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Original Article

Predictors of Emergency Department Visits in Home Healthcare Patients: A Case-Control Study in Taiwan

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SUMMARY

Objectives: Home healthcare (HHC) is an important care choice for ageing people with disabilities; however, the risk factors for emergency department (ED) visits, a poor outcome index, remain unclear. Therefore, we conducted this study to clarify it.
Methods: We conducted a case-control study from a medical center in Taiwan by identifying HHC patients between Aug 1, 2019, and July 31, 2021. Age, sex, iatrogenesis, underlying comorbidities, and ED visit data were collected. Univariable and multivariable logistic regression analyses were performed to identify independent predictors of ED visits.
Results: We identified 240 patients, including 133 patients with and 107 patients without ED visits, for this study. The mean ages were 83.9 and 83.3 years and females accounted for 71% and 60.9% of patients without and with ED visits, respectively. Multivariable logistic regression analyses showed that urinary catheters (adjusted odds ratio [aOR]: 5.84; 95% confidence interval [CI]: 1.48–23.01, $p = 0.012$) and peptic ulcer disease (PUD)/gastroesophageal reflux disease (GERD) (aOR: 2.27; 95% CI: 1.12–4.61, $p = 0.023$) were independent predictors of ED visits. Stratified analyses according to sex and age showed that PUD/GERD and dyslipidemia were significant predictors of ED visits in female patients.
Conclusions and clinical implications: This study identified independent predictors of ED visits in HHC patients. Our results provide an important reference for the early prevention, recognition, and adjustment of care plans for at-risk patients. Further studies recruiting more patients and external validation are warranted.

1. Introduction

The world's population is rapidly aging. In 2020, there were 727 million people above 65 years old in the world and this number is projected to double by 2050.[1] In Taiwan, the ageing people accounted for 14% of the population in 2018 and will exceed 20% by 2025.[2] The number of ageing people with functional disabilities in Taiwan was 0.48 million (16.5%) in 2015 and is projected to increase to 0.95 million by 2031.[3] Compared to conventional hospital-based care, home healthcare (HHC) is more suitable for some patients' and families' needs and may be more cost-efficient, of higher quality, and have better outcomes.[4] Therefore, the Taiwan government initiated integrated HHC in 2015 to provide more convenient healthcare and decrease unnecessary emergency department (ED) visits and hospitalization.[2] The number of patients receiving HHC in Taiwan increased from 7,675 in 2016 to 75,591 in 2021, nearly a ten-fold increase.[2]

The aim of HHC is for aging in place as well as reducing ED visits and hospitalization.[5] ED visits during HHC are indicators of negative outcomes,[2,6,7] which increases the burden on families and medical insurance. Previous studies reported that approximately 20%–30% of patients who receive HHC may visit the ED or get hospitalized.[7,8] Therefore, the early identification of risk factors associated with ED visits in HHC patients, and the adoption of preventive interventions are important to ensure high quality of care.[9] A study conducted in the United States reported that chronic obstructive pulmonary disease (COPD) and home healthcare agency characteristics were associated with ED use.[10] A study conducted in Europe validated seven risk scores, namely, Detection of Indicators and Vulnerabilities for Emergency Room Trips (DIVERT), Community Assessment Risk Screen (CARS), Emergency Admission Risk Likelihood Index (EARLI), previous acute admissions, Changes in Health, End-stage disease, and Symptoms and Signs (CHESS), Fried Frailty Criteria, and the Frailty Index to predict unplanned ED visits or hospitalization.[9] They found that the performance varied across countries and suggested that

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unplanned hospital visits depend on the context of healthcare.[9] Therefore, scores reported from other countries may not be applicable locally due to differences in policy, healthcare, and cultures.[9] Further, studies that predicted of ED visits in HHC patients in the Asian population were not found in the literature; therefore, we conducted this study to clarify it.

2. Methods

2.1. Study design, setting, and participants

We conducted this retrospective case-control study in a medical center, a 1288-bed tertiary medical center in Southern Taiwan.[11] Since 2017, this medical center initiated HHC and has provided continuous and holistic care to its patients.[11] The HHC in the medical center includes not only the patients in need after hospital discharge but also those who are directly discharged from the ED.[6] We included all patients who received HHC between August 1, 2019, and July 31, 2021, in this study (Figure 1). This study was approved by the Institutional Review Board of the Chi Mei Medical Center on 23 Nov 2022 (IRB Serial No.:11111-008).

2.2. Variables and data collection

Patients' data, including age, sex, iatrogenesis, underlying comorbidities, and ED visits were retrospectively collected from the electronic medical records by an experienced physician. The underlying comorbidities were defined as the diagnoses made by the treating physicians in the electronic medical records.

2.3. Case group and control group

We classified the HHC patients who did and did not visit the ED between August 1, 2019, and July 31, 2021, as the case and control groups, respectively.

2.4. Statistics

The two-sample t-test and Wilcoxon rank-sum test were used for continuous variables. Pearson's chi-squared test and Fisher's exact test were used for categorical variables. Multivariable logistic regression analyses were used to identify independent predictors of ED visits, including overall patients and stratified analyses according to sex and age. Statistical Analysis System 9.4 (SAS Institute Inc., Cary, NC, USA) was used for statistical analyses. The significance level was set at 0.05 (two-tailed).

3. Results

We included 240 HHC patients, 107 with and 137 without ED visits, in this study (Table 1). The mean ages of the patients without and with ED visits were 83.9 and 83.3 years, respectively. Participants aged ≥ 85 years were 51.4% and 48.1% among patients without and with ED visits, respectively. The percentages of female participants were 71.0% and 60.9% among patients without and with ED visits, respectively. Compared with patients without ED visits, those with ED visits had higher use of urinary catheters (10.5% vs. 2.8%, $p = 0.021$) and nasogastric tubes (11.3% vs. 1.9%, $p = 0.005$) and a higher prevalence of benign prostate hypertrophy (9.8% vs. 1.9%, $p = 0.012$). The most common underlying comorbidities were hypertension, dementia, diabetes, depression, osteoarthritis, cerebrovascular disease, peptic ulcer disease (PUD)/gastroesophageal reflux disease (GERD), frailty, congestive heart failure, dyslipidemia, Parkinsonism, chronic kidney disease, and malignancy. The mean ± standard deviation of the number of ED visits among patients with ED visits was 2.4 ± 2.0 during the study period.

Multivariable logistic regression analyses showed that urinary catheter use (adjusted odds ratio [aOR]: 5.84; 95% confidence interval [CI]: 1.48–23.01, $p = 0.012$) and PUD/GERD (aOR: 2.27; 95% CI, $p = 0.023$) were independent predictors of ED visits (Table 2). The aOR of COPD/asthma was 3.11; however, the difference was not statistically significant ($p = 0.052$). Age ≥ 85 years and sex were not significant predictors of ED visits.

Stratified analyses according to age and sex revealed that PUD/GERD (aOR: 2.52; 95% CI: 1.03–6.16) and dyslipidemia (aOR: 3.11; 95% CI: 1.12–8.63) were significant predictors of ED visits for the female patients (Table 3). The aORs of urinary catheter use in the four subgroups were increased; however, the differences were not statistically significant.

4. Discussion

We found that half of the HHC patients were aged ≥ 85 years and predominantly female. Independent predictors of ED visits were urinary catheter use and underlying comorbidities of PUD/GERD. In the univariable analysis, nasogastric tube feeding, and a history of benign prostate hypertrophy were significantly higher among patients with than among those without ED visits. Age ≥ 85 years did not predict ED visits. Stratified analyses showed that PUD/GERD and dyslipidemia were independent predictors of ED visits in female patients.

Patients with urinary catheters have more opportunities to visit the ED due to complications of urinary catheter use.[12–14] Patients with benign prostate hypertrophy are at higher risk of urinary retention and subsequent urinary catheter insertion.[15] Another possibility is that functional disabilities in HHC patients with urinary catheters may be more severe, which increases the risk of ED visits.[16] A study conducted in Canada reported that having a urinary catheter increased the risk of ED visits.[14] Another study conducted in the

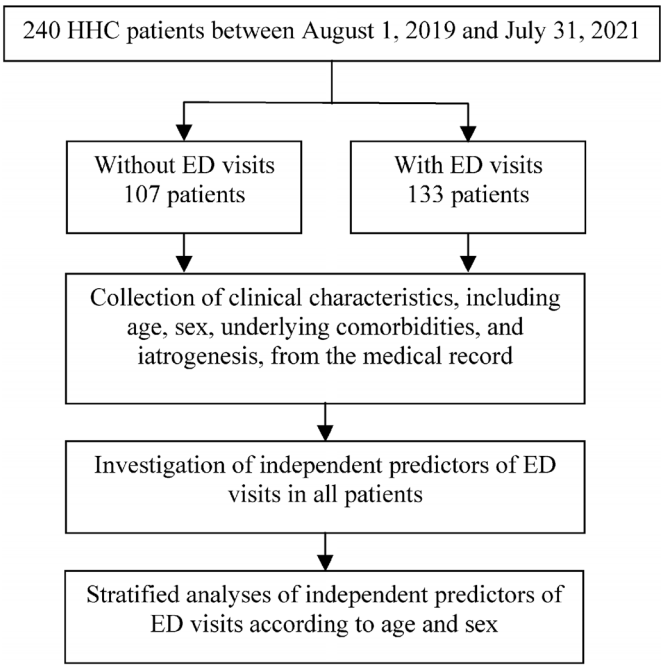

Figure 1. Flowchart of this study. HHC, home healthcare; ED, emergency department.

Table 1
Comparison of clinical characteristics between groups of HHC patients without and with ED visits.

Clinical characteristics	Total (n = 240)	Without ED visits (n = 107)	With ED visits (n = 133)	*p*-value
Age, mean ± SD	83.6 ± 9.2	83.9 ± 8.5	83.3 ± 9.7	
Age, median (Q1–Q3)	84.0 (79.5–90.0)	85.0 (80.0–91.0)	84.0 (79.0–90.0)	0.732#
Age subgroup, n (%)				0.613
< 85	121 (50.4)	52 (48.6)	69 (51.9)	
≥ 85	119 (49.6)	55 (51.4)	64 (48.1)	
Sex, n (%)				0.101
Female	157 (65.4)	76 (71.0)	81 (60.9)	
Male	83 (34.6)	31 (28.9)	52 (39.1)	
Iatrogenesis, n (%)				
Urinary catheter	17 (7.1)	3 (2.8)	14 (10.5)	0.021
Nasogastric tube	17 (7.1)	2 (1.9)	15 (11.3)	0.005
Tracheostomy	1 (0.4)	0 (0.0)	1 (0.8)	> 0.999*
Pigtail/PCN	1 (0.4)	0 (0.0)	1 (0.8)	> 0.999*
AV shunt/Permcath	3 (1.3)	1 (0.9)	2 (1.5)	> 0.999*
Underlying comorbidity, n (%)				
Hypertension	155 (64.6)	70 (65.4)	85 (63.9)	0.808
Dementia	120 (50.0)	59 (55.1)	61 (45.9)	0.153
Diabetes	101 (42.1)	45 (42.1)	56 (42.1)	0.994
Depression	73 (30.4)	36 (33.6)	37 (27.8)	0.330
Osteoarthritis	60 (25.0)	33 (30.8)	27 (20.3)	0.061
Cerebrovascular disease	44 (18.3)	20 (18.7)	24 (18.1)	0.898
PUD/GERD	54 (22.5)	18 (16.8)	36 (27.1)	0.059
Frailty	39 (16.3)	18 (16.8)	21 (15.8)	0.829
Congestive heart failure	41 (17.1)	17 (15.9)	24 (18.1)	0.659
Dyslipidemia	42 (17.5)	15 (14.0)	27 (20.3)	0.203
Parkinsonism	26 (10.8)	12 (11.2)	14 (10.5)	0.865
Coronary artery disease	21 (8.8)	12 (11.2)	9 (6.8)	0.226
Chronic kidney disease	32 (13.3)	10 (9.4)	22 (16.5)	0.103
Malignancy	24 (10.0)	9 (8.4)	15 (11.3)	0.462
COPD/Asthma	19 (7.9)	5 (4.7)	14 (10.5)	0.095
Gout	19 (7.9)	5 (4.7)	14 (10.5)	0.095
Arrhythmia	14 (5.8)	5 (4.7)	9 (6.8)	0.492
Osteoporosis	12 (5.0)	5 (4.7)	7 (5.3)	0.835
Seizure	6 (2.5)	3 (2.8)	3 (2.3)	0.898*
Benign prostate hypertrophy	15 (6.3)	2 (1.9)	13 (9.8)	0.012
Gallbladder stone	4 (1.7)	2 (1.9)	2 (1.5)	> 0.999*
Deep vein thrombosis	2 (0.8)	2 (1.9)	0 (0.0)	0.198*
Hepatitis B/C	2 (0.8)	2 (1.9)	0 (0.0)	0.198*
Rheumatic disease	4 (1.7)	1 (0.9)	3 (2.3)	0.631*
Hematologic disease	7 (2.9)	1 (0.9)	6 (4.5)	0.135*
Liver cirrhosis	2 (0.8)	1 (0.9)	1 (0.8)	> 0.999*
Thyroid disease	5 (2.1)	0 (0.0)	5 (3.8)	0.067*
Adrenal insufficiency	1 (0.4)	0 (0.0)	1 (0.8)	> 0.999*
Number of ED visit, mean ± SD		0	2.4 ± 2.0	
Number of ED visit, median (Q1–Q3)		0	2.0 (1.0–3.0)	

Wilcoxon rank-sum test. * Fisher's exact test.

AV, arteriovenous; COPD, chronic obstructive pulmonary disease; ED, emergency department; GERD, gastroesophageal reflux disease; HHC, home health care; PCN, percutaneous nephrostomy; PUD, peptic ulcer disease; SD, standard deviation.

United Kingdom revealed that 41% of patients with urinary catheter problems were hospitalized and 49% of them received antibiotics following ED visits.[12] Most admissions were indicated for intravenous antibiotics under the impression of urinary catheter-related infections.[12] In a study conducted in Japan, urinary catheter use was found to increase the risk of emergency home visits in HHC patients (relative risk: 1.94; 95% CI: 1.22–3.08, $p = 0.005$).[17] To avoid urinary catheter-related complications, the Centers for Disease Control and Prevention in the United States published the Catheter-Associated Urinary Tract Infections (CAUTI) guideline to help health care physicians appropriately use urinary catheters.[18]

PUD/GERD is a common problem among older people.[19,20] Despite the advancement in treatment for PUD/GERD, the rate of peptic ulcer bleeding and morbidity remains high for ageing patients.[19] Ageing patients are prescribed non-steroidal anti-inflammatory drugs (NSAIDs) and aspirin for pain and prevention of cardiovascular and cerebrovascular diseases, due to multiple comorbidities which increases the risk of complications, ED visits, hospitalization, and even death.[19,20]

Patients with nasogastric tubes often visit the ED due to dislodged and blocked tubes.[13] A study conducted in the United Kingdom reported that 30% of patients with nasogastric tube problems were hospitalized following ED visits, and the average cost per attendance was $1,071.[13] Cautious use of nasogastric tubes is suggested for older frail people because it does not affect the outcome and quality of life. In a study conducted in Taiwan, older patients on nasogastric tube feeding had a higher risk of pneumonia than those on assisted hand feeding (48% vs. 26%, $p = 0.015$).[21] The hospitalization rate and duration in the patients on nasogastric tube feeding were not lower than for those on assisted hand feeding.[21] In addition

Table 2
Independent predictors of ED visits in all HHC patients by logistic regression analyses*.

	cOR (95% CI)	aOR (95% CI)†	*p*-value‡
Age ≥ 85 years (reference: < 85 years)	0.88 (0.53–1.46)	0.85 (0.46–1.56)	0.589
Male sex (reference: female)	1.57 (0.91–2.71)	1.55 (0.83–2.88)	0.168
Urinary catheter (reference: no)	4.08 (1.14–14.59)	5.84 (1.48–23.01)	0.012
Underlying comorbidity (reference: no)			
Hypertension	0.94 (0.55–1.60)	0.94 (0.50–1.76)	0.838
Dementia	0.69 (0.41–1.15)	0.82 (0.44–1.53)	0.526
Diabetes	1.00 (0.60–1.68)	1.03 (0.55–1.91)	0.933
Depression	0.76 (0.44–1.32)	0.98 (0.52–1.85)	0.952
Osteoarthritis	0.57 (0.32–1.03)	0.61 (0.31–1.20)	0.150
Cerebrovascular disease	0.96 (0.50–1.85)	0.72 (0.34–1.56)	0.405
PUD/GERD	1.84 (0.97–3.46)	2.27 (1.12–4.61)	0.023
Frailty	0.93 (0.47–1.85)	1.53 (0.66–3.53)	0.322
Congestive heart failure	1.17 (0.59–2.30)	0.88 (0.39–1.98)	0.752
Dyslipidemia	1.56 (0.78–3.12)	1.92 (0.85–4.38)	0.119
Parkinsonism	0.93 (0.41–2.11)	1.30 (0.53–3.19)	0.563
Coronary artery disease	0.58 (0.23–1.42)	0.39 (0.14–1.07)	0.067
Chronic kidney disease	1.92 (0.87–4.26)	1.55 (0.63–3.79)	0.339
Malignancy	1.38 (0.58–3.30)	1.23 (0.48–3.16)	0.668
COPD/asthma	2.40 (0.84–6.89)	3.11 (0.99–9.75)	0.052
Gout	2.40 (0.84–6.89)	2.51 (0.78–8.09)	0.124
Arrhythmia	1.48 (0.48–4.56)	2.05 (0.56–7.56)	0.282
Osteoporosis	1.13 (0.35–3.68)	1.69 (0.44–6.42)	0.443
Seizure	0.80 (0.16–4.05)	0.85 (0.15–4.75)	0.851

* Variables with more than three observations in each cell (as shown in Table 1) were selected and put into the logistic model. † Adjusted for age, sex, iatrogenesis, and all underlying comorbidities. ‡ For aOR.
aOR, adjusted odds ratio; CI, confidence interval; COPD, chronic obstructive pulmonary disease; cOR, crude odds ratio; ED, emergency department; GERD, gastroesophageal reflux disease; HHC, home healthcare; PUD, peptic ulcer disease.

Table 3
Stratified analyses of independent predictors of ED visits among HHC patients by age and sex*.

	Age < 85 years	Age ≥ 85 years	Male	Female
Age ≥ 85 years (ref: < 85 years)			0.68 (0.21–2.24)	0.96 (0.45–2.03)
Male sex (ref: female)	2.01 (0.77–5.24)	1.57 (0.63–3.93)		
Urinary catheter (ref: no)	4.10 (0.53–31.75)	5.56 (0.87–35.52)	9.03 (0.52–155.71)	3.08 (0.67–14.10)
Underlying comorbidity (ref: no)				
Hypertension	0.55 (0.22–1.37)	1.73 (0.66–4.55)	1.10 (0.35–3.41)	0.70 (0.32–1.55)
Dementia	0.62 (0.25–1.53)	0.94 (0.35–2.53)	0.48 (0.15–1.53)	1.20 (0.55–2.62)
Diabetes	0.70 (0.29–1.69)	1.24 (0.47–3.29)	0.76 (0.24–2.38)	1.17 (0.54–2.54)
Depression	1.23 (0.48–3.18)	0.83 (0.32–2.19)	0.79 (0.21–2.98)	1.17 (0.54–2.53)
Osteoarthritis	0.29 (0.08–0.97)	0.88 (0.35–2.20)	0.72 (0.19–2.77)	0.73 (0.32–1.67)
Cerebrovascular disease	0.53 (0.17–1.64)	0.79 (0.25–2.47)	1.11 (0.27–4.61)	0.59 (0.20–1.72)
PUD/GERD	1.45 (0.54–3.88)	2.53 (0.86–7.43)	1.46 (0.39–5.49)	2.52 (1.03–6.16)
Frailty	3.16 (0.52–19.18)	1.02 (0.34–3.09)	1.07 (0.19–6.11)	1.65 (0.62–4.38)
Congestive heart failure	1.63 (0.54–4.92)	0.52 (0.13–2.15)	0.67 (0.12–3.73)	0.96 (0.36–2.55)
Dyslipidemia	1.72 (0.57–5.16)	1.64 (0.43–6.27)	0.68 (0.15–3.17)	3.11 (1.12–8.63)
Parkinsonism	1.10 (0.31–3.90)	1.67 (0.43–6.45)	1.33 (0.25–6.98)	1.52 (0.52–4.45)
Coronary artery disease	0.61 (0.15–2.45)	0.24 (0.03–1.55)	0.21 (0.02–2.02)	0.60 (0.18–2.04)
Chronic kidney disease	1.37 (0.43–4.34)	1.52 (0.31–7.46)	3.06 (0.50–18.63)	1.23 (0.42–3.63)
Malignancy	1.14 (0.30–4.40)	0.99 (0.24–4.07)	1.23 (0.32–4.72)	1.43 (0.34–6.07)
COPD/asthma	1.30 (0.25–6.88)	4.19 (0.78–22.62)	7.02 (0.27–182.93)	2.16 (0.62–7.48)
Gout	5.31 (0.99–28.42)	1.49 (0.22–10.15)	2.17 (0.31–4.72)	2.87 (0.64–12.91)
Arrhythmia	1.92 (0.22–16.83)	1.99 (0.34–11.45)	0.80 (0.10–6.27)	3.20 (0.50–20.35)
Osteoporosis	1.74 (0.09–35.37)	1.72 (0.36–8.23)	1.67 (0.4–20.37)	1.30 (0.27–6.31)

* Variables with more than five observations in each cell (as shown in Table 1) were selected into the logistic model. All the data were presented as adjusted odds ratios (95% confidence intervals) after adjusting for age, sex, iatrogenesis, and all underlying comorbidities.
COPD, chronic obstructive pulmonary disease; ED, emergency department; GERD, gastroesophageal reflux disease; HHC, home health care; PUD, peptic ulcer disease.

to identifying these predictors, strategies for preventing them during ED visits, including the education of caregivers and health care physicians, are also needed.[13]

Interestingly, patients aged ≥ 85 years did not have higher ED visit rates than those aged < 85 years in this study. Generally, increasing age contributes to increased ED visit rates.[22] However, HHC patients and nursing home residents may not have the same medical resource use with general elders because they already have routine health care. A systemic review showed that there is no clear association between age and ED visits among nursing home residents.[23]

For female patients, PUD/GERD and dyslipidemia were independent predictors of ED visits in this study; however, this result was not found for male patients. The possible reason is that older women have more PUD/GERD-associated symptoms than older men,

contributing to an increased ED visit rate. A meta-analysis reported that women are 40% more likely to have GERD symptoms than men in South America and the Middle East.[24] Because GERD is more prevalent in postmenopausal women, the effect of estrogen is thought to be the cause of the sex difference.[24] In Taiwan, a study including 1238 participants reported that the female sex was an independent predictor of the development of GERD.[25] The odds ratio of the female sex was 1.71 with a 95% CI of 1.26–2.34 after multivariate analyses.[25] The positive association between dyslipidemia and ED visits is difficult to explain based on current evidence. A study on ED visits after bariatric surgery reported that dyslipidemia was an independent predictor.[26] However, the authors did not explain the cause. Further studies are needed to clarify this issue.

The major strength of this study is that it is the first study conducted in Asia to identify independent predictors of ED visits in HHC patients. It provides an important reference for the early prevention and recognition of at-risk patients and may help HHC physicians to adjust care plans. Another benefit of the result of this study is that it provides evidence to decrease the use of urinary catheters in HHC patients. However, this study has a few limitations. First, our data were collected from a single medical center; therefore, the generalization of the result requires external validation. Second, the study period spanned from July 1, 2019, to August 31, 2021, covering the COVID-19 pandemic. This event may have influenced healthcare-seeking behavior, including ED visits. Therefore, caution should be exercised when applying the results of this study to non-pandemic situations. Third, due to the small sample size, variables that did not reach statistical significance still merit attention. Future studies should aim to recruit more HHC patients and conduct validations in other hospitals and non-pandemic contexts. Fourth, the exclusive selection of patients based on ED visits within a specific interval may introduce selection bias. Patients who visited the ED just before or after the study period might have different characteristics or healthcare needs. To enhance the study's methodological rigor, further study should refine the design by including criteria for pre-index or post-index ED visits to ensure a clearer distinction between cases and controls. This adjustment would aim to minimize biases and improve the clarity of the study's conclusions regarding predictors of ED visits.

5. Clinical implication

We found that urinary catheter use and PUD/GERD were independent predictors of ED visits in HHC patients. The possible reasons are that urinary catheter use and PUD/GED increase the risk of complications and subsequent ED visits. Cautious use of urinary catheters in HHC patients is suggested. Another explanation is that patients with these risk factors are frailer than those without these risk factors; therefore, the risk for ED visits may increase. These findings provide an important reference for the early prevention, identification, and adjustment of health care plans for at-risk patients. The study's impact on clinical practice includes enabling more precise predictions of ED visits and the formulation of better care plans during discussions with patients and their families. In the future, the recruitment of more patients and external validation are warranted to better clarify this issue.

Ethics approval and consent to participate

This study was conducted under the declaration of Helsinki and approved by the institution review board of the Chi Mei Medical Center. The approval number is: 11111-008. All the data were anonymized. Because the study was retrospective and observational, patients' informed consent was waived. The waiver does not affect the welfare of the patients.

Consent for publication

Not applicable.

Availability of data and material

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no conflicts of interest.

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Authors' contributions

JWJ, KTT, CCC, and CC Huang designed and conceived this study. PIL, CC Hsu, and HJL assisted in the implementation. CHH and YCC performed the statistical analysis. All the authors wrote, read, and approved the final manuscript.

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