dr. Michetti's question regarding initial line placement is also an excellent one. In our practice, we make a point of repeated emphasis to the members of our trauma teams that central lines should be avoided unless they are clearly indicated. We think that this educational component is an important component our larger efforts to prevent prolonged central line use and catheter-related blood stream infection. We also work diligently to minimize line duration, completely removing and replacing central venous lines with adequate peripheral IV access as absolutely soon as appropriate. We have also used antibiotic coated lines in our ICU for some time. These elements of our practice pre-date the study period, so we hope that our results are reflective of the impact of the QRC use.

As for the effective implementation of sedation holidays, we do have the benefit of having an in-unit ICU fellow that aids in the facilitation of this important daily measure. It is our practice that sedation holidays are routinely completed each morning, with instruction for the nurse to turn the sedation off as the ICU fellow is present and conducting his daily rounds, allowing the fellow to more effectively assist in the evaluation of that patient. We have found that this practice has not, subsequently, proven a significant demand on our nursing or physician staff.

Dr. Michetti's reminder of the importance of multidisciplinary input is also much appreciated. We agree that this type of cooperation is important on every level in order to affect a culture of change that is really a prerequisite for achieving any results with these types of devices.

In response to Dr. Shackford's question about who filled out the checklist and the cost of implementation, the QRC was completed by the ICU fellows and their team of residents and medical students on the daily rounding basis. The cost to us was actually quite minimal. Currently, we use a paper checklist that is completed by the fellow and then entered into an Excel database for analysis and reporting purposes. And as

we are currently working to move these efforts into an exclusively electronic format, our cost may increase slightly, but this remains to be seen.

Dr. Spain inquired about the credit that we have received from our hospital for our efforts with the QRC. In our monthly multidisciplinary meetings, the senior members of our hospital administration are present and have joined in our excitement at the results we have achieved. Subsequently, similar approaches have been introduced in several of the other intensive care units at our facility. So, we have received some recognition and support from our hospital administration for our efforts, and others at our facility have quickly come to recognize the positive impact that such a device can have on patient care.

Dr. Kurtz, the public disclosure of data issue you bring up is very interesting. I think this concept is an important one if you are truly going to affect a culture of change. In the very least the simplicity of our data lends itself to reporting and sharing it with the nursing staff so that we can give them a pat on the back for their job well done in supporting our efforts. Additionally, we have shared our results with the administration and other intensive care units in our facility so that they can adapt these practices for their own use. Perhaps in the future we'll also be able to share these results with the local community.

And finally, to address Dr. Koler's question, about adapting the QRC for use for floor patients. We are currently looking at ways to adapt the tool for that purpose, but as of yet have not done so. The impact of daily prophylactic measures in this environment is also an important aspect of care and we hope the QRC can be adapted to support these efforts.