

# Comparing the Self-care of Type 1 Diabetes Patients who experienced both Multiple Dose Injection and Insulin Pump Therapies; A case study and Recommendation for Practice

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## Abstract

**Objective:** This study assessed the self-care of two type 1 diabetes patients who experienced both the multiple dose injection (MDI) and continuous subcutaneous insulin infusion (CSII) pump therapies.

**Methods:** We assessed two female patients who underwent the MDI therapy during outpatient visits, and then switched to the CSII therapy. We conducted semi-structured interviews about the self-care of the participants while using the MDI and CSII. We asked them about the following aspects of self-care: device operability, physical aspect, daily life activities, social aspect, and psychological aspect.

**Results:** Regarding the CSII, the participants felt that self-care was inconvenient with respect to device operability and daily living aspects owing to the difficulty in operating the device and the heaviness of the pump, which is attributable to the fact that the CSII requires that an insulin pump is always attached to the abdomen. However, because the CSII stabilizes the HbA1c and blood glucose levels better than does the MDI, it improved the physical aspect of self-care, which in turn improved the social and psychological aspects of self-care, thereby easing the sense of burden.

**Conclusion:** The participants reported that with respect to both the CSII and MDI, while experiencing repeated setbacks and successes, they devised ways of coping with the device operability, daily life, social, and psychological aspects of self-care. Interestingly, they did not mention that their self-care improved due to the support from nurses. Thus, even in the midst of the frenetic conditions of outpatient care, nurses need to listen to the patients' doubts, anxieties, and concerns. In doing so, nurses will be able to encourage patients to carry out sound self-care by drawing developing self-care plans with them, which will enable them to lead a comfortable life.

## Introduction

The Multiple Dose Injection (MDI) and Continuous Subcutaneous Insulin Infusion (CSII) pump therapies are two ways of treating type 1 diabetes. In recent years, the insulin pump technology has improved, and therefore, the CSII is being introduced to an increasing number of type 1 diabetes patients. In 1998, the Diabetes Control and Complication Trial (DCCT) highlighted the efficacy of the CSII. The greatest advantage of the CSII is that it can regulate insulin levels to suit the patient's lifestyle, which makes it possible to stabilize blood glucose fluctuations and mitigate the risk of developing severe hypoglycemia [1-5]. The CSII is therefore the recommended treatment for type 1 diabetes. In Japan, the CSII is provided to type 1 diabetes patients who cannot control their blood glucose levels adequately with the MDI, including pregnant patients and patients desiring pregnancy. As of April 2010, medical institutions that fulfilled certain criteria could provide the CSII within the health insurance medical treatment scheme, which increased the opportunities for introducing the CSII to type 1 diabetes patients, thereby enabling their blood glucose level to be maintained at a favorable level over a long period [6].

However, it has proved difficult to determine which treatment is superior. Both the CSII and MDI have their respective advantages and drawbacks, and the question of which therapy is better suited to type 1 diabetes patients has been extensively debated [7-8]. The unique characteristics of the CSII and MDI give rise to a difference in the actual self-care status of patients, which implies that patients do not have the same attitude toward each therapy. Therefore, with a view to identify the nursing care that patients require, it is necessary to ascertain the difference in the self-care between the MDI and CSII.

## Materials and Methods

### Participants

This study was conducted on two adult type 1 diabetes patients who had received the MDI and CSII as part of outpatient care at a diabetes/internal medicine department and had agreed to take part in the study.

Both participants were female. Patient A and B had a 2-year and 9-year history of diabetes, respectively. Both participants had received the MDI after having contracted diabetes and subsequently switched to their present therapy, i.e., the CSII.

### Data collection

After obtaining permission from the patients' doctors in charge, we conducted single-session semi-structured interviews in a part of the waiting area, utilizing the downtime on an outpatient visit day (around an hour after the collection of the blood sample and before being summoned for the consultation). During the interview, the patients spoke freely about their self-care situation while undergoing the MDI and CSII. Based on the participants' consent to do so, we used a digital voice recorder to record the interview content.

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**Citation:** Nishio I, Chujo M, Yamao M (2015) Comparing the Self-care of Type 1 Diabetes Patients who experienced both Multiple Dose Injection and Insulin Pump Therapies; A case study and Recommendation for Practice. Int J Nurs Clin Pract 2: 151. doi: <http://dx.doi.org/10.15344/2394-4978/2015/151>

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### Data analysis

We analyzed the verbatim transcripts of the semi-structured interviews by extracting statements thought to be descriptions of the self-care status during the MDI or CSII. These statements were then categorized into five categories, namely, device operability, physical, daily life activities, social, and psychological aspects, and a comparative assessment was conducted. The categorization of the self-care status descriptions were conducted under the supervision of an expert who was experienced in diabetes nursing research.

### Ethical considerations

This study was approved by the Ethics Committee of the Faculty of Medicine, Tottori University. Informed consent was obtained from all of the patients using the procedure approved by the Ethics Committee (Record Number 2307, January 2013). The confidentiality of the participants' information was protected them that could stop the interview at any time they wished; furthermore, they could refuse to answer any unwanted questions..

## Results

### Case details

Table 1 shows the backgrounds of Patients A and B (age, gender, occupation, disease history, period under the CSII therapy, the HbA1c status after implementing the CSII, reason for switching to the CSII, presence/absence of concurrent disorder) (Table 1).

| Items   | Patient A                              | Patient B  |
|---|--|--|
| Age   | 29 years                               | 38 years   |
| Gender  | Female                                 | Female   |
| Occupation  | House maker                            | Care worker  |
| Disease history                                     | 2 years                                | 9 years  |
| Period under the CSII therapy                       | 1 year 2 months                        | 8 years  |
| The HbA1c status after implementing the CSII (NGSP) | 6%-7% mark (almost 6% the latter half) | 7% mark  |
| Reason for switching to the CSII                    | became pregnant                        | Sometimes, when busy with work, I didn't have time for meals, and so I would often get hypoglycemia. |
| Presence/absence of concurrent disorder             | No                                     | No   |

Table 1: The backgrounds of Patient A and Patient B.

### Self-care Status for the MDI and CSII

Table 2 shows the self-care status of Patients A and B with respect to the MDI and CSII. The patients reported that, while experiencing repeated setbacks and successes, they devised ways of coping with self-care in terms of the device operability, physical, daily life, social,

and psychological aspects. In addition, the patients did not mention that their self-care improved because of the support from nurses (Table 2).

### Device operability aspect

The patients felt that the CSII was cumbersome. It was mentioned, "The device is difficult to operate." They reported that the pump was difficult to use and "it takes time to get used to it," a specific issue in this regard being that "There is no injection. The tube gets jammed." Regarding the MDI, on the other hand, the patients made the following statements: "It's easy. Although I sometimes forget to inject myself" and "I've never experienced any trouble with it," denoting that the MDI has superior operability in that it is easy to use per se, but that the patient sometimes forgets to inject the insulin, which engenders the risk of hyperglycemia or hypoglycemia.

### Physical aspect

With respect to the CSII, it was mentioned that the insertion area is limited in comparison to that of the MDI, the pump needle leaves a mark and sometimes causes a rash, and that injecting the needle is a nerve-racking experience: "You can only insert the device in the abdominal area. It leaves a greater mark as compared to insulin injections. It sometimes gives me a rash. The needle is longer compared to the insulin injections, which makes me nervous." The impact of the injections was also cited as an issue with the MDI: "The injection area turns blue. Sometimes I hit a blood vessel." Regarding injection pain, both therapies were considered to be problematic in this regard: (CSII) "I wouldn't say it's extremely painful, but it is uncomfortable." (MDI) "I'm right-handed, so when I inject the insulin into the left side of my abdomen, the angle of the needle slants, creating pain."

The CSII was reported to have a positive effect on the HbA1c and blood glucose levels, including self-monitoring blood glucose (SMBG) levels, because of the continuous infusion of insulin: "Once I started using the insulin pump, my HbA1c level stabilized and I could get better control over the blood glucose level." "After I started using the insulin pump, my HbA1c levels stabilized. However, even with the insulin pump, I keep a careful watch on the amount I eat, as carbohydrates raise the blood glucose level the most." Under the MDI, the control of blood glucose level was unstable, and hyperglycemia and hypoglycemia were left untreated, creating a life-threatening risk: "My HbA1c levels were high. I can't eat during work, and so sometimes I couldn't inject myself. I didn't want to inject myself in the toilet, so sometimes I missed injections. That's why I would get high HbA1c levels." "My blood glucose levels fluctuated considerably. During work, there were many situations where I could not measure my blood glucose levels even though I wanted to. Therefore, I knew when I got hypoglycemia, but when I got hyperglycemia, I would leave it untreated." Participants reported that the incidence of hypoglycemia was lower under the CSII, but under both therapies, the patients devised their own measures to avoid hypoglycemia: (CSII) "In the case of the insulin pump, I can insert it slightly and see the situation then work out whether I need more insulin. Regulating levels in this way means that I don't get as much hypoglycemia." (MDI) "Sometimes, when busy with work, I didn't have time for meals, and so I would often get hypoglycemia. So I decided that when unable to inject myself at the designated times, I would inject just a little so as to prevent hypoglycemia."

### Daily living aspect

The patients reported that the CSII, for which users are always

|                           | Items                          | CSII   | MDI   |
|---------------------------|--------------------------------|--|---|
| Device Operability Aspect | Device Operability             | The device is difficult to operate. The pump was difficult to use and it takes time to get used to it.   | It's easy. Although I sometimes forget to inject myself.  |
|                           | Trouble                        | There is no injection. The tube gets jammed.   | I've never experienced any trouble with it.   |
| Physical Aspect           | Insertion area                 | You can only insert the device in the abdominal area. It leaves a greater mark as compared to insulin injections. It sometimes gives me a rash. The needle is longer compared to the insulin injections, which makes me nervous. | The injection area turns blue. Sometimes I hit a blood vessel.  |
|                           | Injection pain                 | I wouldn't say it's extremely painful, but it is uncomfortable.  | I'm right-handed, so when I inject the insulin into the left side of my abdomen, the angle of the needle slants, creating pain.   |
|                           | HbA1c(NGSP)                    | Once I started using the insulin pump, my HbA1c level stabilized and I could get better control over the blood glucose level.  | My HbA1c levels were high. I can't eat during work, and so sometimes I couldn't inject myself. I didn't want to inject myself in the toilet, so sometimes I missed injections. That's why I would get high HbA1c levels.HbA1c.  |
|                           | HbA1c and blood glucose levels | After I started using the insulin pump, my HbA1c levels stabilized. However, even with the insulin pump, I keep a careful watch on the amount I eat, as carbohydrates raise the blood glucose level.                             | My blood glucose levels fluctuated considerably. During work, there were many situations where I could not measure my blood glucose levels even though I wanted to. Therefore, I knew when I got hypoglycemia, but when I got hyperglycemia, I would leave it untreated.  |
|                           | Hypoglycemia                   | In the case of the insulin pump, I can insert it slightly and see the situation then work out whether I need more insulin. Regulating levels in this way means that I don't get as much hypoglycemia.                            | My HbA1c levels were high. I can't eat during work, and so sometimes I couldn't inject myself. I didn't want to inject myself in the toilet, so sometimes I missed injections. That's why I would get high HbA1c levels.HbA1c.  |
| Daily Living Aspect       | Cooking                        | It hurts when I press against the cooking table.   | Not particular.   |
|                           | Cleaning                       | I don't seem to get tired so easily. I can't do cleaning in a crouched down position.  | I get tired easily and I don't have enough stamina, so I can't do cleaning without taking breaks.   |
|                           | Child-rearing                  | When I'm carrying my child, his feet sometimes press against the pump, depending on where it is positioned, which makes the pump seem like it is coming loose.   | Not particular.   |
|                           | Bathing                        | When I bathe, I remove the insulin pump part only.   | Not particular.   |
|                           | Sleeping                       | The device is an inconvenience, so I move it about unconsciously (move the device while sleeping).   | Not particular.   |
|                           | Dressing                       | If I don't wear loose clothing, the insulin pump protrudes. One dresses more lightly in the summer, so my clothing options are especially limited then.  | Not particular.   |
|                           | Out or Dining in a restaurant  | CSII does not have the following drawback associated with the MDI.   | It's awkward to inject in the presence of people. It's bothersome to hunt for a suitable place to inject. Sometimes I forget to take my injection kit with me when I go out.  |
| Social Aspect             | Feel a sense of restriction    | The presence of the insulin pump bugged me until I got used to it.   | You have to carry the injection kit with you wherever you go.   |
|                           | Regarding work                 | After switching to the insulin pump, I've been able to make progress at work.  | When at work, I inject myself in the lavatory. If I get hypoglycemia, I wouldn't be able to work anymore.   |
|                           | Medical cost                   | CSII therapy costs around 15,000 yen a month(the CSII pay medical fees of around 5,000 yen more as compared to those under the MDI).   | MDI therapy costs around 10,000 yen a month.  |
| Psychological Aspect      | Body image                     | I have to take certain measures with my clothing so that the insulin pump can't be seen.   | I can't inject myself in the presence of others. I've also told my kids never to mention that I use injection.  |
|                           | Sense of burden                | I don't have to worry so much about getting hypoglycemia, and the fact that I don't have to inject myself four or five times a day is a weight off my mind.  | It was really psychologically stressful knowing you had to inject yourself four or five times a day. My blood glucose levels were unstable, so I sometimes wanted to give up visiting the hospital. My blood glucose levels would fluctuate a lot, and my HbA1c level was high, so I was constantly anxious about controlling them. |

Table 2: The self-care status of Patients A and B with respect to the MDI and CSII.

required to wear an insulin pump on their abdomen, presents an inconvenience when it comes to cooking, cleaning, child-rearing, bathing, sleeping, and dressing: "It hurts when I press against the cooking table." "When I'm carrying my child, his feet sometimes press against the pump, depending on where it is positioned, which makes the pump seem like it is coming loose" "I don't seem to get tired so easily. I can't do cleaning in a crouched down position." "When I bathe, I remove the insulin pump part only." "The device is an inconvenience, so I move it about unconsciously (move the device while sleeping)." "If I don't wear loose clothing, the insulin pump protrudes. One dresses more lightly in the summer, so my clothing options are especially limited then." On the other hand, the MDI did not have much of an effect upon cooking, cleaning, childrearing, bathing, and dressing. I get tired easily and I don't have enough stamina, so I can't do cleaning without taking breaks." The patients reported that under the CSII therapy, they can be out or dining in a restaurant without feeling the inconvenience because the CSII does not have the following drawback associated with the MDI: "It's awkward to inject in the presence of people. It's bothersome to hunt for a suitable place to inject. Sometimes I forget to take my injection kit with me when I go out."

### Social aspect

Regarding body image, both the CSII and MDI affected the patients' body image: (CSII) "I have to take certain measures with my clothing so that the insulin pump can't be seen." (MDI) "I can't inject myself in the presence of others. I've also told my kids never to mention that I use injection." However, regarding the sense of burden, the patients felt a sense of psychological stability when using the CSII: "I don't have to worry so much about getting hypoglycemia, and the fact that I don't have to inject myself four or five times a day is a weight off my mind." The MDI on the other hand was a continuous source of worry and burden: "It was really psychologically stressful knowing you had to inject yourself four or five times a day. My blood glucose levels were unstable, so I sometimes wanted to give up visiting the hospital." "My blood glucose levels would fluctuate a lot, and my HbA1c level was high, so I was constantly anxious about controlling them."

### Psychological aspect

The patients reported that both the CSII and MDI made them feel a sense of restriction: (CSII) "The presence of the insulin pump bugged me until I got used to it." (MDI) "You have to carry the injection kit with you wherever you go." Regarding work, the CSII was said to be helpful: "After switching to the insulin pump, I've been able to make progress at work." When under the MDI, however, the patients reported a sense of inconvenience owing to the inability to inject in a hygienic place or inject at all: "When at work, I inject myself in the lavatory. If I get hypoglycemia, I wouldn't be able to work anymore." Financially speaking, the CSII therapy costs around 15,000 yen a month, while the MDI therapy costs around 10,000 yen a month. Thus, the patients under the CSII pay medical fees of around 5,000 yen more as compared to those under the MDI.

## Discussion

### Comparing the CSII and MDI in terms of the self-care status

The CSII achieves good control of blood glucose by reducing blood glucose and HbA1c levels and decreasing the incidence of hypoglycemia; hence, it raises treatment satisfaction [6]. The improvement in the patients' physical self-care when under the CSII had a beneficial impact on the social aspect because it enabled the

patients to continue their work. It also had a beneficial impact on the psychological aspect. The patients gained psychological stability because the CSII eased the sense of burden of having to inject four or five times a day and the worry about hypoglycemia. Thus, the CSII improves the physical aspect of self-care, which in turn improves the psychological and social aspects. A preceding study on the CSII reported that a recovery in self-care will benefit quality of life [9-11]. This explains the reason for our findings. However, the CSII requires that an insulin pump be worn throughout the day. Therefore, when it comes to the daily life activities such as housework (cooking, cleaning) and living activities (bathing, sleeping, dressing), the presence of the pump itself causes an inconvenience. A preceding study reported that the weight of the pump is a source of discomfort in daily life [8]. The present study clarified, for the first time, that the pump's bothersome presence impacts daily life activities and inhibits self-care. From this finding, we may deduce that the physical aspect of self-care is closely associated with the psychological and social aspects, such that when the status of physical self-care is good, it will effectively encourage good psychological and social self-care. Looking at the self-care status when under the MDI therapy, the patients, while out or dining out, had to vacate their seat to secure a place to administer the injection, and such conditions probably impacted the physical and daily living activities aspects of self-care. Not being able to inject themselves in the presence of others and having to hunt around for a suitable place led to an adverse self-care status in that the patients desisted taking their injections. With respect to the physical aspect of self-care, this situation led to poor blood glucose control as blood glucose and HbA1c levels worsened and hypoglycemia incidence increased. This situation had a knock-on effect on the social aspect of self-care in that it prevented the patients from working. As for the psychological aspect of self-care, the patients developed a sense of burden and psychological stress regarding injections. A similar finding was reported by Garmo et al [12]. Specifically, they reported that the longer a patient continues the MDI therapy, the greater the sense of burden becomes. This evidence suggests that if a patient cannot carry out proper physical self-care, that is, if they cannot control their blood glucose, then the psychological and social aspects of self-care would deteriorate. However, regarding the daily life activities such as housework and living activities, the patients were able to carry out self-care in this aspect when in good health, but they would get fatigued soon when carrying out physically demanding tasks such as cleaning.

These results reveal that when it comes to self-care when using either the CSII or MDI, even if patients felt inconvenienced in the daily activities aspect of self-care, it is the physical aspect, specifically, blood glucose level control, that is the top priority, followed by the psychological and social aspects of self-care.

The two cases examined in the present study had experience of both the MDI and CSII therapy, and they were both continuing with the CSII at the time of the present study. It may be surmised that patients consider the CSII a good choice not only in terms of its therapeutic value, but also in terms of self-care. In a meta-analysis of studies on the CSII, it was reported that it is superior to the MDI in controlling blood glucose in type 1 diabetes patients, but not in those with type 2 diabetes [1]. The results of the present study suggest that the participants may have continued with the CSII therapy because they had type 1 diabetes.

It is important that patients who are undergoing the CSII therapy take steps in their daily lives to prevent their blood glucose control from deteriorating. In the present study, the patients took steps to prevent

this by trying out various strategies with respect to the device operability, physical, daily life activities, social, and psychological aspects of self-care. Similarly, Rasmussen et al [13] found that patients utilize strategies to stabilize their blood glucose level. Orla et al [14] conducted a study on type 1 diabetes patients undergoing insulin-pump therapy, and found that after some time they grew annoyed with the therapy and start feeling burdened and constrained. Though this phenomenon is not restricted to the CSII, the discomfort and irksomeness of having the insulin pump attached for 24 hours a day, 365 days a year, is immeasurable.

## Conclusion

In this study, we identified many situations in which patients struggle with self-care in their daily life. However, the patients who are undergoing the CSII therapy never spoke about an experience in which, after having struggled with self-care, they received support from a nurse whereupon the self-care situation improved. Generally, the CSII therapy is administered as part of outpatient care. Even in the midst of the frenetic conditions of outpatient care, nurses must strive to engage with patients and to listen to their doubts, anxieties, and concerns. This way, the nurses will be able to identify the factors that hinder self-care. In addition to such conversational exchanges, it is also important to prepare pamphlets on what patients must do, to provide focused guidance. In doing so, nurses will be able to devise a self-care plan that allows the patient to go about with their life comfortably, and thus support efficient self-care. If nurses do not master their listening and explanatory skills, they will not be able to provide the guidance necessary to address the factors inhibit patients' self-care. It is therefore important that nurses establish a rapport with patients and brush up their communication skills so that they can identify what the patient is struggling with or what is causing the patient troubles.

## Study Limitations

This study was conducted only on two cases. We therefore must concede that there is a bias in the self-care situations cited. Indeed, there is a need to analyze a greater number of cases in future.

## Competing Interests

The authors declare that they have no competing interests.

## Author Contributions

All the authors equally contributed to the intellectual content of the manuscript and the study design, data collection and analysis, and drafting of the manuscript.

## Author Contributions

We thank the two patients who participated in this study for their contribution and dedication.

## Funding

This work was supported in part by JSPS KAKENHI Grant Number 80402163.

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