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Using a mentoring approach to implement an inpatient glyceemic control program in United States hospitals



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ABSTRACT

Background: establishing an inpatient glyceemic control program is challenging, requires years of work, significant education and coordination of medical, nursing, dietary, and pharmacy staff, and support from administration and Performance Improvement departments. We undertook a 2 year quality improvement project assisting 10 medical centers (academic and community) across the US to implement inpatient glyceemic control programs. **Methods:** the project was comprised of 3 interventions. (1) One day site visit with a faculty team (MD and CDE) to meet with key personnel, identify deficiencies and barriers to change, set site specific goals and develop strategies and timelines for performance improvement. (2) Three webinar follow-up sessions. (3) Web site for educational resources. Updates, challenges, and accomplishments for each site were reviewed at the time of each webinar and progress measured at the completion of the project with an evaluation questionnaire. **Results:** as a result of our intervention, institutions revised and simplified formularies and insulin order sets (with CHO counting options); implemented glucometrics and CDE monitoring of inpatient glucoses (assisting providers with orders); added new protocols for DKA and perinatal treatment; and implemented nursing, physician and patient education initiatives. Changes were institution specific, fitting the local needs and cultures. As to the extent to which Institution's goals were satisfied: 2 reported "completely", 4 "mostly", 3 "partially," and 1 "marginally". Institutions continue to move toward fulfilling their goals. **Conclusions:** an individualized, structured, performance improvement approach with expert faculty mentors can help facilitate change in an institution dedicated to implementing an inpatient glyceemic control program.

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1. Introduction

Hyperglycemia in hospitalized patients with or without diabetes has been linked to adverse outcomes including infections,

prolonged hospital length of stay, and increased mortality, costs and risk of postoperative complications.^{1–13} While overly stringent control is discouraged by guidelines, uncontrolled hyperglycemia remains a recognized quality and safety issue.^{14,15} Based on studies in both medical and surgical patients which show improved outcomes, clinical practice guidelines recommend the use of physiological insulin regimens for the management of inpatient hyperglycemia.^{14,15}

Despite these recommendations and increasing evidence supporting the benefits of inpatient glyceemic control for enhancing patient safety and improving patient outcomes, the management of inpatient hyperglycemia remains poor and the use of sliding-

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scale insulin is pervasive.¹⁶ Planning and implementing a physiologically based glycemic management program is difficult. Barriers include healthcare professionals' over reliance on sliding-scale insulin and lack of knowledge about diabetes management and the principles of insulin therapy,^{17,18} fear of hypoglycemia, and clinical inertia (failure to advance therapy when targets are not being met).^{19,20} Improving glycemic control in hospitals requires continuous quality improvement over many years to break through these barriers, with significant reeducation and coordination of medical, nursing, dietary and pharmacy staff, and support from risk management and hospital administration. To facilitate advances in the nascent field of inpatient glucose management, a performance improvement initiative was developed to assist healthcare organizations in translating glycemic control concepts into action. This paper describes a two year effort assisting ten hospitals to implement a glycemic control program through the use of an external mentoring program.

2. Methods

The Annenberg Center for Health Sciences at Eisenhower Medical Center recruited an interdisciplinary faculty of seven diabetes experts who helped plan the performance improvement initiative and worked directly with the sites as faculty mentors. The faculty included two inpatient endocrinologists, two hospitalists with expertise in inpatient glycemic control, and three advanced practice diabetes specialty nurses (APDN) with expertise in implementing inpatient glycemic control programs.

2.1. Site recruitment and selection

A project description and application instructions were sent to the Chief Medical Officers at hospitals across the United States. Interested hospitals were required to submit an application with the following information:

1. An identified interdisciplinary team that would be responsible for the institution's performance improvement project.
2. Details of the organization's current resources for supporting inpatient glycemic control such as point-of-care-testing equipment, computerized provider order entry (CPOE), and personnel such as diabetes educators.
3. Protocols and policies describing their current inpatient glycemic management practices.
4. Certification that their institution was willing to dedicate sufficient resources to support their participation in the initiative.
5. A statement of institutional goals for participating in the performance improvement initiative.

2.2. Intervention

The intervention was comprised of three specific components: a site visit, web conferences and a project website.

2.3. Site visits

A faculty team (physician and APDN) made an initial day long visit to each site. The visit objectives were to assess each site's current inpatient glycemic control practices; to translate best practices for inpatient glycemic control based on both the American Diabetes Association inpatient recommendations and expert opinion; and to initiate the mentoring process at each site. The typical agenda included:

1. Meeting with the inpatient glycemic control committee to
 - examine all aspects of current state of inpatient diabetes management,
 - identify areas for change and improvement in their inpatient glycemic management,
 - identify institutional barriers to change,
 - plan strategies for overcoming institutional barriers, and
 - develop goals and objectives and timeline for their performance improvement project
2. Meet with various teams involved in diabetes management.
3. Observe current practice.
4. Faculty lecture (large and small groups) to the hospital staff on inpatient glycemic control strategies.

2.4. Web conferences

As follow-up to the initial site visit, three web conferences were held. The objectives were to facilitate interaction among the participating sites, to enhance project implementation, and to provide faculty feedback.

2.5. Web site

The password protected site contained the following features: faculty profiles with contact information; site profiles, a resource center with relevant literature and protocols addressing glycemic control; faculty presentation slides; posting of presentations from web conferences; and a discussion board which provided each site with an opportunity to initiate or participate in a discussion thread related to the initiative.

2.6. Data collection

Demographics and baseline glucose management status were obtained on the initial application. At each web conference and at the conclusion of the project, each site submitted updates on the status of their stated goals. On project completion (10–12 months after the site visit), all institutions completed the Glycemic Control-Performance Improvement Approach Questionnaire.

3. Results

3.1. Sites

Thirteen applications were received and reviewed by the faculty group. Based on their current organization resources, existing insulin order sets, and feasibility of their individual hospital goals for participation, 10 medical centers were accepted for participation. The institutions not chosen either already had advanced diabetes management programs in place or did not have sufficient resources to move forward. The demographics of the selected 10 sites are shown in [Table 1](#).

All of the participating sites had insulin infusion protocols in place in their intensive care units; four lacked basal/bolus insulin order sets; one had a sliding scale order form without an option to order basal insulin; one lacked access to a diabetes educator; and insulin order sets were mandatory at four of the sites. Basal/bolus order sets that were not mandatory were rarely utilized.

Five sites established new interdisciplinary glycemic control teams in order to participate in the performance improvement initiative. Of the five that had a glycemic control team in place prior to the initiative, one team was re-launched with a new charter and personnel changes, another established team changed structure and organization, and three remaining sites reported

Table 1
Demographics of Selected Hospitals.

Hospital	Location	Beds	Facility type	Core team	Computer order entry	Insulin order sets	Providers required to use insulin order sets	Access to diabetes educator	Glucose metrics data collection
1	Mid-West	436	Community/Teaching	Formed for initiative	Yes	Basal/bolus/supplemental; IV insulin infusion	No	Yes	No
2	West	465	Community/Teaching	Formed for initiative	No	Basal/bolus/supplemental; IV insulin infusion	No	Yes	No
3	East	421	Community/nonteaching	Formed for initiative	No	Basal/bolus/supplemental; IV insulin infusion	No	Yes	Yes
4	West	378	Community/nonteaching	In place	In process	Basal/bolus/supplemental; IV insulin infusion	Yes	Yes	Yes
5	East	350	Community/nonteaching	Formed for initiative	no	No basal/bolus. Supplemental only; IV insulin infusion	No	Yes	Yes
6	East	360	Community/teaching	In place	Yes	Basal/bolus/supplemental; IV insulin infusion	Yes	Yes	Yes
7	East	561	University/teaching	In place	Yes	No basal/bolus. Supplemental only; IV insulin infusion	IV insulin Infusion	No	No
8	West	439	County /teaching	In place	No	No basal/bolus. Supplemental only; IV insulin infusion	IV insulin infusion	Yes	No
9	East	242	Community/nonteaching	In place	No answer	No basal. bolus/supplemental; IV insulin infusion	No	Yes	Yes
10	West	542	Community/teaching	Formed for initiative	Yes	No basal/bolus. Supplemental only; IV insulin infusion	No	Yes	No

that participation in the initiative helped to bring additional attention and validation to their teams and their work.

Across the 10 participating institutions, 139 health care professionals from a variety of disciplines served as members of the glycemic control team. The mean size of a hospital's glycemic control team was 13 with a range of 6–31 members. Physicians and nurses had the highest representation on the teams. Two teams did not have a dietitian and one team did not have a pharmacist. Seven teams were led by a certified diabetes nurse educator or by a nurse working in the institution's Performance Improvement Department. Two teams were physician led and one team was lead by a pharmacist.

3.2. Site visits

Day long site visits occurred from November 2010 to March 2011. Common findings included infrequent use of existing basal/bolus order sets and limited data regarding glycemic control outcomes. During the site visit the faculty assessed each institution's current glycemic management program and assisted each site in identifying an initiative project. Lectures by the visiting teams were either incorporated into grand rounds or as a special event. Regardless of the specific forum used, these presentations were individualized to address the specific goals of that hospital, and included evidenced based guidelines, evaluation of barriers and strategies for implementation of changes. 259 Healthcare professionals earned continuing education credit.

3.3. Web conferences

Each site participated in three web conferences from April 2011 to March 2012. The participants were divided into three cohorts of three to four institutions based upon the faculty who had visited the site. During the first web conference the participants introduced team members and their planned performance improvement projects. The second web conference provided an opportunity for each site to give an update on its project's progress. At the final

web conference participants summarized what they accomplished during the initiative.

During each conference, time was allotted for comments and input from faculty and for problem solving strategies for overcoming common implementation challenges. Common implementation system barriers discussed during these conferences included lack of information technology (IT) support for ongoing data analysis to monitor performance; nursing workflow issues related to coordinating the timing of the patient's blood glucose check and insulin administration with delivery of the meal tray; competing priorities with the development of an electronic medical record; and resistance to mandatory use of insulin order sets.

3.4. Web site

The website provided an opportunity for participants to access educational resources such as faculty lecture slides and key articles related to glycemic management and to initiate and participate in discussion threads related to performance improvement activities. The discussion board was monitored by the Annenberg Center staff for reportable adverse events but no such discussion occurred. Participants reported usability issues with the website's software platform, which limited its overall use. Participants tended to access the website early on in the initiative to download educational resources, but rarely revisited the site.

3.5. Sites' performance improvement projects

After discussion with visiting faculty, each hospital identified a performance improvement project for the initiative. Eight of the participating sites' performance improvement projects focused on transitioning away from the use of sliding-scale insulin regimens. In each instance, they either developed or revised their insulin order sets to reflect physiological insulin regimens which included the components of basal, prandial and supplemental insulin. One site focused on improving glycemic control in the intensive care unit and another focused on revising its hypoglycemia protocol

Table 2
Performance improvement projects.

Hospital	Project	Process outcomes
1	Revise hypoglycemia protocol	Revised hypoglycemia protocol and embedded it into insulin order sets
2	Revise and implement physiologic insulin order sets	Revised and implemented physiologic insulin order sets
3	Revise and implement physiologic insulin order sets	Revised physiologic insulin order sets; pilot delayed due to competing interest with development of CPOE
4	Revise and implement physiologic insulin order sets	Revised and implemented physiologic insulin order sets and increased utilization by providers
5	Improve glycemic control in the ICU	Implemented glucose management system for customizing Insulin Infusion in ICU
6	Revise and implement physiologic insulin order sets	Revised and implemented physiologic insulin order sets
7	Develop and implement physiologic insulin order sets	Developed and piloted physiologic insulin order sets
8	Develop and implement physiologic insulin order sets	Developed and piloted physiologic insulin order sets
9	Develop and implement basal insulin order set	Developed and implemented basal insulin order set
10	Develop and implement physiologic insulin order set	Developed and implemented physiologic insulin order sets

and embedding it in its insulin order sets. Each site's performance improvement project and the outcome is shown in [Table 2](#).

3.6. Additional site accomplishments

As a result of faculty input, additional accomplishments of the participating sites beyond their planned performance improvement projects included the following:

1. Glucometrics (systematic analysis of blood glucose data): three sites developed a glucose metric system for data collection and reports.
2. Carbohydrate counting: two sites reported adding a carbohydrate controlled meal plan to their dietary order sets. One site developed a tool that automated the calculation of carbohydrates in the meal plan to assist providers in adjustment of the prandial insulin dose based on actual carbohydrate intake.
3. Formulary simplification: one site reduced the number of insulin products on its hospital formulary to prevent look alike–sound alike insulin errors.
4. DKA/hyperosmolar coma: two sites revised their protocols for diabetic ketoacidosis and hyperosmolar hyperglycemic state.
5. Insulin pump: two sites developed inpatient insulin pump order sets for patients to manage their glucoses in the hospital with their own insulin pump.
6. Perinatal insulin order set: one site developed a perinatal insulin order set.
7. Clinical practice: four sites implemented new clinical practices that included new methods of deploying pharmacists, nurses, and/or endocrinologists in the care of patients with diabetes, and instituted interdisciplinary rounds, and case conferences focused on the management of difficult patients.
8. Glucose measurements: one site redesigned nursing workflow to capture point of care glucose data at appropriate times.
9. Timely data availability: several sites improved laboratory reporting to ensure clinicians have data to manage glycemia.
10. Patient education: two sites employed nurse champions to provide patient education and developed diabetes patient educational material.
11. Provider education: three sites reported enhancing their diabetes education programs for their staff. At one site, case based education on DVDs was produced. CDE's brought these to the physician offices to assist the physicians with use of the DVD based education.
12. Transitions: one site developed and implemented a protocol for transitioning patients from IV insulin to a basal, prandial, and correctional subcutaneous insulin protocol for patients post cardiac surgery.

13. Surgical Care Improvement Project (SCIP): one site improved its frequency for meeting the SCIP measures for improving glycemic control of the post-operative cardiac surgery patient.
14. Personnel: one site hired additional diabetes educators and others assisted staff obtain CDE certification.
15. Joint Commission Certification: one site received Joint Commission Advanced Certification for Inpatient Diabetes.

Sites' Strategies for overcoming clinical inertia:

1. Revised insulin order sets were embedded with an order to call a prescriber for persistent hyperglycemia, calling for a change in orders, not just a single extra dose of insulin.
2. Conducted a pilot of the order sets on a single medical unit to enable refining the insulin doses before hospital-wide roll out.
3. During the implementation of the insulin order sets the diabetes educator was available on medical and surgical units to provide education to hospital staff and to answer questions.
4. The diabetes educator monitored the Inpatient Hypoglycemia and Hyperglycemia Report daily and offered suggestions to providers for enhancing the patients' insulin regimens.

3.7. Sites' evaluation of initiative

A post initiative assessment survey was completed by all of sites to evaluate various components of the initiative (see [Table 3](#)). Sites reported that the faculty site visit, faculty lecture during the visit, as well as the ongoing formal and informal consultations with faculty were effective in helping them achieve their respective project goals. Sites were asked to evaluate the extent they felt their institutional goals were met ([Table 4](#)). Ninety percent of the sites reported that the external recognition provided by participating in the initiative was important for building institutional support for their project.

Regarding the question "To what extent were your institution's goals for participating in this initiative satisfied?" sixty percent reported that their institutional goals were completely or mostly met by participating in the initiative (see [Table 4](#)).

4. Discussion

Implementing change to improve inpatient glycemic control is a very difficult endeavor. Change may take many years and requires support from hospital administrators, physicians, nurses, and pharmacists, as well as laboratory medicine, nutrition services, informatics, and performance improvement groups. Improving glycemic control

Table 3
Participating hospitals' evaluation and the impact of the initiative.

Intervention	Rating average ^a
Faculty site visit	4.6
Faculty lectures during visit	4.7
Faculty consultation with interdisciplinary glycemetic control team	4.2
Informal consultation with faculty after site visit	4.0
Website educational resources and tools	3.0
Web conferences and peer interaction	3.89
Impact	
Participation in the initiative served as a catalyst for changing how we manage inpatient glycemetic control	3.9
The external recognition of being selected to participate in the initiative was important for building support for the project	4.4
Input from external faculty was important in persuading internal stakeholders to make changes	3.9
Hearing other sites discuss the problems and barriers they faced was useful	4.0
Having access to faculty was helpful when encountered problems and needed advice	4.1

^a 1—not valuable; 5—highly valuable.

Table 4
Extent to which Institution's goals were satisfied.

Answer options	Not at all	Marginally	Partially	Mostly	Completely
To what extent were your institution's goals for participating in this initiative satisfied?	0	1	3	4	2

within an institution creates both an educational and logistical challenge. Successful implementation of change into a healthcare organization requires effective leadership, appropriate infrastructure and resources, and administrative support and endorsement. Korytkowski et al.²¹ identified strategies for implementing inpatient glycemetic management into a hospital setting. These include the presence of institutional support, dedication of an interdisciplinary team, development of physiologic insulin order sets, education of hospital staff, and development of quality improvement metrics. It is not surprising that several of the institutions involved in this initiative reported delays in moving ahead with their projects due to various challenges in these areas.

At the institutions in the project, implementation challenges included assessing the institution's configuration of resources to determine what will be effective in that setting, collecting data about current performance, planning a series of interventions, implementing these interventions, and measuring performance and outcomes. The training and education needed to support the implementation of new practices include addressing the targeted needs of specific stakeholder groups. Health care providers need to understand the rationale underlying the new practices; require understanding of the relative advantages of the newer practices over the practices they replace and need to develop skills related to implementing new practices. These may include how to order insulin using a new order set, how to calculate insulin doses according to new protocols, when to perform blood glucose monitoring, and workflow redesign for coordinating insulin administration with meals. Because of the complexity of the tasks and institutional competing interests, organizations frequently encounter barriers and unexpected challenges and are forced to “change gears” and adjust to new conditions.

As demonstrated by their self-reporting of achievement of the goals, we found the ongoing mentoring process with the participating hospitals was an effective strategy in promoting institutional change. Our improvement initiative, within a relatively short time frame, was successful in helping participating hospitals implement new glycemetic control practices by creating an ongoing structure and process for continuous quality improvement. The mentoring teams assisted the hospitals in evaluating their current diabetes management system and plan next steps. Another outcome

was enhancing or establishing an ongoing, interdisciplinary glycemetic control team within the organizational committee structure of each participating hospital. This team has an evolving role related to enhancing policy, quality improvement, and education on issues related to glycemetic control.

We believe that external accountability was also a factor in the success of this initiative. Institutions were selected to participate on the basis of an application, which brought recognition to the project, the team, and institution. The requirement that participants report their progress to peers and faculty also created a sense of responsibility.

As the primary focus of the project was improving the quality of patient care rather than reducing its cost, we did not collect any data about the cost of implementing the intervention, or any saving (or increased costs) that resulted from the project. All institutions participated with a focus of improving quality of care. They were self-selected for the resources available to engage and complete the project using existing hospital budgets.

The experience of having implemented this performance improvement initiative has also given us insight on how this model could be improved and made more efficient. Our initiative allowed participating hospitals to choose their own inpatient glycemetic control performance improvement project. As most sites' projects focused on transitioning away from sliding-scale insulin regimens to basal-bolus insulin administration, standardizing a performance improvement project amongst all participating sites would have enhanced interaction and communication among sites as all would have been pursuing similar projects and goals. Differences in hospital formularies, teaching and non-teaching institutions, staffing policies, state regulations on nursing practice responsibilities, computer systems and electronic medical records all make a unified approach difficult. Nevertheless, a shared vision could facilitate institutional goal setting, and enhance data collection, reporting, and benchmarking. This initiative also needed to be promoted more broadly. Although we sent invitations to 702 chief medical officers across the United States, this marketing strategy only generated 13 applications. Future requests for applications should be sent to the Directors of Performance Improvement, Nursing, and Pharmacy. We think that the initiative website was a lost

opportunity. The website could have been a facilitating factor had it not fallen victim to its slow technology infrastructure.

Limitations of this performance initiative include that only a limited numbers of hospitals applied to participate in the initiative and those hospitals self-selected commitment to the project. Another limitation was the project's short time frame for evaluating clinical and economic outcomes.

5. Conclusion

Changing the culture of inpatient glucose management is a complex institutional challenge. Our initiative provided hospitals a model which helped overcome inertia as well as the barriers to change. Every institution was successful in implementing improved practices whether it was order sets, data collection and reporting or organization of their teams. These changes to their institution will continue to promote their goals as well as provide the resources for the future.

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