Web table 1. Summary of 24 selected articles.

Reference/ Study Design	Aim	Sample (M±SD y/o) [range]	Intervention			Outcome measure	Main results	Jadad Score (0-5)
			Hospital Clowns (HC)	**Control**				
Vagnoli et al,[46] 2005 RCT	To investigate the effects of the presence of clowns on children's preoperative anxiety levels during the induction of anaesthesia and on the anxiety levels of parents accompanying them until they are asleep	40 children Clown Group: (6.85±2.21) Control Group: (7.30±2.72) [5–12 y/o]	(n=20), children were accompanied in the PR room by the clowns and a parent	(n=20), children were accompanied by only 1 of his/her parents		Anxiety. -Children: m-YPAS - Parents: STAI	Anxiety levels in the clown intervention group during the induction of anaesthesia was significantly lower compared with the control group (p=0.001). No significant difference was observed STAI Y-1/Y-2 average scores of parents in either group	1
Golan et al,[47] 2009 RCT	To determine whether specially trained professional clowns allayed preoperative anxiety and resulted in a smooth anaesthetic induction compared to the use of midazolam or no intervention.	65 patients (4.50± NR) [3–8 y/o]	Group 1 (n=21) children interacted with two clowns upon arrival to the PR and throughout the OR entrance	Group 2 (n=22) children did not receive midazolam or clown presence; Group 3 (n= 22) children received 0.5 mg/kg) oral midazolam 30 min before surgery up to a max. of 15 mg		Anxiety. - Children: m-YPAS - Parents: STAI	The m-YPAS score in the preoperative holding area was significantly lower for the clown-treated group than for the control group (p=0.01). The clowns' effect on anxiety reduction continued when the children entered the OR at which point it was equal to the midazolam group (p=0.005). Upon application of the anaesthesia mask, no significant difference was detected among the groups	1
Vagnoli et al,[48] 2010 RCT	To compare the effectiveness of three interventions for reducing preoperative anxiety in children undergoing minor surgery: a pharmacological intervention with sedative premedication (midazolam), clowns +PPIA, or PPIA only	75 patients Clown Group: (7.04 ± 2.23) Premedication Group: (8.04 ± 2.11) Control Group (7.36 ± 2.61) [5–12 y/o]	(n =25) children accompanied to the PR by the clowns and by a parent	(n =25) Premedication group, i.e., premedicated with oral midazolam and accompanied to the PR by one parent	(n=25) Control group only with one parent (PPIA)	Anxiety. - Children: m-YPAS - Parents: STAI	The level of anxiety was significantly reduced in the clown group compared to the premedication group (p=0.038) and the control group	2
Meisel et al,[49] 2010 NRCT	To determine the effect of the presence of clowns on children's distress and maladaptive behaviours while in hospital for minor surgery	61 children (6.00 ± 2.55) [3–12 y/o]	(n=28) children interacted with two clowns	(n=33) children with no clown intervention		Distress and Maladaptive Behaviours - Children: PBHQ FAS	Clowns were unable to reduce the average children's level of distress (p=0.06)	NA
Fernandes et al,[50] 2010 NRCT	To investigate whether clown intervention could reduce preoperative worries and the affective responses of children undergoing minor surgery	70 children (7.93± 2.36) [5–12 y/o]	(n =35) children accompanied by their parents and	(n =35) children accompanied by their parents		Worries and Emotional Responses.	Children in the clown group reported significantly less worries than those in the control group (p<0.001). In addition, these children reported a	NA

			a pair of clowns	but without clowns	- Children: CSWB SAM - Parents: STAI EAS	higher positive affect compared with those in control group ($p<0.01$)	
Hansen et al,[51] 2011 RCT	To assess the effect of the presence of a clown on children treated with botulinum toxin in an outpatient setting	60 children (4.00± NR) [0–15 y/o]	(n=32) children accompanied by one female clown	(n=28) children accompanied by their parents without interaction with clowns	Duration of Crying spells	Girls exhibited significantly shorter periods of crying when the clown was present ($p=0.016$). However, for boys younger than 8 y/o, no significant differences were observed ($p=0.14$)	1
Bertini et al,[52] 2011 RCT	To investigate the effects of the presence of a clown on both the clinical evolution of the on-going disease in children with respiratory pathologies and on some physiological and pain parameters	43 children Clown Group: (7.71±2.47) Control Group: (7.54±2.06) [5–11 y/o]	(n=21) children interacted with two clowns	(n=22) children without clown intervention	Pain - Children: NRS; CHEOPS; Wong Baker Pain Rating Scale	Children in the clown intervention group displayed faster reduction in respiratory symptoms ($p=0.03$) and lower diastolic blood pressure, respiratory frequency and temperature compared to the control group ($p=0.034$)	3
Pinquart et al,[53] 2011 RCT	To test whether clown visits are associated with an increase in psychological and perceived physical well-being of paediatric patients	100 children Clown Group: (10.00±2.30) Control Group: (9.50±2.40) [6–14 y/o]	(n= 50) children receiving clown visit	(n= 50) children without clown visit	Psychological and perceived Physical well-being - Children: KINDL-R	In the experimental group, children showed an increase in self-reported ($p< 0.01$) and parent-reported ($p< 0.01$) psychological well-being at the post-test, but these effects did not persist at follow-up	3
Kingsnorth et al,[54] 2011 NRCT	To examine the effects of therapeutic clowning on inpatients in a paediatric rehabilitation hospital	14 children and adolescents Clown Group: (10.70±5.00) Control Group: (10.7±2.90) [4–21 y/o]	(n= 7) children receiving therapeutic clowning	(n= 7) children exposed to television	Psychological and Emotional Responses - Children: EDA/BVP Respiration Temperature	Significant differences detected between children exposed to clown intervention relative to television exposure ($p<0.05$), with a direct and positive impact of therapeutic clowning on hospitalized children	NA
Tener et al,[55] 2012 NRCT	To examine the role of medical clowns during anogenital examination and their influence on the psychological distress	30 children and adolescents Clown Group: (9.55±4.50)	(n=24) children receiving medical clowns during the examination	(n= 6) children receiving standard care without medical clowns	Posttraumatic stress disorder symptoms - Children: PSS-I	When a medical clown was present during the examination, the child reported less pain ($p<0.05$), fear ($p<0.01$) and invasiveness ($p<0.05$)	NA

		Control Group: (14.52±3.40) [1–17 y/o]					
Wolyniez et al,[56] 2013 RCT	To report the effect of the presence of a medical clown during insertion of an intravenous catheter during their emergency department visit	47 children Clown Group: (7.00±4.00) Control Group: (8.00±4.00) [3–16 y/o]	(n=26) children receiving standard care with medical clown present	(n=21) children receiving standard care	Anxiety and Pain - Children: FPS-R VAS - Parents: STAI	The presence of a medical clown during a painful procedure in the paediatric emergency department tended to improve pain scores in children younger than 7 years (p=0.18). Parental situation anxiety was significantly reduced in parents of children older than 8 years (p= 0.02)	3
Dionigi et al,[57] 2014 RCT	To investigate whether clown doctor intervention could reduce preoperative anxiety in children hospitalized for minor surgery and their parents	77 children Clown Group: (5.70±NR) Control Group: (6.00±NR) [2–12 y/o]	(n=52) children accompanied in the PR by their parents and 2 clowns	(n=25) children accompanied by the parents only	Anxiety - Children: m-YPAS - Parents: STAI	The clown intervention significantly reduced children's preoperative anxiety in the waiting room and PR (p=0.004); also, children interacting with clowns exhibited improved adjustment than children in the control group	2
Goldberg et al,[58] 2014 RCT	To evaluate whether medical clowns can diminish perceived pain and anxiety by children undergoing allergy SPT	91 children Clown Group: (8.02±4.65) Control Group: (8.33±4.58) [2–17 y/o]	(n=45) children allocated to undergo SPT accompanied by their parents and clowns	(n=46) children allocated to undergo SPT accompanied by parents only	Anxiety and Pain - Children: m-YPAS STAIC FLACC VAS - Parents: STAI	A significant reduction in state anxiety after SPT was found in the clown group compared with the control group in parents and children (p= 0.004). Both m-YPAS and FLACC were reduced in the clown group compared with the control group (p<0.001)	1
Yun et al,[59] 2015 NRCT	To examine the effects of clown nurse educational intervention on children undergoing day surgery for strabismus	50 children Clown Group: (4.50±0.99) Control Group: (4.96±1.01) [3–6 y/o]	(n= 23) children receiving clown nurse educational intervention	(n= 27) children receiving only routine care	Anxiety and Pain - Children: m-YPAS FPS-R - Parents: STAI	Children in the intervention group reported significantly lower states of physiological anxiety compared with the control group as evidenced by systolic blood pressure, standardized behavioural anxiety tests, and post-surgery pain (p<0.001)	NA
Meiri et al,[60] 2016 RCT	To investigate the utility of medical clowning in blood tests or line insertion compared to passive and active (local anaesthesia) control conditions	100 children Clown Group: (5.40±2.60) Local	Group 1: (n=33) children allocated to Blood exam/venipuncture	Group 2: (n=34) children allocated to Blood exam/venipuncture by	Anxiety, pain and crying - Children: VAS	Distraction by medical clowns was helpful in children undergoing blood tests or line insertion. Although pain reduction was improved with local anaesthesia (p = 0.04), both duration of crying (p=0.01) and	1

		anaesthetic cream - EMLA® Group: (5.00±2.40) Control Group: (5.50±2.60) [2–10 y/o]	with a medical clown	standard clinical methods Group 3: (n=33) children allocated to Blood exam/venipuncture under local anaesthesia	Total duration of crying - Parents: STAI	anxiety were reduced with a medical clown ($p<0.0001$)	
Felluga et al,[61] 2016 RCT	To investigate whether the presence of medical clowns during painful procedures in the ED affects children's anxiety and pain	40 children Clown Group: (8.00±NR) Control Group: (10.00±NR) [4–11 y/o]	(n=20) children interacted with clowns	(n=20) children allocated to usual care	Anxiety and pain - Children: CAPS or WBS; NRS	Children's anxiety levels in the clown intervention group were significantly reduced compared with the control group ($p=0.013$), whereas children's pain levels were similar in the two groups	3
Kocherov et al,[62] 2016 RCT	To investigate prospectively the potential benefits of the participation of the medical clowns in the outpatient paediatric penile surgery programme	80 children (NR ± NR) [2–16 y/o]	(n=40) children interacted with clowns	(n=40) children allocated to usual care	Anxiety and pain - Children: m-YPAS FLACC or WBS	Clown exposure group had lower preoperative ($p=0.0319$) and post-operative anxiety index ($p=0.0042$). Clown involvement associated with shorter induction time for anaesthesia ($p<0.001$), shorter overall time in the OR ($p<0.0001$), and shorter recovery from surgery and time to hospital discharge ($p= 0.01$)	2
Saliba et al,[63] 2016 NRCT	To correlate exposure of hospitalized children with any acute pathology to clown-doctor (CD) activities and levels of salivary cortisol	36 children Lunch CD: (6.50±NR) Dinner CD: (6.04±NR) [6–7 y/o]	(n=36) children interacted with clowns-doctors, allocated into groups: - (n=18) LunchCD - (n=18) DinnerCD	–	Stress - Children: VAS	Children in the clown intervention group showed a significant ($p < 0.01$) decrease in salivary cortisol levels for post-intervention compared to the pre-intervention measures	NA
Dionigi et al,[64] 2017 NRCT	To test whether a combined intervention of art therapy and clown visits could enhance the efficacy of oral medication in reducing children's anxiety at parental separation prior to induction of anaesthesia	78 children Clown Group: (6.11±2.38) Control Group: (5.32±1.92) [3–11 y/o]	(n=37) children receiving a combined intervention of art therapy and clown visits	(n=41) children allocated to standard care	Anxiety - Children: m-YPAS	Children in the clown group exhibited a significant reduction in m-YPAS scores at parental separation compared to those in the control group ($p < 0.001$)	NA
Sánchez et al,[65] 2017	To evaluate the impact of a humour therapy programme on stress levels in paediatric inpatients	306 children Clown Group:	(n=104) in the first phase: children	(n=94) in the first phase: children not	Emotional stress	In the first phase, the children in the intervention group presented lower salivary cortisol levels	NA

NRCT		(8.19±4.90) Control Group: (8.41±4.20) [2–14 y/o]	exposed to clown intervention - (n=108) in the second phase: children exposed to clown intervention	exposed to clown intervention	- Children: Parker test Weisz Pictorial test	(p=0.0041), lower scores on the Parker test (p=0.097), and higher scores on the Weisz test (p=0.011) compared with children in the non-intervention group. In the second phase, the children exhibited lower salivary cortisol levels and higher scores on the Weisz test after the intervention (p< 0.0001)	
Lopes-Júnior et al.,[66] 2018 NRCT	To examine the feasibility of longitudinal testing of psychophysiological parameters of stress and fatigue in paediatric osteosarcoma patients hospitalized for chemotherapy submitted to clown intervention and to investigate whether changes in the levels of biomarkers are associated with psychological stress and fatigue levels in these patients after the clown intervention	6 children and adolescents with osteosarcoma (12.33 ± 3.32) [6–15 y/o]	(n=6) children and adolescents receiving 1 session of the clown intervention	_	Cancer-related fatigue and psychological stress - Children: ESI PedsQL MFS (self) - Parents: PedsQL MFS (proxy)	No significant effects sizes were observed for psychophysiological outcomes. Effect sizes ranged from 0.54 (cortisol) to 0 (interleukin-1β [IL-1β]). Decreasing overall trends were observed for cortisol levels for all 6 paediatric osteosarcoma patients over time. In addition, a similar pattern of tumour necrosis factor–α (TNF-α) levels over time was observed for all 6 patients. Patients with metastatic osteosarcoma showed a linear trend for a decrease in MMP-9 levels between 1 and 9 hours after the clown intervention and restoration to basal levels after 13 hours	NA
Newman et al.,[67] 2019 RCT	To assess the efficacy of preoperational medical clown therapy on post-operative pain and stress utilizing both standard questionnaires and serum cortisol as an objective stress marker	45 children Clown Group: (5.91±1.46) Control Group: (5.67±1.47) [4–or above y/o)	(n= 23) children and parents were receiving medical clown from admission to post-anaesthesia care unit	(n= 22) children and parents underwent the standard procedure	Pain and stress - Children: WBS SUD - Parents: WBS SUD	No statistically significant difference in WBS scores was observed between the two groups. Statistically significant reduction of parental distress was observed in SUD score in the clown group (-2.97±2.75 vs. -0.81±2.51, p=0.02). Intraoperative serum cortisol levels of children in the clown group were significantly increased compared with the control group (12.52±6.14 vs. 7.46±5.6, p=0.0004)	1
Arriaga et al.,[68] 2020 NRCT	To examine the effects of hospital clowns (HC) on the physical and emotional responses of paediatric patients during ambulatory chemotherapy	82 children and adolescents Clown Group: (11.56±2.29) Control Group: (11.39±2.50) [8-15 y/o]	(n= 41) children and adolescents receiving hospital clown visit	(n= 41) children and adolescents without receiving hospital clown visit	Physical and emotional states - Children: BARF FACES PedsQL VAS SAM - Parents: EAS-P STAI -Y	Compared to the CG, patients receiving the HC visit during chemotherapy reported higher levels of calm and happiness (p<.05) and reduced fatigue (p<0.05), pain (p=0.004), and distress (p=0.034). HCs did not affect nausea. This study showed the importance of HCs as agents of supportive paediatric care, and the short-term effects during ambulatory chemotherapy seem to contribute to increasing the well-being of paediatric patients	NA
Lopes-	To evaluate the effect of	16 children	(n=16) children and	_	Cancer-related	Compared with baseline measurements, the total	NA

Júnior et al.,[69] 2020 NRCT	clown intervention on the levels of psychological stress and cancer-related fatigue in paediatric patients with cancer undergoing chemotherapy	and adolescents with osteosarcoma (11.40 ± 3.44) [6–14 y/o]	adolescents receiving a clown intervention		fatigue and psychological stress - Children: ESI PedsQL MFS - Parents: PedsQL MFS	psychological stress and cancer-related fatigue levels improved after the clown intervention at the collection time point +4 hours (p= 0.003 and p= 0.04, respectively). Salivary cortisol showed a significant decrease after clown intervention at the collection time points +1, +9, and +13 hours ($p < 0.05$); α-amylase levels remained unchanged.	

BARF = Baxter Retching Faces Scale; BVP = Blood Volume Pulse; CAPS = Children Anxiety and Pain Scale – anxiety component; CHEOPS = Children's Hospital of Eastern Ontario Pain Scale; CSWQ = Child Surgery Worries Questionnaire; EAS-P = Emotionality, Activity and Sociability Temperament Survey for Children-parental ratings; ED = Emergency Department; EDA = Electrodermal Activity; ESI = Escala de Estresse Infantil (Child Stress Scale); FLACC = Face, Legs, Activity, Cry and Consolability; FACES = Wong-Baker Faces Scale; FPS-R = Faces Pain Rating Scale-revised; FPS-R = Faces Pain Scale-Revised; KINDL-R = Physical Well-being Scale; M = Mean; m-YPAS = The Modified Yale Preoperative Anxiety Scale; NA = Not Applicable; NR = Not Reported; NRCT = Non-randomized Controlled Trial; NRS = Numerical Rating Scale; OR = Operating Room; PedsQL MFS = The Paediatric Quality of Life Inventory (PedsQL) Multidimensional Fatigue Scale (MFS); PedsQL VAS =The Paediatric Quality of Life Inventory (PedsQL) Present Functioning Visual Analogue Scales (VAS); PPIA = Parental Presence During Induction of Anaesthesia; PR = Preoperative Room; PSS-I = Posttraumatic Stress Disorder Symptoms Scale; RCT = Randomized Controlled Trial; SAM = Self-Assessment Mannequin Scale; SD = Standard Deviation; SPT = Skin Prick Tests; STAI (Y-1/Y2) = State-Trait Anxiety Inventory Form Y; STAIC = State-Trait Anxiety Inventory for Children; SUD = Subjective Units of Distress Scale; VAS = Visual Analogue Scale; WBS = Wong-Baker Faces Scale. Jadad Scale score (0-5): studies scoring < 3 classified as low quality and studies that score ≥ 3 classified as high quality.