JCN Journal of Clinical Nursing

Journal of Clinical Nursing

CLINICAL ISSUES

A cost–effectiveness analysis of a multimedia learning education program for stoma patients

Shu-Fen Lo, Yun-Tung Wang, Li-Yue Wu, Mei-Yu Hsu, Shu-Chuan Chang and Mark Hayter

Study aims. The purpose of this study was to compare the costs and effectiveness of enterostomal education using a multimedia learning education program (MLEP) and a conventional education service program (CESP).

Background. Multimedia health education programs not only provide patients with useful information in the absence of health professionals, but can also augment information provided in traditional clinical practice. However, the literature on the cost–effectiveness of different approaches to stoma education is limited.

Design. This study used a randomised experimental design.

Methods. A total of 54 stoma patients were randomly assigned to MLEP or CESP nursing care with a follow-up of one week. Effectiveness measures were knowledge of self-care (KSC), attitude of self-care (ASC) and behavior of self-care (BSC). The costs measures for each patient were: health care costs, MLEP cost and family costs.

Results. Subjects in the MLEP group demonstrated significantly better outcomes in the effectiveness measures of KSC, ASC and BSC. Additionally, the total social costs for each MLEP patient and CESP patient were US$7396·90 and US$8570·54, respectively. The cost–effectiveness ratios in these two groups showed that the MLEP model was better than the CESP model after one intervention cycle. In addition, the Incremental Cost Effectiveness Ratio was −20·99.

Conclusion. This research provides useful information for those who would like to improve the self-care capacity of stoma patients. Due to the better cost–effectiveness ratio of MLEP, hospital policy-makers may consider these results when choosing to allocate resources and develop care and educational interventions.

Relevance to clinical practice. This study provides a cost effective way of addressing stoma care in the post-operative period that could be usefully transferred to stoma care settings internationally.

Key words: cost of care, experimental design, nurses, patient teaching, stoma care, Taiwan

Accepted for publication: 13 February 2009

Introduction

Surgical formation of a stoma is a significant clinical procedure in numerous ways with stoma patients facing emotional, physical and social challenges that can significantly affect their quality of life (QoL) (Wu *et al.* 2007). Nurses play a key role in educating and supporting patients at this difficult time – particularly in the post-operative period

Authors: *Shu-Fen Lo*, MSc, RN, Lecturer, Department of Nursing, Tzu Chi College of Technology and Doctoral Program Student, School and Graduate Institute of Nursing, National Taiwan University, Taipei, Taiwan; *Yun-Tung Wang*, PhD, MSW, Assistant Professor, Department of Social Work, National Taiwan University, Taipei, Taiwan; *Li-Yue Wu*, BSc, RN, Wound Ostomy and Incontinence Nurse, Department of Nursing, Buddhist Tzu Chi General Hospital, Hualien, Taiwan; *Mei-Yu Hsu*, BSc, RN, Wound Ostomy and Incontinence Nurse, Department of Nursing, Buddhist Tzu Chi General Hospital, and Graduate Student, Graduate Institute of Nursing, Tzu Chi University, Hualien, Taiwan; *Shu-Chuan Chang*, PhD, RN, Director, Department of Nursing, Buddhist Tzu Chi General Hospital, and Associate Professor, Department of Nursing, Tzu Chi University, Hualien, Taiwan; *Mark Hayter*, BA (Hons), MSc, PhD, RN, Cert Ed, Senior Lecturer in Nursing, Centre for Health and Social Care Studies and Service Development, School of Nursing and Midwifery, University of Sheffield, Sheffield, UK

Correspondence: Yun-Tung Wang, Assistant Professor, Department of Social Work, National Taiwan University, No.1, Sec. 4, Roosevelt Road, Taipei, Taiwan 106, ROC. Telephone: 011 886 2 3366 1258.
E-mail: ytwang@ntu.edu.tw

doi: 10.1111/j.1365-2702.2009.02931.x

(O'Connor 2005). However, in resource poor healthcare systems time spent with patients should be cost effective and use the most effective tools available. This paper presents the findings of a study analysing approaches to stoma education by comparing the costs and effectiveness of enterostomal education using a multimedia learning education program (MLEP) and a conventional education service program (CESP) for stoma patients in Taiwan. The paper also discusses the implications of the study for stoma care practice and policy.

Background

Impact of stoma

In Taiwan colon cancer is the third most prevalent form of cancer and surgical formation of stoma is a common treatment (Taiwan Department of Health 2007). The adverse impacts on stoma patients are physical, psychological and social. For example, Nugent *et al.* (1999) examined 391 patients with stoma whose physical problems included leakage, skin problems, ballooning and odor. Further work with stoma patients also reports emotional difficulties including depression and body image disturbance (Silva *et al.* 2003, Ross *et al.* 2007). Studies also demonstrate that social interactions are diminished due to lifestyle restrictions, such as decreased travel frequency and fear of social interaction caused by the stoma (Tseng *et al.* 2004, Ross *et al.* 2007). Surgical nurses play a crucial role for the stoma patients who suffer from a post-surgical change of body function, body image and social roles (Tseng *et al.* 2004, O'Connor 2005). The importance of professionally trained enterostomal therapists in the care of these patients is recognised across numerous health and social cultures (Nugent *et al.* 1999, Karadağ *et al.* 2005, NHS Scotland 2005). However, there are no comprehensive enterostomal training programs in Taiwan as yet – leading to a lack of specialist practitioners (Lin & Hsu 2006). Subsequently, high quality stoma patient care is not easily achieved in Taiwan. Moreover, the majority of general surgical unit staff is assigned 8–10 patients per day making it difficult for them to allocate sufficient time to educate and counsel stoma patients (Su 1993). As a result, care satisfaction of stoma patients has declined in Taiwan (Su 1993, Yang & Huang 2005).

Cost effectiveness of care

The goals of self-care interventions are to improve health, prevent illness, change behavior and to save the time of health providers (Wheeler *et al.* 2003, Richardson *et al.* 2005). As such here is increasing interest in chronic disease self care programs that improve health benefits whilst reducing health care cost (Wheeler *et al.* 2003). Cost–effectiveness analysis (CEA) is a method to examine both the cost and outcomes of nursing care programs to help decision making by administrators and clinicians as well as playing a role in the quality-of-care (Drummond *et al.* 2005). It is primarily used to allocate limited resources to achieve the greatest benefit. A nursing CEA should include six elements: (1) identifying direct costs, (2) estimating net effects in non-monetary terms, (3) using multiple indicators of effectiveness, (4) using cost to effect ratios to evaluate cost–effectiveness, (5) recommending adoption of the intervention with the lowest cost-to-effect ratio and (6) a statement of discount rate (Siegel *et al.* 1996, Allred *et al.* 1998, Drummond *et al.* 2005).

With the rising cost of health care, it is important for health care providers to consider different strategies in teaching patients self-care approaches – this can also act to empower patients and involve them in their own care (NHS Scotland 2005). The concept of self-care is seen as a sequence of developments wherein a patient learns to identify and understand basic health information and then is equipped with skills to apply this knowledge to improve their health (Nijboer *et al.* 2000). A study by Wu *et al.* (2007) found that specific educational interventions can enhance self-efficacy and quality of life in stoma patients. Furthermore, in a study using audiovisual education with 42 elective colorectal patients, Chaudhri *et al.* (2005) found that the study group significant demonstrated a faster time to stoma-care proficiency, had a reduced hospital stay and reduced care costs.

Health care professionals involved in multimedia education have to design innovative and high-quality multi-media learning education programs (MLEP) which are cost effective, easily modifiable and can adapt to changes in content material and computer technology (Caban *et al.* 2001). Dynamic and flexible education programs can help patients by increasing their knowledge of illnesses, treatment and awareness about self-care post-surgery (Issenberg *et al.* 2003). It is proposed that multimedia health education programs not only provide patients with useful information when health professional availability is limited, but also provide an improvement over the insufficient information currently provided in traditional clinical practice (Paperny & Hedberg 1999, Wofford *et al.* 2005). Studies have indicated that multimedia education can be beneficial in improving patient knowledge, changing patient behavior and improving satisfaction with clinical nursing care (Lo 2006, Lo *et al.* 2006). However, there is a lack of cost effectiveness analysis evidence for multi-media education in stoma care – providing the rational for this study.

Aims

The purpose of this study was to evaluate whether a multimedia learning education program (MLEP) was more or less cost–effective than conventional education service program (CESP) for stoma patients. In particular, the researchers hoped to establish the cost–effectiveness (C/E) ratios of MLEP and CESP. The researchers hypothesised that each patient receiving MLEP (experimental group) would experience less care costs, as well as have more knowledge, a more positive attitude and better self-care behavior than those receiving CESP (control group). Based on the cost effectiveness analysis model of Gramlich (1990), Boardman *et al.* (2005) and Drummond *et al.* (2005), Table 1 illustrates the conceptual analysis of the costs and effectiveness of the MLEP and CESP. In this model, 'participant' refers to a patient undergoing stoma surgery. 'non-participant' refers to persons other than the patient. 'Society' combines both the 'participant' and 'non-participants'. The costs for each patient can be divided into three parts: health care cost (including costs of time for education, enema training time cost, stoma bag costs, costs of changing dressing and medical costs), film making cost (including copying the CD-ROM, making the CD-ROM and equipment costs) and family burdens (including salary losses due to absence for work and travel expenses). The effectiveness measures used were knowledge of self-care scale (KSC), attitude of self-care scale (ASC) and behavior of self-care scale (BSC).

Methodology

This study was performed as a randomised experimental design. The stoma specialists randomly selected the subjects by medical record when they transferred to the surgical ward post-operatively between February–November 2006, then referred them to the researcher. The sample selection criteria included: (1) any stoma patient admitted to the surgical unit; (2) at least 18 years of age; and (3) able to speak and read Chinese. Participants were excluded from the study if they met the following criteria: (1) poor levels of consciousness; (2) with serious co-existing medical conditions, such as hemodialysis; (3) with other co-morbidity that may interfere with intervention – for instance clinical depression; and (4) with poor pain relief post operatively. Those who met the sample selection criteria (n = 54; 31 males and 23 females) were randomly assigned to the experimental (MLEP) or control group (CESP). There were 27 subjects in each group.

MLEP intervention

The development of the MLEP intervention was based on a literature review of prior research results (Lin & Hsu 2006, Lo *et al.* 2006). Firstly, a systematic MLEP was developed including stoma, anatomy, indications for stoma formation, stoma care and irrigation, using film and pictures. Subjects and their family members/carers were then introduced to the

Table 1 The conceptual analysis of cost and effectiveness analysis in MLEP and CESP with stoma patients

	MLEP group			CESP group		
Item/groups	Participant	Non-participant	Society	Participant	Non-participant	Society
Cost (monetary)						
Health care cost						
Education spending time fee	0	+	+	0	+	+
Enema training time fee	0	+	+	0	+	+
Stoma bag fee	+	+	+	+	+	+
Changing dressing fee	0	+	+	0	+	+
Medical fee	+	+	+	+	+	+
Filmmaking cost						
Copying CD-ROM fee	0	+	+	0	0	0
Making the CD-ROM fee	0	+	+	0	0	0
Equipment usage fee (e.g. computer)	0	+	+	0	0	0
Family burdens						
Families' salary loss due to absence for work	0	+/0	+/0	0	+/0	+/0
Traffic expenses	0	+/0	+/0	0	+/0	+/0
Effectiveness (non-monetary)						
KSC	+	0	+	+	0	+
ASC	+	0	+	+	0	+
BSC	+	0	+	+	0	+

Note: +, positive value; +/0, positive value/zero; 0, zero.

MLEP and provided with a brochure about stoma with colon cancer one day post-operatively. After the MLEP, the researcher answered any questions the subjects had when they had finished the MLEP. On average, each program session took 30–45 minutes. Each subject and their family members/carers in the control group received only the stoma care brochure-constituting standard care and a subsequent follow-up visit by the researcher to answer any questions. Figure 1 illustrates the flow of participants through the research period.

Data collection

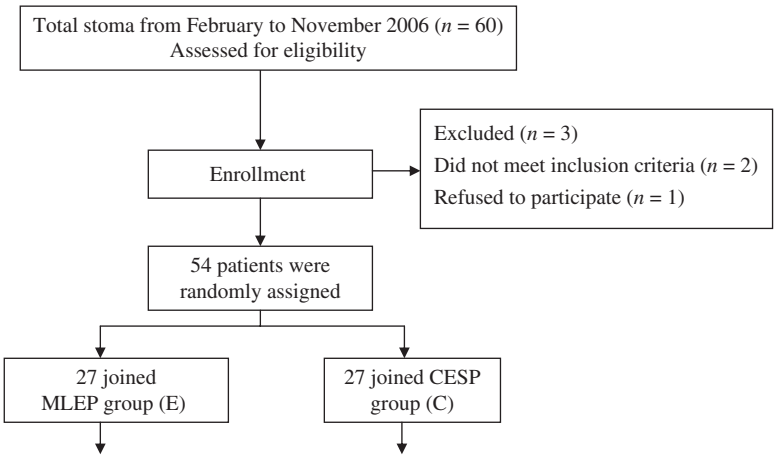
The study was conducted in a 1000-bed academically based medical center with a surgical ward for stoma patients in southeast Taiwan. The intervention program was held in a quiet, private room to maintain privacy. The data were collected using self-administered questionnaires completed by the subjects themselves. The MLEP cost was estimated using market prices and health care costs was collected from standard medical expenses in Taiwan. The researchers also estimated these costs by a survey at Hualien Tzu Chi Medical Center in Taiwan. The subjects of the experimental group received individual MLEP by one instructor. In the control group, subjects and their family members/carers were given the brochure to read. The instructor stayed in the room with the subject during the 20-minute intervention period taking notes or merely conversing with the subject or family members. Each group was followed up for one week. One week after the initial contact, the researcher reserved an appointment with the subjects to obtain the data to complete the final questionnaire. They all completed the questionnaire within 15–20 minutes.

Demographic data

Demographic data were collected from all subjects prior to the start of the study, including age, gender, marital status, level of education, living status, occupation and physical status.

Health care costs

External health care costs were not estimated or calculated due to the difficulty in doing this – only direct stoma health



Instruments	Group	Pre test D0	D3	D5	Post test D7
Demographics data	E	+			
	C	+			
Intervention	E	–	+	+	+
	C	–	–	–	–
CEA analysis	E	+	+	+	+
	C	+	+	+	+
KSC	E	+	+	+	+
	C	+	+	+	+
ASC	E	+	+	+	+
	C	+	+	+	+
BSC	E	+	+	+	+
	C	+	+	+	+

Note : D: day; + : Received intervention, measured/collected data
– : Did not receive intervention, measure/collect data

Figure 1 Flow of participants through the study.

care costs were calculated in this study (Gramlich 1990, Boardman *et al.* 2005, Drummond *et al.* 2005). First, the researchers calculated the individual's education spending cost of the MLEP or CESP per minute based on the specific grade of nurse performing the intervention, costs of enema training time in these two groups were recorded and calculated. Second, the total number of colostomy bags used after surgery from each patient's medical records was recorded. This information was collected to calculate the cost of colostomy bags used in learning stoma self-care. Third, dressing costs were calculated based on the usage of gauze and gloves. Finally, the average treatment costs from each subject's medical records including treatment fee, physical examination fee, laboratory examination fee, operation fee for the two groups in the intervention study period (excluding meals and residence costs) were recorded. Patients were weak immediately following their operation, therefore, their relatives were included in stoma education for both control and intervention groups. This also had the additional benefit of ensuring family members were aware of stoma care prior to the patients discharge. This element was included in the costing of the study as follows: patients' caregivers travel expenses going to and from the hospital and their salary losses due to their absences from work. The costs of primary care nurse were not included because they are not main educator in post surgery period. All costs where estimated according 2006 prices in New Taiwan Dollars (one US dollar in 2006 is about 32·53 NT dollars).

Multimedia learning education programme development costs

The total film making cost for the MLEP was determined from the cost of computer usage, copying CD-ROMs and the time involved editing the MLEP.

Effectiveness analysis

In this study, effectiveness included the measurement of stoma care knowledge, attitudes and behaviours with the KSC, ASC and BSC scales. These questionnaires were developed for the purpose of this study, with their structure and format being based on similar questionnaires used by Kao and Ku (1997) and Su *et al.* (2001). Cronbach's α was used to test the reliability of the instrument. To verify the validity of the questionnaire, six experts including two medical doctors, one professor in this field and three internationally certified enterostomal therapists were invited to examine and assess the suitability of the instrument. In addition, the scales were pilot tested with 10 stoma patients for face validity.

Knowledge of self care scale

The KSC scale was designed to measure patient knowledge of stoma self-care was developed in this study. It consisted of 22 items related to: anatomy of stoma, types of pouching systems and types of accessories and was rated on a dichotomised scale (1, right; 0, wrong). The KSC had a range of possible scores from 0–22. The Cronbach's α coefficient for KSC in this study was 0·75.

Attitude of self care scale

Participants were also asked to answer questions indicating their attitude toward stoma self-care. The ASC scale comprised of 11 items rated on a five-point scale (1, not at all; 2, a little bit; 3, somewhat; 4, quite a lot; 5, very much). The ASC had a range of possible scores from 11–55. A lower score meant a more serious attitude problem of the subject. A Cronbach's α coefficient of 0.77 was reported for ASC in this study.

Behaviour of self care scale

The BSC scale included 12 items measuring a subject's self-care behavior. Respondents answered each of the statements with a four-point Likert rating scale, ranging from 1–4 (1, not at all; 2, a little bit; 3, moderately; 4, extremely). The scores were from 12–48. A Cronbach's α coefficient of 0·70 was reported for BSC.

Data analysis

All data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 14.0 (SPSS Inc., Chicago, IL, USA) and an alpha of 0.05 was chosen for tests of statistical significance. Descriptive statistics for single variables included percentage, mean and standard deviation. Two-variable statistics included chi-square and independent sample *t*-test. Although the sample size in this study is small, it still satisfied the preconditions of the statistical analysis measures employed in the study.

Ethical considerations

Permission to conduct this study was obtained from the relevant Ethics Review Board, which is responsible for the protection of human subjects. Medical services for the patients were not influenced by whether they participated or not and participants were aware they could withdraw from the study at any point. Participants who agreed to take part were given an information sheet and if they were willing to participate, signed a consent form. Participants were then assigned into either the experimental or the control group. Anonymity was assured by assigning identification numbers to participants.

Results

Characteristics of the subjects

Figure 1 illustrates a 90·0% [= (54/60) × 100%] recruitment rate from the three post-surgical wards in the single hospital. Over an 11-month period, from February–November 2006, a total of 60 participants undergoing stoma surgery agreed to participate in the study. Out of 54 patients enrolled, 27 were randomised to the MLEP group and 27 to the CESP groups. Their ages ranged from 18–90 years and the mean was 60·44 years (SD 17·60). Fifty-two percent were married and 63% received elementary school or below education only. Fifty-seven percent were male and 80% were living with families. Seventy-two percent were not employed. The most common physical status was 'acceptable or good' (48·2%). There was no significant difference in demographic variables between MLEP and CESP groups. The preceding statistical information is shown in Table 2. Table 4 displays the costs of stoma education services for each person in these two groups. From these data, the cost per person for the MLEP was estimated at US$7396·90, while the cost per person for CESP was estimated at US$8570·54.

Cost of stoma health care

These 'health care' costs were then applied to a three times per week supervised stoma care program in the intervention period. The researchers estimated the cost of 'education time' per person based on the daily salary of a N4 level practitioner on Taiwanese nursing salary scales – the salary grade at which an enterostomal therapist would practice (US$46·11) divided by 480 [= 8 (working hours per day) × 60 (minutes per hour)] and multiplying the average education spending time in each group. The calculated costs of 'education time' per person in MLEP and CESP groups were US$7·14 and US$12·19, with the average education time in these two groups at 74·37 and 127·89 minutes, respectively. Similarly, the cost of 'enema training time' can be estimated as the average salary per minute of an N4 level enterostomal

Table 2 Demographic data of the subjects (N = 54)

	MLEP groups (n = 27)		CESP groups (n = 27)			
Variables	n%	M ± SD	n%	M ± SD	χ^2/t	p
Age		57·93 ± 17·53		62·96 ± 17·64	0·372	0·545
Sex						
Male	17	62·96	14	51·85	0·682	0·409
Female	10	37·04	13	48·15		
Marital status						
Single	9	33·33	7	25·93	4·421	0·110
Married	16	59·26	12	44·44		
Others	2	7·41	8	29·63		
Education						
None	10	37·04	11	40·74	5·250	0·121
Sixth grade or below	2	7·41	11	40·74		
Junior high school	6	22·22	4	14·81		
Senior high school	6	22·22	1	3·70		
College and above	3	11·11				
Living status						
Living with parents	2	7·41	3	11·11	9·599	0·087
Living with spouse	8	29·63	3	11·11		
Living with child	11	40·74	16	59·26		
Living with friends	4	14·81	0	0·00		
Living alone	2	7·41	5	18·52		
Occupation						
None	17	62·96	22	81·48	2·564	0·287
With jobs	1	3·70	1	3·70		
Retired	9	33·33	4	14·81		
Physical status						
Very poor	2	7·41	3	11·11	1·603	0·659
Unwell	11	40·74	12	44·44		
Acceptable	14	51·85	11	40·74		
Good	0	0·00	1	3·70		

therapist multiplied by the average enema training minutes. The estimates of the cost of 'enema training time' in MLEP and CESP groups were US$3·85 and US$21·71, with the average enema training minutes at 40·10 and 227·81, respectively. Because the salaries of N4 level enterostomal therapists were paid by the hospital (in the 'non-participant' side) instead of the patients ('participant' side), these two costs were only included in the 'non-participant' category.

The stoma bag, changing dressing and medical costs were calculated by examining the inpatient payment record, which includes individual payments and National Health Insurance (NHI) payments. The average stoma bag costs for each patient were US$7·12 (individual payment US$0·87 and NHI payment US$6·25) in MLEP and US$21·02 (individual payment US$3·13 and NHI payment US$17·89) in CESP, respectively. The average changing dressing costs for each patient (as reimbursed by NHI) were US$9·94 in MLEP and US$18·48 in CESP. The average medical costs per participant included the physician fee, treatment fee, surgical fee and physical examination fee were US$7300·13 (including individual payment US$540·00 and NHI payment US$6760·13) in MLEP and US$8384·02 (including individual payment US$465·52 and NHI payment US$7918·50) in CESP.

Cost of filmmaking in the MLEP

In this study, the lecturer used available PREMIERE 6.5 (Adobe Systems Inc., San Jose, CA, USA) non-line film editing software and spent 32 hours to make and edit the stoma film for MLEP use. Because the hourly salary of a lecturer was US$17·68, the total cost of filmmaking per patient was US$20·95 (= US$17·68 × 32 hours ÷ 27).

It is assumed that a notebook computer is readily available within most modern hospitals. Therefore, the equipment usage fee calculated in our study is based only on the actual time the computer was used. The time for use of a public notebook computer facility is established as being five years in Taiwan. The equipment (Acer Travel Mate Notebook) cost per minute was US$0·00224 [= US$1367·97 (original price) ÷ five years ÷ 255 days ÷ eight hours ÷ 60 minutes]. The standard used in Taiwan is 255 working days per year. The average time for learning stoma care using MLEP was 74·93 minutes per patient, making the MLEP computer cost per patient US$0·17 (= US$0·00224 × 74·93 minutes).

Cost of stoma patients' family burdens

The cost and effectiveness analysis model of this study was designed to investigate stoma patient's family burdens in the intervention period. These costs included: families' salary losses due to absence from work to learn stoma care and travel expenses in going from home to hospital. The average families' salary losses due to absence from work were US$34·61 in MLEP and US$88·12 in CESP, based on the results of a questionnaire. The average travel expenses were US$12·07 in MLEP and US$25·00 in CESP respectively.

Comparison of the effectiveness indicators between MLEP and CESP groups

As noted in Table 3, each of the effectiveness indicators showed significant differences between the MLEP and CESP groups. After being in the intervention for one week, subjects in the MLEP revealed significantly better outcomes in KSC (p = 0·001), ASC (p = 0·000) and BSC (p = 0·000) than those in CESP. The average raw scores for KSC, ASC and BSC are shown in Table 3. Then, according to single effectiveness score analysis for each patient, the researchers calculated the difference between the pretest and posttest values, converted these values into scores on a full range of 100 and summed to create the total effectiveness scores (Lin & Tsai 2002), as shown in Table 4. The average scores of effectiveness were 166·89 in MLEP and 110·98 in CESP. Therefore, the participants receiving MLEP showed better clinical outcomes than those in the CESP group.

Calculation of cost–effectiveness

Table 4 shows the Cost/Effectiveness ratio (C/E ratio) which was determined by dividing the average cost by the average effectiveness score of each participant and Incremental Cost Effectiveness Ratio (ICER) that was determined by dividing the difference of average cost between MLEP and CESP by the difference of average effectiveness score of each participant between MLEP and CESP. The C/E Ratio of the MLEP group in society perspective was 44·32, compared to 77·23 in the CESP group. In addition, the ICER in society perspective was −20·99. That is to say, the service of the MLEP group was both more effective and less costly. This results in a cost savings if MLEP is used in lieu of CESP.

Discussion

This study demonstrates that using MLEP to educate individuals with a newly formed stoma provides a cost saving over CESP when outcomes are assessed at one week, as in the model used in this study. Moreover, the patients in the MLEP group showed significantly greater improvement in

Table 3 Comparison of main outcome variables between MLEP and CESP groups* (unit: per person).

Variables	MLEP (n = 27)		CESP (n = 27)		t	p
	M	SD	M	SD		
Self-care knowledge (KSC)						
Pretest	7·30	3·97	5·04	3·56	2·20	0·321
Posttest	20·81	1·90	14·74	1·56	12·83	0·000
Posttest − pretest	13·52	4·07	9·70	3·51	3·69	0·001
Self-care attitude (ASC)						
Pretest	23·78	6·66	26·48	4·96	1·69	0·097
Posttest	50·81	3·10	41·04	2·55	12·65	0·000
Posttest − pretest	27·04	7·14	14·56	5·96	6·97	0·000
Self-care behavior (BSC)						
Pretest	20·22	3·73	21·19	4·76	0·83	0·412
Posttest	47·26	0·94	40·59	4·77	7·13	0·000
Posttest − pretest	27·04	4·02	19·41	7·18	4·82	0·000
Posttest − pretest (total)†	67·59	11·02	43·67	13·37	7·17	0·000

*The numbers shown are the averages of the raw scores.

†Posttest − pretest (total) = [posttest − pretest (KSC)] + [posttest − pretest (ASC)] + [posttest − pretest (BSC)].

Note: The outcome means the difference between posttest and pretest values. The maximum scores of the KSC, ASC, BSC scales are 22, 55 and 48, respectively. The raw scores were multiplied by 100/22, 100/55 and 100/48, respectively, to convert them into new scores in a full range of 100. For example, the pretest and posttest mean scores in KSC are 7·30 and 20·81.

KSC, ASC and BSC than those in CESP. Thus, the effectiveness of MLEP over the CESP has been demonstrated by this study. Furthermore, postoperative patients receiving stoma MLEP experienced significantly better cost-savings during the first week than those receiving CESP management. The average cost per patient per week for CESP group in this study (US$8570·54) was more than the cost identified in MLEP (US$7396·90) findings is supported by Chaudhri *et al.* (2005) and Richardson *et al.* (2005) who carried out a systematic review 39 economic evaluations of self-care interventions were cost-effective and cost saving. On the whole, the stoma patient paid less and had faster rehabilitation, experiencing less emotional and psychological (and sometimes physical) trauma, in the MLEP model.

Recent advances in technologies have brought new possibilities in health care provision. Multimedia learning has become an increasingly valuable information resource for patients in different medical settings, particularly for improving patient self-efficacy (Jerant *et al.* 2007). However, little information exists on the acceptable cost of making and providing illness-related multimedia. Based on the results of this study, the researchers recommend the adoption of MLEP by public hospitals because of its potential cost savings and its effectiveness in patient care. However, it is also important health providers must be appropriately trained and adept in multimedia techniques such as 2D, film editing and rearrangement software.

An additional issue to consider is the immediate postoperative period and its effect upon learning potential. O'Connor (2005) points out that fear, anxiety, pain and fatigue will significantly impact a patient's motivation and ability to learn stoma care in the early post-operative phase. For stoma patients in Taiwan, the family members play a crucial role for the stoma patients in this phase. No previous studies were found offering a head-to-head comparison of the cost of family burden. However, previous studies did demonstrate that the stoma patient's caregivers can suffer from high levels of anxiety and depression (Cotrim 2008). Chen *et al.* (2004) reported that the social and functional aspects of patients' quality of life (QoL) play important role in caregivers' QoL. In this study, the family burden in MLEP was less costly than that in CESP. One possible explanation for this difference is that stoma patients and caregivers are able to learn the knowledge and skills of stoma care together through multimedia education and can conveniently review them as necessary. Likewise, there may be a greater learning effect using MLEP compared to CESP. Further studies may be necessary to offer comparisons to the results of this study and explore other reasons for the notable cost–effectiveness of MLEP over CESP.

In terms of emotional health there is evidence that there is a significant relationship between lack of understanding of stoma information and depression (Pringle & Swan's 2001) and that improving stoma knowledge, therefore, can improve

Table 4 Cost and effectiveness analysis in MLEP and CESP with stoma patients after one intervention cycle (unit: per person)

	MLEP group (n = 27)				CESP group (n = 27)			
		Non-participant				Non-participant		
Item/groups	Participant (service user)	(Health care provider and NHI)	(Caregiver)	Society	Participant (service user)	(Health care provider and NHI)	(Caregiver)	Society
Cost (Monetary) (in US$)								
Health care cost								
Education spending time fee	0·00	7·14	0·00	7·14	0·00	12·19	0·00	12·19
Enema training time fee	0·00	3·85	0·00	3·85	0·00	21·71	0·00	21·71
Stoma bag fee	0·87	6·25	0·00	7·12	3·13	17·89	0·00	21·02
Changing dressing fee	0·00	9·94	0·00	9·94	0·00	18·48	0·00	18·48
Medical fee	540·00	6760·13	0·00	7300·13	465·52	7918·50	0·00	8384·02
Filmmaking cost								
Copying CD-ROM fee	0·00	0·92	0·00	0·92	0·00	0·00	0·00	0·00
Making CD-ROM fee	0·00	20·95	0·00	20·95	0·00	0·00	0·00	0·00
Equipment usage fee	0·00	0·17	0·00	0·17	0·00	0·00	0·00	0·00
Family burdens								
Families' salary loss due to absence for work	0·00	0·00	34·61	34·61	0·00	0·00	88·12	88·12
Travel expenses	0·00	0·00	12·07	12·07	0·00	0·00	25·00	25·00
Total cost	540·87	6809·35 (6856·03)	46·68	7396·90	468·65 (8101·89)	7988·77	113·12	8570·54
Effectiveness (Non-Monetary)								
Self-care knowledge score	61·41	0·00	0·00	61·41	44·09		0·00	44·09
Self-care attitude score	49·15	0·00	0·00	49·15	26·47		0·00	26·47
Self-care behavior score	56·33	0·00	0·00	56·33	40·42		0·00	40·42
Total effectiveness score	166·89			166·89	110·98			110·98
C/E ratios	3·24			44·32	4·22			77·23
ICER (Incremental Cost Effectiveness Ratio)	1·29			−20·99				

Note: The pretest and posttest mean scores in KSC in a full range of 100 are 33·18 (= 7·30 × 100/22) and 94·59 (= 20·81 × 4·55). Therefore, the difference between the pretest and posttest mean scores in KSC in a full range of 100 is 61·41 (= 94·59 − 33·18).

self-efficacy and quality of life for stoma patients (Wu *et al.* 2007). In this study, patients in the MLEP group expressed a significantly higher level of KSC and ASC with their stoma educational program than the CESP group. This study reinforces the belief that interventions using MLEP on stoma patients may result in improved KSC and ASC. Higher knowledge levels within the MLEP group indicate stoma-related concepts are more easily understood through multimedia material than conventional methods. Through this increased knowledge, the patients may reduce their uncertainty about post-surgical conditions, which in turn leads toward a more positive self-care attitude.

Compared with the CESP group, the MLEP group in this study reported a significantly higher level of BSC for stoma care. As suggested by Turnbull (2000) patients' BSC can be improved through the application of standardised post-operative teaching programs for the patients and their families. Multimedia learning education as an intervention is especially salient because it does not need a lot of documentation and can be replicated in other groups to test its merits. In addition to the effectiveness evaluation the art is to decide which three outcome measures have been combined to give a single score best captures the results of intervention (Lin & Tsai 2002). Common outcomes in multimedia computer education program concern measures of participant's knowledge, illness care self-efficacy, self care ability and symptom management respectively (Wofford *et al.* 2005). This may be the first study to demonstrate that an intervention developed for and tested in one hospital setting can be adapted for and made effective among stoma patients within a different hospital settings.

Relevance to clinical practice

This study provides a cost effective way of addressing stoma care in the post-operative period that could be

usefully transferred to stoma care settings internationally. It demonstrates how technology can be used, alongside nursing care, to improve the quality of patient care. It also demonstrates how patient anxiety can be reduced by the effective provision of information and how this information can also improve patient compliance with would dressings.

Limitations of the study

Several limitations of this study should be noted. First, this was a one-week intervention study design and some data, especially effectiveness indicators, were self-reported measures instead of observed ones. Therefore, it is somewhat difficult to precisely ascertain the level of agreement between actual stoma self-care and self-reported behaviors. Consequently, further research is recommended, using measures of directly observed stoma self-care behavior to compare with the findings of this study. Additionally, future studies with one, six and 12 month follow-ups might prove informative. Second, the subjects in this study only included patients receiving stoma in the hospital. The researchers suggest that future studies might explore longitudinal analyses among multiple health care settings. Finally, the difference of 'families' salary loss due to absence for work' cost between caregivers of the participants in MLEP and CESP groups may be due to the differences in salaries. Further studies should address this limitation by enlarging the sample size and carrying out covariance analysis.

Conclusion

This is the first study to use cost–effectiveness analysis method to evaluate learning education programs for stoma patients. This study has demonstrated that a low cost and highly effective multimedia learning education program can be developed within a short time period. This can be achieved through the recycling and reuse of existing health promotion and teaching materials and media. Nursing specialists and other health care providers engaged in the care of stoma may use this data to make informed decisions regarding optimal care strategies for their patients.

Acknowledgements

The authors are most grateful to all of the patients joining this study and to the staff of the Surgical Department in Taiwan Hualien Buddhist Tzu Chi Medical Center for their support and assistance in making this study possible. The authors also would like to acknowledge the 17th Conference of the European Wound Management Association for providing the opportunity for presenting the draft of this paper and EWMA First Time Presenter Award in Glasgow, UK on May 4th, 2007. In addition, we extend our gratitude to our English language editor, Orrin Hoopman of Hualien Taiwan.

Contributions

Study design: SL and YW; data collection: LW, MYH and SC; data analysis and manuscript preparation: SL, MH, MYH and YW.

References

Allred CA, Arford PH, Mauldin PD & Goodwin LK (1998) Cost–effectiveness analysis in the nursing literature, 1992–1996. *Image–the Journal of Nursing Scholarship* **30**, 235–242.

Boardman A, Greenberg D, Vining A & Weimer D (2005) *Cost–Benefit Analysis: Concepts and Practice*, 3rd Edn. Prentice-Hall, NJ.

Caban A, Cimino C, Swencionis C, Ginsberg M & Wylie-Rosett J (2001) Estimating software development costs for a patient multimedia education project. *Journal of the American Medical Informatics Association* **8**, 185–188.

Chaudhri S, Brown L & Hassan I (2005) Preoperative intensive, community-based vs. traditional stoma education: a randomized, controlled trial. *Diseases of the Colon and Rectum* **48**, 504–509.

Chen ML, Chu L & Chen HC (2004) Impact of cancer patients' quality of life on that of spouse caregivers. *Supportive Care in Cancer* **12**, 469–475.

Cotrim H (2008) Impact of colorectal cancer on patient and family: implications for care. *European Journal of Oncology Nursing* **12**, 217–226.

Department of Health, Taiwan, R.O.C., Executive Yuen (2007) *The Prevalence and Number of Patients of Top Ten Tumors in Taiwan.* Department of Health, Taipei.

Drummond MF, Sculpher MJ, Torrance GW, Brien BJ & Stoddard GL (2005) *Method for the Economic Evaluation of Health Care Programmes*, 3rd edn. Oxford University Press, Oxford.

Gramlich EM (1990) *A Guide to Benefit-cost Analysis*, 2nd edn. Prentice-Hall, NJ pp. 150–170.

Issenberg SB, Gordon MS & Greber AA (2003) Bedside cardiology skills training for the osteopathic internist using simulation technology. *The Journal of the American Osteopathic Association* **12**, 603–607.

Jerant A, Kravitz RL, Rooney M, Amerson S, Kreuter M & Franks P (2007) Effects of a tailored interactive multimedia computer program on determinants of colorectal cancer screening: a randomized controlled pilot study in physician offices. *Patient Education and Counseling* **66**, 67–74.

Kao CW & Ku NP (1997) A study on the self-care abilities and related factors of colostomy patients during pre-discharge period. *The Journal of Nursing Research* **5**, 413–424.

Karadağ A, Menteş BB & Ayaz S (2005) Colostomy irrigation: results of 25 cases with particular reference to quality of life. *Journal of Clinical Nursing* **14**, 479–485.

Lin LY & Hsu HC (2006) *A Study of Knowledge and Attitudes Toward Stoma Care Among Nurses*. Proceeding of the 16th biennial congress of the World Council of Enterostomal Therapists, abstract 102.

Lin CL & Tsai SL (2002) Cost analysis of hospital-based psychiatric homecare service. *Taiwanese Journal of Psychiatry* **16**, 230–236.

Lo SF (2006) *The Effectiveness of MELPs on Knowledge, Axiety and Rehabilitation Compliance Behavior of Patients with Surgicals: A Pilot Study*. Proceeding of the 16th biennial congress of the World Council of Enterostomal Therapists, abstract 80.

Lo SF, Wu LY, Hsu MY & Chang SC (2006) *The Effects of Multimedia Intervention on Patients with Stoma in Taiwan: A Pilot Study*. Proceeding of the 16th biennial congress of the World Council of Enterostomal Therapists, abstract 102.

NHS Scotland (2005) *Provisional Service Standards Relating to Provision of Stoma Care Appliances to Patients in the Community*. Available at: http://www.sehd.scot.nhs.uk/appliance_contractors/meetings/sg_papers/220805/220805_paper2.pdf (accessed 10 April 2008).

Nijboer C, Triemstra M, Tempelaar R, Mulder MS, Robbert S & Geertrudis AM (2000) Patterns of caregiver experiences among partners of cancer patients. *The Gerontologist* **40**, 738–747.

Nugent KP, Daniels P, Stewart B, Patankar R & Johnson CD (1999) Quality of life in stoma patients. *Diseases of the Colon and Rectum* **4**, 1569–1574.

O'Connor G (2005) Teaching stoma-management skills: the importance of self-care. *British Journal of Nursing* **14**, 320–324.

Paperny DM & Hedberg VA (1999) Computer-assisted health counselor visits: a low-cost model for comprehensive adolescent preventive services. *Archives of Pediatrics & Adolescent Medicine* **153**, 63–67.

Pringle W & Swan E (2001) Continuing care after discharge from hospital for stoma patients. *British Journal of Nursing* **10**, 1275–1288.

Richardson G, Gravelle H, Weatherly H & Ritchie G (2005) Cost–effectiveness of interventions to support self-care: a systematic review. *International Journal of Technology Assessment in Health Care* **21**, 423–432.

Ross L, Abild-Nielsen AG, Thomsen BL, Karlsen RV, Boesen EH & Johansen C (2007) Quality of life of Danish colorectal cancer patients with and without a stoma. *Supportive Care in Cancer* **15**, 505–513.

Siegel JE, Weinstein MC, Russell LB & Gold MR (1996) Recommendations for reporting cost–effectiveness analyses. Panel on cost–effectiveness in health and medicine. *JAMA: The Journal of the American Medical Association* **276**, 1339–1341.

Silva MA, Ratnayake G & Deen KI (2003) Quality of life of stoma patients: temporary ileostomy versus colostomy. *World Journal of Surgery* **27**, 421–424.

Su HR (1993) The study of job stressors and stress response of clinical nurses. *The Journal of Nursing Research* **1**, 83–93.

Su YL, Dai YT, Chang KJ & Yao KP (2001) Quality of life in patients with colostomy. *Journal of the Formosan Medical Association* **5**, 164–171.

Tseng HC, Wang HH, Hsu YY & Weng WC (2004) Factors related to stress in outpatients with permanent colostomies. *The Kaohsiung Journal of Medical Sciences* **20**, 70–77.

Turnbull GB (2000) The Ostomy files: strategies for improving ostomy outcomes. *Ostomy/Wound Management* **48**, 14–15.

Wheeler JR, Janz NK & Dodge JA (2003) Can a disease self-management program reduce health care costs? The case of older women with heart disease *Medical Care* **41**, 706–715.

Wofford JL, Smith ED & Miller DP (2005) The multimedia computer for office-based patient education: a systematic review. *Patient Education and Counseling* **59**, 148–157.

Wu HK, Chau JP & Twinn S (2007) Self-efficacy and quality of life among stoma patients in Hong Kong. *Cancer Nursing* **30**, 186–193.

Yang KP & Huang CK (2005) The effects of staff nurses' morale on patient satisfaction. *The Journal of Nursing Research* **13**, 141–152.

