Received: 2 March 2021 | Revised: 27 May 2021 | Accepted: 19 July 2021

DOI: 10.1002/nop2.1016

RESEARCH ARTICLE

NursingOpen Open Access WILEY

Evaluation of adverse events and health-related quality of life in patients with colorectal cancer receiving ambulatory home-based chemotherapy in Thailand

Suwannee Sirilerttrakul[1] | Noppaskan Wannakansophon[2] | Pinyo Utthiya[2] | Sineenuch Ckumdee[1] | Patamaporn Tangteerakoon[3] | Phichai Chansriwong[4]

[1]Department of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[2]Department of Nursing, Somdech Phra Debaratana Medical Center Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[3]Chemotherapy Pharmacy Service, Compounding Unit, Department of Pharmacy, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[4]Department of Medicine Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Correspondence
Phichai Chansriwong, Oncology Unit, Department of Medicine, Faculty of Medicine, 270 Ramathibodi Hospital, Mahidol University, 270 RamaVI Rd, Rachathewi, Bangkok 10400, Thailand.
Email: phichaionco103@gmail.com

Funding information
This study was supported by the Faculty of Medicine Ramathibodi Hospital, Mahidol University

Abstract

Aims: To compare adverse events and health-related quality of life in ambulatory home-based chemotherapy with those in inpatient.

Design: Prospective non-randomized observational study.

Methods: Participants were divided into two groups according to patients' preference receiving chemotherapy.

Results: Sixty-four participants were enrolled in the inpatient, and 111 were in an ambulatory home-based chemotherapy. The frequency of anaemia, neutropenia and thrombocytopenia was significantly higher in inpatient group than in ambulatory home-based chemotherapy group ($p < .001$, <.001 and .002, respectively). Nausea, mucositis, and fatigue were more common in ambulatory home-based chemotherapy group than in inpatient group ($p < .001$, .022, and .005, respectively). Patients in the ambulatory home-based chemotherapy group showed higher social well-being (SWB) scores than inpatient group (coefficient 1.92, 95% confidence interval [CI] 0.65 to 3.19, p .003).

KEYWORDS

adverse events, ambulatory home-based chemotherapy, colorectal cancer, health-related quality of life, inpatient

1 | INTRODUCTION

Chemotherapy is one modality for cancer treatment and customarily delivered in a hospital. Ambulatory home-based chemotherapy was initiated in the 1970s in Western countries (DeMoss, 1980). Today, this healthcare service system is implemented worldwide, based on findings demonstrating its effectiveness, safety, cost savings, convenience, patient satisfaction and improved quality of life. Additionally, this approach reduces the length of hospital stay and the risk of hospital-acquired infections (Keshvani et al., 2019).

The equipment used for home chemotherapy administration is either an electronic or a non-electronic infusion device. The elastomeric infusion pump is a non-electronic device that requires no programming and is suited for the home setting owing to its small size, light weight, safety, accuracy, comfort, simplicity of use, ease of fluid filling and lack of maintenance cost (Broadhurst, 2012). Chemotherapy infusion is driven by pressure created by the stretched elastomeric membrane; the flow rate is generated by the pressure gradient across the flow restrictor and the fluid viscosity (Skryabina & Dunn, 2006). Moreover, the patient's body temperature, type

of venous access and position of reservoir influence the flow rate (Broadhurst, 2012).

2 | BACKGROUND

According to GLOBOCAN 2018 data, the incidence of colorectal cancer is rising and it is now the fourth most commonly diagnosed cancer worldwide (Rawla et al., 2019); however, early detection and advanced treatment with multiple modalities have reduced the mortality rate. Fluorouracil (5-FU) combined with oxaliplatin/leucovorin (mFOLFOX6) and irinotecan/leucovorin (FOLFIRI) is a standard treatment regimen in patients with colorectal cancer in an adjuvant or palliative setting. Traditionally, in Thailand, a 5-FU combination regimen with continuous infusion requires hospitalization for 2–3 days. Therefore, most general hospitals have an overload of patients and a shortage of resources and manpower, impeding the accessibility to chemotherapy. Successful cancer treatment requires the interaction of several factors including hospital infrastructure, a multidisciplinary team (MDT), the healthcare service system, new efficient drugs, financial resources and patient compliance. In late 2015, an MDT composed of medical oncologists, nurses and pharmacists initiated the Ramathibodi home-based chemotherapy model (RHCM) as a new healthcare service system in Thailand. The aim of the RHCM is to enhance the quality of healthcare treatment services and the quality of life in patients with cancer.

Health-related quality of life (HRQOL) is a strong independent predictive factor in patients with colorectal cancer (Sharma et al., 2013). HRQOL is affected by disease status and cancer treatment and encompasses physical, psychosocial, environmental and spiritual aspects (Temiz & Durna, 2020). An increased number of chemotherapy cycles and increased severity of adverse events reduces HRQOL (Gozdziewicz et al., 2017). An ambulatory home-based chemotherapy setting can improve patient's mental and spiritual health via receiving support from family, having a greater sense of control over treatment and the familiar home environment. Therefore, this setting might alleviate adverse events and consequently improve quality of life (Lee et al., 2010). Moreover, ambulatory home-based chemotherapy is a patient-centred care that offers benefits for patient-reported outcomes in terms of acceptability, feasibility, safety, cost savings and patient satisfaction (Borras et al., 2001; Cool et al., 2018; Crisp et al., 2014; Evans et al., 2016; Joo et al., 2011; Kelly et al., 2004; Kulthanachairojana et al., 2020; Lee et al., 2010; Lippert et al., 2017).

However, data about the effect of ambulatory home-based chemotherapy on patient HRQOL are still controversial: some studies have shown benefits whereas others have not (Borras et al., 2001; Hinz et al., 2018; Lee et al., 2010).

2.1 | Aims

According to a new paradigm of chemotherapy administration at home in Thailand, in this study, we aimed to compare patient HRQOL scores and common adverse events in an ambulatory home chemotherapy (AC) setting with those of patients in an inpatient setting (inpatient department, IPD).

3 | METHODS

3.1 | Design

This was a prospective non-randomized observational study.

3.2 | Participants

Patients were invited to participate in the study based on the following inclusion criteria: (a) diagnosed with colorectal cancer: (b) older than 18 years with controlled underlying disease; (c) treatment with a 5-FU regimen by continuous infusion in combination with either oxaliplatin or irinotecan; (d) good performance status [PS, ≤2]; (e) good compliance with follow up in the study; and (f) no cognitive impairment.

3.3 | Data collection

3.3.1 | Study protocol

Participants who met the eligibility criteria were enrolled in one of two groups, according to their preference. Group A underwent traditional chemotherapy at the hospital (IPD) and group B received chemotherapy in an ambulatory home-based chemotherapy setting (AC). Participants in group B had an implantable port inserted for chemotherapy administration; these patients had to reside near a hospital in the Bangkok area. For patients being treated at home, 24-hr telephone support would be available to communicate with a nurse case manager. Additionally, for the first three cycles, a nurse case manager telephoned patients in group B to assess whether they had experienced any adverse events and how device functioned in the patient's home. We collected and evaluated demographic data, common adverse events and HRQOL using the Functional Assessment of Cancer Therapy Colorectal (FACT-C) questionnaire (Thai version) for all participants. The data were collected at the time of enrolment, at 8 weeks and at the end of treatment (24 weeks).

3.3.2 | Chemotherapy protocol

Participants in group A required hospitalization for the administration of chemotherapy, for 2–3 days every 2 weeks. Participants in group B received oxaliplatin or irinotecan concurrent with leucovorin for a short infusion of 3–4 hr, followed by 5-FU bolus injection and continuous infusion using an elastomeric infusion pump via the

implanted port at the hospital ambulatory unit; patients then used the infusion pump at home continuously for 50 hr (Figure 1).

3.3.3 | Instruments

FACT-C questionnaire

Patient HRQOL was evaluated using the FACT-C questionnaire version 3 (Thai). The FACT questionnaire was developed by Cella et al. (1993); it was generated from the Functional Assessment of Cancer Therapy-General (FACT-G) and Colorectal Cancer Subscale (CCS) (Ward et al., 1999). The FACT-C has been translated into several languages, including Thai (Ratanatharathorn et al., 2001; Webster et al., 2003). It has been used in clinical settings worldwide and has acceptable psychometric properties for construct validity and reliability, internal consistency; alpha 0.85–0.91(Pullmer et al., 2014; Ward et al., 1999). This self-administered questionnaire with a four-point Likert scale is composed of four core domains and a 36-item subscale: physical well-being (PWB), Seven items (score 0–28); social well-being (SWB), Seven items (score 0–28); emotional well-being (EWB), Six items (score 0–24); and functional well-being (FWB), Seven items (score 0–28). The CCS has nine items; two items were not currently scored; thus, scores were 0–28. The three main outcomes of HRQOL were assessed using the FACT-C Trial Outcome Index (TOI), FACT-G and FACT-C. The sum of scores in the domains PWB, FWB, and on the CCS comprise the FACT-C (TOI) (score 0–84) which indicates physical condition. The sum of the four core domains of PWB, SWB, EWB and FWB comprise the FACT-G (score 0–108). The sum of these core domains and the CCS comprise the FACT-C total (score 0–136). A higher score indicates better HRQOL.

Common terminology criteria for adverse events (CTCAE) version 4

Adverse events were measured using CTCAE version 4, which is the most commonly used instrument to measure adverse events in clinical trials and clinical practice in oncology settings.

3.3.4 | Ethics

The study was reviewed and approved by the Regional Human Research Ethics Committee. All participants were informed about the aim of the study and the methods, risks and benefits. Written informed consent was obtained from all participants.

3.3.5 | Data analysis

Statistical analysis

Due to limited data of FACT-C score in chemotherapy treated colorectal cancer patients, Hee Jung Yoo and colleague (Yoo et al., 2005) reported FACT-C score in postoperative CRC patients in which 70% of patients in this study was received adjuvant chemotherapy postoperation. Therefore, FACT-C score at 6 months (mean [*SD*] of 90.84 [20.71]) postoperation was used as reference for FACT-C score (IPD group) in this study. We set difference of FACT-C between IPD and AC group at 10 to be clinically significant. The study was planned to enrol patients in 1:2 ratio for IPD and AC group, respectively. With type I error of 5% and power of 80%, 52 and 104 patients were needed for IPD group and AC group, respectively.

Baseline characteristics were described using mean and standard deviation (*SD*), median and range, or number and percentage, as appropriate. Comparisons between groups A and B were conducted using the chi-square or Fisher's exact test, as appropriate, for categorical variables and the Student *t*-test for continuous variables. Common adverse events are presented as number of patients and percentage. The mean ± *SD* of HRQOL score was summarized for each domain at baseline, during treatment and at the end of treatment. HRQOL between groups A and B was compared using mixed-effects linear regression models. Significant difference score of HRQOL domain between group A and B would be adjusted in multivariate mixed-effect linear regression model. We considered treatment setting and regimen and any factors with *p*-value from univariate analysis less than .1 were confounding factors that would be adjusted in the final model. All analyses were performed using Stata version 16 (StataCorp LLC, College Station). A *p*-value of less than .05 was considered statistically significant.

4 | RESULTS

4.1 | Patient characteristics

A total of 175 patients with colorectal cancer in Ramathibodi Hospital, Mahidol University, from December 2015 to November 2016 were enrolled in this study. Of these, 64 participants were included in group A (inpatient group) and 111 were included in group B (ambulatory home-based chemotherapy). Most participants (90%) had good ECOG performance status of 0–1. More than 50% of participants had advanced-stage disease at diagnosis and 45% had

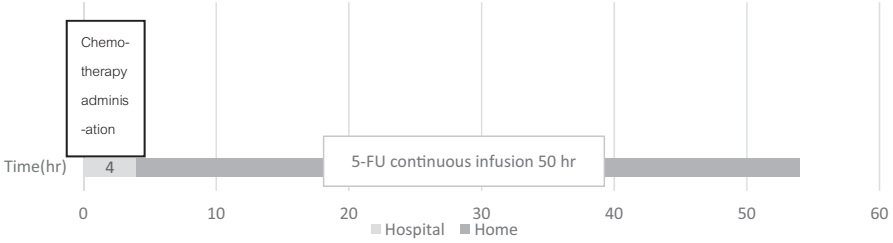

FIGURE 1 Protocol of fluorouracil with oxaliplatin/leucovorin (mFOLFOX6) and fluorouracil with irinotecan/leucovorin (FOLFIRI) administration in group B

recurrent disease. Most participants received an oxaliplatin-based regimen (67%). Baseline characteristics were well balanced between groups, except age. Participants in group A were significantly younger than those in group B, with mean age 57.7 ± 12.6 years and 62.2 ± 9.9 years ($p = .011$), respectively (Table 1).

TABLE 1 Demographic data

Characteristics *N* (%)	Group A (IPD) (*N* = 64)	Group B (AC) (*N* = 111)	*p*-value
Age, years (mean ± *SD*)	57.7 ± 12.6	62.2 ± 9.9	.011
Sex			
Male	38 (59.4)	56 (50.5)	0.254
Female	26 (40.6)	55 (49.5)	
Stage at diagnosis			
II	4 (6.3)	4 (3.6)	.611
III	23 (35.9)	45 (40.5)	
IV	37 (57.8)	62 (55.9)	
ECOG-PS			
0 – 1	58 (90.6)	97 (87.4)	.517
2	6 (9.4)	14 (12.6)	
Treatment setting			
Adjuvant	14 (21.9)	25 (22.5)	.921
Palliative	50 (78.1)	86 (77.5)	
Regimen			
mFOLFOX	39 (60.9)	82 (73.9)	.074
FOLFIRI	25 (39.1)	29 (26.1)	
Recurrent disease			
No	33 (51.6)	66 (59.5)	.310
Yes	31 (48.4)	45 (40.5)	

Abbrevbiations: AC, ambulatory home chemotherapy; ECOG-PS, Eastern Cooperative Oncology Group-Performance Status; FOLFIRI, irinotecan, 5-fluorouracil and leucovorin; IPD, inpatient department; mFOLFOX, modified oxaliplatin, 5-fluorouracil and leucovorin; *SD*, standard deviation.

4.2 | Adverse events

The incidence of common adverse events during treatment (8 weeks) was compared between groups using the CTCAE version 4. Haematologic adverse events, including anaemia, neutropenia and thrombocytopenia were significantly higher in group A than in group B ($p < .001$, <.001 and .002, respectively). For non-haematologic adverse events, nausea, mucositis and fatigue were more frequent in group B than group A ($p < .001$, .022 and 0.005, respectively). A high prevalence of neuropathy was found in both groups (48%–59%). However, most adverse events were mild to moderate and manageable (Table 2).

4.3 | Health-related quality of life (HRQOL)

Mean scores on the FACT-C questionnaire were compared at baseline, during treatment and at the end of treatment in both groups (Table 3 and Figure 2). The overall SWB score was significantly higher in group B than in group A (Coef. 1.92, 95% confidence interval [CI] 0.65–3.19, *p* .003). Univariate analysis showed age and visit were associated with SWB score; thus, age and visit along with treatment setting and regimen were included in multivariate analysis to adjust for confounding factors. The results confirmed that SWB scores were significantly higher in group B than group A (Coef. 2.28, 95% CI 1.01–w3.56, $p < .001$) (Table 4). Additionally, adjusted SWB score declined significantly with age (Coef. −0.07, 95% CI −0.12 to −0.03, *p* .001) (Table 4). The other domains of HRQOL, the FACT-C (TOI), FACT-G and FACT-C (total), had somewhat lower scores in group B than group A, but these were not statistically significant.

TABLE 2 Comparison of haematologic and non-haematologic adverse events between groups

Events	Group A (IPD) Grade 1–2	Group A (IPD) Grade 3–4	Group B (AC) Grade 1–2	Group B (AC) Grade 3–4	*p*-value
Haematologic AEs (*N* = 63,107)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	
Anaemia	38 (60.3)	2 (3.2)	15 (14.0)	0	<.001
Neutropenia	9 (14.3)	6 (9.5)	5 (4.7)	0	<.001
Thrombocytopenia	6 (9.5)	0	0	0	.002
Non-haematologic AEs					
Nausea (*N* = 61,102)	20 (32.8)	0	71 (69.6)	1 (1.0)	<.001
Vomiting (*N* = 61,102)	10 (16.4)	2 (3.3)	29 (28.4)	2 (2.0)	.176
Mucositis (*N* = 62,102)	15 (24.2)	0	43 (42.2)	1 (0.9)	.022
Diarrhoea (*N* = 61,102)	20 (32.8)	2 (3.3)	48 (47.0)	2 (2.0)	.156
Neuropathy (*N* = 62,102)	29 (46.8)	1 (1.6)	58 (56.9)	2 (1.9)	.399
Fatigue (*N* = 62,102)	35 (56.5)	5 (8.0)	76 (74.5)	12 (11.8)	.005

Note: N, number of participants in group A and group B, respectively.

Abbrevbiations: AC, ambulatory home chemotherapy; AE, adverse event; IPD, inpatient department.

TABLE 3 Comparison of health-related quality of life (HRQOL) data by group

HRQOL domain scores, mean ± *SD*	Group A (IPD)	Group B (AC)	Coef. (95% CI)	*p*-value
PWB				
Baseline	19.62 ± 5.38	20.07 ± 5.73	0.52 (−1.08, 2.12)	.525
During treatment (8 weeks)	20.89 ± 4.98	20.43 ± 4.76		
End of treatment (24 weeks)	21.51 ± 4.74	19.46 ± 4.38		
SWB				
Baseline	18.91 ± 4.01	20.78 ± 3.94	1.92 (0.65, 3.19)	.003
During treatment (8 weeks)	17.89 ± 3.74	20.59 ± 3.98		
End of treatment (24 weeks)	18.88 ± 5.40	20.38 ± 3.42		
EWB				
Baseline	17.87 ± 3.94	18.16 ± 4.34	0.31 (−1.01, 1.62)	.645
During treatment (8 weeks)	18.68 ± 4.32	19.01 ± 3.94		
End of treatment (24 weeks)	19.06 ± 4.06	18.44 ± 4.33		
FWB				
Baseline	16.79 ± 5.54	17.84 ± 5.31	1.12 (−0.52, 2.76)	.181
During treatment (8 weeks)	17.04 ± 5.70	17.51 ± 4.95		
End of treatment (24 weeks)	18.04 ± 5.28	16.12 ± 3.98		
CCS				
Baseline	17.10 ± 4.52	17.85 ± 3.88	0.86 (−0.44, 2.15)	.196
During treatment (8 weeks)	18.26 ± 3.96	17.61 ± 4.35		
End of treatment (24 weeks)	18.99 ± 4.33	17.99 ± 3.77		
FACT-C (TOI)				
Baseline	53.51 ± 12.53	55.69 ± 12.13	2.36 (−1.40, 6.12)	.219
During treatment (8 weeks)	56.19 ± 12.41	55.35 ± 11.50		
End of treatment (24 weeks)	58.55 ± 12.06	53.50 ± 10.11		
FACT-G				
Baseline	73.18 ± 13.90	76.68 ± 14.03	3.84 (−0.55, 8.23)	.086
During treatment (8 weeks)	74.50 ± 14.77	77.56 ± 12.89		
End of treatment (24 weeks)	77.49 ± 15.28	74.16 ± 12.37		
FACT-C (Total)				
Baseline	90.28 ± 17.04	94.56 ± 16.92	4.55 (−0.74, 9.83)	.092
During treatment (8 weeks)	92.76 ± 17.77	94.76 ± 15.43		
End of treatment (24 weeks)	96.49 ± 17.86	92.03 ± 15.38		

Note: FACT-C (TOI): PWB+FWB+CCS; FACT-G: PWB+SWB+EWB+FWB; and FACT-C (total): PWB+SWB+EWB+FWB+CCS.

Abbreviations: AC, ambulatory home chemotherapy; CCS, Colorectal Cancer Subscale; CI, confidence interval; EWB, emotional well-being; FWB, functional well-being; IPD, inpatient department; PWB, physical well-being; SWB, social well-being; TOI, Trial Outcome Index.

5 | DISCUSSION

These findings of this study showed that there were no major complications and adverse events were manageable in patients who received both in-hospital chemotherapy and ambulatory home-based chemotherapy. In both groups, most adverse events were of mild-to-moderate severity (grade 1–2). Haematologic adverse events including anaemia, neutropenia and thrombocytopenia were significantly higher in the inpatient group than the ambulatory home-based chemotherapy group ($p < .001$, <.001 and .002, respectively): The reasons for this difference include the following. First, IPD (inpatient, group A) encompassed more patients with recurrent disease than AC (home-based, group B), and second, patients who chose to receive chemotherapy in a hospital might have had some other factors than drove them to this decision, for example, more comorbidities. The IPD group also included more cases of grade 3–4 anaemia and neutropenia than the AC group. All non-haematologic adverse events were mild to moderate (grade 1–2) but of higher frequency in the AC group. In a hospital setting, symptom and adverse event management can be promptly assessed and managed by healthcare

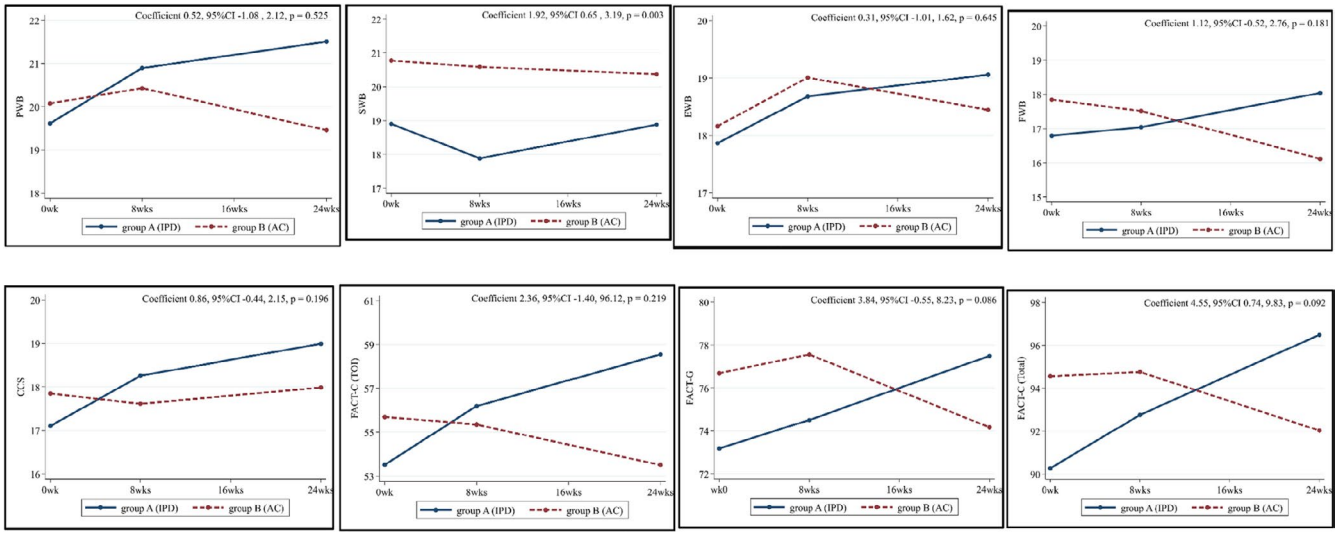

FIGURE 2 (a) comparison of HRQOL scores in group A (IPD) and group B (AC). AC, ambulatory home-based chemotherapy; CI, confidence interval; HRQOL, health-related quality of life; IPD, inpatient department

TABLE 4 Univariate and multivariate analysis of SWB score with potential confounding factors using mixed-effects linear regression model

	Univariate analysis		Multivariate analysis	
Factors	**Coef. (95% CI)**	***p*-value**	**Coef. (95% CI)**	***p*-value**
Group				
A (IPD)	Ref.		Ref.	
B (AC)	1.92 (0.65, 3.19)	.003	2.28 (1.01, 3.56)	<.001
Age (mean ± *SD*, years)	−0.05 (−0.10, −0.01)	.023	−0.07 (−0.12, −0.03)	.001
Visit				
Baseline	Ref.		Ref.	
During treatment (8 weeks)	−0.65 (−1.35, 0.05)	.068	−1.01 (−2.10, 0.09)	.071
End of treatment (24 weeks)	−0.34 (−1.19, 0.50)	.426	−0.13 (−1.30, 1.04)	.833
Stage at diagnosis				
II	Ref.			
III	1.04 (−1.55, 3.64)	.430		
IV	0.29 (−2.25, 2.83)	.820		
ECOG-PS				
0–1	Ref.			
2	0.01 (−1.90, 1.93)	0.990		
Treatment setting				
Adjuvant	Ref.		Ref.	
Palliative	−0.54 (−1.81, 0.72)	.399	−0.29 (−1.52, 0.94)	.645
Regimen				
FOLFOX	0.27 (−0.88, 1.42)	.644	−0.24 (−1.36, 0.88)	.674
FOLFIRI	Ref.		Ref.	
Recurrent disease				
No	Ref.			
Yes	0.68 (−0.39, 1.75)	.215		

Abbreviations: AC, ambulatory home chemotherapy; CI, confidence interval; FOLFIRI, irinotecan, 5-fluorouracil and leucovorin; IPD, inpatient department; mFOLFOX, modified oxaliplatin, 5-fluorouracil and leucovorin.

providers. However, in the home setting, all symptoms and adverse events were managed by patients and caregivers, who might not have strong competency to control symptoms and healthcare providers. Our findings confirmed those of previous studies showing fatigue, numbness, mucositis and nausea as the most common adverse events in colorectal cancer treatment (Borras et al., 2001; Lee et al., 2010; Pettersson et al., 2014). The prevalence of neuropathy was high in both groups (48%–59%), with no significant difference between groups ($p = .399$). Most patients in both groups were treated with an oxaliplatin-based regimen (61%–74%), which is the standard in colorectal cancer treatment. Similarly, a study by Pettersson et al. (2014) showed a high prevalence of symptoms in cancer treatment including numbness (64%), lack of energy (62%), drowsiness (49%) and nausea (45%). The prevalence of fatigue (57%–75%) in this study was in concordance with the findings of Pettersson et al. (2014). The frequency of severe fatigue (grade 3–4) was found to be higher in the AC group (12%) than in the IPD group (8%), which could be because there were more older patients in the AC group (mean age 62 years). This finding was supported by previous studies, with fatigue found in 16%–41% of older patients with colorectal cancer (Williams et al., 2015). Treatment-related symptoms such as fatigue, numbness, sleep disturbance, diarrhoea, stomatitis and nausea/vomiting affect the physical domain, psychological/emotional domain, functional domain and reduced overall quality of life (Gozdziewicz et al., 2017; Temiz & Durna, 2019). To maintain HRQOL in patients with cancer during treatment, healthcare providers should recognize and aim to manage all distressing symptoms related to the treatment.

In terms of HRQOL, ambulatory chemotherapy showed no benefit in terms of global HRQOL and other domains, except SWB. This finding was supported by those of previous studies (Borras et al., 2001; Cool et al., 2019; Corrie et al., 2013; King et al., 2000; Lee et al., 2010; Luthi et al., 2012). The reason for this finding can be explained as follows. First, participants in the ambulatory home-based chemotherapy setting had a higher prevalence of non-haematologic adverse events than those in the IPD setting. Previous studies have reported that treatment-related symptoms reduce overall quality of life (Gozdziewicz et al., 2017; Temiz & Durna, 2019). Second, we determined benefits according to treatment location (hospital versus. home) using a quality-of-life questionnaire rather than using a more sensitive instrument for detecting changes in patients. Cool et al., (2018) stated that "it is difficult to make hard conclusions on the potential (dis)advantages of oncological home hospitalization (OHH) compared with standard hospital care. The fact is that none of the studies using validated HRQOL questionnaires observed differences in QOL between home or hospital cancer drug administration. One should also question whether the available validated QOL questionnaires are sensitive enough to detect rather small variations in QOL and if the rather small samples sizes that were used were powerful enough to detect changes." Third, additional equipment should be used to assess benefits and patient-report outcomes such as patient's satisfaction, feasibility, cost savings and compliance. Finally, in this study, grouping was done according to patients' preference so bias cannot be ruled out, as we mention below. However, the ambulatory home-based chemotherapy setting had benefits in terms of patient's satisfaction owing to the ability to conduct daily life activities, the familiar home environment, cost savings, a better relationship with nursing or care staff, and greater convenience. In Thailand, Kulthanachairojana and colleagues (2020) found that patients with colorectal cancer who completed adjuvant treatment at home had a cost savings of $1,513 per patient; this beneficial result led to a national healthcare policy of reimbursement through universal health coverage. The factors influencing patients' preference are time-consuming hospitalization, education level, family role and employment status, which supports patients while receiving treatment (Borras et al., 2001; King et al., 2000; Lee et al., 2010; Luthi et al., 2012). The study by King and colleagues (2000) was found that 73% of patients (95% CI 59 to 86, p .008) preferred treatment at home after experiencing both treatment locations (hospital and home), with an important reason being waiting time at a hospital. Furthermore, Lassalle et al. (2016) reported an improvement in HRQOL (84%) and stated that 98% of patients with multiple myeloma receiving bortezomib preferred home administration over hospital administration. In our experience with the RHCM, patients prefer to receive chemotherapy administration in a home setting versus a hospital setting because they are concerned about delayed treatment owing to insufficient hospital beds, time-consuming hospital services and uncertainty. However, in home settings, patients are also concerned about support from healthcare professionals, safety, device assessment and care, and control of symptoms/adverse events and control of unexpected events at home.

Home-based chemotherapy showed benefits in terms of the SWB domain whereas the other domains showed no significant difference (Coef. 2.28, 95% CI 1.01–3.56, $p < .001$). This finding is supported by previous studies (Crisp et al., 2014; DeMoss, 1980; Lee et al., 2010). Crisp et al. (2014) mentioned the concept of the home as a "natural habitat" that the home does not only represent a dwelling but also encompasses personal identity, security and privacy. Patients affected by cancer and cancer treatment experience a loss of control, frustration and depression. Therefore, healthcare providers should try to maintain the normal daily life of patients and their families as much as possible while treatment is ongoing; patients should also receive emotional support from their families (Gozdziewicz et al., 2017; Williams et al., 2015). A multivariate analysis showed a statistically significant decline in SWB scores with age (Coef,−0.07, 95% CI −0.12 to −0.03, p .001). This finding was confirmed by Gozdziewicz et al. (2017) who found that participants age 40–50 years scored higher than other patients in SWB, EWB, FWB and global HRQOL, and SWB scores were lowest in participants' age >70 years.

In summary, this study, an ambulatory home-based chemotherapy is confirmed that offers benefits for patient-reported outcomes in terms of safety and HRQOL especially SWB domain.

6 | LIMITATIONS

This was a prospective, non-randomized, observational study with a small sample size, with grouping according to participants' preference. Therefore, selection bias cannot be ruled out.

7 | RECOMMENDATIONS FOR A FUTURE STUDIES

The initiation of this study would challenge the further studies in Thailand. Other potential and sensitive aspects about patient-reported outcomes such as safety, patient satisfaction, comorbidities, effect on caregivers, cost-effectiveness, length of hospital stay and clinical outcomes (disease-free survival and survival) should be considered as outcomes in ambulatory home-based chemotherapy in further studies. Importantly, further studies with an appropriate study design and a greater number of potential outcomes should be conducted, to confirm the benefits of ambulatory home-based chemotherapy in Thailand.

8 | CONCLUSION

The results of this study emphasized the benefits of ambulatory home-based chemotherapy for patients with colorectal cancer in terms of safety and HRQOL with respect to SWB. This new service option was proven to be useful for patients and caregivers, healthcare providers and a new paradigm in the healthcare service system in my hospital, which can be expanded to public hospitals across Thailand. Therefore, healthcare providers would provide education and empower cancer patients and their caregivers to enhance competency for caring themselves and device at home.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants and our multidisciplinary colleagues at Ramathibodi Hospital, Mahidol University, for initiating the new healthcare service system for Thai patients with cancer. Special thanks to Mary Magee Gullatte, PhD, RN, ANP-BC, AOCN, FAAN, nurse scientist and International Oncology Nurse Consultant, Atlanta, Georgia, USA, for her mentorship and guidance and Dr. Songporn Oranratnachai, M.D., medical oncologist, Sriphat Medical Center, Faculty of Medicine, Chiangmai University for serving as a statistics consultant. We are also grateful to Dr. Wonnapha Prapaipanich, nursing instructor at the School of Nursing, Ramathibodi Hospital, Mahidol University, Thailand for providing support and kind advice. We would like to thank the statistician Mr. Dittapol Muntham, lecturer at the Department of Mathematics, Faculty of Science and Technology, Rajamangala University of Technology Suvarnabhumi, Thailand, for data analysis and statistical consultation. Finally, we thank Analisa Avila, ELS, of Edanz Group (https://en-author-services.edanz.com/ac) for editing a draft of this manuscript.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

All authors contributed to the conceptualization, design and data collection of the study. The manuscript was written by SS and edited by PC. The final version was approved by all authors.

ETHICAL APPROVAL

The study was approved by Regional Human Research Ethics Committee (no. MURA2015/675), the Faculty of Medicine Ramathibodi Hospital, Mahidol University.

CLINICAL TRIAL REGISTRATION NUMBER

TCTR identification number is TCTR20201117001.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the first author and corresponding author upon reasonable request.

ORCID

Suwannee Sirilerttrakul https://orcid.org/0000-0002-8871-3384
Phichai Chansriwong https://orcid.org/0000-0002-2220-0068

REFERENCES

Borras, J. M. (2001). Compliance, satisfaction, and quality of life of patients with colorectal cancer receiving home chemotherapy or outpatient treatment: A randomised controlled trial. *BMJ*, *322*(7290), 826–826. http://dx.doi.org/10.1136/bmj.322.7290.826

Broadhurst, D. (2012). Transition to an elastomeric infusion pump in home care. *Journal of Infusion Nursing*, *35*(3), 143–151. http://dx.doi.org/10.1097/nan.0b013e31824d1b7a

Cella, D. F., Tulsky, D. S., Gray, G., Sarafian, B., Linn, E., Bonomi, A., Silberman, M., Yellen, S. B., Winicour, P., & Brannon, J. (1993). The functional assessment of cancer therapy scale: Development and validation of the general measure. *Journal of Clinical Oncology*, *11*(3), 570–579. http://dx.doi.org/10.1200/jco.1993.11.3.570

Cool, L., Missiaen, J., Vandijck, D., Lefebvre, T., Lycke, M., De Jonghe, P. J., Vergauwe, P., Foulon, V., Pottel, H., Debruyne, P., & Van Eygen, K. (2019). An observational pilot study to evaluate the feasibility and quality of oncological home-hospitalization. *European Journal of Oncology Nursing*, *40*, 44–52. https://doi.org/10.1016/j.ejon.2019.03.003

Cool, L., Vandijck, D., Debruyne, P., Desmedt, M., Lefebvre, T., Lycke, M., De Jonghe, P. J., Pottel, H., Foulon, V., & Van Eygen, K. (2018). Organization, quality and cost of oncological home-hospitalization: A systematic review. *Critical Reviews in Oncology/Hematology*, *126*, 145–153. https://doi.org/10.1016/j.critrevonc.2018.03.011

Corrie, P. G., Moody, A. M., Armstrong, G., Nolasco, S., Lao-Sirieix, S.-H., Bavister, L., Prevost, A. T., Parker, R., Sabes-Figuera, R., McCrone, P., Balsdon, H., McKinnon, K., Hounsell, A., O'Sullivan, B., & Barclay, S. (2013). Is community treatment best? A randomised trial comparing delivery of cancer treatment in the hospital, home and GP surgery. *British Journal of Cancer*, *109*(6), 1549–1555. http://dx.doi.org/10.1038/bjc.2013.414

Crisp, N., Koop, P. M., King, K., Duggleby, W., & Hunter, K. F. (2014). Chemotherapy at home: Keeping patients in their "natural

habitat". *Canadian Oncology Nursing Journal*, *24*(2), 89–94. http://dx.doi.org/10.5737/1181912x2428994

DeMoss, C. J. (1980). Giving intravenous chemotherapy at home. *American Journal of Nursing*, *80*(12), 2188–2189.

Evans, J. M., Qiu, M., MacKinnon, M., Green, E., Peterson, K., & Kaizer, L. (2016). A multi-method review of home-based chemotherapy. *European Journal of Cancer Care*, *25*(5), 883–902. https://doi.org/10.1111/ecc.12408

Gozdziewicz, B., Strugala, M., Talarska, D., Stanislawska, J., & Baczyk, G. (2017). Functioning of people with colorectal cancer during chemotherapy. Demographic and clinical determinants of quality of life of patients with colorectal cancer receiving chemotherapy. Pilot study. *European Journal of Cancer Care*, *26*(3). https://doi.org/10.1111/ecc.12616

Hinz, A., Weis, J., Faller, H., Brähler, E., Härter, M., Keller, M., Schulz, H., Wegscheider, K., Koch, U., Geue, K., Götze, H., & Mehnert, A. (2018). Quality of life in cancer patients—a comparison of inpatient, outpatient, and rehabilitation settings. *Supportive Care in Cancer*, *26*(10), 3533–3541. http://dx.doi.org/10.1007/s00520-018-4211-4

Joo, E. H., Rha, S. Y., Ahn, J. B., & Kang, H. Y. (2011). Economic and patient-reported outcomes of outpatient home-based versus inpatient hospital-based chemotherapy for patients with colorectal cancer. *Supportive Care in Cancer*, *19*(7), 971–978. https://doi.org/10.1007/s00520-010-0917-7

Kelly, D., Pearce, S., Butters, E., Stevens, W., & Layzell, S. (2004). Achieving change in the NHS: A study to explore the feasibility of a home-based cancer chemotherapy service. *International Journal of Nursing Studies*, *41*(2), 215–224. https://doi.org/10.1016/j.ijnurstu.2003.05.002

Keshvani, N., Hon, M., Gupta, A., Brown, T. J., Roy, L., Marley, E., Lindsey, S., Johnson, D. H., Sadeghi, N., & Li, H. C. (2019). Reducing hospitalizations: Institution of outpatient infusional EPOCH-based chemotherapy at a safety net hospital. *Journal of Oncology Practice*, *15*(8), e644–e651. https://doi.org/10.1200/JOP.18.00738

King, M. T., Hall, J., Caleo, S., Gurney, H. P., & Harnett, P. R. (2000). Home or hospital? An evaluation of the costs, preferences, and outcomes of domiciliary chemotherapy. *International Journal of Health Services*, *30*(3), 557–579. https://doi.org/10.2190/CY03-EV15-K38Y-X4AA

Kulthanachairojana, N., Chansriwong, P., Thokanit, N. S., Sirilerttrakul, S., Wannakansophon, N., & Taychakhoonavudh, S. (2020). Home-based chemotherapy for stage III colon cancer patients in Thailand: Cost-utility and budget impact analyses. *Cancer Medicine*, https://doi.org/10.1002/cam4.3690

Lassalle, A., Thomaré, P., Fronteau, C., Mahé, B., Jubé, C., Blin, N., Voldoire, M., Dubruille, V., Tessoulin, B., Touzeau, C., Chauvin, C., Loirat, M., Lok, A., Bourcier, J., Lestang, E., Mocquet, R., Barbarot, V., & Moreau, P. (2016). Home administration of bortezomib in multiple myeloma is cost-effective and is preferred by patients compared with hospital administration: Results of a prospective single-center study. *Annals of Oncology*, *27*(2), 314–318. https://doi.org/10.1093/annonc/mdv563

Lee, Y. M., Hung, Y. K., Mo, F. K., & Ho, W. M. (2010). Comparison between ambulatory infusion mode and inpatient infusion mode from the perspective of quality of life among colorectal cancer patients receiving chemotherapy. *International Journal of Nursing Practice*, *16*(5), 508–516. https://doi.org/10.1111/j.1440-172X.2010.01876.x

Lippert, M., Semmens, S., Tacey, L., Rent, T., Defoe, K., Bucsis, M., Shykula, T., Crysdale, J., Lewis, V., Strother, D., & Lafay-Cousin, L. (2017). The Hospital at Home program: No place like home. *Current Oncology*, *24*(1), 23–27. https://doi.org/10.3747/co.24.3326

Lüthi, F., Fucina, N., Divorne, N., Santos-Eggimann, B., Currat-Zweifel, C., Rollier, P., Wasserfallen, J.-B., Ketterer, N., & Leyvraz, S. (2012). Home care—a safe and attractive alternative to inpatient administration of intensive chemotherapies. *Supportive Care in Cancer*, *20*(3), 575–581. http://dx.doi.org/10.1007/s00520-011-1125-9

Pettersson, G., Berterö, C., Unosson, M., & Börjeson, S. (2014). Symptom prevalence, frequency, severity, and distress during chemotherapy for patients with colorectal cancer. *Supportive Care in Cancer*, *22*(5), 1171–1179. http://dx.doi.org/10.1007/s00520-013-2069-z

Pullmer, R., Linden, W., Rnic, K., & Vodermaier, A. (2014). Measuring symptoms in gastrointestinal cancer: A systematic review of assessment instruments. *Supportive Care in Cancer*, *22*(11), 2941–2955. http://dx.doi.org/10.1007/s00520-014-2250-z

Ratanatharathorn, V., Sirilerttrakul, S., Jirajarus, M., Silpakit, C., Maneechavakajorn, J., Sailamai, P., & Sirisinha, T. (2001). Quality of life, functional assessment of cancer therapy-general. *Journal of the Medical Association of Thailand*, *84*(10), 1430–1442.

Rawla, P., Sunkara, T., & Barsouk, A. (2019). Epidemiology of colorectal cancer: Incidence, mortality, survival, and risk factors. *Przegląd Gastroenterologiczny*, *14*(2), 89–103. https://doi.org/10.5114/pg.2018.81072

Sharma, A., Walker, L. G., & Monson, J. R. T. (2013). Baseline quality of life factors predict long term survival after elective resection for colorectal cancer. *International Journal of Surgical Oncology*, *2013*, 1–6. http://dx.doi.org/10.1155/2013/269510

Skryabina, E. A., & Dunn, T. S. (2006). Disposable infusion pumps. *American Journal of Health-System Pharmacy*, *63*(13), 1260–1268. https://doi.org/10.2146/ajhp050408

Temiz, G., & Durna, Z. (2020). Evaluation of quality of life and health care needs in cancer patients receiving chemotherapy. *Journal of Cancer Education*, *35*(4), 796–807. http://dx.doi.org/10.1007/s13187-019-01533-2

Ward, W. L., Hahn, E. A., Mo, F., Hernandez, L., Tulsky, D. S., & Cella, D. (1999). Reliability and validity of the functional assessment of cancer therapy-colorectal (FACT-C) quality of life instrument. *Quality of Life Research*, *8*(3), 181–195. http://dx.doi.org/10.1023/a:1008821826499

Webster, K., Cella, D., & Yost K. (2003). The Functional assessment of chronic illness therapy (FACIT) measurement system: Properties, applications, and interpretation. *Health and Quality of Life Outcomes*, *1*(1), 79. http://dx.doi.org/10.1186/1477-7525-1-79

Williams, G. R., Nyrop, K. A., Deal, A. M., Muss, H. B., & Sanoff, H. K. (2015). Self-directed physical activity intervention in older adults undergoing adjuvant chemotherapy for colorectal cancer: Design of a randomized controlled trial. *Contemporary Clinical Trials*, *42*, 90–97. https://doi.org/10.1016/j.cct.2015.03.008

Yoo, H. J., Kim, J. C., Eremenco, S., & Han, O. S. (2005). Quality of life in colorectal cancer patients with colectomy and the validation of the functional assessment of cancer therapy-colorectal (FACT-C), version 4. *Journal of Pain and Symptom Management*, *30*(1), 24–32. https://doi.org/10.1016/j.jpainsymman.2004.12.009

How to cite this article: Sirilerttrakul, S., Wannakansophon, N., Utthiya, P., Ckumdee, S., Tangteerakoon, P., & Chansriwong, P. (2021). Evaluation of adverse events and health-related quality of life in patients with colorectal cancer receiving ambulatory home-based chemotherapy in Thailand. *Nursing Open*, 8, 3036–3044. https://doi.org/10.1002/nop2.1016