Identifying and Treating Hyperglycemia in Non-Critically Ill Inpatients from Admission to Discharge
Etiologies of Inpatient Hyperglycemia

- Diagnosed diabetes mellitus
- Undiagnosed diabetes mellitus
- Impaired glucose tolerance
- “Stress” hyperglycemia
- Steroid-induced hyperglycemia
- Enteral and parenteral nutrition


Inpatient hyperglycemia in patients with and without a history of diabetes is common and is associated with increased hospital morbidity and mortality. What is the etiology of patients coming in with high glucose levels? Some of those people have diabetes, some of them have not yet had diabetes diagnosed, some people have impaired glucose tolerance and the stress of being admitted actually tips them over into hyperglycemia, some people truly have stress hyperglycemia, meaning they did not have diabetes, they didn't have any abnormalities before admission, but upon admission, they were so stressed that they had hyperglycemia. There are special situations, such as steroids, enteral, parenteral feedings, and others, that iatrogenically cause inpatient hyperglycemia.

References
Summary
Less than 40% of patients had no glucose abnormalities. Nearly 60% of patients either had DM or manifested hyperglycemia during their hospital stay. Almost a third of patients without diabetes had transient or 'stress' hyperglycemia.

Study Description
A sample of a managed care outpatient database (8547 patients) with linkage to inpatient data from June 1, 2003 to June 30, 2006, evaluating hyperglycemia management pre-admission (PA), during index admission (IA), and post-discharge (PD). Diabetes mellitus (DM) status was determined from ICD-9 codes.

Reference
Hyperglycemia was associated with increased mortality independent of illness severity. Increasing hyperglycemia was associated with an increased risk of mortality; this relationship was actually stronger for patients with no prior history of diabetes.

**Study Description**

The relationship between glycemia and mortality was evaluated in 259,040 admissions from October 2002 to September 2005. Age, diagnosis, comorbidities, and laboratory variables were used to calculate a predicted mortality rate, which was then analyzed with mean glucose to determine the association of hyperglycemia with hospital mortality.

**References**


Inpatient Hyperglycemia Is Associated with Increased Morbidity/Mortality Even in Non-ICU Patients

<table>
<thead>
<tr>
<th>Study</th>
<th>Patient Population</th>
<th>Glycemic Cutoff (mg/dL)*</th>
<th>Significant Hyperglycemia-Related Outcomes</th>
</tr>
</thead>
</table>
• 15% ↑ AEs for each 18 mg/dL* ↑ in glucose  
• Increased risk of death |
| Cheung et al, 2005     | TPN                | ≥126                      | • Each 18 mg/dL* ↑ in glucose = ↑ risk of complications by a factor of 1.58 |
| McAlister et al, 2005  | CAP                | >126                      | • Longer LOS  
• Increased in-hospital complications  
• Increased risk of death |
| Umpierrez et al, 2002  | All admitted patients (87% non-ICU) | FPG ≥126 or RPG ≥200     | • Longer LOS  
• More ICU admissions  
• Increased risk of death  
• Fewer home discharges |

*Converted from mmol/L.  
CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease; FPG, fasting plasma glucose; LOS, length of stay; RPG, random plasma glucose; TPN, total parenteral nutrition.

Summary

While it is generally appreciated that inpatient hyperglycemia is a marker of poor outcomes in critically ill patients, emerging data is showing that this is also true for patients who are not critically ill. In non-critically ill patients, inpatient hyperglycemia is associated with longer lengths of stay, increased complication rates, more discharges to nursing homes or other non-home settings, and an increased risk of death.

References


Summary

For the majority of noncritically ill patients treated with insulin, the pre-meal blood glucose (BG) target should generally be less than 140 mg/dL in conjunction with random BG levels less than 180 mg/dL, provided these targets can be safely achieved.

To avoid hypoglycemia, consideration should be given to reassessing the insulin regimen if BG levels decline below 100 mg/dL.

Modification of the regimen is necessary when BG values are < 70 mg/dL, unless the event is easily explained by other factors (such as a missed meal).

More stringent targets may be appropriate in stable patients in whom tight glycemic control was achieved previously. Less stringent targets may be appropriate in terminally ill patients or patients with severe comorbidities.

Hypoglycemia is defined as any BG level < 70 mg/dL. Severe hypoglycemia in hospitalized patients has been defined by many clinicians as BG < 40 mg/dL, although this value is lower than the approximate 50 mg/dL level at which cognitive impairment begins in normal persons.

Scheduled subcutaneous administration of insulin, with basal, nutritional, and correction components, is the preferred method for achieving and maintaining glucose control. Prolonged treatment with sliding-scale insulin as the sole regimen is discouraged. Noninsulin anti-hyperglycemic agents are not appropriate in most hospitalized patients who require treatment for hyperglycemia.

Reference

Barriers to Good Glycemic Control in the Hospital

- Most patients are admitted for reasons other than hyperglycemia
- Reliance on sliding scale insulin regimens
- Fear of hypoglycemia
- Inadequate knowledge/understanding of diabetes, hyperglycemia, and their management among health care providers
- Poor communication during patient transfers
- A lack of ownership for hyperglycemia
- Lack of integrated information systems that allow tracking and trending of glycemic control and hypoglycemia


Summary
There are many barriers to good glycemic control in the hospital. Most patients with hyperglycemia are admitted for other reasons and there may be a lack of attention to this clinical finding. The use of sliding scale insulin is discouraged because it is a reactive, rather than a proactive, method of addressing hyperglycemia. Inadequate knowledge about the proper use of insulin and/or a lack of hyperglycemia and hypoglycemia protocols contribute to the challenge. Many of the changes needed to improve the management of the inpatient with hyperglycemia involve changes to culture, long standing practice patterns, as well as processes of care and work flow habits. Other challenges are listed on the slide.

Reference
Transition Out of the Hospital

- Diabetes management therapy plan is tailored to the educational, financial, and motivational needs of the patient
- Provide adequate education for discharge
  - Survival skills
    - Hypoglycemic event risk reduction
- Provide instructions for follow-up
  - Outpatient diabetes self-management education
  - Community resources

This slide summarizes the characteristics of a quality discharge plan.
Patients Newly Diagnosed with Diabetes During Hospitalization

- Discharge plan must include follow-up and treatment of hyperglycemia
- A clear care plan should include:
  - Survival skills
  - Self-monitoring of blood glucose
  - How to administer medications if needed
  - Signs/symptoms of hypoglycemia and treatment
  - Medical nutrition therapy
- Follow-up
  - Medication may or may not be required
  - More likely if A1c > 7%

Improving Inpatient Diabetes Care: A Call to Action Conference, AACE, 2006.

Summary
An effective diabetes discharge process has been defined as one in which the patient has received the necessary skills training and has been provided with a clear and understandable post-discharge plan for diabetes care. This also includes clear instructions about medications.

Hospital pharmacists can work in collaboration with nursing to provide the basic diabetes survival skills that patients need to comply with their diabetes regimen safely until more thorough outpatient diabetes education can be obtained.

Reference
Summary
Pharmacists should also work with nursing to ensure that patients have a blood glucose meter, know how to use it, and have the necessary supplies to monitor their BG once discharged.
### Discharge Planning: New Hyperglycemia

<table>
<thead>
<tr>
<th>A1c</th>
<th>General Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5.2%</td>
<td>Patient does not have diabetes</td>
</tr>
<tr>
<td></td>
<td>Repeat screening in future with FBG or OGTT</td>
</tr>
<tr>
<td>5.2% to 6%</td>
<td>May have diabetes</td>
</tr>
<tr>
<td></td>
<td>Repeat screening in future with FBG or OGTT</td>
</tr>
<tr>
<td>6% to 7%</td>
<td>Likely will have diabetes diagnosis in the future</td>
</tr>
<tr>
<td></td>
<td>Discharge with lifestyle therapy plan</td>
</tr>
<tr>
<td></td>
<td>FBG or OGTT as soon as patient is stable</td>
</tr>
<tr>
<td>7% to 9%</td>
<td>Likely will have diabetes diagnosis in the future</td>
</tr>
<tr>
<td></td>
<td>Discharge with lifestyle therapy plan</td>
</tr>
<tr>
<td></td>
<td>Consider oral BG-lowering agent</td>
</tr>
<tr>
<td>&gt; 9%</td>
<td>Most patients should be on basal-bolus insulin regimen at discharge</td>
</tr>
</tbody>
</table>

FBG, fasting blood glucose; OGTT, oral glucose tolerance test.


### Summary

This slide summarize discharge plan considerations for patients with newly identified hyperglycemia. As can be seen, the availability of a recent A1c level to determine whether or not the patient has diabetes and if they do, what degree of therapy is needed, is essential to determining next steps.

### Reference

**Summary**

Similarly, this slide summarizes discharge planning considerations for patients with known diabetes, depending on their current level of glycemic control.

**Reference**


<table>
<thead>
<tr>
<th>A1c</th>
<th>General Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7%</td>
<td>Continue pre-admission diabetes management therapy plan</td>
</tr>
<tr>
<td>7% to 8%</td>
<td>Increase dose of preadmission diabetes medications and/or add a second/third oral agent or basal insulin at bedtime</td>
</tr>
<tr>
<td>&gt; 8%</td>
<td>If on 2 diabetes medications, add basal insulin at bedtime</td>
</tr>
<tr>
<td>&gt; 9% to 10%</td>
<td>Most patients should be on basal-bolus insulin at discharge</td>
</tr>
</tbody>
</table>

Discharge Planning for New Hyperglycemic

- Check HbA1C:
  - > 6% highly likely to have DM
  - < 5.2% unlikely to have DM
  - 5.2-6% indeterminate
- Need close follow up
  - FBG or OGTT
  - Consider home BG testing
- Refer patient for diabetes education with follow-up education


Summary

Often new hyperglycemia is ignored in the hospital and patients are discharged with other diagnoses but without a plan for management of this condition. We are well on our way though because throughout this discussion we have been mentioning that the new hyperglycemic is going to be treated similar to the known diabetic. When we approach d/c, it is already toward the front of our consciousness but now we have to decide what to do. Obtaining a HbA1c can be quite helpful for several reasons but in a patient with “new” hyperglycemia, it has been predictive of who will later be diagnosed with DM. The ADA recommends obtaining one if there is not one available from the prior month, but as of yet there are no diagnostic criteria for DM using the HbA1c.

Since the diagnosis of DM is based on OGTT or FBG during a steady state, we have to make some “educated guesses” prior to discharge and then follow up with specific diagnostic testing.

Reference

Discharge Planning for Patients With Known Diabetes

- Admission HbA1c Helpful
- If pre-admission control acceptable, go back to home regimen
- If HbA1c > 8% on maximum oral agents, probably needs basal insulin


Summary
Hospitalization is an opportunity to evaluate long-term diabetes control and adjust or initiate new therapy. If the A1c is > 8% on maximal doses of oral agents, it may be time to transition to insulin.

Reference
“Survival Skills” to Be Taught Before Discharge

- How and when to take medication/insulin
  - What to expect from the medication
- How and when to test BG (SMBG)
  - What are target glucose levels
- Basics on meal planning
- How to treat hypoglycemia
- Sick-day management plan
- Date/time of follow-up visits
  - Including diabetes education
- When and who to call on the healthcare team
  - What community resources are available

SMBG = self-monitoring blood glucose.


Summary

A primary focus of (often brief) education sessions in the hospital is on teaching “survival skills.” Survival skills are crucial to safe practice at home. One of these skills is blood glucose monitoring, including interpreting results and when to call for help.

Because many patients in the hospital are at risk for subsequent illness, a clear discussion of how to manage medications and glucose testing on “sick days” is critical.

Also important is an understanding of how to take diabetes medications (including insulin) and awareness of hypoglycemia, including its treatment and prevention.

Basic nutrition should also be incorporated into survival skills education, especially the clear identification of carbohydrates versus fats versus proteins.

Reference

Functional Health Literacy and Understanding of Medications at Discharge

172 patients discharged from community-based teaching hospital with prescriptions for 1 or more new medications.

Summary

In general, patients have limited knowledge about their medications after discharge, an area where pharmacists can provide substantial support.

In this survey, 86% were aware that they had been prescribed new medications, but fewer could identify the name (64%) or number (74%) of new medications or their dosages (56%), schedule (68%), or purpose (64%). Only 11% could recall being told of any adverse effects, and only 22% could name at least 1 adverse effect.

Reference

Transition of Care to the Outpatient Setting

- Involve family and caregivers in patient education
- Ensure that patient has a plan for outpatient follow up
- Facilitate referral for outpatient services and healthcare providers
- Assist patient with resolving issues relating to the cost of outpatient services and treatments

Involvement of family and friends is especially important for interventions involving lifestyle modifications.

This slide simply summarizes some practical aspect of improving the transition of the patient to their home environment.
Summary

- Collaborate with HCPs and patient (and family)
- Tailor the plan to the educational, financial, and motivational needs of the patient
  - Review and teach survival skills
- Assess the diabetes pharmacotherapy plan based on admission A1c
  - Conduct a complete medication reconciliation
- Ensure that patient has a plan for outpatient follow up
  - Facilitate referral for outpatient services and healthcare providers
  - Assist patient with resolving issues relating to the cost of outpatient services and treatments
  - Ensure patient (and family) understanding

Expert Opinion, Evidence Level C
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