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SYMPOSIUM

Use of Continuous Subcutaneous Insulin Infusion (Insulin Pump) Therapy in the Hospital: A Review of One Institution's Experience

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Abstract

Background:

This article reviews the performance of our hospital's inpatient insulin pump policy.

Methods:

Twenty-five hospital admissions of 21 unique patients receiving outpatient insulin pump therapy were reviewed.

Results:

Between November 1, 2005, and November 30, 2006, there were 25 hospital admissions involving 21 patients receiving outpatient insulin pump therapy. The average age and duration of diabetes among these 21 patients was 50 and 29 years, respectively; 67% were women, 90% had type 1 diabetes, and all were white. The mean length of hospital stay was 4 days, and the average reported length of insulin pump therapy was 4 years. Patients in 16 of the admissions were identified as candidates for continued use of the insulin pump during the hospital stay. Over 90% of patients remaining on the insulin pump had documentation by nursing of the presence of the pump at the time of admission; 100% of the patients had an admission glucose recorded; 88% had a record of signed patient consent; 81% had evidence of completed preprinted insulin pump orders; 75% received a required endocrine consultation; and 75% of cases had documentation of completed bedside flow sheet. A high frequency of both hypoglycemic and hyperglycemic events occurred in the patients; however, no adverse events were related directly to the insulin pump.

Conclusions:

Insulin pump therapy can be safely continued in the hospital setting. While staff compliance with required procedures was high, there was still room for improvement. More data are needed, however, on whether this method of insulin delivery is effective for controlling hyperglycemia in hospitalized patients.

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Abbreviations: (CPOE) computerized physician order entry, (CSII) continuous subcutaneous insulin infusion, ($BedGluc_{avg}$) bedside glucose average

Keywords: continuous subcutaneous insulin infusion; diabetes mellitus; hospitalizations; insulin infusion; insulin pumps

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Introduction

Hospitalizations are common for patients with diabetes,[1–2] and since 1988, the number of patients discharged from the hospital with a diagnosis of diabetes has doubled.[3] Moreover, hospitalizations represent the largest share of economic costs associated with diabetes.[4] Recent data have indicated that good blood glucose control in hospitalized patients may result in better outcomes.[5-6] Quality improvement organizations are developing standards for inpatient diabetes management[7–8] and are working to disseminate guidelines for inpatient diabetes care.[9]

Continuous subcutaneous insulin infusion (CSII), commonly referred to as the insulin pump, delivers intensive insulin therapy to optimize glucose control. As the popularity of CSII increases, hospital health care providers may more frequently face the issue of how to manage the inpatient care of patients who have been receiving outpatient insulin pump therapy. Many of these patients have invested considerable time and money in an attempt to master the technology. Our clinical experience has indicated that patients receiving CSII would like to continue their therapy in the hospital, but at the same time may be uncomfortable in transferring responsibility and control of diabetes care to hospital staff.

We recently designed and published guidelines to assist practitioners with the management of CSII in our hospital.[10] The guidelines were developed both as a result of an institutional gap in care of the hospitalized patient with an insulin pump, and as a response to the very limited availability of peer reviewed published suggestions on how to manage care of a patient with CSII when he or she has been admitted to the hospital.[11] The objectives of our inpatient guidelines were to promote the patient's independence in the use of the insulin pump during hospitalization while maximizing the patient's safety in accordance with established requirements for glucose self-management.[12] We present a review of how the inpatient insulin pump policy has performed and show data on the quality of glycemic control in patients who received insulin pump therapy throughout their hospital stay.

Methods

Description of Facility

Our tertiary care academic teaching hospital is a 200-bed facility in metropolitan Phoenix, Arizona. All general medical and surgical specialties for adult patients are represented, including transplantation services. The hospital also has a level II trauma center and an inpatient rehabilitation unit. Inpatient care is provided by various types of practitioners, including resident physicians, students in allied health studies and in medical school, physician assistants, nurse practitioners, and faculty. An electronic medical record links outpatient and inpatient records with laboratory results and pharmacy orders.

Summary of Insulin Pump Policy

We organized our inpatient CSII guidelines into a formal written policy (**Appendix 1**). The policy included proposed contraindications for continued insulin pump use in the hospital (**Table 1**), a set of rules to guide medical staff about insulin pump management following admission (**Table 2**), and the requirement for signed informed consent from the patient that details the criteria for continued use of CSII while hospitalized.[10]

Table 1.
Contraindications for Continued Insulin Pump Therapy in the Hospital

Patient with altered state of consciousness
Critically ill patient (e.g., sepsis, trauma) requiring intensive care
Patient at risk for suicide
Patient refuses or is otherwise unable to participate in own care
Family member, friend, or significant other refuses or is otherwise unable to participate in care
Other circumstances identified by the physician

Table 2.
Current Procedures for Patients Admitted on Insulin Pump Therapy

Medical staff identifies presence of insulin pump, brand of pump, and insulin type
Blood or capillary glucose level is determined
Contraindications for continued insulin pump use are assessed
Physician order for alternative insulin therapy is obtained if CSII[a] must be discontinued
Patient consent for CSII is obtained
Admitting physician writes initial order for insulin pump therapy using the preprinted order form
Endocrinology, diabetes educator, and nutrition consults ordered by admitting physician
Insulin Pump Basal/Bolus Blood Glucose Record flow sheet is placed at bedside

[a]CSII, continuous subcutaneous insulin infusion.

Operationally, hospital CSII procedures require a signed patient consent and completion of a template of orders and a bedside flow sheet. The consent form (**Appendix 2**) instructs the patient to provide their own insulin pump supplies (e.g., infusion sets, catheters), because it is not practical for our facility to stock these items. The order set (**Appendix 3**) guides the practitioner principally on how to order insulin pump basal rates and bolus amounts, and includes a requirement for an endocrinology consultation. The bedside flow sheet (**Appendix 4**) is used by the patient to record basal rates, bolus amounts, carbohydrate intake, and bedside glucose values.

In our original publication of the policy, we proposed metrics to characterize hospitalized patients receiving insulin pump therapy and to evaluate their outcomes. These metrics included age, sex, duration of diabetes, length of stay, pump-related adverse events, proportion of consent forms signed by the patient, use of the preprinted order sets and bedside flow sheets, and data on glucose control.[10]

Case Selection

From November 1, 2005, to November 30, 2006, we recorded 25 hospital admissions involving a patient with an insulin pump. We conducted a retrospective chart review to determine whether the CSII policy had been implemented in these cases. The initial nursing assessment was recorded electronically; other documents (consent form, flow sheet, and order set) were scanned into the electronic medical record.

Extraction of Glucose Data

After we identified hospital cases involving an insulin pump, we linked data through identifiers of patients to our electronic laboratory database to retrieve information on capillary glucose values. In our institution, bedside glucose monitoring is performed with an instrument that scans and records patient identification, followed by direct downloading to our laboratory database. Commercial software (Medical Automation Systems, Inc., Charlottesville, Virginia) facilitates the interface of glucometer data with the electronic laboratory file.

Data Analysis

We used our proposed metrics as a template to review the performance of our inpatient insulin pump therapy. Basic demographics (age, sex, race/ethnicity, reason for admission, and length of hospital stay) were extracted from the electronic medical record. Available data on type of diabetes, duration of diabetes, and length of time that the patient received CSII therapy before admission were recorded. We also determined staff compliance with major policy components (documentation by nursing of the presence of the pump at the time of admission; measurement of an admission glucose; presence of a signed patient consent form; evidence of completed preprinted insulin pump orders; an endocrine consultation; documentation of a completed bedside flow sheet).

To assess the status of glucose control among patients remaining on CSII therapy, we averaged bedside glucose measurements for each patient and determined the composite bedside glucose average ($BedGluc_{avg}$) level.[12–14] We calculated the frequency of hypoglycemic values (bedside glucose <70, <60, <50, and <40 mg/dl) and hyperglycemic values (bedside glucose >200, >250, >300, >350, and >400 mg/dl) for each patient, and we reported the results as the quantity of these values per patient per 100 measurements. This method allowed adjustment for different numbers of measurements across the patients and captured information on multiple episodes of hypoglycemia or hyperglycemia in individual patients.[13–15]

Results

Patient Characteristics

Between November 1, 2005, and November 30, 2006, there were 25 hospital admissions involving 21 unique patients receiving insulin pump therapy; one patient was hospitalized on four separate occasions and another had two admissions. Of the 21 patients, 7 were not being managed as outpatients by our endocrinology staff before admission. The mean age of the 21 patients was 50 years, with an average duration of diabetes of 29 years. The average duration of CSII therapy was four years and the average length of stay was four days. All patients were white, 67% were women, and 90% were identified in their records as having type 1 diabetes (**Table 3**); one patient did not have documentation of diabetes type. Most of the patients were admitted for an acute problem (e.g., emesis, fever, positive stress test requiring urgent coronary artery bypass grafting). Three hospitalizations involved elective short-stay procedures (e.g., lymph node removal, dilatation and curettage, renal stone lithotripsy).

Continuous subcutaneous insulin infusion therapy was discontinued in 9 of the hospitalizations and continued in 16. Reasons for discontinuation included the patient not having access to his or her insulin pump supplies, altered mental status, receipt of a pancreas transplant, and pump malfunction. Two admissions involved patients who required a major operative procedure (e.g., coronary

artery bypass grafting); in these instances, the insulin pump therapy was discontinued during the procedure but restarted after recovery. If CSII therapy was temporarily discontinued for a surgical procedure and restarted and then maintained after recovery from the procedure, we considered these cases as having continued CSII therapy during the hospital stay. CSII therapy was discontinued in one patient who had congenital deafness; on further evaluation of the patient's knowledge about diabetes, we discovered that she did not understand how to adjust her pump settings, and she began receiving subcutaneous insulin injections.

Adherence to Post-Admission Procedures

The presence of an insulin pump was documented at hospitalization in 84% of all 25 CSII-related admissions, the brand of the pump in 68%, and the type of insulin being infused in 80%. Because some patients had the insulin pump discontinued appropriately after their initial assessment, we examined compliance with the policy for only the 16 hospitalizations in which CSII therapy was continued. In these 16 hospital cases, review of the initial nursing assessment showed that 81% of patients had the presence of the insulin pump recorded, 69% the brand of the pump, and 81% the type of insulin being infused (**Table 4**). All hospital admissions were accompanied by an assessment of glucose level. Written consent was included in the documentation of 88% of patients who continued the insulin pump therapy and the completed preprinted order set was found in the documentation of 81%. An endocrinology consultation was requested in 75% of cases in which the pump therapy was continued; the bedside flow sheet was found in 75%. No adverse events were reported in the patients who continued insulin pump therapy.

Glycemic Control

Among the 16 hospitalizations in which CSII therapy was continued, the mean length of hospital stay was 4 days (range, 1–25 days); however, 50% of the patients were hospitalized for only 1 day. The average number of bedside glucose values was 4.5 per day (range, 1–6). The mean blood glucose level at admission was 189 mg/dl and the mean level at discharge was 166 mg/dl. Overall, glucose control was fair in these 16 hospitalizations, with a mean $BedGluc_{avg}$ of 187 mg/dl. Hypoglycemia occurrences were less common than hyperglycemia incidents: 33% of patients had at least one bedside glucose value that was less than 70 mg/dl, but 80% had at least one value that was greater than 200 mg/dl. The frequency of hypoglycemic measurements was lower (**Figure 1A**) than the frequency of hyperglycemic measurements (**Figure 1B**).

Table 3.
Characteristics of 21 Unique Hospitalized Patients with Insulin Pump Therapy

Characteristic	Value
Age, y, mean ± SD	50 ± 16
Diabetes duration, y, mean ± SD	29 ± 16
Duration of insulin pump therapy, y, mean ± SD	4 ± 3
Length of hospital stay, d, mean	4
Women, %	67
White, %	100
Type 1 diabetes, %	90
Acute admission, %	64

SD, standard deviation.

Table 4.
Compliance with Insulin Pump Policy for 16 Hospitalized Patients in whom Continuous Subcutaneous Insulin Infusion Therapy was Continued After Admission

Policy component	Patients	
	No.	%
Recognition of patient's insulin pump		
Presence of pump	15	94
Brand of pump	11	69
Type of insulin in pump	13	81
Glucose reading at admission	16	100
Consent of patient	14	88
Use of preprinted insulin pump order form	13	81
Consultation by endocrinology/diabetes education team	12	75
Presence of bedside flow sheet	12	75

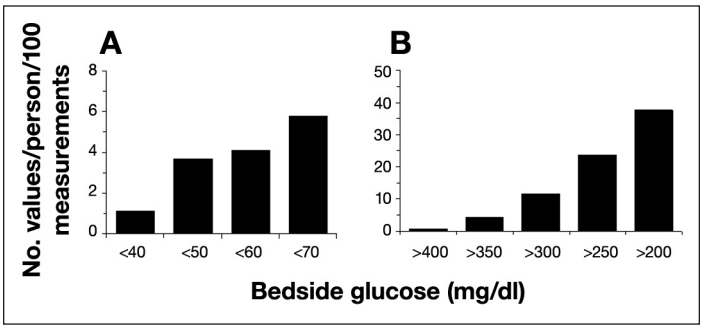

Figure 1. Frequency of **(A)** hypoglycemic **(B)** and hyperglycemic events among hospitalized patients receiving continuous subcutaneous insulin infusion (insulin pump) therapy.

Discussion

The experience at our institution has been that patients who receive CSII as outpatients are eager to continue the therapy during a hospital stay. However, insulin errors are common in the hospital setting.[17–20] Also, insulin pumps are foreign to most hospital personnel and add to the already complicated nature of the delivery of insulin therapy. Because of the differences in the available insulin pump models and the infrequency of seeing patients who use an insulin pump, practitioners in hospitals cannot be expected to become experts on the assessment and management of CSII. Thus, the potential for errors in CSII use is likely great. However, patients who receive insulin pump therapy are educated intensively in diabetes self-management and invest considerable time in mastering insulin pump technology and could be allowed to self-manage under the right circumstances. With the dual goals of allowing patients the flexibility to continue their insulin pump therapy while ensuring their safety, we developed a policy to guide personnel and patients on the continued use of CSII in the hospital.[10] This analysis is a follow-up to that first published report and was conducted to determine how well the guidelines were implemented.

Nearly two-thirds of hospitalized patients were able to continue or restart CSII therapy following admission. We found that overall institutional compliance with the insulin pump policy was high: the presence of the pump was documented at the time of hospital admission, and among patients who continued on CSII therapy during the hospital stay, the consent form was signed, a glucose level reading was taken, the bedside flow sheet and order set were completed, and the necessary consultations were requested in most cases. In some instances, the required elements were missing; however, we were unable to determine whether items were missing because staff did not comply with necessary procedures or the components simply were not scanned into the medical record. We have conducted extensive and ongoing education for staff, including nurses, midlevel health care professionals (i.e., nurse practitioners and physician assistants), and resident physicians, about the use of inpatient insulin pumps; however, familiarization with the policy may not yet be widespread within the institution and, hence, some nonadherence would have been expected as the insulin pump policy was introduced.

Emerging evidence indicates that hyperglycemia in hospitalized patients leads to worse outcomes and that blood glucose control improves those outcomes.[5–6] A question does arise about how effective CSII is in managing inpatient hyperglycemia. The frequencies of hypoglycemic and hyperglycemic events in these patients who used an insulin pump were higher than in our general population of non-critically ill hospitalized patients with diabetes,[15] Data from our hospital[15–16] indicate that among non-critically ill hospitalized patients with diabetes, the prevalence of hypoglycemia (bedside glucose, <70 mg/dl) was only 21% and averaged about 2 episodes per patient per 100 bedside glucose measurements. Among the patients remaining on CSII who were evaluated here, however, hypoglycemia was far more frequent, with a prevalence of 33% and a frequency of nearly 6 episodes per patient per 100 measurements. In addition, hyperglycemia was more common among CSII-treated patients. In our population of non-critically ill patients with diabetes, 68% had hyperglycemia (bedside glucose, >200 mg/dl) with a frequency of about 25 episodes per patient per 100 measurements.[15] However, 80% of the patients remaining on insulin pump therapy had hyperglycemia, with a frequency that averaged almost 40 episodes per patient per 100 measurements.

Although our data suggest that CSII may not be effective in treating inpatient hyperglycemia, no definitive conclusion can be made yet about the ability of insulin pumps to manage hyperglycemia adequately in hospitalized patients. Our number of available insulin-pump cases was too small to assess the efficacy of CSII in controlling glucose levels in the acute-care setting. Moreover, a large percentage of the patients who used an insulin pump were hospitalized for only a single day, which makes it difficult to introduce any changes in insulin delivery rates or to evaluate the effect of such changes. The type of diabetes (type 1 vs type 2), the duration of diabetes, and the severity of diabetes complications may all factor into how effective CSII can be in controlling hyperglycemia in the hospital. Over time, our sample size will undoubtedly increase, and as it does, better evaluation of the efficacy of CSII in the hospital setting can be conducted.

A limitation of our analysis is that we cannot be certain that we identified every patient receiving insulin pump therapy who was admitted to our hospital. We now have the capability to produce a daily electronic report identifying patients with an insulin pump who are admitted. This report is made possible because CSII infusion rates are entered electronically into the pharmacy database. This capability allows us to conduct a daily electronic survey of new patients with insulin pumps and to alert the inpatient endocrinology team to conduct assessments.

Another limitation of this study is the difficulty in calculating from available data the amount of insulin delivered by the pump. One of our original metrics was to calculate daily amounts of insulin and track basal infusion rates.[10] We previously extracted non-insulin pump data from our electronic records.[15] Although the presence of the insulin pump is documented in these records and the basal and bolus rates are recorded on the bedside flow sheet, the determination of the total daily insulin doses from this format is cumbersome and we found that the pump basal rates/bolus amounts may not be a practical (or even important) metric to track.

One of the new challenges we face in the continued implementation of our inpatient insulin pump policy is our upcoming transition to computerized physician order entry (CPOE). CPOE has required migration of the preprinted insulin pump order set from a paper format to an electronic one. Future training will require familiarization of staff not only with the principles of the insulin pump procedures but also with how to order using the CPOE system. In addition, some questions have arisen about the operation of CSII intraoperatively—an issue our original policy did not address.

We believe that, in general, implementation of our inpatient insulin pump policy has been successful. Patients are identified at admission and assessed for their candidacy for continued CSII use, and the pump therapy is discontinued if it is not deemed appropriate. Patient consent is obtained, and necessary documentation is achieved for most patients, although improvement is needed to reach 100% compliance in performance of all components. Our analysis also provided us with new information about the characteristics of the inpatient population that receives CSII. Furthermore, no adverse events have been associated with the use of CSII in properly selected patients, and patients have been accepting of the necessary requirements for self-management. Determining whether CSII is an effective means to control hyperglycemia in the hospital setting will require ongoing investigation.

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Appendix 1 — Patient Care Policies
Management of the Inpatient Receiving Insulin via a Continuous Subcutaneous Insulin Infusion Pump

Purpose

1. To assure safe and accurate administration of insulin for inpatients with an existing continuous subcutaneous insulin infusion (CSII) pump.
2. To provide adequate and safe monitoring of inpatients with diabetes who are capable of self-management and require administration of insulin via a CSII pump.

Definitions

1. Continuous Subcutaneous Insulin Infusion (CSII): a method of 24 hour insulin delivery, using rapid acting insulin, by basal and bolus doses with the purpose of maintaining blood glucose control.
2. Basal Rate: The amount of insulin the patient requires to maintain a normal metabolic state when not eating. It is administered by continuous delivery.
3. Bolus Dose: The amount of insulin infused by the patient for meals or hyperglycemia. The patient programs this dose as needed. The patient is taught to adjust this dose based on blood glucose reading, food intake, and expected exercise.
4. Inpatient: Patient admitted with either Inpatient or Observation status.

Policies

1. Continuous subcutaneous insulin infusion pump therapy is appropriate for inpatients with an existing CSII pump who are alert and oriented to person, place, and time and are capable of self-management.
   a. If the patient requires assistance with the operation of the insulin infusion pump, a family member must stay with the patient at all times during the patient's hospitalization. If this is not possible, the insulin infusion pump will need to be disconnected.
   b. If the family member needs to leave the patient's bedside for a short period of time, e.g. lunch in the cafeteria, but remain in the hospital, the family member is given a courtesy pager by the patient's nurse so the family can be notified if the patient requires assistance with the insulin infusion pump.
2. Contraindications for maintaining inpatient CSII pump therapy include an altered state of consciousness, risk of suicide, and/or refusal or inability of the patient/family member to participate in care.
3. Inpatients who are undergoing a surgical procedure necessitating general anesthesia are evaluated prior to surgery for the appropriateness of continuing with CSII pump therapy during the surgical procedure.
4. An endocrine consult is ordered on admission by the physician, if the patient has a CSII pump.
5. The patient maintains his/her own CSII pump while hospitalized, per physician orders.
6. The admitting physician writes the order for CSII pump therapy using the preprinted physician's order for continuous subcutaneous insulin infusion pump administration. The order includes the type of insulin, basal rate, and bolus dose for hyperglycemia and meals. The endocrinologist is available to answer any questions regarding insulin pump therapy.

7. A physician order is written as necessary for:
   a. leaving the pump in place and continuing the basal rate;
   b. the frequency of blood glucose monitoring;
   c. bolus algorithms for meals and hyperglycemia;
   d. the basal rate or changes to the basal rate;
   e. the target glucose range;
   f. the patient/family to assist in site and rate changes.;
   g. removal of the insulin pump prior to any radiological procedure.
8. The registered nurse (RN) and/or physician assess the patient's level of consciousness including person, place, time, and appropriateness to situation.
   a. If the patient is alert and appropriate, the patient continues to use the CSII pump per physician order.
   b. If an altered state of consciousness or appropriateness is noted, the patient's blood sugar level is checked and:
      i. if the patient is hypoglycemic, treatment is given per the *Hypoglycemia Protocol* policy, as appropriate, and the physician is notified of the patient's condition;
      ii. if the patient is **not** hypoglycemic, the physician is notified of the patient's condition;
      iii. if the physician orders that the insulin be suspended the RN calls the telephone number on the back of the patient's pump for instructions to suspend the infusion.
   c. A physician order for alternative insulin therapy is obtained if the CSII pump is to be discontinued.
9. The RN obtains the patient's consent for the Continuous Subcutaneous Insulin Infusion Pump Therapy Patient Agreement (**Appendix 2**) on admission to the hospital. The physician is notified if the agreement is not signed by the patient.
10. The patient uses his/her own non-medication supplies for the CSII pump. Insulin is obtained from the Pharmacy for refill of the infusion pump.
11. On admission, the physician verifies the type of insulin in the patient's insulin pump. The patient may continue with his/her own insulin prefilled in the insulin pump until the pump requires a refill. For refilling the infusion pump, insulin is obtained from the pharmacy.
12. An Insulin Pump Basal/Bolus-Blood Glucose Record is placed at the patient's bedside. Basal and bolus rate doses are recorded by the patient/family and the results of blood glucose testing are taken by the RN. A target glucose range is listed on the glucose record as ordered by the endocrinologist or diabetic nurse educator.
13. A consult for the diabetes educator is initiated on admission to the hospital for patients who are receiving insulin via a CSII pump. The diabetic educator:
   a. evaluates the patient's knowledge in the use of the insulin pump;
   b. downloads the insulin pump record (when possible) and places it in the patient's chart;
   c. assists nursing staff with documentation forms, evaluation, and care of the patient with an insulin pump;
   d. assesses the patient's home blood glucose monitor, downloads the report (when possible), and places the report in the patient's chart;
   e. orders a nutrition consult to initiate/reinforce carbohydrate counting skills.

14. The Hypoglycemia Protocol for Known Diabetic Patients policy is followed if the patient experiences hypoglycemic events, and the physician is notified of the event.

15. If the patient requires a bolus dose to cover an elevated blood sugar episode and requires assistance from a family member to operate the pump and the family member does not respond to a page within 5 minutes, the RN gives a bolus dose of subcutaneous insulin to cover the elevated blood sugar episode, according to the physician order.

16. The patient changes the infusion set and reservoir every three (3) days with RN observation. More frequent changes are made if:

    a. the site is red, swollen, or warm to the touch;

    b. bleeding is noted at the site;

    c. discomfort is felt at the site;

    d. a "no delivery" alarm occurs without a tubing problem;

    e. two consecutive blood glucose readings are greater than 240 mg/dl

17. If the patient is visually impaired, a sighted family member participates in all aspects of care related to CSII pump therapy.

18. The CSII pump must be removed prior to any radiological procedure that uses electromagnetic fields, such as MRI, CT scan, and/or X-rays. The pump is kept outside the room during any of these procedures. A physician order for an alternative dose of fast acting insulin is obtained prior to discontinuing the use of the pump.

Procedures

1. On admission, identify the presence of the insulin pump, the brand of the insulin pump, the type/name of insulin used, and the basal rate of infusion. Notify the physician of the presence of the insulin pump.

2. Assess the patient's ability to maintain control of the CSII pump on admission, by assessing level of consciousness, orientation to person, place and time, medications ordered that could result in an altered state of consciousness, patient risk for suicide, and patient/family participation in self-care.

3. Have the patient sign the Continuous Subcutaneous Insulin Infusion Pump Therapy Patient Agreement.

4. Notify the physician if the patient does not sign the agreement.

5. Obtain physician orders for use of the CSII pump.

6. Place the Bedside Insulin Pump Basal/Bolus–Blood Glucose Record at the patient's bedside and instruct the patient/family to record the insulin doses administered.

7. Place the completed forms of the Bedside Insulin Pump Basal/Bolus–Blood Glucose Record in the patient's medical record. (The form will be scanned in the patient's medical record after discharge.)

8. Monitor the insertion site of subcutaneous needle for insulin administration.

9. Monitor the patient/family use of the insulin pump, including administration of basal dose, bolus dose, and dietary intake.

10. Assess the patient's level of consciousness, orientation to person, place and time, patient risk for suicide, and patient/family participation in self-care once a shift and prn (as needed).

11. Assist the patient/family with changing the site every 3 days as needed.

12. Notify the family if the insulin infusion is stopped and the patient is given an alternative dose of insulin.

13. If problems arise with the function of the insulin pump, refer to the telephone number on the pump for problem solving and call the endocrine physician on call for further orders.

Documentation

1. Document that the CSII pump is present and infusing on admission, include the brand of the insulin pump, the type/name of insulin, and the basal rate.
2. Document the initial assessment of the patient's ability to perform self-care.
3. Document the patient's signature of the agreement.
4. Document the assessment of site of injection of the needle, the patient's level of consciousness, orientation to person, place and time, the patient's risk for suicide and patient/family participation in self-care as performed.
5. Document the basal rate of insulin, bolus doses, and blood glucose readings.

Additional Information

1. Do not remove the insulin reservoir/syringe from the pump while the infusion set is still attached to the patient.
2. During times of stress or infection, the patient often has increased insulin needs.
3. Blood glucose measurements used to determine bolus adjustments must be current. It is much safer to use values obtained from the point of care information available on the nursing unit rather than waiting for serum laboratory values to return. Any insulin dose given must be based on a reading obtained from the blood glucose monitor, due to its daily quality control and the connection of its information to the laboratory.

Resource(s):

Animas Corporation, Insulin Pump, Manufacturer's Information, 2003.

Appendix 2
Continuous Subcutaneous Insulin Infusion Pump Therapy Patient Agreement

For your safety and optimal medical care during this hospitalization, we request that you agree to the following recommendations. If you feel that you cannot agree to these recommendations, we would like to treat your diabetes with insulin injections and request that you discontinue the use of your insulin pump.

During my hospital stay, I will agree to:

1. Show the nurse the bolus dose I am giving with each blood sugar, as needed.
2. Show the nurse my basal rate. Changes in any of my basal rates will only be made with a doctor's order.
3. Change the infusion set every 48–72 hours or as needed for:
   a. Skin problems, or
   b. Two blood glucose readings greater than 300 mg/dl in a row.
4. Provide my own non-medication insulin pump supplies.
5. Show and report the total daily dose of insulin.
6. Report signs of low blood sugar to the nurse.
7. Report any pump problems.
8. Ask questions that I may have about the use of the pump or doctor's orders.
9. If I cannot manage the pump myself, I may have a family member assist me and the medical staff with the operation of the insulin infusion pump on the condition that they must remain in the hospital during my entire stay. If the family member cannot remain in the hospital, the insulin infusion pump will need to be disconnected.

I also understand that my pump may be discontinued and a different insulin delivery given for any of the following:

a. A doctor's order
b. Changes in my judgment
c. Changes in my level of awareness or consciousness
d. An x-ray procedure (may include pump removal by tubing disconnect and/or removal of the pump and tubing by a physician's order)
e. Other reasons deemed necessary by the medical staff.

Patient Signature	Date
Family Member Signature	Date
Witness Signature	Date

Appendix 3 — Physician Orders
Insulin Pump Orders for Patient Self-Administration

Patient is provided with Insulin Infusion Pump Therapy Agreement

1. ☐ Diet _____ ☐ Tube Feeding ☐ TPN
2. Bedside Glucose Monitoring: ☐ Before meals & at bedtime ☐ Every 6 hours ☐ Other _____
3. ☐ Draw Hemoglobin A1c
4. Record insulin pump basal rates and bolus doses: ☐ Before meals & at bedtime ☐ Every 6 hours ☐ Other _____
5. Type of insulin in pump: ☐ Aspart ☐ Regular (Human) ☐ Lispro/Glulisine
6. Provide bedside insulin pump blood glucose record to patient.
7. ALERT: Prior to suspending or stopping the insulin pump, call the physician for an alternative dose of fast acting insulin.
8. Consults:

   Diabetes Educator (Mandatory)

   Endocrinology (Call physician on-call)
9. Patient to Manage Pump according to the following parameters:

Time	Insulin (units/hour)
0100	
0200	
0300	
0400	
0500	
0600	
0700	
0800	
0900	
1000	
1100	
1200	

Time	Insulin (units/hour)
1300	
1400	
1500	
1600	
1700	
1800	
1900	
2000	
2100	
2200	
2300	
2400	

10. Bolus insulin for meals: (Patient to program insulin pump)

    ☐ Insulin to carbohydrate ratio _____ unit per _____ grams of carbohydrate (1 serving = 15 grams)

    ☐ Set doses: Breakfast _____ units Lunch _____ units Dinner _____ units

11. Correction bolus for high glucose:

    ☐ 1 unit insulin lowers glucose _____ mg/dl
    Correct to glucose of _____ mg/dl

    ☐ See Sliding Scale Order Form

Date: _____ Time: _____

Physician signature: _____

Pager number: _____

Printed name: _____

Appendix 4

Insulin Pump Basal/Bolus-Blood Glucose Record

Number (above) and Name

Blood Glucose
Target Range ____________ **Insulin: Carbohydrate ratio** ___________

Name of Pump ____________ **Correction Factor** __________________

Date		1 AM	2	3	4	5	6	7	8	9	10	11	12N	1 PM	2	3	4	5	6	7	8	9	10	11	12 MN
	Glucose																								
	Insulin: Basal rate																								
	Bolus dose																								
	Correction Bolus																								
	Carbohydrates																								
	Infusion Set Change																								

Date		1 AM	2	3	4	5	6	7	8	9	10	11	12N	1 PM	2	3	4	5	6	7	8	9	10	11	12 MN
	Glucose																								
	Insulin: Basal rate																								
	Bolus dose																								
	Correction Bolus																								
	Carbohydrates																								
	Infusion Set Change																								

Date		1 AM	2	3	4	5	6	7	8	9	10	11	12N	1 PM	2	3	4	5	6	7	8	9	10	11	12 MN
	Glucose																								
	Insulin: Basal rate																								
	Bolus dose																								
	Correction Bolus																								
	Carbohydrates																								
	Infusion Set Change																								