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Jirakit Duangjuk

Usavadee Asdornwised

Kessiri Wongkongkam

Teerapong Tocharoenchok

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Original article

Effect of an information and communication technology program on the anxiety of coronary artery bypass graft patients' caregivers in intensive care unit

Jirakit Duangjuk[a], Usavadee Asdornwised[b,] *, Kessiri Wongkongkam[b], Teerapong Tocharoenchok[c]

[a]*Program in Nursing Science, Faculty of Nursing, Mahidol University, Bangkok, Thailand*
[b]*Faculty of Nursing, Mahidol University, Bangkok, Thailand*
[c]*Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

Background: The caregivers of coronary artery bypass graft (CABG) patients are typically very anxious while the patients are treated in the intensive care unit (ICU).
Objective: To study the effects of an information and communication technology program on the anxiety level of CABG patients'caregivers during patients' admission to the ICU.
Methods: This is a quasi-experimental research. The sample group is caregivers of CABG patients. Thirty-four caregivers in the control group that received only routine nursing care while 34 caregivers in the experimental group received the information and communication technology program and routine nursing care. Data were collected using the Thai hospital anxiety and depression scale (Thai HADS) and the visual analogue scale (VAS) for measuring anxiety level.
Results: The results showed that the mean anxiety scores measured by the VAS instrument on the day of surgery and the day of being discharged from the ICU were significantly lower in the experimental group than in the control group ($P = 0.01$, $P < 0.001$). Using the Thai HADs, the mean scores for anxiety in the experimental group were statistically lower than those for the control group only on the day of being discharged from the ICU ($P = 0.03$). In the experimental group that received the information and communication technology program, the mean scores for anxiety level were significantly lower on the day of surgery and on the day of being discharged from the ICU than the day before surgery ($P < 0.05$).
Conclusions: The information and communication technology programs should be recommended for nursing care in order to decrease the anxiety level of caregivers of CABG patients while the patients are being treated in the ICU.

Keywords: Anxiety, caregivers, information and communication technology program, intensive care unit.

Coronary artery bypass graft (CABG) is a treatment for coronary artery disease. Data from the Society of Thoracic Surgeons of Thailand show that there were 4,917 CABG patients in 2013, with an increase to 5,171 patients in 2017.[1] CABG is a highly complex surgical procedure due to the involvement of a cardiopulmonary bypass machine. Consequently, postoperative patients in the cardio-thoracic intensive care unit require close care and monitoring for complications. Because sometimes patients have to make treatment decisions while in the intensive care unit (ICU), thus the caregivers play an important role in making treatment decisions on their behalf.[2, 3]

According to a study conducted on the experiences of caregivers having a family member in an intensive care unit, caregivers have to take time off from their work and sometimes lose their income.[4] Studies [5 – 7] have reported that family caregivers experience stress (46.7%), [5] depression (57.3 - 59.0%)[5, 7], and anxiety (68.0 – 69.0%).[5, 8] In particular, if the patients are at high risk of dying, 80.0% of the family caregivers experience high level of anxiety.[9] Anxiety can make caregivers eat less, have poor sleep [4, 8] and experience sleep disturbances. [7, 10] According to previous research findings, 58.1% of caregivers report poor sleep quality

***Correspondence to: Usavadee Asdornwised,** Faculty of Nursing, Mahidol University, Bangkok 10700, Thailand.
E-mail: usavadee.asd@mahidol.edu
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caused by sleep disturbance, leading to moderate or severe insomnia.[10] The caregivers of CABG patients have reported that anxiety also has an influence on their learning and understanding of the discharge planning information for the patients.[11]

Many studies have been conducted on the variety programs on reducing anxiety in caregivers. These programs [12 – 16], such as pre-operative educational intervention programs,[12] nursing supportive programs [13], and nursing intervention programs, [14] have successfully reduced the level of anxiety in caregivers of cardiac surgery's patients. In Thailand, there have been a few studies on information programs [15, 16] with mothers of child patients receiving heart surgery. However, no studies have been conducted using information and communication technology programs for adults in reducing their anxiety in providing care for CABG patients during ICU treatment.

Therefore, the objective of this study was to investigate the effects of an information and communication technology program that integrates knowledge for CABG patients' caregivers based on the literature review, including technology uses such as multimedia (video media) and Line@ application uses in the process of supporting caregivers'needs and information.

Materials and methods

This quasi-experimental research has been approved by the Institutional Review Board (IRB), Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand (COA no. SI 073/2018). The subjects were males and females aged 18 years and older that had been identified by CABG patients as primary caregivers. The effect size of this study was based on a previous study.[17] This study used the effect size of 0.61, a power of test 0.80, and a significance level of 0.05. The sample size was calculated using the G*Power program. Finally, the sample size was 34 subjects for each group.

The inclusion criteria for the patients were an elective case for receiving CABG surgery or CABG with valvular heart surgery. Family caregivers were included in this study if they met the following inclusion criteria: 1) being a couple/spouse or direct relatives of CABG patients that were not paid for their care; 2) having no experience being admitted to an ICU, and never having had direct relatives admitted to an ICU; 3) being able to communicate in the Thai language and able to communicate via the Line@ application on a smart phone; 4) being able to visit the patient in the ICU at least one time; and, 5) having a score of 9 using the general practitioner assessment of cognition (GP-COG) for caregivers whose age is 60 or older. Family caregivers were excluded if they had psychiatric problems or were being treated with medications such as antidepressants and / or anxiety suppressants.

Instruments were used: The GP-COG [18] was used to screen the participants that were 60 years or older. Data Collection Instruments, the demographic data record form for the caregivers and the patient's demographic data. The measurement of anxiety for this study used the visual analogue scale (VAS)[19] and the Thai hospital anxiety and depression scale (Thai HADs).[20] The information and communication technology program. This program was developed by the researcher and team. The program includes multimedia presentations (video media) with contents including the ICU environment, ICU rules, CABG patient conditions after surgery, and medical equipment. Technology such as the Line@ application was used to communicate with the caregivers. The researcher would provide information and answer the caregivers' questions in person or via the Line@ application on a smartphone. The researcher acted as the coordinator among the multidisciplinary teams, such as the surgical team and the nursing care team, for the patients undergoing patient care. The researcher provided support and guidance for the caregivers beginning on the day before the surgery until the day of discharge from the ICU.

Data collection

The researcher first collected data from the control group because they were in the same study setting in order to prevent diffusion of treatment. Next, the information and communication technology program was implemented with the experimental group and with matched pairs with the control group that had the same gender, and age range. For the patients, pairs were matched based on the type of surgery, such as having CABG or CABG with valvular heart surgery.

The control group received routine nursing care. The caregivers would visit patients in the cardiothoracic ward and received information about the practices and rules in the ICU, the medical equipment and instruments provided for patients after surgery in the ICU, and the postoperative symptoms of the patients and treatment plans. In some cases,

caregivers would be provided information about patient discharge and the average time of care in the ICU and ward by the ICU nurses based on their knowledge and experience.

The experimental group received routine nursing care in addition to the information and communication technology program. The researcher acted as the coordinator among the medical, nursing, and multidisciplinary personnel in caring for patients as planned. The researcher also provided guidance to the caregivers, beginning at the preoperative stage until being discharged from the ICU. On the day before the surgery, the researcher instructed the caregivers by watching multimedia (video media) with them. The content included an introduction to the ICU unit and its environment and information about the patients' postoperative conditions and equipment uses. On the day of the surgery, the researcher visited the caregivers in the waiting room, and greeted and supported them. The researcher informed the caregivers when the patients came out of surgery and were admitted to the ICU via the Line@ application on a smartphone. The researcher would meet the caregiver and provide information about the postoperative condition and treatment plans for the patients. The researcher then gave the caregivers opportunities to ask questions. In addition, the researcher offered emotional support and let the caregivers visit the patients. From post-operation until being discharged from the ICU, the researcher would contact the caregivers every morning from 8:00 am to 9:00 am via the Line@ application on a smartphone. The information as needed by the caregivers, such as symptoms and treatment plans for the patient, would be provided. In addition, the researcher in the coordinator role also provided answers to any questions as needed.If the caregivers were not available to visit the patients, they could contact the researcher via the Line call function from 8:00 am to 8:00 pm. They could also make an appointment with the researcher if they needed any help. If a patient was transferred from the ICU to the cardiothoracic ward, the researcher would meet with the caregiver and provide information about updated treatment plans, the patient's condition, discharge planning from the ICU, and the duration of stay in the hospital.

Statistical analysis

The demographic data on the CABG patients and caregivers in both groups were analyzed using descriptive statistics and the differences in the demographic data for the CABG patients and caregivers were compared between the control and experimental groups using Fisher's exact test and Chi-square statistical test. Data were expressed as mean ± standard deviation (SD). The mean anxiety scores between the control group and the experimental group were compared using unpaired student *t* - test and Chi-square statistics. The paired *t* - test and Wilcoxon signed-rank test were used to examine the differences in the mean anxiety scores of the experimental group before and after participating in the information and communication technology program.

Results

Characteristics of the CABG patients and caregivers

According to the characteristics of the CABG patients, there were no significant differences between the control and experimental groups in terms of gender, age, *the New York heart association (NYHA) classification*, co-morbidities, type of surgery, post-surgery complications, or the length of stay (LOS) in the ICU.

The caregivers in the experimental and control groups also did not differ in terms of gender, age, relationship, education, or family monthly income (Table 1).

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Using the VAS, the mean scores for anxiety in the experimental group were significantly lower than those in the control group on the day of surgery and the day of being discharged from the ICU ($P = 0.01$; $P < 0.01$ respectively) (Table 2). In addition, the assessment using the Thai HADs instrument found that the mean score for anxiety in the experimental group was significantly lower than that for the control group only on the day of being discharged from the ICU ($P = 0.03$) (Table 3.)

In the experimental group, which participated in the information and communication technology program, the mean scores for the anxiety level measured using the VAS and Thai HADs were significantly lower on the day of surgery and the day of being discharged from the ICU than the day before surgery ($P < 0.05$) (Table 4, 5).

Table 1. Comparison of demographic data of the patients and caregivers in the experimental and control groups.

Characteristics	Control (n = 34) Number (%)	Experimental (n = 34) Number (%)	Total (n = 68) Number (%)	*P*-value
Patients				
Gender				0.60[a]
Male	25 (73.5)	23 (67.6)	48 (70.6)	
Female	9 (26.5)	11 (32.4)	20 (29.4)	
Age (years)				0.87[a]
45 – 59	9 (26.5)	8 (23.5)	17 (25.0)	
60 – 74	15 (44.1)	14 (41.2)	29 (42.6)	
≥ 75	10 (29.4)	12 (35.3)	22 (32.4)	
Mean ± SD (years)	67.9 ± 11.0	68.7 ± 11.0	68.1 ± 11.0	
Min - Max (years)	45 – 80	46 – 81	45 – 81	
NYHA classification				0.76[a]
Class I & II	28 (82.4)	27 (79.4)	55 (80.9)	
Class III & IV	6 (17.6)	7 (20.6)	13 (19.1)	
Comorbidity				1.00[b]
None	3 (8.8)	3 (8.8)	6 (8.8)	
HT	2 (5.9)	7 (20.6)	9 (13.2)	
DLP	1 (2.9)	1 (2.9)	2 (2.9)	
CKD	1 (2.9)	0 (0.0)	1 (1.5)	
Gout	1 (2.9)	0 (0.0)	1 (1.5)	
HT and DM	2 (5.9)	3 (8.8)	5 (7.4)	
HT and DLP	8 (23.5)	6 (17.6)	14 (20.6)	
HT and CKD	1 (2.9)	0 (0.0)	1 (1.5)	
DM and DLP	0 (0.0)	5 (2.5)	5 (7.4)	
HT, DM and CKD	4 (11.8)	1 (2.9)	5 (7.4)	
HT, DM and DLP	10 (29.4)	7 (20.6)	17 (25.0)	
HT, DM, DLP and CKD	1 (2.9)	1 (2.9)	2 (2.9)	
Type of surgery				0.23[a]
CABG	29 (85.3)	25 (73.5)	54 (79.4)	
CABG and valve surgery	5 (14.7)	9 (26.5)	14 20.6)	
LOS in ICU				0.29[a]
≤ 24 hours	22 (64.7)	26 (76.5)	48 (70.6)	
> 24 hours	12 (35.3)	8 (23.5)	20 (29.4)	
Post-surgery complications				0.43[a]
None	25 (73.5)	22 (64.7)	47 (69.1)	
Complications	9 (26.5)	12 (35.3)	21 (30.9)	
Arrhythmia	2 (5.9)	5 (14.7)	7 (10.3)	
Bleeding	2 (5.9)	2 (5.9)	4 (5.9)	
Lung complications	1 (2.9)	1 (2.9)	2 (2.9)	
Caregivers				
Gender				1.00[a]
Male	9 (26.5)	9 (26.5)	18 (26.5)	
Female	25 (73.5)	25 (73.5)	50 (73.5)	
Age (years)				0.94[a]
< 40	7 (20.6)	7 (20.6)	14 (20.6)	
40 – 49	12 (35.3)	13 (38.2)	25 (36.8)	
50 - 59	7 (20.6)	8 (23.5)	15 (22.1)	
≥ 60	8 (23.5)	6 (17.6)	14 (20.6)	
Mean ± SD (years)	49.4 ± 13.4	48.3 ± 11.4	48.8 ± 12.4	
Min - Max (years)	24 - 73	25 - 64		
Relationship				0.49[b]
Child	20 (58.8)	22 (64.7)	42 (61.8)	
Spouse	11 (32.4)	7 (20.6)	18 (26.5)	
Brother or sister	3 (8.8)	5 (14.7)	8 (11.8)	

Table 1. (Con) Comparison of demographic data of the patients and caregivers in the experimental and control groups.

Characteristics	Control (n = 34) Number (%)	Experimental (n = 34) Number (%)	Total (n = 68) Number (%)	*P*-value
Education				0.40[a]
Elementary school – high school	14 (41.2)	10 (29.4)	24 (35.3)	
High vocational certificate	8 (23.5)	5 (14.7)	13 (19.1)	
Bachelor's degree	8 (23.5)	13 (38.2)	21 (30.9)	
Master's degree and above	4 (11.8)	6 (17.6)	10 (14.7)	
Family monthly income (in Thai Baht)				
< 20,000	5 (14.7)	9 (26.5)	14 (20.6)	0.06[a]
20,000 - 39,999	9 (26.5)	3 (8.8)	12 (17.6)	
40,000 - 59,999	11 (32.4)	6 (17.6)	17 (25.0)	
≥ 60,000	9 (26.5)	16 (47.1)	25 (36.8)	

Note: HT = Hypertension, DM = Diabetic mellitus, DLP = Dyslipdemia, CKD = Chronic kidney disease. CABG = Coronary artery bypass graft
Lung complication = Pleural effusion, Lung atelectasis
Other = Arrhythmia and bleeding, Arrhythmia and lung complication, Bleeding and lung complication, Death
[a]Chi-square *P* - value, [b]Fisher's exact test *P* - value

Table 2. Comparison of anxiety scores between caregivers of the control and experimental groups using the VAS instrument.

Time	Control group (n = 34) Mean (SD)	Experimental group (n = 34) Mean (SD)	*P*- valve
On the day before surgery	49.2 (29.1)	42.7 (25.2)	0.33
On the day of surgery	52.9 (28.4)	35.2 (24.4)	0.01*
On the day of being discharged from ICU	33.8 (28.0)	16.4 (13.9)	0.00*

Note: *t* = Unpaired *t* - test, * = $P < 0.05$

Table 3. Comparison of anxiety scores between caregivers of the control and experimental groups using Thai HADs instrument.

Time	Control group (n = 34) n (%)	Experimental group (n = 34) n (%)	Statistic value	*P*- value
On the day before surgery			0.07[a]	0.96
0 - 7 scores	13 (38.2)	14 (41.2)		
8 - 10 scores	14 (41.2)	13 (38.2)		
11 - 21 scores	7 (20.6)	7 (20.6)		
Mean ± SD	8.9 ± 3.6	8.5 ± 2.8		
On the day of surgery			2.19[a]	0.33
0 - 7 scores	12 (35.3)	18 (52.9)		
8 - 10 scores	13 (38.2)	10 (29.4)		
11 - 21 scores	9 (26.5)	6 (17.6)		
Mean ± SD	9.0 ± 3.6	7.6 ± 2.5		
On the day of being discharged from ICU			6.14[b]	0.03*
0 - 7 scores	23 (67.6)	30 (90.9)		
8 - 10 scores	7 (20.6)	3 (9.1)		
11 - 21 scores	4 (11.8)	0 (0)		
Mean ± SD	7.1 ± 3.2	5.8 ± 1.7		

Note: [a]Chi-square *P* – value, [b]Fisher's exact test *P* - value, * = $P < 0.05$

Table 4. Comparison of anxiety scores for the caregivers of experimental group pre-post program using VAS instrument.

Time	Anxiety scores (n = 34)		
	Mean (SD)	*t*	*P*- valve
The day before surgery and the day of surgery	42.7 (25.2); 35.2 (24.4)	2.29	0.03*
The day before surgery and the day of being discharged from ICU	42.7 (25.2); 16.4 (13.9)	6.94	< 0.001*
The day of surgery and the day of being discharged from ICU	35.2 (24.4); 16.4 (13.9)	5.76	< 0.001*

Note: *t* = Pair *t* - test, * = $P < 0.05$

Table 5. Comparison of anxiety scores for caregivers of experimental group pre-post program using Thai HADs instrument.

Time	Anxiety scores (n = 34)		
	Mean (SD)	*Z*	*P*- value
The day before surgery and the day of surgery	8.5 (2.8); 7.6 (2.5)	-2.01	0.045*
The day before surgery and the day of being discharged from ICU	8.5 (2.8); 5.8 (1.7)	-4.34	< 0.001*
The day of surgery and the day of being discharged from ICU	7.6 (2.5); 5.8 (1.7)	-4.18	< 0.001*

Note: Z = Wilcoxon signed-rank test, * = $P < 0.05$

Discussion

The findings of the study support the hypothesis that the anxiety levels of the CABG patients' caregivers during the patients' admission to the ICU for the group participating in the information and communication technology program were lower than those for the group receiving only routine nursing care on the day of surgery and the day of being discharged from the ICU. After participating in the program, the caregivers of the experimental group had less anxiety levels than before participating in the program.

The caregivers had high levels of anxiety while the patients were admitted for ICU treatment.[3, 5, 6, 13, 21 – 23] The anxiety of the caregivers was related to the environment in the ICU and medical instruments, such as devices for monitoring the patients' vital signs and various alarms[3, 5, 11, 24] that they had not been effectively prepared for before and after the surgery[25], and the emotion and anxiety of the caregivers corresponded with the postoperative symptoms and conditions of the patients. In our study, the caregivers that participated in the information and communication technology program were prepared to release their anxiety. The program provided information via the multimedia (video media) that were needed by the CABG's caregivers, including the environment of the ICU, the rules and practices for visiting patients, and which also answered the caregivers'questions via the Line@ application on a smartphone. The result of this study are supported by the study of Saivaree J, *et al.*[15] Malivun A, *et al*.[17], and Srisupha-olarn I, *et al*.[26], who provided information about the ICU environment, ICU rules and symptoms, and treatment plans for the patients using face-to-face communication [15, 17, 26] and a handbook. [15, 26] The level of anxiety of the experimental group after participating in the program was significantly less than that of the control group. The suggestions of previous study [17, 26] suggested providing the information program using video media. This study also was supported by Hamester L. and Souza's study, [14] where audiovisual resources provided guidance to families before their first visit to the patients during the immediate post- operative period of cardiac surgery. The program was seen to decrease the levels of anxiety at a statistical significance, making the caregivers feel better prepared for the moment.

In addition, our intervention program, which provided information to caregivers during critical times, such as their families' admission to the ICU, is congruent with many research studies, such those of Simeone S, *et al*.,[12] Rezaei T, *et al.,*[13] and Chiang VC, *et al.*[27]

Furthermore, the study of Simeone S, *et al*., [12] focused on a pre-operative educational intervention to decrease anxiety among parents of children with congenital heart disease. They used the intervention of providing information and education and used a

simulation of a real case. The parents were involved in patient care, and those that participated in the program reduced their anxiety with statistical significance.

Additionally, a study of Rezaei T, *et al.,*[13] reported that a nursing supportive program for the family members of post-cardiac surgery patients helped the family members have less anxiety and stress levels than those of the control group. The nursing supportive program included providing information, emotional and mental support, and reassurances to the family members, which is similar to our study. While some of contents in their study, such as the patients' clinical status and the recovery process and care received, were provided by pamphlets, our study used multimedia presentations where the information was all displayed. In addition, the nursing supportive program emphasized listening attentively to the family concerning their fears and worries and supported them. Our program also supported the caregivers via face-to-face communication and communication via the Line@ application.

The study of Chiang VC, *et al.,*[27] also supported our study as it provided information and education for family caregivers via mobile tablet computers (tab) developed by the ICU team. The information and education included introductory information about ICU care and specific information by individual patients. The family members who participated in the program experienced a significant reduction in their level of anxiety. In our study, the intervention also included communication technology via a smartphone using the Line@ application. This technology is available to Thai people as 50.5% of Thai people have smartphones.[28] However, they usually do not use them for health care, especially with transitional care or care at home.

Furthermore, communication techniques are another factor that needs to be added to the program. In our study, the caregivers were able to release their anxiety by communicating with the researcher, for example by asking questions about the things that they were worried. The researcher also notified the caregivers and provided them information about the surgery, the patients' postoperative condition, and symptoms and treatment plans for the patient. The researcher also provided psychological support. Further, if the caregivers could not visit the patient, they would receive information about such things as the patients' postoperative condition and plans for treatment via the Line@ application. This was able to reduce their anxiety at a statistical significance in the experimental group. Some of the caregivers who participated in the experimental program stated that they felt confident visiting their families' caregivers while the patients were being admitted to the ICU. They indicated that they understood how the equipment helped the patients. In addition, communication via the Line@ application with the researcher, who coordinated with the multidisciplinary team, made the caregivers secure and less anxious during that critical time.

This study used both instruments, the VAS and Thai HADs, for measuring anxiety. The VAS is a self-report instrument that evaluates the extent to which respondents experience anxiety at that time. On the other hand, the Thai HADs [20] is a psychometric questionnaire that measures anxiety experienced by respondents during the previous time. Therefore, the participants may not be able to distinguish the level of anxiety if the times are very close, such as the day before the surgery and the day of the surgery, which is usually less than 12 hours. Using the Thai HADs then may not detect the differences in anxiety level.

The information and communication technology program may be limited in its use for some populations, such as high-income or high-technology users.

Conclusion

The results show that the information and communication technology program is effective in decreasing the anxiety level of caregivers during CABG patients' admission to the intensive care unit. Furthermore, the representative caregivers said that the line@ application was more comfortable to communicate between them and researcher during the experiment to reduce the anxiety and also increase their consolation. Healthcare teams should adapt and implement this program in order to decrease the anxiety level of caregivers of CABG patients that are being treated at critical times, for example when they are being admitted to the ICU.

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Conflicts of interest

The authors, hereby, declare no conflict of interest.

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