Research Articles

Symptom Interference in Thai Patients with End-Stage Renal Disease Undergoing Hemodialysis

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Abstract

Objectives: *To explore the prevalence, frequency, severity, and distress of physical and psychological symptoms among end-stage renal disease (ESRD) patients undergoing hemodialysis (HD).* ***Methods:*** *Two hundred and three ESRD patients undergoing HD completed the Thai Memorial Symptom Assessment Scale-ESRD (the Thai MSAS-ESRD). The content validity was 0.96 and the stability reliability was 0.94 for frequency, 0.93 for severity and 0.95 for distress. The data were analyzed using descriptive statistics.* ***Results:*** *The results showed that the majority of participants (98.52%) had a symptom interference, and the average number of symptoms was 11.50 (SD = 7.19). The top five prevalence of physical symptom interferences were itching (64.53%) and dry skin (64.53%), followed by lack of energy (60.59%), trouble falling asleep (57.64%), and trouble staying asleep (52.71%). The top three prevalence of psychological symptom interferences were boredom (61.08%), irritability (49.75%), and worry (39.41%). Regarding frequency, the most of physical symptom interference at the rarely level was dry skin (54.96%), whereas lack of energy (60.16%) was reported at the occasionally level. In terms of psychological symptom interference, worry (75.00%) was reported at the rarely level. Regarding severity, lack of energy (65.04%) was reported the most common of physical symptom interference, whereas worry (46.25%) was reported the most common of psychological symptom interference. Regarding distress, trouble staying asleep (47.66%) was reported the most common of physical symptom interference, whereas boredom (29.03%) was reported the most common of psychological symptom interference. In terms of severity level and distress level, all of physical and psychological symptom interferences were reported at slightly severe level.* ***Conclusion:*** *Thai ESRD patients undergoing HD experience interference from multiple symptoms that need appropriate management.*

Keywords: symptom interference; end-stage renal disease; hemodialysis

Significance of the problem

Chronic kidney disease (CKD) is a major public health problem around the world because it is progressively increasing with a prevalence of 11 -13% worldwide.[1,2] The Thailand renal replacement therapy (TRT) 2020 report showed that 170,774 patients with end-stage renal disease (ESRD) were registered to receive renal replacement therapy, stating a prevalence of 2,580 patients per one million, while over 129,724 (75.96%) of these patients were undergoing hemodialysis (HD).[3] In Health Region Four, in central Thailand, the prevalence of patients with ESRD undergoing HD in 2009 was 2,394, and the number of patients has increased every year. According to a 2015 report, the number of patients increased to more than 5,670, or 596.8 patients per million population. Health Region Four has a large number of patients with ESRD undergoing HD, accounting for 10.50% of the total number of patients nationwide.[4] However, according to the report from the Nephrology Society of Thailand during the past 6 years, there were no data reported on the number of cases classified by region, there was a report of increasing hemodialysis units in throughout Thailand. Remarkably, hemodialysis units in central Thailand grow by 10.10-11.30%, indicating an increase in the number of patients requiring dialysis services in this region.[4]

CKD is a structural or functional disorder of kidney lasting more than 3 months and incurable progressive disease. ESRD is the last stage of CKD with complications directly related to the disease and requiring renal replacement therapy (estimated glomerular filtration rate (eGFR) of less than 6 ml/min/1.73 m^2).[5] The pathophysiology and progression of ESRD affects multiple organs and causes physical or psychological symptoms, such as, itching, nausea, vomiting, loss of appetite, dyspnea, swelling, restless legs, muscle cramps, anxiety, and depression.[6] Patients with ESRD face much interference from symptoms, with an average of 7.22 (standard deviation [SD] = 6.92) symptoms[7], which affect patients' daily lives and quality of life.[8] In particular, as the severity of symptoms increases, quality of life in relation to physical health, psychological state, and social relationships decreases.[9]

A meta-analysis by Murtagh, Addington-Hall and Higginson[6] in 2007, which included a total of 59 research and reported 11 symptoms in patients with ESRD undergoing HD, peritoneal dialysis or kidney transplantation: fatigue (71%), itching (55%), constipation (53%), anorexia (49%), pain (47%), sleep problems (44%), anxiety (38%), dyspnea (35%), nausea (33%), restless legs (30%), and depression (27%). Several studies in Thailand have examined symptom interference among patients with CKD at all stages,[10,11] whereas the studies in HD patients are rare. Only one study was found, Tainsaard, Chaiviboontham and Phinitkhajorndec[8] explored symptom burdens, financial burdens, and quality of life among 101 patients with ERSD undergoing HD. This study reported the participants perceived an average of 13.96 symptoms (SD = 7.85); the mean score for the burden of all symptoms was 22.26, and the top five of prevalence symptoms were dry skin, itching, dry mouth, muscle soreness, and muscle cramp.[8] Notably, the study of Tainsaard, Chaiviboontham and Phinitkhajorndec[8] explored only prevalence and distress of symptoms among ERSD patients undergoing HD. However, symptom frequency and symptom severity among these patients were not documented.

The Theory of Unpleasant Symptoms (TOUS) was developed by Lenz, et al.[12] in 1995 and updated in 1997 comprising three major components: symptoms, influencing factors, and performance.[10] In the TOUS, symptoms refer to an individual's perception of a change in the body's normal functioning and its impact on them. Symptoms may

occur singly or concurrently. When one symptom occurs, it may trigger other symptoms and cause the first symptom to be more severe. Each symptom is assessed in four dimensions: frequency, severity, distress, and quality. A previous study reported that the TOUS is appropriate to be used as a framework to explore symptoms among patients with CKD.[10]

However, previous studies explored only some dimensions of symptoms among small samples of patients with ESRD undergoing HD. These existing results might not appropriate to represent the symptoms of ESRD patients in Health Region Four, Thailand, whereas the prevalence of ESRD patients in this area is ranked the 3rd of Thailand. Therefore, it is a need to explore the prevalence frequency, severity, and distress of physical and psychological symptoms among ESRD patients undergoing HD.

Research questions

1. What are the prevalence of symptoms among ESRD patients undergoing HD?

2. What are the frequency, severity, and distress of physical and psychological symptoms among ESRD patients undergoing HD?

Objectives

1. To explore the prevalence of symptom among ESRD patients undergoing HD.

2. To explore the frequency, severity, and distress of physical and psychological symptoms among ESRD patients undergoing HD.

Research design

Conceptual framework

The Theory of Unpleasant Symptoms (TOUS) developed by Lenz, et al.[12] was used as a flamework in the thesis entitle "The factors predicting symptom interference in patients with end -stage renal disease undergoing hemodialysis". The present study described only symptom interference in terms of frequency, severity, and distress among patients with ESRD undergoing HD. However, the dimension of quality of symptom interference was not included in this study as it reflects individualized definitions that are qualitative data, whereas this study design used descriptive statistics. In the present study, the concept of symptoms was used to guide in exploring symptom interference among patients with ESRD undergoing HD.

Methods

A descriptive research design was used to examine symptom interference among patients with ESRD undergoing HD in Health Region Four of Thailand from August 2020 to January 2021.

The participants were patients with ESRD undergoing HD at the hemodialysis units of Bhumirajanagarindra Kidney Institute Hospital and four hospitals (Thammasat University Hospital, King Narai Maharaj Hospital, Phra Phutthabat Hospital, and Inburi Hospital) in Health Region Four, Thailand. The research settings were selected by stratified random sampling according to the hospital level and the sample size was calculated based on population proportion of the selected hospitals, included Bhumirajanagarindra Kidney Institute Hospital 50 cases, Thammasat University Hospital 71 cases, King Narai Maharaj Hospital 13 cases, Phra Phutthabat Hospital 29 cases, and Inburi Hospital 40 cases.

Population and sample

Sample size calculation was performed based on the power analysis by using G*Power 3.1 program. The statistical significance was .05, the power of test was .95, and determined the small effect size was .15 based on the recommend of Polit and Sherman.[13] which yielded a sample size of 203 patients.

A convenience sample of participants was recruited based on the following inclusion criteria: 1) age 18 years or older, 2) diagnosed with ESRD (eGFR < 6 ml/min/1.73 m^2), 3) receiving conventional intermittent HD 2-3 times a week for 1 year or more, 4) able to communicate and understand the Thai language correctly, 5) conscious with no cognitive impairment, and 6) the cognitive impaiment score was ≥ 23 for patients aged 60 years or older, assessed by the Thai Mental State Examination (TMSE). The participants were excluded in case they had dyspnea, chest pain, and drowsiness or unconscious.

Ethical consideration

This study received ethical approval from the Ethical Review Committee Board for Human Research Involving Sciences, Thammasat University, EC approval number: 074/2020, approval date 19 July 2020 to 18 July 2021, the institutional review board (IRB) committee of King Narai Hospital, EC approval number: KNH 21/2020, approval date 14 July 2020 to 15 July 2021, and the IRB committee of Bhumirajanagarindra Kidney Institute Hospital, EC approval number: 2/2020, approval date 20 November 2020 to 20 February 2021. The participants received information about the research project, the risks and benefits of the study, and the confidentiality issues. They were informed that their participation was voluntary and that they could withdraw from the study at any time.

Data collection instrument

The researcher approached potential participants who met the inclusion criteria, described the details of the study, and invited them to participate in the study. After each participant confirmed their willingness to participate in the study, they were asked to sign an informed consent form before completing the questionnaire, which takes time about 20-30 minutes in a separated room in the HD Unit. However, there were 42 participants in this study, who were unable to read or complete the questionnaire by themselves. For these participants, the researcher read the questions and wrote down the answers for them. In addition, the researcher collected the participants' health information from the medical records.

The instruments used for collecting data were a demographic data form and the Thai MSAS-ESRD. The demographic data form collected personal information and health-related information, including age, gender, marital status, education level, occupation, income, body mass index (BMI), comorbidities, HD frequency, duration of HD in years, history of starting HD, and adequacy of HD (Kt/V) within one month.

The Thai MSAS-ESRD developed by the researcher. This instrument was modified from the MSAS, which developed by Portenoy, et al.[14] and translated to Thai language by Suwisith, et al.[15] The Thai MSAS-ESRD was modified to capture 32 physical and psychological symptoms reported among ESRD patients undergoing HD by conducting literature review to identify specific symptoms and appropriate questions. The Thai MSAS-ESRD that differ from the Thai MSAS of Suwisith, et al.[15] are sweats, feeling bloated, difficulty swallowing, sore mouth, weight loss, "I don't look like myself", and skin changes.

The Thai MSAS-ESRD can be used to assess symptom interference in the dimensions of frequency, severity, and distress during a one-week period. The answers are scored on a five-point Likert scale. For frequency, the scale is as follows: 0 = no symptom, 1 = rarely have a symptom, 2 = occasionally have a symptom, 3 = frequently have a symptom, and 4 = almost constantly have a symptom. If the frequency scale was 0, the data not included in severity and distress analysis. For severity, 0 = not affected by a symptom, 1 = slightly severe, 2 = moderately severe, 3 = very

severe, and 4 = most severe. For distress, 0 = not affected by a symptom, 1 = slight distress, 2 = moderate distress, 3 = very distressed, and 4 = most distress. The content validity was tested by five experts, and the CVI was 0.96. The stability reliability was tested by test-retest method within one week among 30 patients with ESRD undergoing HD and analyzed by Pearson Product - Moment correlation. The correlation coefficient were 0.94 for frequency, 0.93 for severity, and 0.95 for distress.

Data analysis

The demographic data and symptom interference data were analyzed using descriptive statistics. The data distribution was tested prior to the analysis. The data was non - normal distribution and reported as frequency and percentage.

Results

Participant characteristics

The participants were aged 23-89 years old (M = 58.03, SD = 13.56). The proportions of males (50.24%) and females (49.76%) were similar. The participants' average BMI was 23.56 (SD = 4.78). The most common comorbidities were hypertension (HT) (99.01%), anemia (71.42%), and diabetes mellitus (DM) (51.72%). Most participants received HD three times per week (67.49%). The average time on HD was 4.17 years (SD = 3.49), and 56.15% of the participants had been on HD for 1–3 years. More than half of the participants had received unplanned HD and had complications that were reported at the first HD session (56.17%). Their Kt/V ranged between 0.81 and 2.91 (mean = 1.85, SD = 0.81) (Table 1).

Table 1 Participant characteristics (N = 203)

	Male (n = 102)		Female (n = 101)		Total (N = 203)	
	n	%	n	%	n	%
Age (years) (M = 58.03, SD = 13.56)						
23-39	11	10.78	13	12.87	24	11.82
40-59	29	28.43	43	42.57	72	35.46
60-89	62	60.79	45	44.56	107	52.72
Marital status						
Single	17	16.66	22	21.78	39	19.21
Married	76	74.50	50	49.50	126	62.06
Divorced	4	3.92	6	5.94	10	4.92
Widowed	5	4.92	23	22.78	28	13.81
Education level						
No formal education	1	0.98	8	7.92	9	4.43
Primary School	22	21.56	34	33.66	56	27.58
High School	33	32.34	23	22.77	56	27.58
Diploma	11	10.78	5	4.95	16	7.88
Bachelor's Degree	35	34.34	31	30.70	66	32.53
BMI (kg/m^2)						
(min = 16.02, max = 43.90, M = 23.59, SD = 4.78)						
< 18.5	5	4.90	14	13.86	19	9.35
18.5-30.9	90	88.23	79	78.21	169	83.25
≥ 31	7	6.87	8	7.93	15	7.40

Table 1 (Continued)

	Male (n = 102)		Female (n = 101)		Total (N = 203)	
	n	%	n	%	n	%
Comorbidities (answer more than 1 item)						
Hypertension	101	99.01	100	99.00	201	99.01
Anemia	74	72.54	71	70.29	145	71.42
Diabetes Mellitus	57	55.88	48	47.52	105	51.72
Dyslipidemia	46	45.09	44	43.56	90	44.33
Heart disease	37	36.27	22	21.78	59	29.06
HD frequency						
2 times/week	29	28.43	37	36.63	66	32.51
3 times/week	73	71.57	64	63.37	137	67.49
Time on HD (Years) (min = 1, max = 16, M = 4.17, mode = 1)						
1-3	56	54.90	58	57.42	114	56.15
4-6	25	24.50	22	21.78	47	23.15
7-9	12	11.76	9	8.91	21	10.34
10-12	3	2.94	9	8.91	12	5.91
13-16	6	5.90	3	2.98	9	4.45
History of starting HD						
Planned & no complications	30	29.41	30	29.70	60	29.55
Planned & complications	14	13.72	15	14.85	29	14.28
Unplanned & complications	58	56.87	56	55.45	114	56.17
Kt/V (min = 0.81, max = 2.29, M = 1.85, SD = 0.81)						
Adequate	80	78.43	89	88.11	169	83.25
Not adequate	22	21.57	12	11.89	34	16.75

Symptom interference

The results showed that the majority of participants (98.52%) had a symptom interference. A total of 32 symptoms were reported and the average number of symptom interference was 11.50 (SD = 7.19). The top five prevalence of physical symptom interferences were itching (64.53%) and dry skin (64.53%), followed by lack of energy (60.59%), trouble falling asleep (57.64%), and trouble staying asleep (52.71%). The top three prevalence of psychological symptom interferences were boredom (61.08%), irritability (49.75%), and worry (39.41%) (Table 2).

Frequency

The participants reported, the most of physical symptom interferences at the rarely level included dry skin (54.96%), trouble staying asleep (50.47%) and itching (50.38%), whereas lack of energy (60.16%) and trouble falling asleep (37.61%) were reported at the occasionally level. In terms of psychological symptom interferences, worry (75.00%), irritability (74.26%), and boredom (50.38%) were reported at the rarely level (Table 2).

Severity

Regarding severity, lack of energy (65.04%) was reported the most common of physical symptom interference, whereas worry (46.25%) was reported the most common of psychological symptom interference. In terms of severity level, most participants reported all physical symptom interferences were slightly level at 31.62% to 45.53%, whereas all psychological symptom interferences

were slightly severe level at 30.69% to 36.25% (Table 3).

Distress

Regarding distress, trouble staying asleep (47.66%) was reported the most common of physical symptom interference, whereas boredom (29.03%) was reported the most common of psychological symptom interference. In terms of distress level, most participants reported all physical symptom interferences were slightly distress level at 24.43% to 30.84%, whereas all psychological symptom interferences were slightly level at 30.69% to 36.25% (Table 4).

Table 2 Frequency of symptom interference (N = 203)

Symptom interference	Patient with symptom interference(%)	Frequency			
		Rarely 1	Occasionally 2	Frequently 3	Almost Constantly 4
Physical symptoms					
1. Itching	131(64.53)	66(50.38)	32(24.43)	10(7.63)	23(17.56)
2. Dry skin	131(64.53)	72(54.96)	27(20.61)	8(6.11)	24(18.32)
3. Lack of energy	123(60.59)	45(36.59)	74(60.16)	3(2.44)	1(0.81)
4. Trouble falling asleep	117(57.64)	39(33.33)	44(37.61)	18(15.38)	16(13.68)
5. Trouble staying asleep	107(52.71)	54(50.47)	31(28.97)	13(12.15)	9(8.41)
Psychological symptoms					
1. Boredom	124(61.08)	82(66.13)	32(25.81)	7(5.65)	3(2.42)
2. Irritability	101(49.75)	75(74.26)	18(17.82)	7(6.93)	1(0.99)
3. Worry	80(39.41)	60(75.00)	15(18.75)	5(6.25)	0

Table 3 Severity of symptom interference (N = 203)

Symptom interference	Patients with severe symptom interference(%)	Not affected by a symptom 0	Severity of symptom interference			
			Slightly severe 1	Moderately severe 2	Very severe 3	Most severe 4
Physical symptoms						
1. Lack of energy (n = 123)	80(65.04)	43(34.96)	56(45.53)	16(13.01)	4(3.25)	4(3.25)
2. Itching (n = 131)	85(64.89)	46(35.11)	53(40.46)	8(6.11)	10(7.63)	14(10.69)
3. Trouble falling asleep (n = 117)	75(64.10)	42(35.90)	37(31.62)	20(17.09)	8(6.84)	10(8.55)
4. Dry skin (n = 131)	75(57.43)	56(42.75)	49(37.40)	10(7.63)	8(6.11)	8(6.11)
5. Trouble staying asleep (n = 107)	58(54.21)	47(45.79)	40(37.38)	8(7.48)	4(3.74)	6(5.61)
Psychological symptoms						
1. Worry (n = 80)	37(46.25)	43(53.75)	29(36.25)	6(7.50)	2(2.50)	0
2. Boredom (n = 124)	57(45.97)	67(54.03)	40(32.26)	14(11.29)	3(2.42)	0
3. Irritability (n = 101)	41(40.59)	60(59.41)	31(30.69)	7(6.93)	3(2.97)	0

Table 4 Distress of symptom interference (N = 203)

Symptom interference	Patients in distress (%)	Not affected by a symptom 0	Distress of symptom interference			
			Slightly distress 1	Moderate distress 2	Very distress 3	Most distress 4
Physical symptoms						
1. Trouble staying asleep (n = 107)	51(47.66)	56(52.34)	33(30.84)	9(8.41)	5(4.67)	4(3.74)
2. Trouble falling asleep (n = 117)	55(47.01)	62(52.99)	29(24.79)	16(13.68)	4(3.42)	6(5.13)
3. Itching (n = 131)	61(46.56)	70(53.44)	37(28.24)	8(6.11)	5(3.82)	11(8.40)
4. Lack of energy (n = 123)	51(41.46)	72(58.54)	32(26.02)	15(12.20)	2(1.63)	2(1.63)
5. Dry skin (n = 131)	47(35.88)	84(64.12)	32(24.43)	9(6.87)	2(1.53)	4(3.05)
Psychological symptoms						
1. Boredom (n = 124)	36(29.03)	88(70.97)	25(20.16)	6(4.84)	5(4.03)	0
2. Worry (n = 80)	23(28.75)	57(71.25)	17(21.25)	5(6.25)	1(1.25)	0
3. Irritability (n = 101)	24(23.76)	77(76.24)	18(17.82)	3(2.97)	3(2.97)	0

Discussion

In this study, the participants' demographic data are similar to those reported in the annual reports on RRT in Thailand for 2020[3] and previous studies in terms of age, comorbidity, and adequacy of HD (Kt/V).[7,8] More than half of the participants were older adults. When a person gets older, which cause organs degeneration and the vessel walls become thicker and narrower, resulting in decreased blood supply to the kidneys.[16-18] While HT causes high pressure in the renal capillaries, protein leaks in the urine and damages endothelial cells and fibrosis in the renal tissue, altering the function of the kidneys.[18] Kt/V reported in this study is in a normal range, similar to study's result of Chaiviboontham, et al.[7] According to the Nephrology Association of Thailand, in order to ensure quality of care for HD patients, all HD centers have to comply the standard guideline.[19]

The top five prevalence of physical symptoms were itching, dry skin, lack of energy, trouble falling asleep, and trouble staying asleep. Symptom interference is a consequence of CKD pathophysiology, such as, the accumulation of urochrome and urea in the skin, and a decrease in sweat and sebaceous glands resulting in dry skin and itching.[20] In addition, the inflammatory process, parathyroid hormone, calcium, and phosphate level abnormalities also stimulate itching in patients with CKD.[21] Lack of energy in patients with ESRD could be influenced by many causes, including uremia, anemia, sleep disturbance, and stress.[22] Trouble falling asleep and trouble staying asleep are consequence of physical discomfort, such as, dyspnea, pain, itching or restless leg, and it can also be caused by psychological coadditions, such as stress or anxiety.[23,24]

This study's results showed that itching and dry skin were the most prevalence of symptoms, which congruent with the previous study by Chaiviboontham, et al.[7] However, the percentage of these symptoms were inconsistent, may be possibly difference in instrument and period of symptoms assessment. The Dialysis symptom Index - Thai (DSI-THAI) was used in their study, which assessed symptoms in terms of prevalence, severity dimension and assessed symptoms period in the past month. Additionally, some parts of this study's results are different to those in previous studies in Switzerland,[9] Uruguay,[25] and Jordan.[26] For example, the study conducted in Switzerland reported that the most of symptoms in

severity included decreased interest in sex (M = 4.1, SD = 1.1) and difficulty becoming sexually aroused (M = 4.1, SD = 1.1). A decrease in interest in sex and difficulty becoming sexually aroused were not reported in the present study, possibly due to cultural differences relating to the disclosure of personal perspectives regarding sex.

In terms of psychological symptoms interference, the present study found that boredom, irritability, and worry were the top three most prevalent, while worry and boredom were at the most level in the severity and distress dimensions. Boredom and irritability may result from the ongoing treatment process and the perception of ESRD progression that cannot be cured.[27] In terms of prevalence of irritability, the present study found 49.75% whereas there were reported 30.50-94.70% in previous studies.[7,28,29] Worry is due to perceived changes, perceived loss of image, or perception of worsening health because of CKD progression.[30] The result on prevalence and severity of worrying in this study is different from the study conducted in Thailand by Chaiviboontham et al.[7] in 2020, which found that the prevalence was 37.60% and mean score of severity was 0.83 (SD = 1.24). In the study conducted in Switzerland, the top three prevalence of psychological symptoms were feeling anxious (37.80%), feeling nervous (36.10%), and worrying (35.30%).[9] In different studies, psychological symptoms in persons with ESRD undergoing HD have been reported to be varied. Possibly there are other individual factors that may result in different perceptions regarding psychological symptoms.[31]

Using the TOUS as a framework helps the study to explore symptoms covering 3 dimensions. This allows healthcare providers to understand the symptom interference among patients with ESRD undergoing HD clearer. In additions, the results of this study may be useful information for planning on assessment and monitoring symptoms in these patients.

Limitation

This study was conducted with a convenience sample of patients with ESRD undergoing HD 2 – 3 times a week at the Bhumirajanagarindra Kidney Institute Hospital and four hospitals in Health Region Four, Thailand. Due to the COVID - 19 pandemic situations, the change in service context of some hospitals, which reduced the number of patients and necessary to expand data collection from other hospitals. Therefore, symptom interference reported in this study might not represent all patients with ESRD undergoing HD in Health Region Four. In this study, 42 participants were unable to read or answer the questionnaires by themselves. Therefore, interview was used to collect data among these patients. Collecting data with a different method may be a limitation of this study.

Conclusion

This study found that Thai patients with end-stage renal disease undergoing HD experienced interfering physical and psychological symptoms, especially itching, dry skin, lack of energy, trouble falling asleep, trouble staying asleep, boredom irritability, and worry. This information indicates that regular symptom assessment and more effective symptom management are needed.

Recommendations and Implications

Symptom interference in patients with ESRD undergoing HD reported in this study was assessed at only one time point. However, symptom interference can change over time. Therefore, assessment of symptom interference should continue and cover all symptom dimensions. In order to achieve this standard of care, the Thai MSAS-ESRD should be launched on mobile applications, which HD patients can access and report their symptoms at any time anywhere. Data reports from the applications should be recorded in the system and healthcare providers can use the information to create care plan and appropriate symptom

management strategies for individual patient. In addition, in order to establish effective two-way communications, more menu functions such as online online message, questions and answers should be added in the mobile application. Furthermore, common symptom management strategies should be added in the mobile application.

Participation in article writing

Charuedee Putruttanamaneekun contributed in developing research proposal, data collection, data analysis and writing the manuscript. Yaowarat Matchim and Adis Tasanarong contributed in shaping research design, data analysis and helping in revising the manuscript.

Conflict of interest

None

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