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SYMPOSIUM

Understanding and Improving Management of Inpatient Diabetes Mellitus: The Mayo Clinic Arizona Experience

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Abstract

We present an overview of strategies our institution has taken to understand the state of its inpatient diabetes management. We first describe how we utilized information systems to assess inpatient glycemic control and insulin management in noncritically ill patients and discuss our findings regarding mean bedside glucose levels, the prevalence and frequency hypoglycemic and hyperglycemic events, the patterns of insulin therapy, and evidence of inpatient clinical inertia. We also review the development of a survey to determine practitioner attitudes and beliefs about inpatient diabetes. Results of this survey study found that, in general, practitioners believed in the importance of controlling hyperglycemia but were not comfortable with many aspects of inpatient diabetes care, particularly with the use of insulin. Finally, we suggest steps to follow in developing a quality-improvement program for hospitals.

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Introduction

Diabetes mellitus confers a substantial burden on the hospital system. Hospitalizations associated with diabetes have increased in the past decade.[1,2] During 2001, more than 500,000 U.S. hospital discharges listed diabetes as the principal diagnosis, and more than 4 million listed it as a codiagnosis.[1,2] Diabetes is the fourth leading co-morbid condition associated with any hospital discharge in the United States.[3] Nearly one-third of diabetes patients require two or more hospitalizations in any given year,[4] and inpatient stays account for the largest proportion of direct medical expenses incurred by persons with the disease.[5]

There is now a greater appreciation about the consequences of sustained hyperglycemia in hospitalized patients, and the topic of inpatient diabetes has been extensively reviewed.[6–9] Recent consensus guidelines stress the importance of maintaining good glucose control in all inpatients, propose target inpatient glucose levels, and advocate the development of broad-based

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Abbreviations: ($BedGluc_{avg}$) composite bedside glucose average, ($F24BedGluc_{avg}$) average bedside glucose measurements obtained during the first 24 h after admission, (ICD-9-CM) International Classification of Diseases, 9th Revision, Clinical Modification, (IDQIP) inpatient diabetes quality-improvement program, ($L24BedGluc_{avg}$) average bedside glucose measurements obtained during the last 24 h before discharge, (LOS) length of stay

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quality-improvement programs targeting hyperglycemia in hospitalized patients. Although inpatients with known diabetes will likely constitute the largest and most visible percentage of persons requiring treatment of high glucose, the recommendation to control glucose applies to all inpatients regardless of whether they were diagnosed with diabetes before hospitalization or manifested hyperglycemia only during their hospital stay.[6–8] National[10–12] and regional[13] organizations and professional societies[7,8,14] have been working rapidly to develop and disseminate guidelines about the management of hyperglycemia in inpatients.

Despite the attempts of numerous organizations to enhance care, diabetes and glucose control continue to be overlooked frequently in the hospital, appropriate therapeutic responses to hyperglycemia do not occur,[15–18] and there is ongoing concern about the slow pace at which hospitals are implementing recommendations about glycemic control.[8] In our own institution, we have found that diabetes is often "forgotten" after admission, with a resulting lack of documentation of the problem and no plan for glucose management detailed in a substantial number of daily progress notes.[16]

We review the steps undertaken in our hospital to further our understanding of inpatient diabetes management, with an emphasis on employing information systems to evaluate the status of glucose control and treatment, our use of survey data to understand practitioner attitudes, and our efforts to develop an overall quality-improvement program. Our particular focus has been in the nonintensive care environment, an area for which there is little data to guide evidence-based management of hyperglycemia.[19] The use of continuous subcutaneous insulin (insulin pump) therapy in the hospital is reviewed elsewhere in this issue.

Overview of Facility

Our tertiary care academic teaching hospital is a 200+ bed facility located in metropolitan Phoenix, Arizona. All adult general medical and surgical specialties (except obstetrics) are represented, including transplantation services. Our electronic medical record links outpatient and inpatient records with laboratory results and pharmacy orders. The core electronic health record system is the Centricity/LastWord platform (GE/IDX). The ancillary core systems, including laboratory and pharmacy, are interfaced into the Centricity system and maintained by Mayo Clinic information technology professionals on-site.

Characteristics of Inpatient Diabetes Patient Population

We examined historical electronic hospital data for the calendar years between 2001 and 2004 to gather information on patients with diabetes who were treated in our hospital. Patients discharged with an International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis code for diabetes (ICD-9-CM code 250.xx) or hyperglycemia (ICD-9-CM code 790.6) were identified in a search of the hospital's electronic billing records.[18] Between January 1, 2001, and December 31, 2004, a total of 7361 discharges (16% of all discharges) from our facility had either a diabetes or hyperglycemia diagnosis; a recent data update shows that the percentage of discharges from our hospital attributable to diabetes rose from 15% in 2001 to 22% in 2007.

Our analyses concentrated on noncritically ill patients [defined as those patients who did not require a stay in the intensive or intermediate care units and who had a length of stay (LOS) of ≥3 days (N = 2916)].[18] The reasons for evaluating hyperglycemia management in the noncritically ill in this analysis were twofold. First, the critically ill may migrate in and out of intensive care and, consequently, experience different intensities of glucose management. Second, the therapeutic approach to hyperglycemia management in our facility is different in the critically versus noncritically ill; the critically ill may receive intravenous and/or subcutaneous insulin, while only subcutaneous insulin therapy is used in the noncritical care setting. We restricted the final analysis to patients who had a LOS ≥3 days so that differences in glucose control and insulin therapy between the first and last 24 h of the hospital stay could be assessed.[18] The average age of patients in the final analytic data set was 69 years, and the average LOS was 5.7 days. Most of the discharged patients were men (57%), and 90% were white. Most patients were discharged from primary care (45%, general internal medicine or family medicine) or surgical services (34%), whereas the rest were discharged from other specialties (e.g., cardiology or transplant medicine).[18]

Assessment of Glycemic Control

We utilized point-of-care (bedside glucose) data to assess inpatient glycemic control. In our institution, bedside glucose monitoring is performed with an instrument that scans and records patient identification from a bar code, followed by direct downloading of the results to

our laboratory database. Commercial software (Medical Automation Systems, Charlottesville, VA) facilitates the interfacing of glucometer data with the electronic laboratory file.

To extract our bedside glucose data, we linked patient demographic data with our electronic laboratory records. All available bedside glucose measurements were first averaged for each patient, and the composite bedside glucose average ($BedGluc_{avg}$) was then determined. We also computed the average bedside glucose measurements obtained during the first 24 h after admission ($F24BedGluc_{avg}$) and during the last 24 h before discharge ($L24BedGluc_{avg}$), then we examined the distributions of these three measures.[18] For each patient, we calculated the frequency of hypoglycemic values (bedside glucose <70, <60, <50, or <40 mg/dl) and hyperglycemic values (bedside glucose >200, >250, >300, >350, or >400 mg/dl), and we reported the results as the number of values per person per 100 measurements.[16,18,20]

We found that nearly 25% of patients were hyperglycemic ($F24BedGluc_{avg}$ >200 mg/dl) during the first 24 h of hospitalization (see **Figure 1A**), 20% had persistent hyperglycemia ($BedGluc_{avg}$ >200 mg/dl) throughout their entire hospitalization (see **Figure 1B**), and 21% were hyperglycemic ($L24BedGluc_{avg}$ >200 mg/dl) during the last 24 h before discharge (see **Figure 1C**).[18] Of those patients admitted with hyperglycemia, 42% were discharged with bedside glucose values >200 mg/dl.

The frequency of hypoglycemic measurements was low (see **Figure 2A**) compared with the frequency of hyperglycemic episodes (see **Figure 2B**).[18] A similarly low number of hypoglycemic events and a high number of hyperglycemic measurements have also been observed in a study of 10 different hospitals,[21] which suggests that hyperglycemia, rather than hypoglycemia, may currently be the bigger problem in hospitals.

Hyperglycemia Therapy in the Hospital Setting

The aforementioned patient data were linked to our inpatient electronic pharmacy records to gain insight on the pharmacologic management of inpatient hyperglycemia.[18] The design of our electronic pharmacy records is such that intravenous insulin, scheduled oral medications and subcutaneous insulin, and insulin administered on a one-time or as needed basis (e.g., sliding scale insulin) are documented electronically as separate categories. In our hospital, intravenous insulin is administered only in the intensive care setting or as a component of total parenteral nutrition, and we excluded intravenous insulin use from this data. Thus our analysis of insulin therapy focused only on determining the patterns of subcutaneous treatment in the noncritically ill.

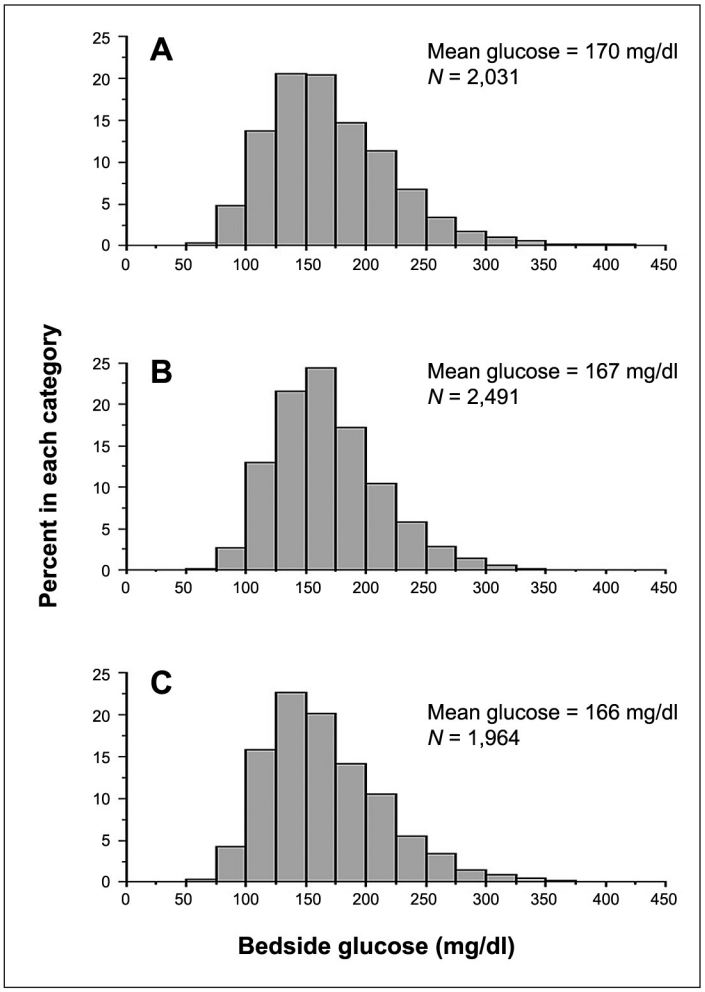

Figure 1. Distribution of average bedside glucose values (mg/dl) for **(A)** $F24BedGluc_{avg}$, for **(B)** $BedGluc_{avg}$, and for **(C)** $L24BedGluc_{avg}$. Reprinted with permission from Cook *et al*.[18]

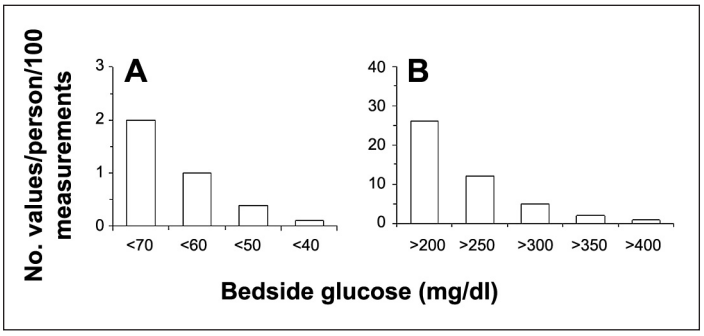

Figure 2. Frequency of **(A)** hypoglycemic measurements and **(B)** hyperglycemic measurements. Reprinted with permission from Cook *et al*.[18]

For the management of hyperglycemia in noncritically ill patients, the use of a programmed basal-bolus insulin program is advocated over the use of only a short-acting bolus or sliding scale regimen;[6,7] a recent report demonstrated the superiority of a basal-bolus approach to treatment over the sliding scale method.[22] Therefore we characterized subcutaneous insulin regimens as bolus only, basal-bolus, or basal only;[18] and because only a small number (1%) of patients received basal only, we excluded them from further analysis. We calculated the difference between the average total units of insulin administered to the patient during the last 24 h before discharge with the amount administered during the first 24 h of hospitalization; changes in the amount of administered insulin were classified as increased, decreased, or no change. The $BedGluc_{avg}$ values were then divided into tertiles, and the differences in the proportion of patients by each type of insulin treatment regimen and the categories of insulin change were analyzed by the severity of hyperglycemia.[18]

As hyperglycemia worsened, there was an appropriate shift away from oral agents to insulin (see **Figure 3**). Among insulin users, 58% received bolus only and 42% received basal-bolus injections. The use of a basal-bolus insulin program increased from 34% for patients whose $BedGluc_{avg}$ was in the first tertile to 54% for those who had $BedGluc_{avg}$ in the third tertile ($p < .001$) (see **Figure 4, left**). Thus although there was a greater transition to a more intensive insulin regimen with worsening hyperglycemia, a substantial number of patients (46%) with the highest $BedGluc_{avg}$ still did not have their insulin regimen intensified to a basal-bolus program.[18]

With worsening hyperglycemia, more patients had their insulin increased by the time of discharge; 41% of persons whose $BedGluc_{avg}$ was in the first tertile were receiving more insulin at discharge compared with 65% of those who had $BedGluc_{avg}$ values in the third tertile (see **Figure 4, right**). However, nearly 31% of patients whose BedGlucavg was in the highest tertile actually had a decrease in insulin; this decrease occurred despite evidence of a low frequency of hypoglycemia (only 1.2 values <70 mg/dl per person per 100 measurements) and a high frequency of hyperglycemia (55.4 values >200 mg/dl per person per 100 measurements).[18]

These findings regarding insulin therapy were encouraging. Practitioners were responding to the severity of hyperglycemia by using a more appropriate basal-bolus insulin program and by increasing the amount of administered insulin. However, nearly half

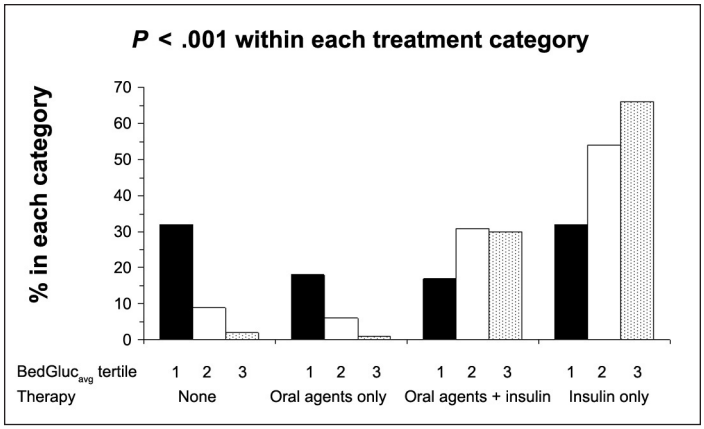

Figure 3. Distribution of therapies by $BedGluc_{avg}$ tertiles: tertile 1 (129 mg/dl), tertile 2 (165 mg/dl), and tertile 3 (219 mg/dl). Reprinted with permission from Cook *et al*.[18]

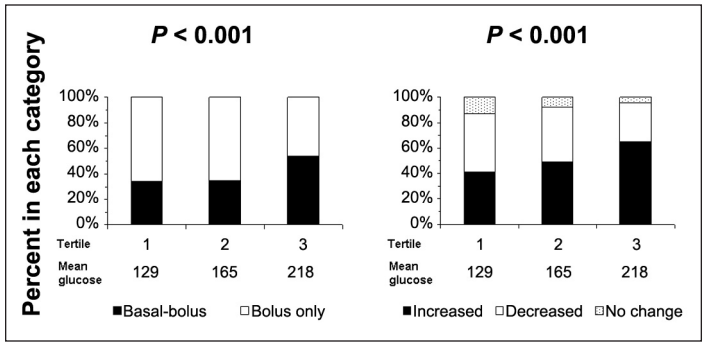

Figure 4. Changes in insulin regimen (**left**, $N = 2084$) and in the amount of insulin administered (**right**, $N = 1680$) by tertiles of $BedGluc_{avg}$. Reprinted with permission from Cook *et al*.[18]

the patients in the highest tertile of glucose values were still either being treated with short-acting insulin alone—probably an ineffective regimen[20,22,23]—or did not have more insulin administered when needed. These findings substantiated our earlier report[16] that clinical inertia (i.e., the failure to intensify therapy when needed) exists in the hospital just as it does in the outpatient setting.[24–28]

Beyond clinical inertia, however, there was evidence of negative therapeutic momentum: nearly one-third of patients in the highest glucose tertile had their insulin decreased rather than increased, despite the low frequency of hypoglycemia and the high frequency of hyperglycemia. The reasons for this negative therapeutic momentum are unclear. It is possible that even a single episode of hypoglycemia concerned practitioners enough to induce them to deintensify therapy; if that is the case, the clinical response in these situations should be to investigate and correct the circumstances leading to the hypoglycemia rather than to necessarily decelerate

treatment in the face of continued hyperglycemia. The varied application of insulin therapy for the treatment of hyperglycemia might reflect the level of comfort that practitioners have about using this pharmacologic agent, a possibility supported by survey data (see next section).

Practitioner Beliefs About Inpatient Glucose Control

Before educational interventions and policies directed at improving the management of hospital hyperglycemia can be developed, institutions must gain a better understanding of how practitioners view the importance of glucose control in inpatients and what barriers they perceive as limiting their ability to care for such patients. We developed a questionnaire and surveyed our resident physicians and inpatient midlevel practitioners (nurse practitioners and physician assistants) to examine their views about inpatient glucose control.[29,30]

In response, 52 out of 70 residents and 51 out of 65 inpatient midlevel practitioners completed the survey. Of the combined responses, 95% indicated that these practitioners believed glucose control was "very important" in critically ill patients; 68% believed it was "very important" in noncritically ill patients; and 80% believed it was "very important" to treat hyperglycemia in perioperative patients. Most of the respondents indicated that they would target a therapeutic glucose range within recommended published guidelines. However, only 43% said that they felt "very comfortable" managing hyper glycemia, just 48% said that they felt "very comfortable" managing hypoglycemia, and only 43% and 38%, respectively, indicated that they were "very comfortable" using subcutaneous insulin and intravenous insulin. Respondents were generally not familiar with existing institutional polices and preprinted order sets relating to the management of hypoglycemia and the use of intravenous insulin and insulin pumps in the hospital.[29,30]

The most common barrier to successful hyperglycemia management in the hospital cited by residents and midlevel providers was "knowing what insulin type or regimen works best" (58% of respondents); the "risk of causing patient hypoglycemia" was second on the list of concerns (38% of respondents).[29,30] Intensive educational efforts will be needed in the hospital to improve the confidence of practitioners regarding their ability to manage inpatient diabetes, particularly as it relates to the application of insulin therapy.

Improving Inpatient Hyperglycemia Care

There is a general perception that the state of diabetes care in the hospital is one of "glycemic chaos."[31] Care of the hyperglycemic patient in the hospital is complex. The population of inpatients with hyperglycemia is heterogeneous, composed of persons with preexisting diabetes, persons with previously undiagnosed diabetes, and persons in whom hyperglycemia develops because of acute illness. Diabetes is not typically the principal reason for hospitalization; hence it runs the risk of getting lost as a health problem.[15,16] Unpredictable timing of procedures, various and changing forms of nutritional support, and different levels of staff expertise all contribute to the challenges of managing inpatient hyperglycemia. In many instances, inpatient practitioners may be trying to play "glycemic control catch-up" in hospitalized persons who have had poor glucose control as outpatients. Adding to these challenges is practitioner confusion about how best to apply therapy insulin[29,30] while also trying to reduce the high frequency of errors associated with its use.[32]

Creating "glycemic order" out of "glycemic chaos" in the hospital will require a multidisciplinary effort at the institutional level.[31,33] On the basis of our experience,[13] the formation and success of an inpatient diabetes quality-improvement program (IDQIP) depends on six factors: recognition of the problem, supportive infrastructure, involvement of leadership, prioritization and incremental implementation, sustained commitment by stakeholders, and iterative development.

Recognition of the Problem

An institution must acknowledge the relevance of better-organized inpatient diabetes care as the first step toward constructing an IDQIP. The rapidly rising volume of hospital diabetes cases, the considerable body of evidence confirming the relationship between hyperglycemia and adverse outcomes in the hospital, the published data showing the benefit of treating hyperglycemia in hospitalized patients, and the increased attention from a number of national organizations easily justifies the formation of an institutional IDQIP.

Supportive Infrastructure

Administrative commitment is essential, and the success of any IDQIP will not be possible without the support of the parent organization. The organization must provide critical infrastructure, assisting with the coordination of meetings and providing adequate space and personnel.

Information technology will also be a critical component of assessing care and determining the results of quality-improvement efforts on hospital glycemic control.

Involvement of Local Thought Leaders

Diabetes care requires multiple areas of expertise. Local thought leaders and stakeholders from numerous disciplines within the institution must be actively recruited to participate in an IDQIP. Our institution's IDQIP is composed of physicians (endocrinologists and physicians in family medicine, hospital internal medicine, and anesthesiology), quality managers, pharmacists, information technologists, nutritionists, nurses, and representatives from our laboratory. The broad representation from numerous physician specialties and allied health professions provides considerable depth of experience and assures the airing of points of view from all stakeholders.

Prioritization and Incremental Implementation

Gaps in care must be identified. An IDQIP cannot resolve all the problems at once, so priorities must be set. The process of quality improvement is evolutionary rather than revolutionary; thus, making simple, single changes will build team confidence and enhance care over time.

Sustained Commitment by Stakeholders

The IDQIP membership is the driving force behind its achievements. The willingness of members to volunteer their time and share their information and experiences will foster a sense of collaboration and maintain a high level of enthusiasm that will enable the continuation of the effort. Ensuring regular communication between stakeholders and administrative leaders can help maintain commitment and interest.

Iterative Development Process

Policies and procedures must be reviewed, and changes must be pilot tested and then revised. The results of these changes must be reviewed again and modified as needed. This iterative development process will ensure that institutional care guidelines continue to be met.

Summary

Inpatient diabetes has emerged as a new focus in national quality-improvement initiatives. We summarize the efforts of one hospital to understand the current status of glycemic control among inpatients and how insulin is used to treat hyperglycemia. Hyperglycemia, rather than hypoglycemia, is the predominant problem in hospitals, and insulin therapy is subject to both clinical inertia and negative therapeutic momentum. Practitioners believe that inpatient glucose control is important, but they lack the management techniques—particularly insulin management—to implement and maintain such control in their patients. The formation of inpatient diabetes quality-improvement programs is possible, but it requires specific factors to ensure a successful effort.

References:

1. Centers for Disease Control and Prevention. Hospitalizations for diabetes as first-listed diagnosis. http://www.cdc.gov/diabetes/statistics/dmfirst/index.htm. Accessed May 19, 2008.
2. Centers for Disease Control and Prevention. Hospitalizations for diabetes as any-listed diagnosis. http://www.cdc.gov/diabetes/statistics/dmany/index.htm. Accessed May 19, 2008.
3. Elixhauser A, Yu K, Steiner C, Bierman AS. Hospitalization in the United States. Rockville: Agency for Healthcare Research and Quality; 2000.
4. Jiang HJ, Stryer D, Friedman B, Andrews R. Multiple hospitalizations for patients with diabetes. Diabetes Care. 2003;26(5):1421–6.
5. Hogan P, Dall T, Nikolov P, American Diabetes Association. Economic costs of diabetes in the US in 2002. Diabetes Care. 2003;26(3):917–32.
6. Clement S, Braithwaite SS, Magee MF, Ahmann A, Smith EP, Schafer RG, Hirsch IB, American Diabetes Association Diabetes in Hospitals Writing Committee. Management of diabetes and hyperglycemia in hospitals. Diabetes Care. 2004;27(2):553–91.
7. Garber AJ, Moghissi ES, Bransome ED Jr, Clark NG, Clement S, Cobin RH, Furnary AP, Hirsch IB, Levy P, Roberts R, Van den Berghe G, Zamudio V, American College of Endocrinology Task Force on Inpatient Diabetes Metabolic Control. American College of Endocrinology position statement on inpatient diabetes and metabolic control. Endocr Pract. 2004;10(1):77–82.
8. ACE/ADA Task Force on Inpatient Diabetes. American College of Endocrinology and American Diabetes Association consensus statement on inpatient diabetes and glycemic control. Endocr Pract. 2006;12(4):459–68.
9. Donner TW, Flammer KM. Diabetes management in the hospital. Med Clin North Am. 2008;92(2):407–25.
10. Institute for Healthcare Improvement. Getting started kit: prevent surgical site infections. http://www.ihi.org/NR/rdonlyres/00EBAF1F-A29F-4822-ABCE-829573255AB8/0/SSIHowtoGuideFINAL.pdf. Accessed May 19, 2008.
11. Institute for Healthcare Improvement. Implement effective glucose control. http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Changes/ImplementEffectiveGlucoseControl.htm. Accessed May 19, 2008.
12. Joint Commission on Accreditation of Healthcare Organizations. Inpatient diabetes certification addendum. http://www.jointcommission.org/CertificationPrograms/Inpatient+Diabetes/. Accessed May 19, 2008.
13. Cook CB, Stockton L, Baird M, Osburne RC, Davidson PC, Steed RD, Bode BW, Reid J, McGowan KA. Working to improve care of hospital hyperglycemia through statewide collaboration: the Georgia Hospital Association Diabetes Special Interest Group. Endocr Pract. 2007;13(1):45–50.

14. Society of Hospital Medicine. Glycemic control resource room. http://www.hospitalmedicine.org/ResourceRoomRedesign/GlycemicControl.cfm. Accessed August 29, 2007.
15. Levetan CS, Passaro M, Jablonski K, Kass M, Ratner RE. Unrecognized diabetes among hospitalized patients. Diabetes Care. 1998;21(2):246–9.
16. Knecht LD, Gauthier SM, Castro JC, Schmidt RE, Whitaker MD, Zimmerman RS, Mishark KJ, Cook CB. Diabetes care in the non-ICU setting: is there clinical inertia in the hospital? J Hosp Med. 2006;1(3):151–60.
17. Schnipper JL, Barsky EE, Shaykevich S, Fitzmaurice G, Pendergrass ML. Inpatient management of diabetes and hyperglycemia among general medicine patients at a large teaching hospital. J Hosp Med. 2006;1(3):145–50.
18. Cook CB, Castro JC, Schmidt RE, Gauthier SM, Whitaker MD, Roust LR, Argueta R, Hull BP, Zimmerman RS. Diabetes care in hospitalized non-critically ill patients: more evidence for clinical inertia and negative therapeutic momentum. J Hosp Med. 2007;2:203–11.
19. Wexler DJ, Cagliero E. Inpatient diabetes management in non-ICU settings: evidence and strategies. Cur Diabetes Rev. 2007;3(4):239–43.
20. Queale WS, Seidler AJ, Brancati FL. Glycemic control and sliding scale insulin use in medical inpatients with diabetes mellitus. Arch Intern Med. 1997;157(5):545–52.
21. Cook CB, Moghissi E, Joshi R, Kongable GL, Abad VJ. Inpatient point-of-care bedside glucose testing: preliminary data on use of connectivity informatics to measure hospital glycemic control. Diabetes Technol Ther. 2007;9(6):493–500.
22. Umpierrez GE, Smiley D, Zisman A, Prieto LM, Palacio A, Ceron M, Puig A, Mejia R. Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes (RABBIT 2 trial). Diabetes Care. 2007;30(9):2181–6.
23. Gearhart JG, Duncan JL III, Replogle WH, Forbes RC, Walley EJ. Efficacy of sliding-scale insulin therapy: a comparison with prospective regimens. Fam Prac Res J. 1994;14(4):313–22.
24. Grant RW, Buse JB, Meigs JB, Team UHCUDBP. Quality of diabetes care in U.S. academic medical centers: low rates of medical regimen change. Diabetes Care. 2005;28(2):337–442.
25. Grant RW, Cagliero E, Dubey AK, Gildesgame C, Chueh HC, Barry MJ, Singer DE, Nathan DM, Meigs JB. Clinical inertia in the management of type 2 diabetes metabolic risk factors. Diabet Med. 2004;21(2):150–5.
26. Kennedy AG, MacLean CD. Clinical inertia: errors of omission in drug therapy. Am J Health Syst Pharm. 2004;61(4):401–4.
27. O'Connor PJ. Overcome clinical inertia to control systolic blood pressure. Arch Intern Med. 2003;163(22):2677–8.
28. Shah BR, Hux JE, Laupacis A, Zinman B, van Walraven C. Clinical inertia in response to inadequate glycemic control: do specialists differ from primary care physicians? Diabetes Care. 2005;28(3):600–6.
29. Cook CB, McNaughton D, Braddy CM, Jameson KA, Roust LR, Smith SA, Roberts D, Thomas SL, Hull BP. Management of inpatient hyperglycemia: assessing perceptions and barriers to care among resident physicians. Endocr Pract. 2007;13(2):117–24.
30. Cook CB, Jameson KA, Hartsell ZC, Boyle ME, Leonhardi BJ, Farquhar-Snow M, Beer KA. Beliefs about hospital diabetes and perceived barriers to glucose management among inpatient midlevel practitioners. Diabetes Educ. 2008;34(1):75–83.
31. Umpierrez G, Maynard G. Glycemic chaos (not glycemic control) still the rule for inpatient care: how do we stop the insanity? J Hosp Med. 2006;1(3):141–4.
32. Institute for Safe Medication Practices. ISMP's list of high-alert medications: March 2005. http://www.ismp.org/Tools/highalertmedications.pdf. Accessed August 29, 2007.
33. Cook CB. Creating "glycemic order" out of "glycemic chaos": response to Bradley Flansbaum D.O, M.P.H. J Hosp Med. 2006;1:383–5.