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The Effects of Telenursing with Goal Attainment Scaling in Diabetic Patients: A Case Report

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Abstract

Background: This study investigated the effectiveness of using patient participation goal attainment scaling in a telenursing system for self-management behavior in two Japanese type 2 diabetic patients.
Methods: The intervention consisted of using goal attainment scaling to set goals, and efforts toward realizing these goals were made using a telenursing system that included on-demand webcam conversations, e-mail and phone calls. Over the intervention period of 6 months, the patients performed daily self-monitoring and the nurse provided telenursing support according to the patients' needs and nursing care requirements.
Results: Both patients had improved self-management behavior and a positive opinion of the telenursing system and goal attainment scaling.
Conclusion: Incorporating goal attainment scaling into a telenursing system for type 2 diabetic patients was effective in continuing self-management behavior, suggesting that it is effective in providing continued home nursing care in diabetic patients.

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Introduction

Diabetes care

Globally, the number of adults affected by diabetes is increasing and expected to reach 439 million (7.7% of the global population) by 2030 [1]. Of all diagnosed cases of adult diabetes, type 2 diabetes accounts for about 90-95% [2]. The goal of treatment for type 2 diabetes is to prevent the development and progression of complications through better glycemic control and implementation of regular outpatient visits accompanied by diet, exercise, and drug therapy [3]. To date, effective behavioral interventions have been developed for diabetic patients [4, 5], such as "mutual goal setting" and daily "self-monitoring" (observing and recording one's own behavior) [6,7].

Mutual goal setting and goal attainment scaling

Mutual goal setting is an effective nursing intervention in patients with chronic diseases [8,9], and involves patients and nurses collaborating to set patient goals and reaching a mutual agreement about these goals as treatment intervention [10]. Goal attainment scaling (GAS) is one way of putting this intervention into practical use [11].

GAS involves discussion between the patient and nurse to maintain and recover health in the future, thereby establishing agreement for mutual goal attainment. A Goal Attainment Follow-up Guide (GAFG) is used in this process and includes realistic and practical goals (3 to 5 levels) based on mutual understanding between the patient and nurse, goal weighting, and setting dates to assess the degree of goal attainment. Based on this agreement, the nurse implements a specific intervention plan towards mutual goal attainment. The goal attainment score is used to quantitatively evaluate the degree of mutual goal attainment. These effects can be calculated by a formula, namely, the goal attainment score.

The goal attainment score is calculated using formula (1) below [12], where "wi" is the weight assigned to the ith goal and "xi" is the attainment level (between -2 and +2) of the ith goal.

$$\text{Goal Attainment Score} = 50 + \frac{10\Sigma w_i x_i}{[0.7w_i^2 + 0.3(\Sigma w_i)^2]^{1/2}} \quad (1)$$

GAS involves comparing the goal attainment scores when the goals are set to when they are evaluated. A score exceeding 50 means that the expected level of goal attainment has been either reached or surpassed [11]. A P value can be used to reflect the estimated average interrelation of the goal attainment score. Kiresuk and Sherman [11] argued that a P value of 0.30 can be safely used as a constant in formula (1). On the other hand, MacKay, Somerville, and Lundie [13] reasoned that the P value could not be presumed based on intuition, but rather should be computed retrospectively on a case-by-case basis by adjusting it to achieve a desired range of scores. GAS has been validated in a study evaluating the effects of drug therapy [14], and is used not only in the assessment of individual goal achievement in therapeutic processes, but also in comparative studies of relative success in achieving goals, making it suitable for evaluation projects [15,16].

Telenursing

Recently, there has been interest in telenursing as a new healthcare service to support home care patients [17,18,19]. Telenursing refers to the use of telecommunications and information technology to provide nursing care at a distance, which may help solve increasing shortages of nurses, reduce both travel distance and time, and keep patients out of the hospital [18].

Research has shown that the use of telenursing increases patient

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satisfaction, improves the efficiency of nursing services, and is highly assessed by both patients and nurses [20, 21]. In particular, studies using telenursing for diabetic patients have shown effectiveness in improving HbA1c levels [12], reducing the burden of diet therapy [22], confirming the efficacy of short-term intervention [23] and clarifying the process of blood pressure and glycemic changes [24]. However, a standard methodology for telenursing has yet to be established. Furthermore, web applications that offer specific programs to meet the needs of patients have yet to be validated. Researchers such as Nijland et al. [25] believe that such applications should be designed in order to allow individuals to tailor specific programs to their own Needs.

Telenursing system

In 2004, Kawaguchi et al. [26] developed a telenursing web application for managing patient care using the Internet. This web application was developed as a system to implement continued treatment and nursing care using cutting-edge information technology. The features of Kawaguchi's telenursing system [17] include being able to select information technology (on-demand webcam conversations, e-mail, and phone calls) for intervention according to patient needs and nursing care requirements, being able to record patient self-monitoring information as part of the health record, and graphing of the self-monitoring information in the health record so that patients are able to view their own data at any time (Figure 1).

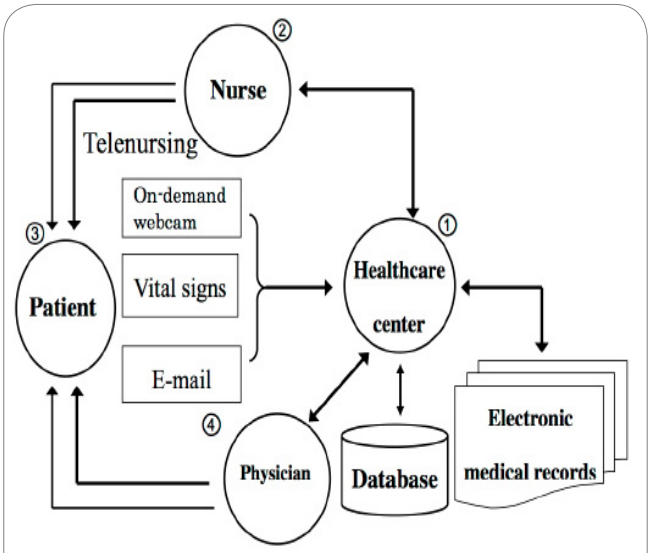

Figure 1: Schematic overview of the Internet-based telenursing system. The system comprised a mutual network via a healthcare center server (1). The network consisted of a nurse (2), a patient (3), and a physician (4). The healthcare center mainly functioned to house the database. Continued treatment and nursing care were implemented by an on-demand webcam, telephone guidance, and health consultations via e-mail. The system provided health information, support for individual health management that included regular health checks and guidance, support for self-management through personalized web-based medical records, and identification of patients needing direct care support.

This report presents our evaluation of the effectiveness of using patient participation GAS in a telenursing system for self-management behavior in two Japanese type 2 diabetic patients.

Materials and Methods

Study design: Intervention protocol incorporating GAS in a telenursing system.

Case presentation: Patient 1 was a 61-year-old woman with a 20-year history of type 2 diabetes. Patient 2 was a 64-year-old woman with a 10-year history of type 2 diabetes. Table 1 shows the patients' characteristics at the start of intervention.

Healthcare professionals involved in telenursing: The attending nurse was a woman in her early 30s who had 7 years of practical nursing experience and was qualified as a Certified Diabetes Educator of Japan. The attending physician was a specialist at a diabetes outpatient clinic at a hospital affiliated with the University of Tsukuba. The study was also supported by two full-time system engineers who ensured that the telenursing system operated smoothly and were in charge of security checks and dealing with communication problems.

Intervention protocol: The nurse, together with the system engineers, first set up the equipment at the patients' homes. At that time, the nurse and each patient established mutual goals using the GAFG. Patients, on days of their own choosing and with their preferred means of communication (on-demand webcam conversations, e-mail and phone calls), received real-time consultations and guidance from the attending nurse. The nurse reviewed the self-monitoring record input by each patient and provided telenursing support to achieve mutual goal attainment. Telenursing support was provided twice a week according to the lifestyle of the patients. The nurse also provided face-to-face intervention directly with the patients at regularly scheduled monthly outpatient visits.

Evaluation method and data collection: The goal attainment scores [11] at the start of intervention and after 6 months of intervention were assessed and compared.

A semi-structured interview was used for the goal attainment score. Structural questions were used to collect data on telenursing implementation from the patients in order to evaluate the systemwhen the intervention was completed. Data were collected in private rooms to ensure privacy.

Ethical considerations: The study protocol was approved by the Clinical Research Ethics Committee of the University of Tsukuba Hospital on July 14, 2011 (certification no. UMIN000005925) and conformed to the Declaration of Helsinki. Participation was voluntary and all participants provided written informed consent.

Written explanations of the benefits and risks of participating in the study were provided to both patients, and their questions were answered before they signed the consent form. The benefit of participating was that the patient would receive intervention toward diabetes self-management at home. There were two risks of participating in the present study. First, telenursing is not conducted through direct face-to-face communication; therefore, miscommunications may occur. As a countermeasure, a nurse who could explain the treatment in plain language and was easily understood by the patients was selected. Second, data those patients enter into the telenursing system, such as blood pressure and weight, could be leaked through the network. Therefore, personal information in the present study. First, telenursing is not conducted through direct face-to-face communication; therefore, miscommunications may occur. As a countermeasure, a nurse who could explain the treatment in plain language and was easily understood by the patients was selected. Second, data those patients enter into the telenursing system, such as blood pressure and weight, could be leaked through the network. Therefore, personal information in the present study was recorded only on paper and records were stored in a locked room in a building with a security system. The written explanation of the study given to the patients and the consent form clearly stated that the patients would be recorded. We informed the patients that the audio tapes would be erased after

	Patient 1	Patient 2
Basic attributes		
Age (years)	61	64
Sex	Female	Female
Body mass index (kg/m^2)	25.5	20.4
Duration of type 2 diabetes (years)	20	10
HbA1c (%)	10.1†	7.4‡
Blood glucose (mg/dL)	328†	140‡
Complications		
Retinopathy	Simple diabetic retinopathy in both eyes	None
Nephropathy (stage)	Stage 1	Stage 1
Neurological disorder	None	None
Hypertension	Present and taking antihypertensive medication	Present and taking antihypertensive medication
Dyslipidemia	Present and taking ntihyperlipidemic medication	Present and taking antihyprlipidemic medication
Other	None	Angina pectoris at age 58, percutaneous coronary intervention at age 62
Past history	Toxemia of pregnancy at age 27	Breast cancer and mastectomy at age 50
Prescription		
Diet	Daily limit of 1440 kcal	Manage weight, eat balanced meals, avoid sweets
Exercise	Valsalva-type exercise, no intense exercise	Walking 10,000 steps daily is desirable
Prescription medicine (mg/day)	Metformin hydrochloride (750)	Acarbose (150)
	Miglitol (150)	Aspirin (100)
	Glimepiride (3)	Bisoprolol fumarate (5)
	Candesartan cilexetil (4)	Amlodipine besilate (2.5)
	Manidipine hydrochloride (20)	Nicorandil (5)
	Rosuvastatin calcium (5)	Rosuvastatin calcium (5)
		Lansoprazole (15)

Table 1. Patient characteristics before intervention.
†2-hour post-prandial; ‡fasting.

the data had been transcribed. We obtained consent forms from the patients before any activities were taped. We also informed participants that they were free to withdraw from the study at any time.

Results

Intervention using telenursing

Patient 1: Treatment guidance using telenursing was provided a total of 91 times. This included 74 webcam conversations, four phone calls, and 13 e-mail exchanges. The patient had intervention six times at outpatient visits. Patient 2: Treatment guidance using telenursing was provided a total of 95 times. This included 53 webcam conversations, five phone calls, and 37 e-mail exchanges. The patient had intervention three times at outpatient visits.

The intervention period was 168 days for both patients, during which the number of days that patients input data using the telenursing web application self-monitoring screen was 118 days for patient 1 and 132 days for patient 2.

Goal attainment score

Patient 1's goals were as follows: (1) "adjusting fruit intake to the appropriate amount"; (2) "adjusting carbohydrate intake to the appropriate amount"; (3) "eating vegetables at the start of meals"; (4) "performing step exercises each day"; and (5) "taking a 15-min walk after one meal each day". After 6 months of intervention, the degree of attainment of all goals increased. The goal attainment score increased from 30.58 at the start of intervention to 69.4 after 6 months of intervention. Table 2 shows an example of the goals and goal attainment at the 2-month GAS follow-up for patient 1.

Patient 2's goals were as follows: (1) "moderating intake of nonessential grocery items"; (2) "walking for exercise"; and (3) "measuring the amount of carbohydrate intake". After 6 months of intervention, the degree of attainment of all goals increased. The goal attainment score increased from 23.57 at the start of intervention to 76.4 after 6 months of intervention.

Assessing the telenursing system

The patients were asked to assess the telenursing system [16], and responses included the following: "a good thing was being able to choose the means of communication and times suited to my preferences and lifestyle"; "graphing the self-monitoring data made it easier to check my self-management status and increased my motivation"; and "explanations about the data and how to exercise from the nurse using a webcam made things easy to understand."

Assessing intervention using GAS in telenursing

The patients were also asked to assess the operational aspects of intervention using GAS in telenursing, and responses included the following: "because I was able to reflect on my self-management status when the goals were set, I understood the lifestyle habits that I needed to improve"; "when I checked the follow-up guide, I was able to realize that I could gradually attain the goals without being impatient"; "I was glad when the GAS levels increased"; and "I was able to set and work towards the goals together with the nurse".

HbA1c

Patient 1's HbA1c was 10.1% at the start of intervention, and decreased by 0.7% by the fourth month of intervention; however, it

	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
	Fruit intake adjustment	Carbohydrate intake adjustment	Eating vegetables at the start of every meal	Step exercises	15-min walk after one meal/day
Weight of goal	5	4	3	2	1
Worst expected outcome (-2)	2 units intake†	1/4 portion rice remaining after lunch†	Once/day†	0 min/day	0 days/week
Worse than expected outcome (-1)				15 min/day	1 day/week
Expected outcome (0)	1.5 units intake	1/3 portion of rice remaining after lunch	Twice/day‡	30 minday†,‡	2 days/week†
Better than expected outcome (+1)		‡		45 min/day	3 days/week‡
Best expected outcome (+2)	1 unit intake‡	1/2 portion rice remaining after lunch	3 times/day	60 min/day	4 days/week

Table 2. Example of patient 1's goals and goal attainment levels as displayed in a goal attainment scaling follow-up guide.
†Initial performance with goals set on August 6, 2011; ‡Attained performance with goals evaluated 2 months after intervention.

increased by 0.7% after 6 months of intervention, returning to the same level as that before intervention. Patient 2's HbA1c was 7.4% at the start of intervention, and decreased by 0.8% after 6 months of intervention. Drug therapy was not changed in either patient.

Discussion

Incorporating GAS in the telenursing system [17] was effective in continuing self-management behavior in type 2 diabetic patients. This system allowed for the selection of appropriate intervention technology that met patient needs and nursing requirements, enabled graphing of self-monitoring data, and permitted patients to review their own data at any time. These features reduced the difficulty of continued use of telenursing and were effective for continued treatment. Continuing appropriate self-management behavior can prevent the development and progression of complications through better glycemic control and implementation of regular outpatient visits [3].

In a previous study, the self-monitoring methods used with our system were found to be associated with improved performance [27]. Snyder and Gangestad [6] noted that individual differences in self-monitoring influenced human behavioral adjustment and were associated with ease of adoption of coping behaviors. In the present study as well, the patients were able to monitor and evaluate their own behavior and were able to self-react to the results. This enabled them to implement and continue behaviors to attain their goals.

Maves [10] stated that with GAS intervention, successful information exchange with patients through the setting of mutual goals and efforts made by the patients themselves towards health goals helped to create a more desirable situation for patients. In addition, King [28] stated that goal attainment could be realized by setting mutual goals between the patient and nurse, finding a means to attain the goals, agreeing about the means, and starting activities towards goal attainment. In the present study, the nurse provided the necessary knowledge and skills towards mutual goal attainment and continued support to improve patient motivation. This allowed the patients to actively participate in treatment.

GAS not only involves quantitative evaluation using a score, but, along with the GAFG used for setting mutual goals and assessing the degree of goal attainment, also allows for visual self-evaluation [11]. Visual analysis allows the initial performance to be compared with the level of attainment per goal and across goals for each patient [29]. In addition, a small-step approach is said to be effective when setting goals [30]. With regard to patients setting and gradually being able to attain their own goals, this visualization confirms effectiveness.

GAS has been validated in studies evaluating the effects of drug therapy [14], assessing individual goal achievement in therapeutic processes and comparative studies of relative success in achieving goals [15, 16], making it suitable for evaluation projects.

Although GAS is widely used in pharmacology and rehabilitation science, it is still not popular in nursing self-management education. One reason for this is that as an evaluation index of an intervention for patients with diabetes, changes in HbA1c has been used. The Problem Area in Diabetes (PAID) scale [31] and the Self-efficacy on Health Behaviour scale [32, 33] have traditionally been used to assess the psychological health of patients, and the stage of change in the transtheoretical model [34] has been used to evaluate self-management behavior. In recent years, self-management education has changed from a "leadership" model to a "learning-assisted" model; an "empowerment approach" is also becoming widespread. Therefore, in addition to the evaluation techniques listed above, GAS is an effective nursing intervention in patients with diabetes that involves communication between the patient and nurse and establishing agreement for mutual goal attainment to maintain and recover health in the future.

There are two possible reasons why the goal attainment score increased but HbA1c worsened for patient 1. The first is because the nurse and patient evaluated the goal attainment score together; therefore, the patient's evaluation of the nurse involved in care may have been influenced by the nurse's presence. The second reason, as discussed by Bandura [32], may be that the level of self-control was decreased by self-monitoring control. Patient 1 was often away overnight at winter events or long vacations and self-monitoring input into the telenursing system was not continuous. Patients may take a break and be away from telenursing care; therefore, we decided to update the system to include portable terminals that can easily be used anytime anywhere in order to avoid this problem in future interventions.

This was a pilot study and included results from only two patients. Therefore, the effectiveness of this study's system should be further investigated with a larger number of patients in the future. In addition, further investigations of the practical applications of this telenursing system, including the introduction of entertainment features using social networking services and game sensation, which will make the system more enjoyable for patients to use, are necessary.

Kumar [19] stated that the reason telenursing is still not popular is that it is fraught with potential legal, ethical, and regulatory issues. Therefore, safe and ethical practices regarding privacy and confidentiality of patient information must also be considered when investigating and developing telenursing systems.

Conclusion

Incorporating GAS into a telenursing system for type 2 diabetic patients was effective in continuing self-management behavior, suggesting that it is effective in providing continued home nursing care in diabetic patients.

Competing Interests

The authors declare that they have no competing interests.

Author Contributions

Kaori Higano, Taiga Shibayama, Masao Ichikawa, Takayasu Kawaguchi, and Kayuri Furuya designed the study. Kaori Higano, Taiga Shibayama, Miwa Motomura, Hitoshi Shimano, Yasushi Kawakami, and Takayasu Kawaguchi collected and analyzed the data. Kaori Higano and Takayasu Kawaguchi wrote the manuscript. All authors read and approved the final manuscript.

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