Appendix S1 Search strategy

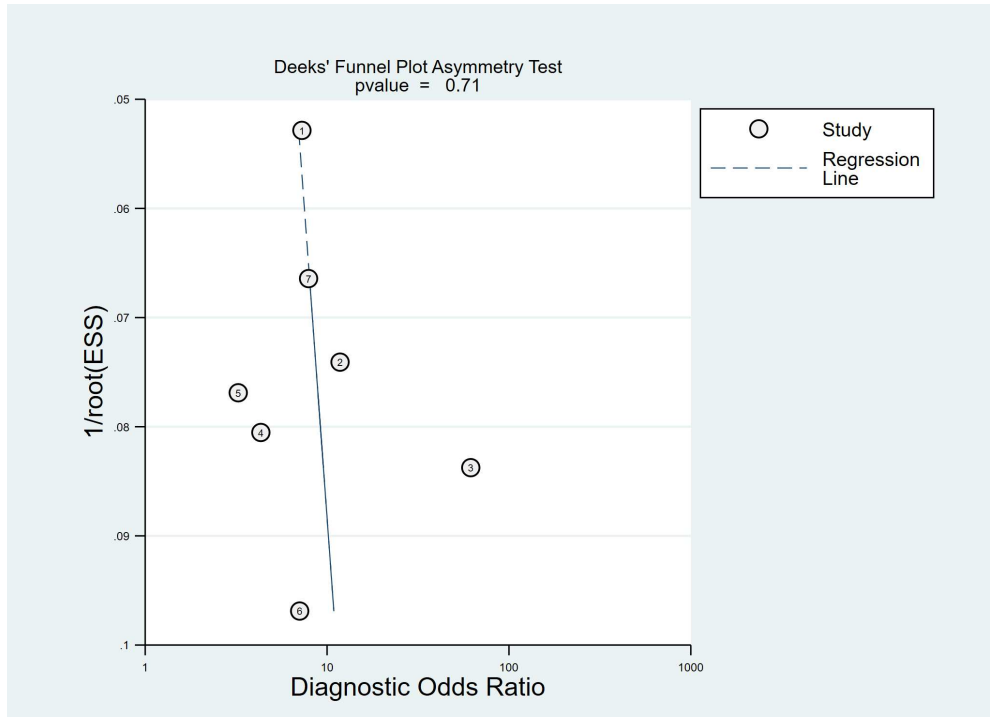| |
|---|
| ("palliative care"[MeSH Terms] OR "palliative care"[Title/Abstract] OR "advance care planning"[MeSH Terms] OR "advance care plan*"[Title/Abstract] OR "terminal care"[MeSH Terms] OR "terminal care"[Title/Abstract] OR "terminally ill"[MeSH Terms] OR "terminally ill"[Title/Abstract] OR ("hospices"[MeSH Terms] OR "hospice care"[MeSH Terms]) OR "hospice"[Title/Abstract] OR "hospice care"[MeSH Terms] OR "hospice care"[Title/Abstract] OR "life support care"[MeSH Terms] OR "life support care"[Title/Abstract] OR "death"[MeSH Terms] OR "death"[Title/Abstract] OR "palliat*"[Title/Abstract] OR "advance directives"[Title/Abstract] OR "end of life care"[Title/Abstract] OR "supportive care"[Title/Abstract] OR ("last"[All Fields] AND "months of life"[Title/Abstract]) OR "last year of life"[Title/Abstract] OR "life-limiting"[Title/Abstract] OR "life-threatening"[Title/Abstract] OR "deterioration"[Title/Abstract]) |
| AND |
| ("screening tools"[Title/Abstract] OR "tool*"[Title/Abstract] OR "instrument"[Title/Abstract] OR "assessment"[Title/Abstract] OR "guidance"[Title/Abstract] OR "guideline"[Title/Abstract] OR "indicator"[Title/Abstract] OR "risk assessment"[MeSH Terms] OR "risk assessment"[Title/Abstract] OR "mass screening"[MeSH Terms] OR "mass screening"[Title/Abstract] OR "screen*"[Title/Abstract] OR ("diag*"[All Fields] AND "tool"[Title/Abstract]) OR "evaluation"[Title/Abstract] OR ((("ieee int conf automation sci eng case"[Journal] OR "case phila"[Journal] OR "case"[All Fields]) AND "n3"[All Fields]) AND "finding"[Title/Abstract])) |
| AND |
| ("early identification"[Title/Abstract] OR "early identifying"[Title/Abstract] OR "early recognition"[Title/Abstract] OR "timely identification"[Title/Abstract] OR "timely assessment"[Title/Abstract] OR (("identif*"[All Fields] AND "n3"[All Fields]) AND "palliative"[Title/Abstract]) OR (("identif*"[All Fields] AND "n3"[All Fields]) AND "tool"[Title/Abstract]) OR (("identif*"[All Fields] AND "n3"[All Fields]) AND "instruments"[Title/Abstract]) OR (("identif*"[All Fields] AND "n3"[All Fields]) AND "dying"[Title/Abstract]) OR ("identif*"[All Fields] AND "n3 patients"[Title/Abstract])) |

Appendix S2 Risk of bias for the included studies (Cohort study)

First author,Year	Quality Rating Questions								Score 1	Score 2	Mean
	1	2	3	4	5	6	7	8			
Rainone 2007	a*	a*	a*	a*	none	b*	a*	d	6	7	6.5
Haga 2012	b*	a*	a*	a*	none	b*	a*	a*	7	5	6
O'Callaghan 2014	a*	a*	a*	a*	none	a*	a*	a*	7	7	7
Raubenheimer 2019	b*	a*	a*	a*	none	b*	a*	b*	7	7	7
Gómez-Batiste 2017	a*	a*	a*	a*	none	b*	a*	b*	7	7	7
Calsina-Berna 2018	a*	a*	a*	a*	b**	a*	a*	a*	9	7	8
Gastelurrutia 2019	a*	a*	a**	a*	none	a*	a*	d	7	7	7
TaberneroHuguet 2020	c	a*	a*	a*	b*	a*	a*	d	6	8	7
Wang 2019	a*	a*	d	a*	b*	a*	a*	a*	7	7	7
Yen 2020	a*	a*	a*	a*	b**	b*	a*	b*	9	7	8
Yen 2022	a*	a*	a*	a*	b**	b*	a*	b*	9	7	8
Yen 2022	a*	a*	a*	a*	b**	b*	a*	d	8	7	7.5
DeBock 2017	a*	a*	a*	a*	none	a*	a*	d	6	7	6.5
SyChan 2020	a*	a*	a*	a*	none	a*	a*	a*	7	7	7
Piers 2021	b*	a*	a*	a*	none	a*	a*	a*	7	6	6.5
VanWijmen 2021	a*	a*	a**	a*	none	b*	a*	b*	8	7	7.5
Low 2021	b*	a*	a*	a*	none	a*	a*	d	6	8	7

Appendix S2 Risk of bias for the included studies (RCT study)

First author, Year	Bias					
	Selection bias (Random sequence generation)	Selection bias (Allocation concealment)	Blinding of participants and researchers	Detection bias (Blinding of outcome assessment)	Attrition bias (Incomplete outcome data)	Reporting bias (Selective reporting)
Mitchell 2018	High risk	Unclear risk	Low risk	Low risk	Low risk	Unclear risk

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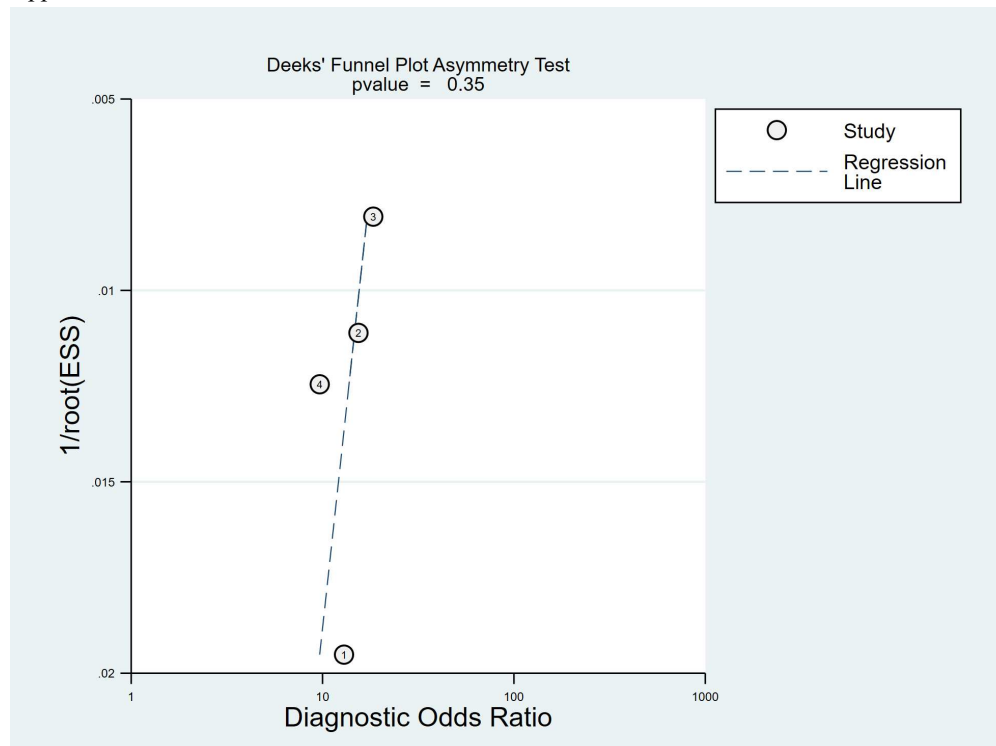
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Appendix S3 Publication bias of SPICT

Appendix S3 Publication bias of NECPAL
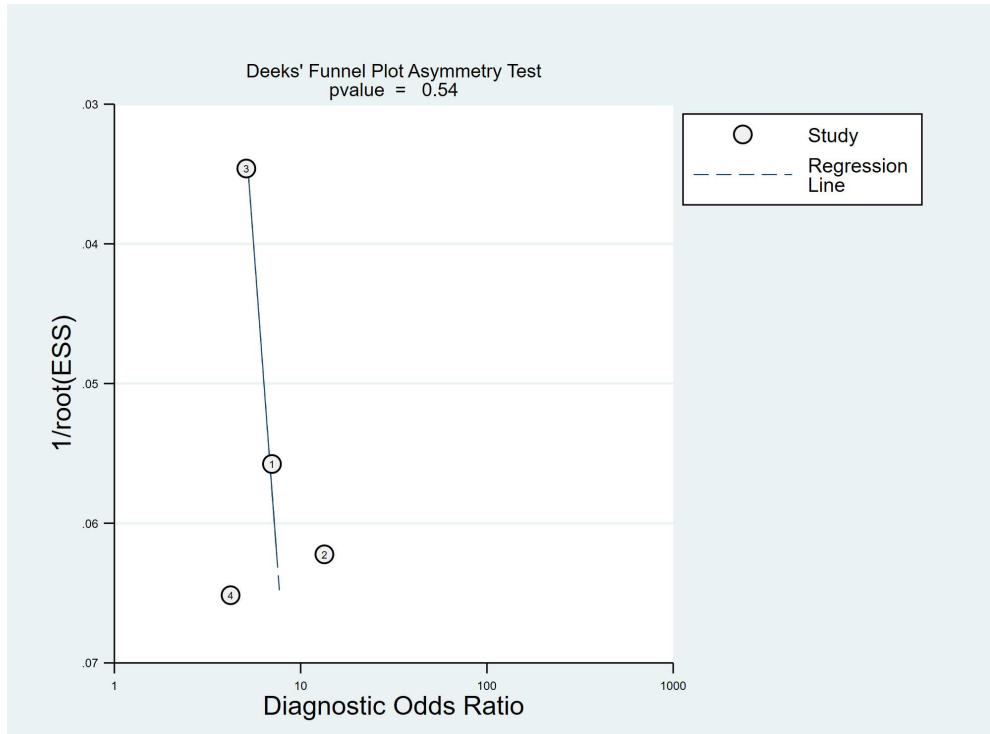
Appendix S3 Publication bias of TW-PCST

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Appendix S4 Main features of the identified screening instruments (Continued)

	GSF-PIG	RADPAC	NECAPL	SPICT	TW-PCST	Rainone	Anticipal
General indicators							
Functional performance	General physical decline; Spends 50% of the day in bed or chair; Experiencing increased dependence on most daily activities;	NM	Karnofsky or Barthel score > 30%; Loss more than 2 activities of daily living; Persistent symptoms;	Poor performance status; Spends 50% of the day in bed or chair;	Assessing performance status using ECOG scale.	Karnofsky score > 50%; Loss ≥2 activities of daily living; ECOG score≤3;	The entry indicates a very poor code
Unplanned hospital admissions	Repeated	NM	More than 2 unplanned hospital admittances at last 6 months.	Unplanned hospital admissions;	More than 6 hospital admissions for the same diagnosis in the past 30 days; An ICU stay exceeding 30 days with a poor prognosis or ineffective treatment;	Recurrent or extended hospital admissions for the same illness in the past 12 months	NM
Symptom burden	Unstable, deteriorating, complex symptom burden	NM	NM	Persistent symptoms despite optimal but ineffective treatment.	Unacceptable pain	NM	NM
Specific clinical indicators	Cancer, General Neurological, CHF, COPD, Liver disease, Frailty, Dementia, Stroke, Kidney disease, Parkinson's disease, Motor Neurological disease, Multiple Sclerosis	Cancer, COPD, CHF	Cancer, COPD, CHF, Dementia, Frailty, Stroke, Chronic Neurological Diseases, Chronic Liver disease, Chronic kidney disease	Cancer, Heart/ vascular disease, kidney disease, Dementia/Frailty, Respiratory disease, Liver disease, Neurological disease	2 points for any of the following: Cancer, COPD, Liver disease, Kidney dialysis, Cardiac disease, Neurologic disease (stroke, coma, dementia), ARDS, Sepsis, or MODS	AIDS, Cancer, CHF, COPD, Dementia	Cancer, Heart/ vascular disease, Dementia, Frailty, Stroke, Kidney disease, Liver disease

(Continued)

Appendix S4 Main features of the identified screening instruments (Continued)

	GSF-PIG	RADPAC	NECPAL	SPICT	TW-PCST	Rainone	Anticpal
Comorbid illness	Significant multi-morbidities	NM	>2 chronic diseases	NM	1 point for each cancer and five comorbidities	NM	Codes indicating multi-organ failure and multiple morbidity
Psychosocial aspects	NM	NM	Cognitive decline: Loss > minimental or > 3 Pfeiffer; Detection of Emotional Distress Scale (DME) > 9	NM	Psycho-spiritual problems out of control	Patients or family members are frustrated after an acute illness attack because the results are not optimal after the best treatment.	NM
Adverse events happen	Seriously fall, bereavement, transfer to nursing home	NM	Geriatric Syndromes (≥ 2 geriatric syndromes (recurrent or persistent)	NM	NM	NM	NM
Choosing palliative care	Choosing no further active treatment	NM	Limitations of therapeutic effort were mentioned by patients, family or team members.	Patients request palliative care or reduce treatment or wish focus on quality of life.	Patients/family/team need help with complex decision making and goal setting.	NM	NM
Others	Considered eligible for DS1500 payment.	NM	Demand: Have the patient, family, or team members made any requests to limit treatment or palliative care? Need: Identified by healthcare professors	The carter needs more help. Care Plan Recommendations.	NM	NM	NM

ARDS, acute respiratory distress syndrome; COPD, chronic obstructive pulmonary disease; CHF, Congestive heart failure; MODS, multiple organ dysfunction syndrome; GSF-PIG, Gold Standards Framework Prognostic Indicator Guidance; NECPAL, Necesidades Paliativas [PalliativeNeeds]; RADPAC, RADboud indicators for PAlliative Care needs; SPICT, Supportive and Palliative Care Indicators Tool; TW-PCST, Taiwanese version Palliative Care Screening Tool; SQ, Surprise Question; DS1500, a medical report that enables advanced diseases patients in the UK to access social care; NR, not reported; NM, not mentioned; NA, not applicated;

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Appendix S5 Summary of the psychometric properties of screening instruments for early identification of patients in need of palliative care

	Reference (Country)	Content validity						Structural validity		Internal consistency		Cross-cultural validity		Reliability		Measurement error		Criterion validity	
		Relevance		Comprehensiveness		Comprehensibility													
		MQ	QR	MQ	QR	MQ	QR	MQ	OR	MQ	QR	MQ	QR	MQ	QR	MQ	OR	MQ	QR
GSF-PIG	UK	NR		NR		NR		NR		NR		NR		NR		NR		NR	
	Italia	NR		NR		NR		NR		NR		NR		NR		NR		NR	
RADPAC	Netherland	3	-	3	-	3	-	NR		NR		NR		NR		NR		NR	
NECPAL	Spain	3	+	3	+	3	+	NR		NR		NR		NR		NR		NR	
	Portugal	3	±	3	±	3	?	NR		NR		NR		NR		NR		NR	
	Israel	3	+	2	+	3	?	NR		NR		NR		1	+	NR		NR	
SPICT	UK	3	±	3	-	3	-	NR		NR		NR		NR		NR		NR	
	German	3	±	3	?	3	-	NR		NR		NR		NR		NR		NR	
	Spain	3	±	3	-	3	-	NR		2	+	NR		2	+	NR		NR	
	Italia	2	+	2	+	2	+	NR		1	+	NR		2	+	NR		NR	
	Thailand	2	+	2	+	3	+	NR		2	-	2	+	2	+	NR		NR	
	Denmark	3	±	2	+	3	-	NR		NR		NR		NR		NR		NR	
	Sweden	2	±	3	-	3	-	NR		NR		NR		NR		NR		NR	
	Indonesia	3	?	3	?	3	?	NR		2	+	NR		1	+	NR		NR	
	Japan	3	±	3	?	3	-	NR		NR		NR		NR		NR		NR	
	Chile	3	?	3	?	4	-	NR		1	+	NR		NR		NR		NR	
TW-PCST	China Taiwan	4	?	4	?	4	?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Rainone	USA	4	?	4	?	4	?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
AncitiPal	UK	2	-	2	-	3	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	

MQ, measurement quality; QR, quality rating; NR, not reported

1 = very good, 2 = sufficient, 3 = doubtful, 4 = inadequate;

+, sufficient; −, insufficient; ±, inconsistent; ? indeterminate

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Appendix S6 Details clinical performance of the identified screening instruments reported in performance studies

Reference (Author, Year)	Screening instruments	Time frame of instruments	No. patients assessed (n)	No. Identified/Not identified (n)	No. patients died (n)	No. patient survival(n)	Sensitivity% (95% CI)	Specificity% (95% CI)	LR+ (95% CI)	LR- (95% CI)	PPV% (95% CI)	NPV% (95% CI)	c-statistic (95% CI)	DOR
Haga K et al 2014[49]	GSF-PIG	12-month	138	110 / 28	36 / 7	74 / 21	83.0	22.0	1.06	0.77	33.0	5.0	NR	1.38
O'Callaghan A et al 2014[50]	GSF-PIG	12-month	501	99 / 402	67 / 40	32 / 362	62.6	91.9	7.73	0.41	67.7	90.0	NR	18.85
Raubenheimer PJ et al 2019[51]	GSF-PIG	12-month	822	218 / 604	122 / 42	98 / 562	74.0 (68.0-81.0)	85.0 (83.0-88.0)	5.10 (4.15-6.26)	0.30 (0.23-0.39)	56.0 (49.0-63.0)	93.0 (91.0-95.0)	NR	17.00
Gómez-Batiste X et al 2017[52]	NECPAL	12-month	1059	780 / 279	261 / 25	519 / 254	91.3 (87.2-94.2)	32.9 (29.6-36.3)	1.36	0.26	33.5 (30.2-36.9	91.0 (86.9-94.0)	NR	5.23
Calsina-Berna A et al 2018[53]	NECPAL	12-month	236	97 / 139	70 / 53	27 / 86	56.9	76.1	2.38	0.57	72.2	61.9	0.665	4.18
Gastelurruti P et al 2019[54]	NECPAL	12-month	922	897 / 625	65 / 24	232 / 601	73.0	72.1	2.62	0.37	21.9	96.2	0.73 (0.68-0.78)	7.08
Tabernero Huguet E et al 2020[55]	NECPAL	12-month	363	87 / 276	54 / 30	33 / 246	64.3	88.2	5.70	0.43	62.1	89.1	NR	13.23
De Bock et al 2017[61]	SPICT	12-month	410	228 / 182	111 / 21	117 / 161	84.1	57.9	4.23	0.58	48.7	88.5	NR	7.29
Mitchell GK et al 2018[60]	SPICT	12-month	1525	78 / 1447	16 / 31	31 / 1416	34.0 (25.3-42.8)	95.8 (93.0-98.6)	8.10	0.65	20.5 (12.6-28.4)	97.9 (96.8-99.0)	NR	12.46
van Wijmen MPS et al 2020[62]	SPICT-NL	12-month	3640	101 / 3539	21 / 15	80 / 3524	58.0 (43.0-73.0)	98.0 (97.0-98.0)	29.00	0.43	20.8	99.6	NR	67.44

(Continued)

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Appendix S6 Details clinical performance of the identified screening instruments reported in performance studies (Continued)

Reference (Author, Year)	Screening instruments	Time frame of instruments	No. patients assessed (n)	No. Identified/Not identified (n)	No. patients died (n)	No. patient survival(n)	Sensitivity% (95% CI)	Specificity% (95% CI)	LR+ (95% CI)	LR- (95% CI)	PPV% (95% CI)	NPV% (95% CI)	c-statistic (95% CI)	DOR
Piers R et al 2021[64](AGUs)	SPICT-FR and SPICT-NK	12-month	209	124 85	42 9	82 76	82.4	48.1	1.59	0.37	33.9	89.3	0.822	4.30
Piers R et al 2021[64] (CUs)	SPICT-FR and SPICT-NK	12-month	249	101 148	34 20	67 128	63.0	65.6	1.83	0.56	33.7	86.8	0.651	3.28
Low J et al 2021[21]	SPICT	12-month	117	61 56	33 8	28 48	80.5 (65.1-91.2)	63.2 (51.3-73.9)	2.19	0.31	54.1 (40.8-66.9)	85.7 (73.8-93.6)	0.718 (0.636-0.800)	7.06
Chan AS et al 2022[63]	SPICT	6-month	227	137 90	91 18	46 72	83.5	61.0	2.14	0.27	66.4	80.0	NR	7.93
Wang SS et al 2019[56]	TW-PCST	6-month	8493	2568 5925	585 132	1983 5793	81.6	74.5	3.20	0.25	22.8	97.8	0.84 (0.83-0.86)	12.80
Yen YF et al 2020[57]	TW-PCST	3-month	47153	4897 42256	1225 896	3672 41360	57.8	91.8	7.05	0.46	25.0	97.9	NR	15.33
Yen YF et al 2022[59]	TW-PCST	6-month	111483	7428 104055	1973 2005	5455 102050	49.6 (48.0-51.1)	94.9 (94.8-95.1)	9.73	0.53	26.6 (25.8-27.4)	98.1 (98.0-98.2)	0.723	18.36
Yen YF et al 2022[58]	TW-PCST	12-month	21109	2363 18746	806 953	1557 17793	45.8 (43.4-48.2)	92.0 (91.6-92.4)	5.73	0.59	34.1 (32.6-35.7)	94.9 (94.7-95.2)	0.689 (0.677-0.701)	9.71
Rainone F et al 2007[22]	Rainone	NR	839	NR	NR	NR	94.0	97.0	31.33	2.00	36.0	99.0	NR	15.67

DOR, diagnostic odds ratio; LR+, positive likelihood ratio; LR–, negative likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; GSF-PIG, Gold Standards Framework

Prognostic Indicator Guidance; NECPAL, Necesidades Paliativas [PalliativeNeeds]; RADPAC, RADboud indicators for PAlliative Care needs; SPICT, Supportive and Palliative Care Indicators

Tool; TW-PCST, Taiwanese version Palliative Care Screening Tool; NR = not reported