



# The effect of web-based education programs on self-efficacy and self-care behavior in quality of life among diabetic type 2 patients in public hospital

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**Received:** 15-Apr-2022, Manuscript No. AERR-22-60961; **Editor assigned:** 18-Apr-2022, PreQC No. AERR-22-60961 (PQ); **Reviewed:** 02-May-2022, QC No AERR-22-60961; **Revised:** 09-May-2022, Manuscript No. AERR-22-60961 (R); **Published:** 19-May-2022, DOI: 10.51268/2736-1853.22.10.061.

## ABSTRACT

**Aim:** This study investigated the intentions, opportunities, and barriers to engaging in a meaningful internationalization of higher education in Malawi, once a global player, to reposition itself on the global stage.

**Objective:** This study aims to identify the effects of web-based educational programs on Diabetic Self-efficacy Management (DSEM), Diabetic Self-care Behavior Management (DSCM) in Quality of Life (QoL) among type 2 diabetes patients in public hospitals.

**Methods:** This study used a quantitative quasi-experimental design of pre-test and post-test. Diabetic-N-Care program was conducted at Orthopedic Clinic Hospital Sultana Nur Zahirah Kuala Terengganu for 34 days, where purposive sampling involved type 2 diabetic patients who were divided into intervention groups (IG) (n=60) and control group (CG) (n=60). Respondents are the same individual for each phase of measurement.

**Results:** Data analysis method the general linear model repeated measures ANOVA, Split-plot ANOVA (SPANOVA) and paired t-test was conducted on 120 patients to see the effect of using Diabetic-N-Care on IG. The results of Split-plot ANOVA analysis showed a significant overall effect of DSEM, DSCM and QoL (p=0.000) on IG. Meanwhile, paired t-test analysis there was a significant mean difference in DSEM, DSCM and QoL at pre-test and post-test (p=0.000) to IG compared to CG.

**Conclusion:** Web-based health education can have an impact on DSEM, DSCM in the QoL of type 2 diabetic patients where greater than before confidence, change the old behavior to new behavior to improve quality of life in the long term planning. Therefore, this study concludes that web-based methods such as Diabetic-N-Care need to be widely adapted in current health education methods.

**Keywords:** Web-based, Diabetic self-efficacy management, Diabetic self-care behavior management, Quality of life.

## INTRODUCTION

The phenomenon of diabetes mellitus is a global challenge today and has reached an alarming level. Several factors have triggered the development of 90% type 2 diabetes and caused metabolic disorders characterized by a variety of complications (Abdullah et al., 2018; Hameed et al., 2015). Based on statistics from The Second National Health and Morbidity Survey, shows that more than 3.4 million Malaysians were diagnosed with diabetes in 2010, which is about 11.8% of the total population in Malaysia, and a dramatic increase of 4.5 million in 2020 (Humaira, 2018). The study from Abdullah et al (2018) and Zanariah et al (2015) believes that apart from the existing factors, cultural practice factors influence this epidemic because of Malaysia's multi-racial harmony and harmony in terms of customs and culture itself, in addition to the influence of family genetics (Abdullah et al., 2018; Hussein et al., 2015). Cultural food practices that are still practiced, the influence of western food, and food modifications to look more appetizing make an increase in diabetic statistics compared to treatment interventions.

Self-efficacy is considered the most important and key predictor of self-care behavior among type 2 diabetic patients (Lee et al., 2020; Dehghan et al., 2017; Sarkar et al., 2006). The concept of Quality of Life (QoL) related to improved health is increasingly recognized as an important outcome of rehabilitation programs and also as an indicator of how diabetic patients can adapt after a treatment or after discharge from the hospital (Dhatariya et al., 2020). Technology has proven to be a support tool as a medium to conduct key interventions to provide advantages to improve patient health levels and adherence to health-related information communicated by the health profession (Zuhaida et al., 2021; Rasoul et al., 2019; Muegge et al., 2016). 21st century patients and healthcare professions need new tools to manage the growing burden of chronic disease (Muegge et al., 2016).

Self-efficacy is able to influence attitudes towards self-care behavior for diabetics but how to convey this concept is still disrupted and need transformation in intervention (Karimy et al., 2018). Meanwhile, education intervention for diabetic patients is inconsistent in controlling glucose levels effectively (Jiang et al., 2019). If seen, health education has traditionally had certain limitations and has caused disconnection between health education and patients. Nevertheless, the absence of long-distance health education guidelines for the treatment of post-discharge disconnection

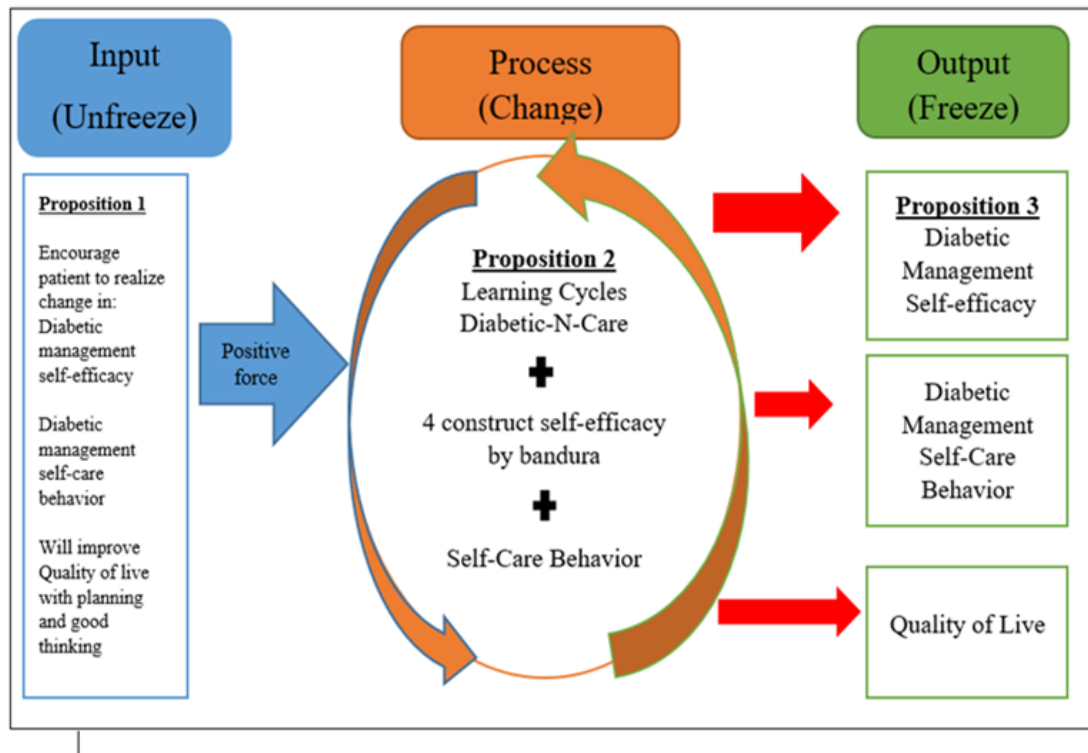
contributes to a poor prognosis. The previous concept of transformation is not enough in health education where there is an increase in the rate of diabetic patients with severe complications. This situation clearly occurs during a natural disaster or COVID-19 pandemic that causes major changes in diabetic life and management. Diabetic patients tend to have various levels of negative emotions, such as depression and anxiety and the effects of this pandemic make them burdened where they have to do diabetic self-management and standard practice of precaution COVID-19 (Banerjee et al., 2020). This situation will affect the effort, suppression, emotion, venting, and wishful thinking in them when in the midst of the COVID-19 pandemic.

This can be clearly seen when clinics are closed for patient rehabilitation, patients are transferred and wards are made COVID-19 patients, and patients start returning home at their own risk for fear of COVID-19 spread in hospitals when treatment is still needed. This condition will worsen in just 7 days if there is no appropriate intervention to help these diabetic patients (Wargny et al., 2021). What can be seen, the traditional educational interventions performed are not sufficient to obtain the desired results because there are no reforms in educational programs such as using theory (Jiang et al., 2019). Diabetic web-based education intervention is a way of self-management that is encouraged in the individual and in turn improves the level of quality of life for a long period of time. The web-based educational intervention program is an innovation and addressing educational problems face-to-face.

This article will briefly highlight some of the key developments in the field of diabetic health education, and how this technology can be integrated into this practice.

## MATERIALS AND METHODS

Quantitative quasi-experimental method approach (pre-test and post-test) repeated-measures design with intervention and control group. Pre-tests for this study were used to determine whether there were similarities between groups and as a statistical control. Meanwhile, post-test to determine the difference between the intervention group and control group. Both groups received routine diabetes treatment and the intervention group was given health education interventions based on Lewin's (1947) model of change theory and self-efficacy theory by Bandura (1977) applied in web technology-based diabetes education program interventions (Figure 1).



**Figure 1.** Conceptual framework: Diabetic Web-Based Education Programs on Self-Efficacy and Self-Care Behavior in Quality of Life among Diabetic Type 2 Patients, adapted from Nguyen, Jiang & Poo (2015).

### Population and sampling

The majority of patients were Malay, non-probability purposive sampling techniques were used based on sample size using Raosoft's online sample calculator (Raosoft Incorporation, 2004). The population size that has been identified is 168 and the recommended sample size is 118 respondents. The sample size for this measure was rounded to 120 respondents for division into intervention (n=60) and control groups (n=60) in this study.

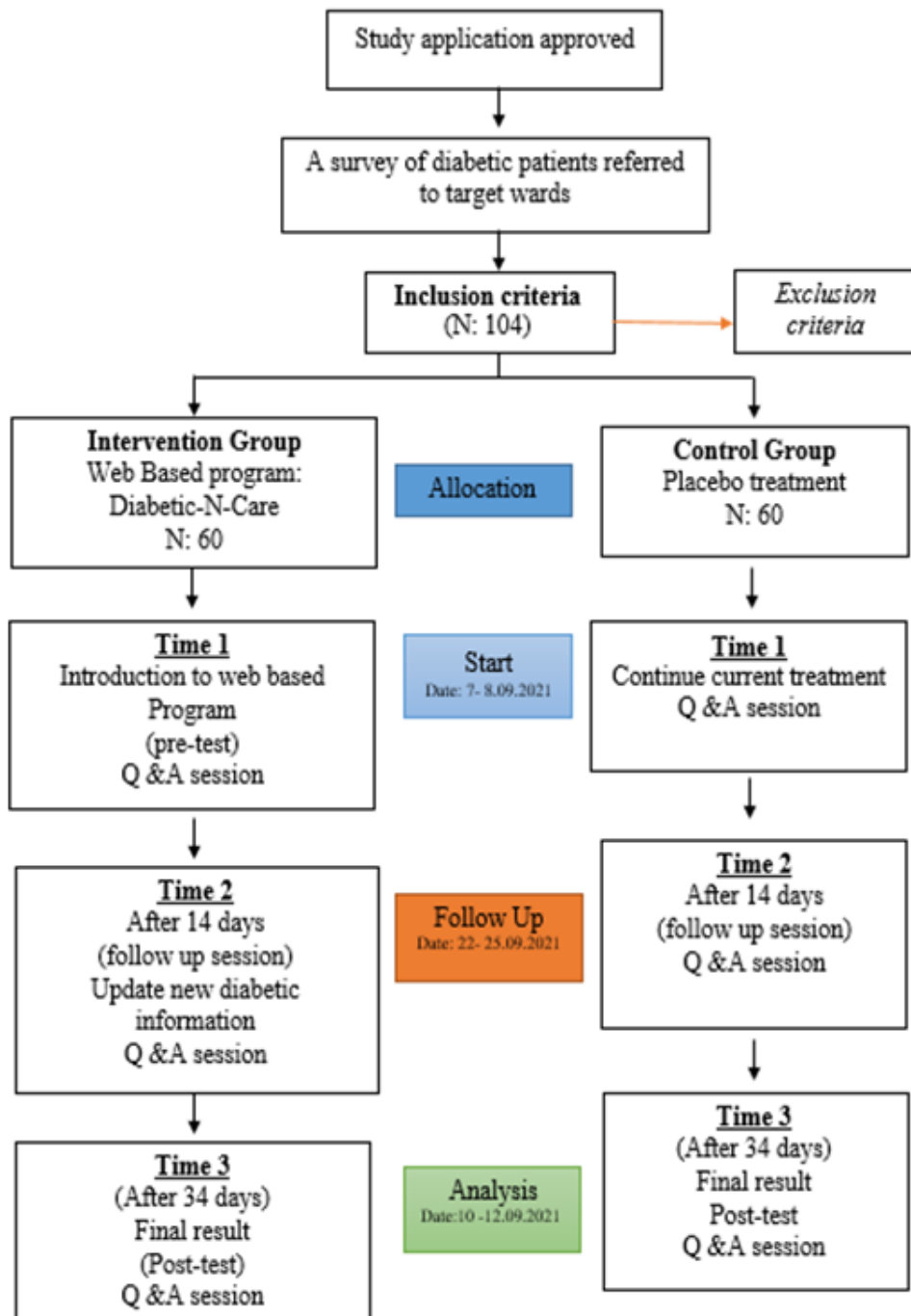
### Research instruments

This instrument was developed by the researcher based on previous studies (Sangruangake et al., 2017; Tharek et al., 2018; John et al., 2019). The questionnaire was translated into Bahasa Melayu, through the back-to-back translation technique. The majority of questionnaires use the Likert Scale 1 to 5 (DSEM; Unsure to Extremely Confident; DSCM; Very Poor to Very Good; QoL; Strongly Disagree to Strongly Agree). The results showed for DSEM Cronbach's value  $\alpha$  0.83, DSCM Cronbach's value  $\alpha$  0.93 and QoL Cronbach's value  $\alpha$  0.93. The next process is face validity for relevance issues, comprehensiveness, and clarity, where the researcher has determined 5 professional experts for the review of this study instrument which consists of a research supervisor, orthopedic specialist doctors, head nurse, and two nurses with diabetic post-basic course

(Lam et al., 2018; Bonett et al., 2015).

### Research procedure

This study is divided into three phases to identify the effect of the use of diabetic education through web-based among respondents. Diabetic-N-Care is a research tool used in educating patients related to diabetic knowledge through web-based. Diabetic-N-Care was formed through the use of Google Sites. The three phases in this research were adapted from the three phases of Kurt Lewin's theory in addition to using the principles of Bandura's Social Cognitive Theory. Time 1 as a pre-test, Time 2 follow up session after 14 days of the program, and Time 3 final result as a post-test after 34 days of the program (Figure 2). For the selection of inclusion criteria, respondents aged between 20 to 59 years who were diagnosed with type 2 diabetes and no vision and hearing problems. For the exclusion criteria of respondents with a chronic diagnosis and unable to implement the program (e.g. multiple chronic diagnoses e.g. spine and cancer) and type 1 diabetes and pregnant women. While the withdrawal criteria were that respondents could choose to withdraw at any time, the investigator considered it detrimental or risky for the subject to continue, and those who withdrew from the study before entering the follow-up phase would be replaced immediately and through the same process.



**Figure 2.** The study workflow.

## Data collection process

### Step 1: Implement of material program

After the patient is examined by the doctor, the patient from the intervention group will answer the questionnaire first as a pre-test. After that the researcher will explain the intervention process to the patient. Both groups will respond to the same questionnaire and routine interventions, example: Assessment, health education and treatment by orthopedic doctor and clinic nurses.

### Step 2: Education program

The way to access this web is to simply scan the bar code provided as a button badge and patients can see the information related to diabetics provided at any time for reference (Figure 3). After a 2 week of intervention program, the intervention group will receive the latest information *via* the web related to daily diabetic management. The latest information is based on the lowest scores related to the daily management of diabetics, to increase patient understanding and confidence. Furthermore, IG will also receive orders *via* what's App application to log-in and read new information updated by researchers.



**Figure 3.** QR code for web-based education program.

### Step 3: Evaluation program

After 34 days of the intervention program, this phase is a post-test to evaluate the effect of this program. The researcher was meeting the patient during an appointment date with the specialist to assess the patient's condition. Patients from the intervention group and the control group were asked to re-answer the same questionnaire. At the final stage of the program, program interventions will be performed on both groups.

### Statistical test

After completing the questionnaire by the respondents according to the study phase, the data was then entered into the SPSS-version 25 software. The results were reported in statistical analysis formats such as descriptive statistics (frequency, mean and standard deviation) and inferential statistic. The General Linear Model Repeated Measures ANOVA, Split-plot ANOVA (SPANOVA) and Paired t-test were performed to see the effects and differences to make comparisons between two types of independent variables, one variable consisting

of repeated data and interventions on each dependent variable separately in this study. On the other hand, Box's M and Levene's test were  $p < 0.05$  and the Kolmogorov-Smirnov test performed showed values from all variables  $p = 0.200$ , this indicates that the SPANOVA test variance value equality condition has complied. The results of the study indicate that the Kolmogorov-Smirnov test is the best normality test because of its goodness of fit in measuring the fit between the distributions of a series of samples with a specific frequency distribution. The data distribution is positively skewness (Skewness=0.43, Kurtosis=1.92). Data analysis was performed for each phase of the study to see the requirements and weaknesses of respondents through new information to be uploaded in Diabetic-N-Care.

## RESULTS

### Profile of the sample

The overall demographic data and relates to the clinical characteristics information of respondents for this study (Table 1 and Table 2).

**Table 1.** Exploratory analysis data for demographic information of respondents.

Variables	Category	Diabetic-N-Care Intervention Group (n:60)	N Missing	Mean S.D	Control Group (n: 60)	N Missing	Mean S.D
Age (years)	20-25	0 (0%)	0	5.883	0 (0%)	0	6.317
	30-35	8 (13.3%)			3 (5.0%)		
	36-39	9 (15.0%)			7 (11.7%)		
	40-45	11 (18.3%)		12 (20.0%)			
	46-49	6 (10.0%)		5 (8.3%)			
	50-55	6 (10.0%)		12 (20.0%)			
	56-59	20 (33.3%)		21 (35.0%)	1.8603		

Gender	Male	37 (61.7%)	0	1.383	30 (50%)	0	1.5
	Female	23 (38.3%)		0.4903	30 (50%)		0.502
Ethnic	Malay	58 (96.0%)	0	1.05	57 (95%)	0	1.05
	Chinese	3(5.0%)			3 (5.0%)		
	India	0 (0%)		0.2198	0 (0%)		0.2198
	Other	0 (0%)			0 (0%)		
Education level	Primary	22 (36.7%)	0	1.75	29 (48.3%)	0	1.617
	Secondary	31 (51.7%)		0.6542	25 (41.7%)		0.6662
	Tertiary	7 (11.7%)		-	6 (10.0%)		
Occupation status	Employed	31 (51.7%)	0	1.483	15 (25.0%)	0	1.75
	Unemployed	29 (48.3)		0.5039	45 (75.0%)		0.4367
Marital status	Single	1 (1.7%)	0	2.05	1 (1.7%)	0	2.033
	Married	57 (95.0%)			57 (95.0%)		
	Widower	2 (3.3%)		0.3873	1 (1.7%)		0.3171
	Widow	0 (0%)			1 (1.7%)		
Total Sample N: 120							

**Table 2.** Clinical Characteristics information of Respondents (n:120).

Variables	Category	Frequency (f)	Percent (%)
Duration of diabetic (years)	0-4	24	20
	9-May	41	34.2
	14-Oct	40	33.3
	15+	15	12.5
	Total	120	100
Co-morbidities	Hypertension	52	43.3
	Hart problem	23	19.2
	Renal problem	8	6.7
	Stroke	3	2.5
Diabetic treatment management	Diet control	30	25
	Oral medication	52	43.3
	Injection insulin	55	45.8
	Other: Traditional	3	2.5
Smoking status (Male only)	Smoking	28	41.7
	Never	35	52.2
	Ex-smoker	4	5.9
	Total	67	100
Received diabetic education before	Yes	65	54.2
	No	55	45.8
	Total	120	100

The effect of web-based education programs on self-efficacy and self-care behavior in quality of life among diabetic type 2 patients.

As can be seen in Table 3, shows the data value for descriptive analysis between the intervention and control groups on dependent variables (DSEM, DSCM, and QoL) according to three phases, namely pre-test, follow-up, and post-test for 34 days of this study. Where the data value for each variable showed an increase in the mean value for the pre-test intervention

group ( $44.85 \pm 9.92$ ) to post-test ( $64.13 \pm 3.65$ ) for DSEM, DSCM showed pre-test ( $30.6 \pm 6.47$ ) to post-test ( $39.75 \pm 3.43$ ), and QoL showed pre-test ( $56.91 \pm 7.76$ ) to post-test ( $62.30 \pm 2.95$ ). While the mean value for the control group showed recorded data and almost no change. Comparisons between the intervention and control groups using the Paired t-test showed statistically significant differences in the mean scores of each variable for each phase of the study (Table 4).

**Table 3.** Analysis descriptive statistics (n=120).

Variables	Group	Mean / Std. deviation			N
		Pre test	Follow-up	Post test	
Self-Efficacy	Intervention	44.85	50.4	64.13	60
		9.92	7.46	3.65	
	Control	51.18	50.85	50.31	60
		4.33	5.08	5.05	
	Total	48.01	50.62	57.22	120
		8.26	6.36	8.2	
Self-Care Behaviour	Intervention	30.6	36.31	39.75	60
		6.47	4.02	3.43	
	Control	26.95	28.88	28.23	60
		2.91	2.7	2.72	
	Total	28.77	32.6	33.99	120
		5.32	5.05	6.55	
Quality of Life	Intervention	56.91	60.53	62.3	60
		7.76	4.51	2.95	
	Control	55.11	56.11	55.8	60
		3.21	3.09	3.55	
	Total	56.01	58.32	59.05	120
		5.98	4.44	4.61	

**Table 4.** Paired t-test analysis between intervention group and control group (n=120).

Variable	Intervention Group (IG) (n=60)				Control Group (CG) (n=60)			
	The mean total M±SD		Diff. (Pre-Post) M±SD	Paired t test, p	The mean total M±SD		Diff. (Pre-Post) M±SD	Paired t test, p
	Pre – test	Post – test			Pre – test	Post – test		
DSEM	44.8	64.1 (3.65)	-19.2	0	51.7 (5.19)	50.3	1.4	0.079
	-9.92		-8.45			-5.05	-6.07	
DSCM	30.6	39.7	-9.15	0	26.9	28.23	-1.28	0.001
	-6.47	-3.43	-4.7			-2.91	-2.72	
QoL	56.3	62.3	-5.38	0	55.1	55.8	-0.68	0.134
	-7.76	-2.95	-6.06			-3.21	-3.55	

Objective and research questions were answered using inferential statistics the general linear model repeated measures ANOVA, Split-plot ANOVA (SPANOVA) to examine significant differences in mean scores of dependent variables (DSEM, DSCM, and QoL) among type 2

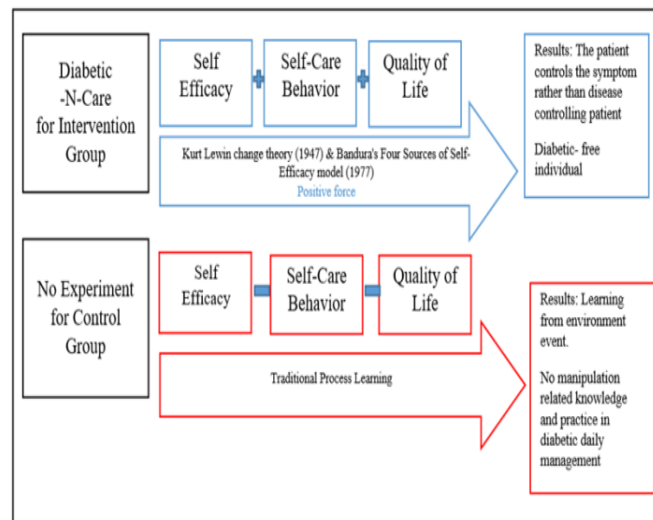
diabetic patients between group's intervention and control. Presents the SPANOVA results that include Within-subject and Between-subject effects intervention and control groups (Table 5).

**Table 5.** The Generalized Linear Model, Split-Plot ANOVA for The Effect of Web-Based Education Programs on Self-Efficacy and Self-Care behavior in Quality of Life Among Diabetic Type 2 Patients.

Variable		Sum of squares	df	Mean square	f	Sig.
DSEM	Within-subject					
	DSEM	5406.272	1.612	3353.954	167.176	0
	DSEM * group	6441.739	1.612	3996.339	199.195	0
	Error(DSEM)	3815.989	190.205	20.062	-	-
	Between-subject					
	Group	494.678	1	494.678	5.715	0.018
	Error	10214.611	118	86.565		
DSCM	Within-subject					
	DSCM	1751.239	1.543	1135.241	181.793	0
	DSCM * group	928.717	1.543	602.041	96.408	0
	Error(DSCM)	1136.711	182.029	6.245		
	Between-subject					
	Group	5107.6	1	5107.6	138.243	0
	Error	4359.689	118	36.947		



QoL	Within-subject					
	QoL	602.206	1.372	439.019	41.146	0
	QoL * group	332.772	1.372	242.597	22.737	0
	Error(QoL)	1727.022	161.862	10.67		
	Between-subject					
	Group	1617.136	1	1617.136	34.878	0
	Error	5471.061	118	46.365		



**Figure 4.** Overview of Diabetic-N-Care intervention for DM Type 2 patients.

Overall the results through inferential analysis showed significant differences, and alternative hypotheses were accepted. Where researchers have confirmed there are significant differences in web-based educational programs on self-efficacy and self-care behaviors in improving quality of life among type 2 diabetes patients in this study. Figure 4 shows as an in one piece how the process of this study has been carried out and has shown the level of health that can be improved.

## DISCUSSION

This study is an intervention in conveying diabetic daily treatment modification information and also as a moderator to confidence for action during limited movement of patients to seek counseling such as the last COVID-19 pandemic situation. This situation is necessary in identifying and revealing that the danger is if the patient only has the knowledge but not the element of confidence in performing management actions. The situation and variety of diabetic complications cause patients to become increasingly less confident and environmental situations to be less helpful. The results of this study are reinforced by the use of

two theories, Kurt Lewin change theory (1947) and Bandura's Four Sources of Self-Efficacy model (1977) are elements of knowledge transfer and change to diabetic type 2 patients by able to influence the choice, and related behavior change to perform and reduce stress levels and lower risk of depression than those with low self -efficacy (Hood et al., 2015).

The findings of this study have reported that web-based interventions through Diabetic-N-Care are significantly effective on DSEM, DSCM and QoL changes among type 2 diabetic patients. The key in management is enhanced confidence and this confidence needs to be applied in management correct diabetics from interventions from professionals (Abedini et al., 2020; Hurst et al., 2020). DSEM is an indicator of a better quality of life (Rasoul et al., 2019). This study is a learning approach known as 'mobile alert' to DSCM from IG after DSEM is enhanced. The findings of this study are a clear source of data because of the data collection process, the findings of the measured analysis and the implementation of the program for 34 days during the MCO, where the face-to-face paralysis of the health education system is widespread. This is a picture of research in real

situations is a reality data. Based on Kurt Lewin change theory (1947) and Bandura's Four Sources of Self-efficacy model (1977), a presentation can be implemented effectively and comprehensively especially in providing new knowledge and practices such as food label reading, influence control, glucometer machine reading when exit and more effective medication management. This learning cycle has also had an impact on improving quality of life in accepting health levels and trying to change to a more comfortable and productive lifestyle. While the effect on QoL, self-efficacy interventions are able to influence behavior in improving quality of life through more effective chronic disease management in looking at health outcomes and making comparisons (Peters et al., 2019; Sinha et al., 2011).

However, researchers have detected some difficulties in changing the domain of physical activity and glucose management through glucose inspection before food intake and carrying a glucometer machine when going out is very low for DSCM. Once DSEM is enhanced, patients need to adapt to DSCM (Yee et al., 2018). This cycle is important because it affects 50% of diabetic complications from unbalanced practices (Karimy et al., 2018; Yee et al., 2018). The results of subscale analysis of the physical activity domain still require an increase in the diversity of interventions and unbalanced dietary pattern intake is still consistent with a significant increase in diabetic cases (Banerjee et al., 2020; Kuan et al., 2021). In addition, researchers have detected a financial factor concern in failure and continuing treatment and self-management among diabetic patients. This is in line with the findings of the studies of Raghavendran, Inbaraj & Norman (2020), Cefalu et al (2018) and Campbell et al (2017) where this issue is increasingly worrisome for each consecutive year (Raghavendran et al., 2020; Cefalu et al., 2018; Campbell et al., 2017).

### **Implication**

Through the development of industry 4.0 technology and widespread acceptance among the community has given a privilege in the development of health education strategies. This study has given a new breath in web-based health education among type 2 diabetic patients at HSNZ Kuala Terengganu (dan Analisis, 2018). The disconnection and treatment process when the patient is discharged from the ward is a matter that needs to be taken into consideration because the period of follow-up treatment at the health clinic takes a long time. This web-based is a medium for patients to enhance and do reflection for each health education delivered in the ward when environmental factors and personal factors are not helpful.

Continuing health education can provide a positive impact and diversify intervention strategies from the health profession itself can form a more complete treatment cycle. Through web-based education, Diabetic-N-Care has given patients a privilege in browsing information resources related to daily diabetic management and facilitated health educators such as nurses who always think about what patients will do after discharge from the ward. This situation has provided a privilege and facility to reduce the burden from various parties.

### **Limitation of the Study**

This study was only conducted at the orthopedic clinic, HSNZ Kuala Terengganu which only involved one hospital and clinic. This is because the number of type 2 diabetic patients can be placed in any ward such as general surgical ward and diabetic resource center as outpatients. The limited population and sample during the data collection process of this study is the compliance with the SOP to COVID-19 at that time by the hospital and the head of department.

### **CONCLUSION**

For this quantitative quasi-experimental study, it has been proven that the web-based Diabetic-N-Care diabetic education intervention has an effect on the variables of this study namely DSEM, DCM and QoL for type 2 diabetic patients of 60 people for IG.

Throughout this study there were no side effects experienced by the patient such as malpractice or death. Statistically significant effects have shown better improvement when compared to traditional learning such as face to face, oral methods, and current experience. The results of this study have given a new breath to educational and learning interventions related to the management of daily diabetics and diabetic patients where greater than before, change the old behaviour to new behaviour to improve quality of life in the long term planning. Therefore, this study concludes that web-based methods such as Diabetic-N-Care need to be widely adapted in current health education methods.

### **RECOMMENDATION**

Findings from the study can be suggested by involving the psychological management of status among type 2 diabetic patients especially among newly diagnosed patients. Here what can be seen, newly diagnosed patients are somewhat marginalized perhaps because they have only one diagnosis or the progress of diagnosis treatment is still stable. Acceptance of disease diagnosis at a young age and career

can disrupt the level of psychology that disrupts individual function to the community.

## CONFLICT OF INTEREST

None.

## FUNDING

Self-funding

## ACKNOWLEDGMENT

The study was conducted according to guidelines and approved by the Medical Research Ethics Committee of the Ministry of Health Malaysia (MREC) (NMRR- NMRR-21-1446-59624/KKM/NIHSEC/P21-1403, approval date: 9 September 2021).

This study did not receive funding from any institutions.

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