

Quality Control Circle improves self-monitoring of blood glucose in Type 2 diabetic patients

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KEY WORDS

Quality control circle, diabetes mellitus, blood glucose monitoring, frequency

ABSTRACT

Objective

To determine the effect of quality control circle (QCC) activity on self-monitoring of blood glucose (SMBG) in type 2 diabetic patients.

Design

Pre-test Post-test study.

Setting

Outpatient clinic of a tertiary hospital in Eastern China.

Subjects

A total of 110 insulin-treated type 2 diabetic patients.

Interventions

Quality control circle.

Main outcome measures

Quality of self-monitoring of blood glucose and blood glucose control in patients.

Results

At the end of QCC activity, the proportion of patients performing regular SMBG and the frequency of SMBG were significantly increased. The incidence of using expired test strips, incorrect timing of blood glucose monitoring, improper operation and non-calibration of meters were all significantly decreased. Consequently, the levels of glycosylated hemoglobin, one-week fasting blood glucose, and one-month incidence of hypoglycemia were significantly decreased in these patients.

Conclusion

The QCC activity plays an active and beneficial role in improving SMBG and blood glucose control in patients with diabetes. This activity should be promoted in future clinical work.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Acknowledgement

We thank Drs. Shihua Wang and Kristin Best for their help in reviewing of manuscript. We also thank all nurses in the Department of Endocrinology for their helps during the study.

Declaration of Conflicts of Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

INTRODUCTION

A quality circle or quality control circle (QCC) refers to a group of workers who do the same or similar work, or perform work complementary to each other. QCC activities have played important roles in the management of major enterprises in the United States of America, Europe, Japan and other developed countries. In recent years, QCC activities have been applied to management in various fields. The health care industry is of no exception. In daily hospital management, the QCC applies scientific analysis methods to find the crux of problems so as to develop corresponding implementation plans and goals and carry them out through different stages. QCC activities have been practiced in the management of medical quality (Wang et al 2013), wait time between continuous surgery (Zhang et al 2015), surgical site infection (Liu and Wang 2016) and hand hygiene compliance (Chen et al 2016) in Chinese hospitals. A previous study evaluated the effect of QCC on 1,103 type 1 diabetic patients receiving an intensive insulin treatment. Their results showed significant decrease in levels of glycosylated hemoglobin, incidence rates of severe hypoglycemia and ketoacidosis (Muller et al 1999).

The prevalence of diabetes mellitus continues to increase worldwide (International Diabetes Federation 2016; NCD Risk Factor Collaboration 2016). In China, a 10-fold increase in the prevalence of diabetes mellitus has been observed in the thirty years between 1980 and 2010 (Ma et al 2017). It is estimated there were as many as 114 million diabetic patients in China in 2010, and half of the Chinese adults had pre-diabetes mellitus (Xu et al 2013; Yang et al 2010). The complications and mortality associated with diabetes mellitus place a large economic burden on patients and the health care system (NCD Risk Factor Collaboration 2016; Diabetes Prevention Program Research 2012; Yang et al 2010). In contrast to the high prevalence, inadequate attention has been paid to self-monitoring of blood glucose (SMBG) in diabetic patients in China. Many diabetic patients demonstrate poor compliance and lack of systematic management of SMBG (Qin et al 2017; Zeng et al 2014).

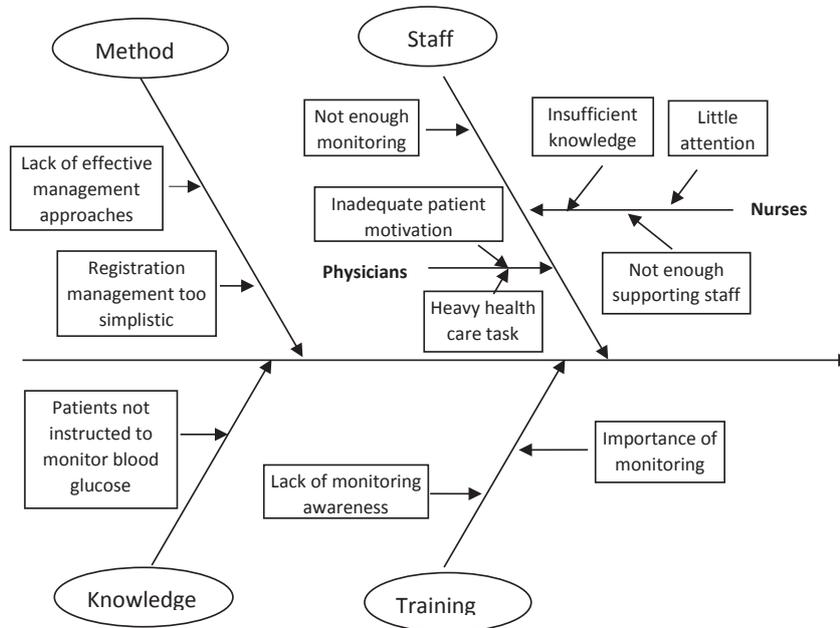
Type 2 diabetes mellitus is a chronic systemic disease. In addition to drugs, diet and exercise are important for the patients' treatment. SMBG is a simple and accurate reflection of the efficacy of treatment. This operation should be a part of treatment from the beginning of care. This study was designed to determine whether the QCC activity could improve the SMBG and blood glucose control in type 2 diabetic patients.

METHODS

The QCC was formed following the procedures described previously (Wang et al 2013). Nine experienced nurses from a total of 18 nurses working in the Department of Endocrinology self-selected to become members of the QCC. Of them, four had a Bachelor degree and five others had an Associate degree. One nurse was elected as the manager responsible for planning and organising the activities, and a senior nurse worked as a counselor to supervise activities of QCC. The QCC activity was initiated by the manager and participated by all nine members. The QCC activities were performed during July-December of 2016. The activity was held monthly within the Department. This study was approved by the Medical Ethics Committee of the hospital.

Based on the rationality, urgency, supervisors' suggestions, feasibility, expected outcomes, and ability to implement QCC members, to improve the SMBG in insulin-treated type 2 diabetic out-patients was selected as the theme for the QCC. The QCC was named as sugar control circle. The factors causing no or irregular SMBG were analysed from the aspects of staff, knowledge, methods and training (figure 1).

Figure 1: Factors of causing no or irregular self-monitoring of blood glucose in patients.



Inclusion criteria

All insulin-treated type 2 diabetic patients who had regular monthly doctor's visits during the last two years.

Exclusion criteria

Patients with incomplete or no records of SMBG, and patients without finishing the six-month QCC activity were excluded.

Based on the identified factors causing no or irregular SMBG in the patients, the following countermeasures were put forward to solve the issues in lack of SMBG in diabetic patients:

1. At the beginning of the study; all patients attended education sessions to understand the importance of controlling the blood glucose and the correct technique of SMBG.
2. Text message or other communication approaches were established to remind patients to monitor glucose every day.
3. Records of SMBG in diabetic patients were collected during each doctor's visit.
4. Members of QCC met monthly to check patients' records, identify problems and their causes, and bring about solutions.

The efficacy of QCC was evaluated based on changes in the following indicators before and after the activity:

1. frequencies of SMBG and the way of using glucose meters in patients. This information was obtained through survey during QCC activity, and cross-validated by the medical record;
2. blood glycosylated hemoglobin, morning fasting blood glucose levels, one-month incidence of hypoglycemia in patients;

3. scores of intangible results for members, including self-growth, engagement, personal ability, team spirit, communication and articulationskills and the use of the QCC(Wang et al. 2013).The intangible results were arbitrarily scored with 1~5points (1 - very poor; 2 - poor; 3 - fair; 4 - good; 5 - excellent) by each QCC member.

Statistical analysis

Data were analysed using the SPSS17.0 software package (SPSS Inc, Chicago, IL)(Chen et al. 2016).Quantitative data were presented as mean \pm standard deviation. The t-test was applied to examine their differences before and after QCC activity. The qualitative data was expressed as percentage. The χ^2 test was used to compare their differences before and after the QCC activity.A $P < 0.05$ was considered to be statistically significant.

FINDINGS

A total of 110 insulin-treated type 2 diabetic patients were recruited in this study. The medical records showed that 59 patients (53.64%) did not perform regular SMBG. Of them, 17 patients (28.81%) were unconcerned with the need for SMBG due to lack of knowledge about diabetes; 13 patients (22.03%) neglected SMBG because of inadequate attention to the treatment; 23 patients (38.98%) had irregular SMBG owing to forgetfulness, inconvenience and intolerance to pain. These three factors accounted for 89.83% of patients who lacked regular SMBG.

Our result revealed that the proportion of patients withregular SMBGincreased from 46.37% before the QCC activity to 93.64% after the activity ($P < 0.001$). The frequencies of SMBG were significantly increased in patients at the conclusion of the QCC activity, as compared with those before the QCC activity (table 1).

Table 1: Frequencies of self-monitoring of blood sugar before and after the QCC activity.

Frequencies of blood monitoring	Prior to QCC (n=110)	After QCC (n=110)	P value
Yes	51 (46.37)*	103 (93.64)	<0.0001
1~15/month	32 (29.09)	42 (38.18)	
≥ 15 /month	19 (17.27)	61 (55.45)	

* Data were presented as number (%).

After the QCC activity, the incidence of using expired test strips($P < 0.0001$), incorrect timing of blood glucose monitoring($P < 0.0001$), improper operation and non-calibration of blood glucose meters ($P < 0.0001$), and incorrect recording of blood glucose values ($P < 0.0001$) were all significantly decreased (table 2).

Table 2: The use of glucose meters before and after the QCC activity.

Indicators	Prior to QCC (n=110)	After QCC (n=110)	P values
Use of expired test stripes	34 (30.91)	4 (3.64)	<0.0001
Incorrect timing of monitoring	67 (60.91)	22 (20.00)	<0.0001
Improper operation of meter	35 (31.82)	11 (10.00)	0.0001
No calibration of meter	89 (80.91)	26 (23.64)	<0.0001
Incorrect recording of blood glucose	54 (49.09)	17 (15.45)	<0.0001

Compared to data prior to the QCC activity, levels of glycosylated hemoglobin ($P<0.001$), one-week fasting blood glucose ($P=0.001$), and the one-month incidence of hypoglycemia ($P=0.039$) were significantly decreased after the QCC activity (table 3).

Table 3: Glycosylated hemoglobin, fasting blood glucose levels and one-month incidence of hypoglycemia before and after the QCC activity.

Indicators	Before QCC (n=110)	After QCC (n=110)	P values
HbA1c (%)	6.36 ± 0.23	5.74 ± 0.60	<0.001
Fasting blood glucose levels (mmol/L)	10.39 ± 3.23	9.06 ± 3.11	0.001
One-month incidence of hypoglycemia (%)	33 (33.00)	19 (17.27)	0.039

After the QCC activity, self-growth ($P<0.0001$), personal ability ($P<0.0001$), team spirit ($P<0.0001$), communication and articulation skills ($P<0.0001$) and the use QCC ($P<0.0001$), were significantly improved in QCC members (table 4).

Table 4: Scores the intangible results in QCC members (nurses) before and after the end of QCC activity.

Intangible results	Before QCC (n=9)	After QCC (n=9)	P values
Self-growth	2.44±0.78	4.23±0.86	<0.0001
Engagement	1.29±0.38	3.29±0.42	<0.0001
Personal ability	2.59±0.42	4.04±0.56	<0.0001
Team spirit	2.22±0.38	4.23±0.58	<0.0001
Communication and articulation skills	2.23±0.21	4.22±0.36	<0.0001
Use of QCC	1.15±0.28	3.98±0.74	<0.0001

DISCUSSION

The QCC was first introduced by Japanese doctor Kaoru Ishikawa. The QCC activities solve problems in accordance with scientific procedures and continue to improve the overall quality of management (Feng et al 2017; Chen et al 2016). This current study determined the effect of the QCC activity organised by a group of nurses on the SMBG in type 2 diabetic patients. The results revealed that QCC improved SMBG and blood glucose control in these patients.

The first finding in this study was that type 2 diabetic patients improved their SMBG after the completion of the QCC activity. A significantly higher proportion of patients perform SMBG and these patients demonstrated a significant increase in the frequencies of SMBG. On the other hand, using expired test strips, incorrect timing blood glucose monitoring, improper operation and no calibration of glucose meters, and incorrect recording of blood glucose occurred significantly less in these patients. We speculate that participation in QCC activity helped patients to change their traditional concept of treatment, realise the importance of SMBG, and enhance their awareness of self-monitoring. The patients were therefore more willing to fully mobilise and empower their self-discipline, and move from passively to actively accepting the treatment. Participation in QCC activity thus improves the SMBG in these patients. Similar to these findings, several previous studies have reported the beneficial effects of QCC on management in various fields in China (Chen et al 2016; Liu and Wang 2016; Zhang et al 2015; Wang et al 2013).

As a chronic systemic disease, blood glucose monitoring is particularly important for patients with type 2 diabetes. The American Diabetes Association recommends that SMBG is a must for diabetic patients prescribed drug treatment, and a powerful weapon in the control of ideal blood glucose levels (Chamberlain

et al 2016). Clinical application guide of blood glucose monitoring in China (Chinese Diabetes Society 2015) also recommends daily monitoring of blood glucose for diabetes patients. The data in this study provided strong evidence supporting the importance of regular and correct SMBG during the treatment of patients with type 2 diabetes. With the improvement in SMBG after participation in QCC activity, the patients demonstrated a significant decrease in the levels of glycosylated hemoglobin and fasting blood glucose. In addition, the one-month incidence of hypoglycemia was also significantly decreased in these patients. These results imply that SMBG assists to enhance the efficacy of blood glucose reducing treatments, stabilise blood glucose levels and effectively reduce complications of diabetes. Improvement in SMBG thereby has its potential to enhance the overall health of the patients.

This study demonstrated that intangible results of members (nurses) improved after participation in the QCC activity. During the QCC activity, members cooperated collectively, drew upon useful opinions and developed themes for the project. The factors causing no or irregular SMBG were identified and corresponding approaches were developed by members in this QCC activity. All members of QCC evaluated and confirmed the process to ultimately achieve the desired outcomes (Zhang et al 2015). Members in QCC automatically and spontaneously participated in the management of patients' SMBG. The QCC activity allowed members to alter working attitudes, become more active, inspire their team awareness, and fully mobilise their initiative. Indeed, self-growth, engagement, personal ability, team spirit, communication and articulating skills, and use of QCC were all significantly improved in members after their participation in the QCC.

The limitations of this study include a non-random study design without a control group. There is a possible selection bias in patients who participated in the QCC. It is noted among all insulin-treated type 2 diabetic patients who had regular monthly doctor's visits during the last two years, only nine patients were excluded from the study due to no interest in this activity ($n=6$) or non-compliance with the study ($n=3$). Another limitation is that other confounding information related to blood glucose control including drug treatment was not included. In addition, the intangible outcomes were not scored objectively. Though no control group was included, this study found the QCC activity lasting for six months improved SMBG and blood glucose control in type 2 patients within six months. Before the activity, a high proportion of these patients performed no or irregular SMBG for two years.

CONCLUSION

The QCC activity plays a positive role in the patient's SMBG. It improves the frequencies and corrects the improper way of monitoring, and consequently enhances the efficacy the treatment. It also improves team awareness and empowerment in health care teams. QCC is a worthwhile process that should be promoted in clinical work in the future.

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