

APPENDIX 1

The screenshot shows a medical software window with a blue title bar. The title bar contains the text "4.4.71 Tuesday Jun 22, 2010 11:22" on the left and "User: Deborah Wexler, M.D." on the right. Below the title bar is a navigation area with a "Select pt" dropdown menu showing "CARLSON, NELS R" and "MGH 2902320". To the right of this are fields for "MGH G1440B", "Admitted: 06/21/2010", "M 52y", "UNITED PPO/EPO/POS/OTHERS", and "PCP: WEXLER, DEBORAH". There are also buttons for "Care Trm" and "Pt Details".

The main content area has a blue header that reads "Revised Study Only - Insulin Orders - Page 1 of 3 Pt: CARLSON, NELS R". On the left side of this area is a vertical menu with buttons for "Orders", "DEx", "Results", "PEPL", "eMAR", "Options", "Handbook", "Knowledge Link", "Phone Dir", "Help", "Feedback", and "Exit".

The main content area contains the following text:

Welcome! This order set is to help start glargine (long-acting) and aspart (short-acting) insulin on inpatients with type 2 diabetes with blood sugars greater than 200 mg/dl on sliding scale insulin alone. NPH and regular insulin is another option to treat these patients, but is not covered in this order set.

This order set should not be used for patients with Type 1 Diabetes, nor for patients who are pregnant, on enteral nutrition or TPN, in renal failure, in liver failure, or otherwise complicated.
Please consult Endocrine with any questions.

Click the "Next Page" button below to get started.

At the bottom of the main content area is a row of buttons: "Prev Page", "Next Page", "Edit", "More Info", "OK", and "Cancel".

4.4.71 Tuesday Jun 22, 2010 11:22 User: Deborah Wexler, M.D.

Select pt **CARLSON, NELS R** MGH 2902320 MGH G1440B Admitted: 06/21/2010
M 52y UNITED PPO/EPO/POS/OTHERS Care Tm Pt Details
PCP: WEXLER, DEBORAH

Orders Revised Study Only - Insulin Orders - Page 2 of 3 Pt: CARLSON, NELS R

Results

PEPL

eMAR

Options

Handbook

Knowledge Link

Phone Dir

Help

Feedback

Exit

ORDERS

Step 1: Estimate the total daily dose (TDD) of insulin required for your patient

A. Determine the patient's actual weight in kilograms

B. Estimate the daily amount of insulin required by multiplying the weight by 0.5 units/kg. This estimate reflects the total amount of insulin per day your patient will need, including all basal (long-acting) and prandial (short-acting) doses. It is only an estimate, and as such you will need to titrate the doses on subsequent days.

Click the "Next Page" button below to order the insulin using your estimate from above.
Click "More info" button to use insulin dose calculator.

Prev Page Next Page Edit More Info OK Cancel

4.4.71 Tuesday Jun 22, 2010 11:22 User: Deborah Wexler, M.D.

Select pt CARLSON, NELS R MGH 2902320 MGH G1440B Admitted: 06/21/2010
M: 52y UNITED PPO/EPO/POS/OTHERS Care Tm Pt Details
PCP: WEXLER, DEBORAH

Revised Study Only - Insulin Orders - Page 3 of 3 Pt: CARLSON, NELS R

Orders

DEx

Results

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ORDERS

[Step 2: Prescribe long-acting insulin](#)

;Insulin glargine 0 units sc qhs <di> routine; 1/2 of total daily insulin requirement

[Step 3: Prescribe short-acting insulin](#)

Ordering aspart AC standard doses:

Insulin aspart 0 units sc ac <di> hold if: npo routine <l> 1/6 of total daily insulin requirement before each meal

[Step 4: Prescribe supplemental sliding scale insulin](#)

Insulin aspart sliding scale if bs <= 150 give 0 units ; for bs from 151 to 200 give 2 units ; f <l> Give before all meals (not at HS)

Instructions: Add to pre-meal standing insulin

Summary | Instructions |

INSULIN GLARGINE
0 UNITS SC
QHS
Pharmacy's Suggested Dose Instructions: Insulin GLARGINE (Lantus) is long acting.

Prev Page Next Page Edit More Info OK Cancel

Insulin Dosage Calculator - Microsoft Internet Explorer provided by Partners HealthCare System

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites

Address <http://lcsintranet.mgh.harvard.edu/POEinsulinDosageCalc/calc.htm> Links

Insulin Total Daily Dosage Calculator

Enter patient weight into the appropriate box and click *Calculate* (or press *Enter*):

Insulin-sensitive (lean or glu < 200)	Insulin-resistant (obese or glu >=200)
<input type="text"/> lbs	<input type="text"/> lbs
kgs X 0.4 units/kg	kgs X 0.5 units/kg

Calculate

Close Window

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INPATIENT MANAGEMENT OF TYPE 2 DIABETES

No algorithm applies to all patients with diabetes. These guidelines apply to patients with type 2 diabetes who are not on glucocorticoids, have no history of ketoacidosis, and do not have the following risk factors for hypoglycemia: chronic kidney disease, chronic liver disease, pregnancy, and impaired

1. If hyperglycemic, check HbA1c, monitor point-of-care (POC) glucose bid or AC and HS.
2. Order No Concentrated Sweets diet (consult Nutrition if questions or for patient education).
3. As a first step, prescribe regular insulin sliding scale.
4. If POC glucose is consistently > 180 mg/dl, start basal-bolus insulin as outlined below.

Type 2 DM, ON ORAL HYPOGLYCEMICS prior to admission:

Follow steps 1-4 as above. In addition:

5. Hold metformin if dye studies planned, patient is hypovolemic, or volume shifts are anticipated.
6. Hold sulfonylurea when patient is NPO or if erratic oral intake is anticipated.
7. Thiazolidinediones can be continued for short peri-procedure stays, but otherwise are not useful in the inpatient setting.
8. Start basal-bolus insulin if (1) HbA1c >8% and patient is compliant with oral regimen, *or* (2) POC glucose is consistently >180 mg/dl on regular insulin sliding scale:
 - a. Calculate total daily dose of insulin (TDD) as 0.4 units/kg for fasting blood glucose (FBG) <200 mg/dl and 0.5 units/kg for FBG ≥200 mg/dl.
 - b. Basal or long-acting insulin: Give ½ of TDD as long-acting insulin:
 - i. Glargine at bedtime or
 - ii. NPH divided between breakfast and dinner.
 - c. Prandial insulin: Give 1/6 of TDD as short-acting insulin (aspart or regular) before each meal:
 - i. Specify that prandial insulin should be held if patient is NPO or reduced if patient is eating poorly
 - ii. Patients treated with morning NPH may not require pre-lunch short-acting insulin, allowing dosing of short-acting insulin before breakfast and dinner:
 - d. Supplemental, or “sliding scale”, insulin should be the same type as the prandial insulin.
 - i. Give AC only, since HS sliding scale can cause hypoglycemia in patients on long-acting insulin.
 - ii. Sliding scale insulin should be added to pre-meal insulin to correct excursions.
 - iii. Sliding scale insulin should be given when patient is NPO to correct glycemic excursions.
 - iv. Sliding scales should be adjusted to patient’s degree of insulin resistance. Lean patients are usually insulin-sensitive, and obese patients are more likely to be, but are not always, insulin resistant.

Examples of different sliding scales; adjust per patient response.

Plasma glucose	Sensitive	Usual	Resistant
<150 mg/dl	0 units	0 units	0 units
151-200 mg/dl	1	2	4
201-250 mg/dl	2	4	7
251-300 mg/dl	3	6	10
301-350 mg/dl	4	8	13
>350 mg/dl	5	10	16

9. Adjust insulin daily based on patient response:
 - a. Check POC glucose AC, and HS to monitor effect of insulin—but do not cover with sliding scale at bedtime in patients on long-acting insulin to avoid overnight hypoglycemia.
 - b. Anticipate adjusting long-acting insulin by 10-20% every 1-2 days and pre-meal and sliding scale insulin by 1-2 units every 1-2 days, unless patient is severely hyperglycemic or develops hypoglycemia.
 - c. If POC glucose rises from HS to 2 am to 7 am, increase evening long-acting insulin; if glucose is falling from HS to 2 am to 7 am, decrease evening long-acting insulin.
 - d. In patients on NPH and short-acting insulin before breakfast:
 - i. If POC glucose is high at lunch and dinner, increase am NPH
 - ii. If POC glucose is high at lunch and normal at dinner, increase pre-breakfast short-acting insulin.
 - iii. If POC glucose is normal at lunch and high at dinner, increase am NPH and decrease pre-breakfast short-acting insulin to avoid lunchtime low.
 - iv. If POC glucose is high at bedtime, increase pre-dinner short-acting insulin.
 - e. In patients on glargine, adjust pre-meal insulin based on POC glucose at the meal following the dose to be adjusted.

Type 2 DM, ON INSULIN prior to admission:

Follow steps 1, 2 and 4 above. Note that regular insulin sliding scale alone is usually insufficient for patients who need insulin prior to admission. ***The approach outlined in steps 5-9 above applies to patients on insulin prior to admission, with the following additional guidelines and considerations.***

10. For long-acting insulin, determine whether the dose is meeting the patient's basal needs:
 - a. If patient skips a meal, does he or she have hypoglycemia? Then dose should be decreased in the hospital by 25-50%.
 - b. If patient has uncontrolled DM (elevated HbA1c) or symptoms of polyuria/polydipsia in the afternoon, then long-acting insulin can probably be continued at current dose.
 - c. If unsure, decrease dose of long-acting insulin initially by 20-50%, but increase rapidly if hyperglycemia ensues.
11. For patients on long- and short-acting insulin:
 - a. If ½ of TDD is given in long-acting insulin, and approximately 1/6 is given before meals, then the long-acting dose probably meets patient's basal insulin requirement, and should be continued at the same or slightly reduced (i.e., no more than 20% reduced) dose.
 - b. Short-acting insulin should be given before meals at slightly lower doses (i.e., reduce by 20-40% depending on clinical situation and typical diet) since patients usually eat less in the hospital. In the order parameters, specify that pre-meal insulin should be held if pt is NPO or reduced if eating poorly.
 - c. Add sliding scale insulin as outlined in Step 8 above.

Converting premixed insulins to MGH formulary insulins (NPH, regular, and aspart):

- The total dose in premixed insulin can be approximated by a combination of NPH and short-acting insulin in the percentage specified by the product name. Example: Equivalent dose of 50 units of 70/30: NPH 35 units plus regular 15 units.
- See PCOI (http://oi.mgh.harvard.edu/pcoi/frontpage_frames.asp) → Drug Information → MGH Insulin Product Information for details on converting various insulin brands and pre-mixed insulins to MGH inpatient formulary insulins.

References:

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 Umpierrez, GE. Diabetes Care 2007; 30: 2181. RCT of basal-bolus versus sliding scale in gen med pts.

Appendix 2. Results of repeated and correlated measures analysis.

The difference in mean glucose between groups remained significant in models controlling for clustering by patient, provider, and adjusting for baseline glucose, patient and provider. The analysis was performed using proc genmod in SAS version 9.1

Mean glucose adjusted for repeated measures analysis

	Control (n=63)		Intervention (n=65)		P value
	Mean	Std Err	Mean	Std Err	
Mean glucose adjusted for:					
Clustering by patient	220	6.4	190	5.8	0.0001
Baseline glucose and patient clustering	216	4.9	199	5.4	0.02
Clustering by provider	217	7.1	192	6.4	0.02
Baseline glucose, clustering by patient					
And provider	216	4.9	199	5.4	0.02