

# A study of pattern management performed by nurses certified in diabetes nursing in Japan and clarification of the related factors

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**Introduction:** To reveal the actual conditions of blood glucose pattern management (BGPM) performed by nurses certified in diabetes nursing (DCNs) in Japan and clarification of the related factors. DCNs are the specialists for people with diabetes and are certified by the Japanese Nursing Association (JNA). BGPM refers to a method aimed at improving blood glucose control by ascertaining changes (patterns) in blood glucose levels and conducting a systematic and multi-dimensional analysis of the factors contributing to these patterns.

**Method:** Subjects were DCNs ( $n = 303$ ) whose names and affiliations were publicly available on the JNA website in November 2011. The study was conducted through a postal questionnaire, involving items about how they were conducting guidance, the details of the BGPM (i.e. method and target) and the state of their overview of facilities, from January 2012 to February 2012.

**Result:** The questionnaire was returned by 148 respondents. Regarding the statement 'Looking with the people with diabetes for patterns in their blood glucose levels brings unexpected discoveries', 140 (95.2%) selected 'Agree' or 'Somewhat agree'. The respondents' coefficient analyses showed a significant correlation between 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels' and 'The doctors at our facility are cooperative when it comes to BGPM'.

**Conclusion:** In this study, most of the DCNs performed BGPM for people with diabetes and recognized that performing BGPM has been useful for most people with diabetes. In addition, building a good relationship between doctors and nurses is suggested for performing BGPM effectively.

**Keywords:** Pattern management, SMBG, Diabetes education, Nurses certified in diabetes nursing, Questionnaire survey

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## Introduction

For people with diabetes, daily activities such as taking meals and doing exercise are closely related to blood glucose level; so the role of nurses is important for supporting them in managing their blood glucose comprehensively according to each individual's condition. Blood glucose pattern management (BGPM) is an 'application of a systematic analysis of data by both persons with diabetes, and healthcare providers in the daily weekly, and long-term management of blood glucose levels'.<sup>1</sup> Using BGPM, people with diabetes retrieve daily information on their blood glucose levels through self-monitoring of blood glucose (SMBG) so as to discern patterns of change in the levels and subsequently adjust their self-management methods (such as diet, exercise and insulin therapy) to suit these patterns. BGPM is a process of recognizing patterns of blood glucose levels, detecting factors which cause people with diabetes to miss their blood glucose level goals and discuss better

ways of diabetes management along with people with diabetes and healthcare professionals. Therefore 'the process provides patients with information to make decisions regarding their diabetes self-management'.<sup>2</sup>

In BGPM, SMBG is an important tool. It has been said that SMBG is useful in solving problems and improving decision-making skills.<sup>3</sup> Previous studies show that using SMBG improves blood glucose levels in people with Type 1 or Type 2 diabetes, using insulin therapy.<sup>4,5</sup> Recently, a previous study has shown that an educational programme associated with structured self-monitoring of blood glucose significantly improves glycaemic control in people with Type 2 diabetes.<sup>6</sup> In addition, studies have revealed that structured self-monitoring of blood glucose significantly reduces A1c levels in poorly controlled, non-insulin-treated Type 2 diabetes.<sup>7</sup> Using meta-analysis, the randomized clinical trials performed to date provided positive results on the effectiveness of interventions with self-monitoring of blood glucose in Type 2 diabetes.<sup>8</sup>

As stated above, there are many studies that showed that SMBG has been useful on self-management for people with diabetes. Concurrent development of blood glucose measuring devices is ever improving. Recent continuous glucose monitoring (CGM) devices have gradually become popular. On the other hand, SMBG is costly, painful and bothersome for people with diabetes. Although a study<sup>9</sup> stated that people with Type 1 diabetes need to perform SMBG over four times a day to keep good glucose control, it is not easy for people with diabetes to continue doing so. To use SMBG effectively and efficiently is essential to support people with diabetes to be able to do BGPM.

BGPM includes core concepts of American Association of Diabetes Educators.<sup>10</sup> Although there is a lot of literature to recommend BGPM,<sup>2–12</sup> there is no research that shows how nurses provide support for people with diabetes. Relevant facts regarding BGPM nursing practices and the means to overcome attendant problems related to supporting BGPM for people with diabetes are needed to better distribute BGPM.

In Japan, nurses with over 5 years' experience in nursing (including over 3 years' experience in diabetes nursing) take training for 6 months, pass the examination to obtain certification and get a licence as a nurse certified in diabetes nursing (DCNs). Because this training programme includes BGPM, DCNs have a skill to support BGPM for people with diabetes.

### Study objectives

This study aims to reveal the actual conditions of BGPM performed by the DCNs in Japan and clarification of the related factors.

### Terminology

#### Blood glucose pattern management

BGPM refers to a method aimed at improving blood glucose control by ascertaining changes (patterns) in blood glucose levels and conducting a systematic and multi-dimensional analysis of the factors contributing to these patterns. In this study, BGPM includes looking back at SMBG or HbA1c results along with people with diabetes and nurses to find patterns of blood glucose levels and to identify what changes should be made.

#### Nurses certified in diabetes nursing

DCNs are the specialists trained in the specific nursing of diabetes, and are certified by the JNA.

A nurse is certified as a DCN by accumulating a certain amount of experience, obtaining a national licence for nurses and then passing the credentialing examination given by the JNA after completing the required education programme for certification. BGPM is the role recognized in DCNs.

### Method

#### Subjects

This study is composed of 303 DCNs, whose names and the workplace affiliations were publicly available on the JNA website in November 2011. While this research was conducted, Japan had only 322 DCNs nationwide. DCNs were considered appropriate subjects, given their knowledge and skills in the area of BGPM, acquired as part of their certification education programme and their guaranteed expertise in diabetes nursing.

#### Questionnaire survey

We sent the questionnaire to 303 DCNs, by mail. We first mailed letters to the personnel in charge of healthcare facilities, requesting them to distribute our self-response questionnaires to their DCNs. We created the questionnaires based on preceding investigation and they were checked by the specialists and DCNs. The questionnaire items queried respondents on the following topics: how they conducted individual counselling, the details of the BGPM procedures they followed (method and target) and the state of their overview of facilities. For questions related to counselling and the estimate of BGPM methods (four on each item), the responses were measured by a five-point Likert scale. For questions about BGPM practices and target, tool, facilities of BGPM, respondents were asked to select all applicable responses.

#### Ethical consideration

Regarding ethical considerations, anonymity was maintained and consent was obtained from the respondents when they completed and returned the questionnaires by mail. The study was approved by the Research Ethics Committee of the Division of Health Sciences at Osaka University.

#### Method of analysis

Simple tabulation of the survey data was made to determine the proportion of valid responses in the sample. Correlation analysis was conducted between individual factors pertaining to the respondents and the state of their facilities to investigate the factors associated with their responses of being 'very good at finding changes (patterns) in blood glucose levels or HbA1c levels'. Mann–Whitney *U*-tests were also performed to determine whether differences existed in the state of the facilities of the nurses who responded.

### Results

The questionnaire was returned by 148 respondents out of a total of 303 DCNs, to whom it was sent (i.e., a 48.8% response rate). Excluding one respondent who left most of the questions blank, valid responses were obtained from 147 respondents (48.5%).

**Table 1** Profiles of the respondents.

Mean age	41.8 ± 6.1
Sex (M/F)	1/146
Mean no. of years of experience as DCNs	3.5 ± 2.6
Department	
Outpatient ward	63 (42.9%)
Hospital ward	60 (40.8%)
Outpatient and hospital wards	5 (3.4%)
Other	19 (12.9%)

**Table 2** Overview of the facilities to which the respondents are affiliated.

Facilities	No. of respondents
Hospitals	145 (98.6%)
Clinic	1 (0.7%)
Unspecified	1 (0.7%)
Provision of specialist diabetes outpatient ward in facility	
Yes	113 (76.9%)
No	33 (22.4%)
Unspecified	1 (0.7%)
Provision of room for consultation with diabetes outpatients in facility	
Yes	88 (59.9%)
No	58 (39.5%)
Unspecified	1 (0.7%)

**Characteristics of the respondents**

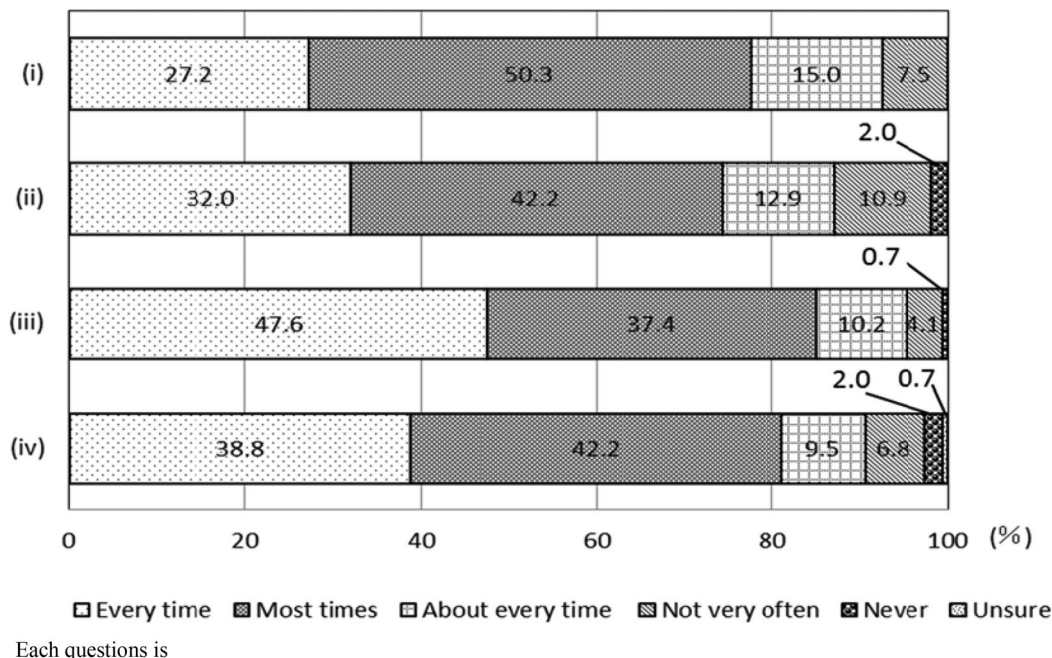
The respondents' characteristics are detailed in Tables 1 and 2.

**Realities of BGPM**

*Implementation frequency of BGPM* We asked the respondents about the frequency of their implementation of BGPM performed during the individual counselling sessions focussed on lifestyle adjustments. More than 75% of the respondents selected the option of 'every time' or 'almost every time' for all of the questions (see Figure 1).

*BGPM implementation by the respondents* All of the respondents (147) responded affirmatively to the following statement: 'I am performing BGPM in some form to support people with diabetes'. A total of 135 respondents (91.8%) responded negatively to the following statement: 'In some cases, the BGPM has led to a deterioration of people with diabetes' blood glucose control'. Similarly, 46 respondents (31.3%) disagreed with the following statement: 'In some cases, the BGPM support did not improve blood glucose control, but may have led to improvements in the QOL (quality of life)' (see Table 3).

*Targets of BGPM* A total of 138 respondents answered that they were currently facilitating of Type 1 diabetes performing SMBG and Type 2 diabetes receiving



**Figure 1** Implementation frequency of certain types of nursing practices related to BGPM during lifestyle-based individual guidance and consultation sessions (n = 147).

**Table 3** BGPM practices performed by DCNs ( $n = 147$ ).

	Yes	No
I am performing BGPM in some form to support people with diabetes	147 (100%)	0 (0%)
In some cases, the introduction of BGPM support has led to a deterioration of people with diabetes blood glucose control	12 (8.2%)	135 (91.8%)
In some cases, the introduction of BGPM support did not improve blood glucose control, but may have led to improvements in the QOL	101 (68.7%)	46 (31.3%)

insulin therapy in the treatment performing SMBG. Additionally, BGPM was performed by respondents on the people with diabetes who are not undergoing SMBG, although this proportion was lower than that of the people with diabetes undergoing SMBG. These results are depicted in Table 4.

#### State of the facilities for BGPM

*Tools for conducting BGPM* The results in Table 5 indicate whether or not each respondent's health facility provided special record sheets for BGPM or pamphlets to assist in BGPM implementation.

*State of the implementation of BGPM at the facilities* Respondents were queried on the facilities established for BGPM support, such as the provision of a diabetes classroom for people with diabetes' in terms of BGPM. They were also asked if other nurses, apart from those respondents, conducted BGPM. Their responses are shown in Table 6.

**Table 4** Provision of BGPM support by respondents ( $n = 147$ ).

Type of patient and treatment	No. of respondents providing BGPM support	No. of respondents not providing BGPM support
Type 1 diabetes performing SMBG	138 (93.9%)	9 (6.1%)
Type 1 diabetes not performing SMBG	20 (13.6%)	127 (86.4%)
Type 2 diabetes receiving insulin therapy and performing SMBG	138 (93.9%)	9 (6.1%)
Type 2 diabetes insulin therapy and not performing SMBG	35 (23.8%)	112 (76.2%)
Type 2 diabetes who have non-insulin therapy but are performing SMBG	65 (44.2%)	82 (55.8%)
Type 2 diabetes who have non-insulin therapy and are performing SMBG	29 (19.7%)	118 (80.3%)

**Table 5** Tools used to perform BGPM ( $n = 147$ ).

Type of tool	Provided	Not provided
Special record sheets for people with diabetes to use for BGPM	32 (21.8%)	115 (78.2%)
Special record sheets for nurses to use for BGPM	14 (9.5%)	133 (90.5%)
Pamphlets to assist in the conduct of BGPM	12 (8.2%)	135 (91.8%)

#### Perceptions regarding the conduct of BGPM

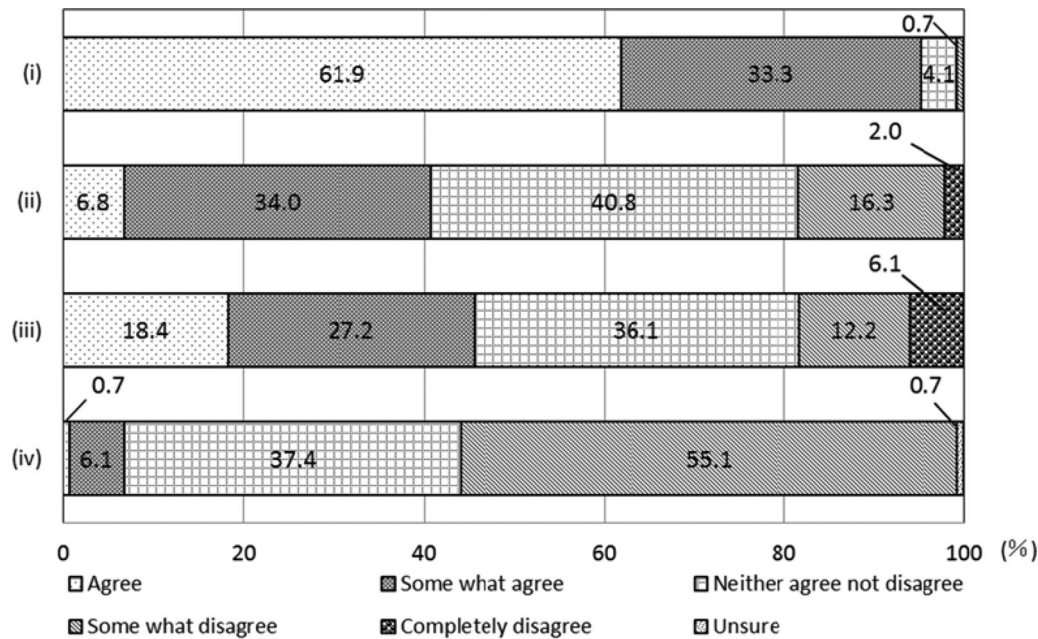
A total of 140 respondents (95.2%) agreed, or somewhat agreed, with the following statement: 'Looking jointly with the people with diabetes for patterns in their blood glucose levels brings unexpected discoveries'. Similarly, 136 respondents (93%) somewhat disagreed, or completely disagreed, that BGPM was ineffective. Regarding the statement, 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels', 60 respondents (40.8%) agreed or somewhat agreed, while 67 (45.6%) agreed or somewhat agreed with the statement, 'The doctors at our facility are cooperative when it comes to BGPM' (see Figure 2).

#### Results for the statement of 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels' and related items

The Pearson correlation coefficient between the statements, 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels' and 'The doctors at our facility are cooperative when it comes to BGPM', was 0.315, which was significant ( $P = 0.000102$ , 95% confidence interval [0.16,0.45]). Although the relationship between the statement of 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels' and years of experience as a respondents was not significant, the Pearson correlation coefficient between them was 0.248, which was significant ( $P = 0.0024$ , 95% confidence interval [0.0879, 0.3941]). Mann-Whitney  $U$ -tests were also performed to determine whether any differences

**Table 6** Actual state of the facilities for BGPM ( $n = 147$ ).

	Yes	No
Provision of a diabetes classroom equipped for patients' performance of BGPM	7 (4.8%)	140 (95.2%)
Requirement of an approval from the attending doctor before each people with diabetes may begin BGPM	26 (17.7%)	121 (82.3%)
Provision of BGPM support by nurses who are non-DCNs	53 (36.1%)	94 (63.9%)
Disapproval of people with diabetes self-adjustment of their insulin levels from one or more specialist diabetes doctors at the workplace	28 (19.0%)	119 (81.0%)
Prohibition of nurses from carrying out BGPM support	4 (2.7%)	143 (97.3%)



Each questions is

- (i), Checking the patterns of blood glucose levels with the people with diabetes brings unexpected discoveries
- (ii), I am very good at finding changes (patterns) in blood glucose or HbA1c levels.
- (iii), The doctors at our facility are cooperative when it comes to BGPM
- (iv), BGPM is ineffective

**Figure 2** Respondents' perceptions regarding the conduct of BGPM ( $n = 147$ ).

existed in the distribution that depended on the availability of a specialist diabetes outpatient ward or a nursing consultation room for people with diabetes in the respondents' workplaces. However, these  $P$ -values were 0.436 and 0.105, respectively, meaning that a significant distribution was not found. When these scores were compared with the results on the state of the facilities for BGPM, a significant difference ( $P = 0.026$ ) was only found between the distribution of scores for the following statements: 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels' and 'Blood glucose BGPM support is also provided by nurses who are non-DCNs.' Of the 53 respondents who responded affirmatively to the latter statement, 28 (52.8%) agreed, or somewhat agreed, with the former statement. In contrast, among the 94 respondents who responded negatively to the statement of 'Blood glucose BGPM support is also provided by nurses who are non-DCNs', 32 (34.0%) agreed, or somewhat agreed, with the following statement: 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels'.

## Discussion

### Implementation of BGPM

In this study, most of the respondents with diabetes on BGPM were receiving insulin therapy and undergoing SMBG, regardless of the type of diabetes. Blood

glucose monitoring is a critical element of pattern management.<sup>12</sup> In addition, under Japan's healthcare system, SMBG is not covered by health insurance unless a person with diabetes is receiving insulin therapy. This may also be a contributing factor to why most SMBG people with diabetes take insulin.

For the Type 2 diabetes patients undergoing SMBG, their receipt of insulin therapy had a significant effect on whether or not they undergo BGPM: the proportion of people with diabetes under this treatment while taking insulin was 93.9%, whereas the proportion of those under non-insulin therapy was 44.2%. Although the first step in pattern management involves identifying blood glucose goals and monitoring blood glucose levels four to six times a day,<sup>1,7</sup> it is not easy for most people undergoing non-insulin therapy to pay all the costs for SMBG by themselves. For this reason, limiting the number of SMBG treatments for people with diabetes significantly reduces its effectiveness for BGPM. Previous studies have demonstrated the effectiveness of SMBG for Type 2 diabetes patients who are not using insulin,<sup>7,13</sup> some have also provided evidence that integrating BGPM concepts into patient support can improve blood glucose control with the requirement of relatively fewer measurements of blood glucose levels.<sup>7</sup> If SMBG for people non-insulin therapy Type 2 diabetes is covered by health insurance for even only the first step

(e.g. 1 week or 1 month), it would greatly help people with Type 2 diabetes find basic patterns of blood glucose in their lives and to set their goals. This will be a more effective support for them to achieve good blood glucose control with only a few times of SMBG a day.

In an intervention group in a previous study<sup>7</sup> the completed records of blood glucose levels of people with diabetes who had undergone SMBG and recorded it had only been reviewed by physicians. This study also showed that this intervention was significantly effective in HbA1c and general well-being. In Japan, for SMBG records to be reviewed only by physicians is not realistic because a lot of people with diabetes visit an outpatient clinic. Physicians are also often unable to support BGPM for lack of time.

To perform pattern management, support of a healthcare team (not physicians alone) is needed.<sup>1</sup> A recent research<sup>14</sup> showed using a metre offering automatic blood glucose pattern recognition and in-the-moment messaging was significantly faster and more accurate for healthcare professionals than using a logbook. Using such a new technology, nurses should play a key role in supporting people with diabetes who undergo BGPM. Approximately 70% of the respondents in this study had experienced cases in which the introduction of BGPM support did not improve the control of blood glucose, but may have led to improvements in the QOL.

On the other hand, they constituted only a small proportion of the total sample (8.2%). Some respondents agreed with the following statement: 'In some cases, the introduction of BGPM support has led to a deterioration of the patients' blood glucose control'. In this research no detail of this phenomenon was shown; so future research is needed. The IDF guidelines (2009)<sup>15</sup> state the appropriate use of SMBG by people not only with insulin-treated diabetes but also with not-insulin-treated diabetes has the potential to optimize diabetes management through timely treatment adjustments based on SMBG results and improve both clinical outcomes and QOL. To achieve improvement towards blood glucose control as well as the QOL, we should give attention to criteria for introducing pattern management and not a general guideline alone.

#### Facilities and environments in which BGPM was being performed

Although all of the respondents in the survey applied some form of BGPM, only a limited proportion were using specially designed materials such as record sheets and pamphlets. Recently two studies<sup>7,11</sup> showed evidence that new record forms were effective and useful. IDF (2009)<sup>15</sup> and AADE (2014)<sup>10</sup> recommended some forms of pattern management. These findings point to the importance of management tools. Therefore, we may need to consider how to use such tools more efficiently and effectively to provide support to outpatients in a

limited time, or whether or not such tools are in fact necessary.

Although they constituted a small proportion of the total sample in this study, several respondents stated that the specialist diabetes doctor(s) at their facility did not approve of people with diabetes adjusting their own insulin levels. Self-adjusting insulin intervention for people with Type 1 diabetes has been reported to be efficient for blood glucose control, and enhancing the QOL.<sup>16,17</sup> Furthermore, a recent study<sup>6</sup> has shown that an educational programme for insulin self-adjustment associated with structured self-monitoring of blood glucose significantly improves glycaemic control in people with Type 2 diabetes. In Japan, the programme for self-adjustment of insulin is developing.<sup>18</sup> Because the self-adjustment of insulin will be a more important element of support for BGPM in the future, nurses need to understand each person's specific demands and to be able to discuss with a doctor about insulin self-adjustment for each individual with diabetes.

In this study, the two statements of 'The doctors at our facility are cooperative when it comes to BGPM' and 'BGPM support is also provided by nurses who are non-DCNs' showed a significant relationship with the following perception: 'I am very good at finding changes (patterns) in blood glucose or HbA1c levels.' There has been no previous research which has factored in the nurses' skill of BGPM. If we consider this alongside the fact that a significant relationship was also found between this skill, perceived as being 'very good' and the duration of being a DCNs, then we can predict that the facilities, in which the doctors are cooperative, will provide more opportunities to offer BGPM support, thereby making it easier for DCNs to improve their skills. Moreover, if the effectiveness of BGPM is experienced and understood by doctors as well as DCNs within their practice, this kind of people with diabetes support could also be extended to non-DCNs. This synergistic effect is apparent in the results of this study. SMBG is treated as a part of people with diabetes education and people with diabetes treatment programmes. A review article about pattern management<sup>19</sup> pointed out that it is important to optimize the patient-healthcare-provider relationship. The fact that close cooperation between diabetes patients and their healthcare team has become an important factor in the improvement of blood glucose control indicates that the support of doctors and other members of the healthcare team is crucial.

#### Limitations and directions for further research

This study has revealed the realities of BGPM as performed by the DCNs in Japan, and further indicates several directions for further investigation. However, one limitation of this study is that it exclusively targeted DCNs. Future intervention studies should expand the target group and use the results to discuss better methods of providing support for people with diabetes.

## Conclusion

In this study, most DCNs performed BGPM for people with diabetes and recognized that BGPM is useful for most people with diabetes. In addition, it is suggested that to perform BGPM effectively, it is important to build a good relationship between doctors and nurses.

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