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Medical clown intervention shortens length of hospitalization in children with pneumonia

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Community-acquired pneumonia (CAP) is a leading cause of hospitalization in children. The hospitalization duration depends on factors as child's well-being, vital signs, need for parenteral treatments, and development of complications. Medical clowns (MCs) are known to assist in reducing pain and alleviating anxiety and have been integrated into many aspects of hospital treatment routines. Our aim was to evaluate the effect of MC intervention on length of hospitalization in children admitted with CAP. A prospective quasi-randomized controlled trial allocated 51 children (2–18 years) hospitalized for CAP to receive standard care (control group, $n = 25$) or standard care plus 15-minute MC visits twice daily during the first 48 h of hospitalization (intervention group, $n = 26$). The primary outcome was hospitalization duration. Both groups were comparable in all demographic and clinical characteristics at admission with a mean age of 4.4 ± 3.6 years. The intervention group had significantly shorter duration of hospitalization (43.5 vs. 70 h, $p = 0.03$) and IV antibiotic treatment duration (48 vs. 72 h, $p < 0.01$) compared to controls. When comparing day 1 to day 2 in each group, significant decreases in respiratory rate, heart rate, white blood cell count, and absolute neutrophil count were noted in the study group. No significant differences were observed between the two groups in changes in patient well-being. The integration of MC into the pediatric CAP care-team reduced length of hospitalization and need for IV antibiotics. This can improve the quality of care as well as the burden and cost endured by hospitalization with CAP. Future larger studies are warranted to support these positive effects of MC.

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Keywords Pneumonia, Medical clown, Pediatrics

Abbreviations

ANC	Absolute neutrophil count
CAP	Community-acquired pneumonia
CRF	Case report form
CRP	C-reactive protein
IDSA	Infectious diseases society of america
IV	Intravenous
MC	Medical clown
VAS	Visual analogue scale
WBC	White blood cells

Community-acquired pneumonia (CAP) is one of the most frequent infectious diseases in children, leading to a large antibiotic usage and hospitalization rate even in industrialized countries[1]. Globally, CAP is the leading cause of death in children < 5 years age. Although challenging to quantify precisely, it is estimated that up to 155 million cases of pneumonia occur in children annually[2]. According to The Infectious Diseases Society of America (IDSA) guidelines, CAP in the inpatient setting may require 3–5 days of hospitalization[2]. For the subset

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of patients necessitating hospitalization, the mean cost escalates to $12,000 per episode, exacerbating the family's burden through parental days of work loss and increased family stress, which can adversely affect parental health and family morale[3]. Shortening hospital length of stay in cases of CAP may save discomfort, costs and many other resources[1,4]. There is also an urgent need to reduce antibiotic overuse and antimicrobial resistance in children with CAP[5].

In recent years there are a flourishing number of studies on humor considered as a valid moderator of stressful or painful situations. Studies have shown that Medical Clowns (MCs) can relieve acute pain in children[6,7] and improve medical care of many procedures in children such as treating burn injuries[8], venipuncture in pediatric emergency department[9,10], intra-articular injections[11], allergy prick skin tests[12] and pulmonary function performance[13]. A recent meta-analysis also found that clown therapy appears effective in reducing procedural pain in children[14]. Some findings support the benefits of humor and laughter on physiologic parameters as attenuation of: catecholamines[15], pain perception[16], discomfort thresholds[17], coping with stress by modulating stress hormones, lowered salivary cortisol levels[18,19] and immune enhancement in children and adults[20–22]. Furthermore, a recent meta-analysis found that MCs have substantial positive and beneficial effects on reducing stress and anxiety in children and their families[23]. Several reviews[21,24,25] have proposed using humor in its various forms to stimulate patients' vitality and recovery. The prevalence of fear of clowns in the general pediatric hospitalized population is only 1.2%[26], indicating that they can be widely used as a positive tool.

It is also possible that the presence of MCs along with alleviation of stress and laughter have a physiological effect on the respiratory system. A study that evaluated the influence of laughter in chronic obstructive lung disease found that laughter reduced air trapping[27]. Moreover, the presence of MCs correlated with reduced mean length of hospital stays and shortened duration of respiratory symptoms among children hospitalized for varied respiratory pathologies[28]. Reviewing current literature, we found a paucity of knowledge of the influence of medical clowns on pneumonia in hospitalized children. The aim of the current study was to evaluate the effect of MC intervention on length of hospitalization in children admitted due to CAP.

Methods

Study design and participants

This was a single-center prospective quasi-randomized controlled trial conducted between October 2018 to November 2023, and recruiting children aged 2 to 18 years who required hospitalization for CAP in the Department of Pediatrics, The Lady Davis Carmel Medical Center in Haifa, Israel. The study has been approved by the Carmel Medical Center institutional review board (approval number CMC-0170-16), and a parent had to give a written informed consent before recruitment. Exclusion criteria comprised of children who were hemodynamically unstable or required transfer to an intensive care unit; children with other systemic comorbidities or chronic respiratory diseases (excluding asthma), including but not limited to congenital bronchopulmonary malformations, cystic fibrosis, immune compromise, genetic malformations, and congenital heart disease (excluding patent foramen ovale and atrial septal defect); children from families unable to comprehend and sign an informed consent form.

To determine the sample size required to establish a difference in the hospitalization duration in the study population, given confidence level of 95% and power of 80%, to detect a difference of 0.8 standard deviation (SD) in hospitalization duration between the intervention group and the control group, a sample size of 26 subjects in each group was needed.

Following a senior doctor's diagnosis of CAP based on the combination of clinical, laboratory and radiological results in the Emergency Department, the criteria for admission included at least one of the following: hypoxemia, dehydration, inability to take oral medications, moderate-to-severe respiratory distress, toxic appearance, complicated pneumonia (such as medium-to-large pleural effusion, empyema, lung abscess, pneumatocele, or necrotizing pneumonia), or failure of oral antibiotic treatment[2,29]. All these patients were presumed to have bacterial pneumonia and were treated with antibiotics though we did not specifically test for viral or bacterial origin.

The hospitalazed children were randomly assigned to either the intervention or control group based on their order of arrival in a 1:1 case–control and were treated in separate rooms. Both groups received comparable medical treatment (as needed intravenous (IV) antibiotics, adequate respiratory support, hydration, pain and antipyretic treatment) and investigations, with the intervention group additionally receiving 15-minute visits from MCs twice daily during the first two days of admission.

The medical clowns in this study were part of 'The Dream Doctors Project', a unique Israeli non-profit organization that integrates professional medical clowns into hospitals and trains them to work as members of multidisciplinary care teams. In our study, three clowns conducted 15-minute visits twice daily during the first two days of admission, exclusively for the intervention group. Each visit was conducted by a single clown per patient. They used various techniques to help relax the patients, including playing musical instruments, singing, making decorated balloons, using humor, and guided imagination. Through these methods, they tried to encourage children to start drinking and eating on their own.

All laboratory and radiology tests, as well as treatment decisions, including admission and discharge, were based solely on clinical judgment by pediatricians who were blinded to the study and not involved in it (the clinical team was separate from the research team). Criteria for discharge were based on the IDSA Clinical Practice Guidelines for CAP[2] and included clinical improvement, a stable activity level, appetite, and improvement in work of breathing, tachypnea, tachycardia, as well as maintaining oxygen saturation ≥90% on room air and having no fever for at least 12–24 h. Additionally, patients had to tolerate their home oral antibiotic regimen and fluid intake. In our department, discharges occur at the same rate on weekends as on weekdays, so the length of hospitalization should not be affected by weekend admissions.

Study assessments

A doctor's daily case report form (CRF) (Supplementary 1) and a parent CRF (Supplementary 2) were completed on the first two days of admission. In both groups, the child's primary caregiver, who accompanied them during the hospital stay answered the parent CRF. These forms documented details of child's treatment, clinical assessment, vital signs, symptoms, and overall well-being as perceived by a parent (regarding respiratory state, mood and vitality) and the treating doctor (regarding pain, mood and vitality). The well-being variables were evaluated by a visual analogue scale (VAS) in the CRF's grading their opinion between 1 (lowest score) to 10 (best score) except for pain where VAS meaning was 1 = not suffering at all to 10 = most suffering.

The primary outcome parameter was length of hospitalization in hours, determined by the duration between admission and discharge from the pediatric department. Secondary outcome parameters included the duration of IV treatment, need for chest tube insertion, changes in well-being scores as reported by both the parent and the treating physician, and alterations in vital signs and laboratory results.

Statistical analysis

Statistical analyses were performed using IBM statistics (SPSS) vs. 24. The continuous variables are presented by mean, and SD or Median & IQR, as appropriate. The categorical variables are presented in percentages. To check differences between the two groups, Chi square test was used for the categorical variables and independent t-test, or Mann Whitney for the continuous variables. $P < 0.05$ is considered statistically significant.

Results

Fifty-one patients were included in the study, with the patients quasi-randomly distributed; 26 patients were allocated to the study group, and 25 patients to the control group (Fig. 1). The mean age of the entire cohort was 4.4 ± 3.6 years, and 30 patients were male (58.8%). Regarding the medical history of the participants, 5 patients had a previous doctor's diagnosis of asthma (10%), and 4 patients (8%) had known allergies (Table 1).

Clinical parameters on admission, including body temperature, heart rate, respiratory rate, and O_2 saturation levels, both while awake and asleep, showed no statistically significant differences between the groups. The need for O_2 supplementation on admission was slightly higher in the control group (16.0%) compared to the study group (11.5%), but this difference was not statistically significant ($p = 0.95$). Similarly, the need for IV fluid administration was comparable between the groups (study group: 30.7%, control group: 40%, $p = 0.69$). Laboratory results at admission also showed no significant differences between the groups in terms of white blood cell count (WBC, $p = 0.82$), absolute neutrophil count (ANC, $p = 0.67$), or C-reactive protein (CRP) levels ($p = 0.2$) (Table 1).

The study group had a significantly shorter duration of hospitalization compared to the control group (43.5 vs. 70 h, $p = 0.03$) (Fig. 2). Additionally, the duration of IV antibiotic treatment was significantly shorter in the study group compared to controls (48 vs. 72 h, $p < 0.01$). There were no significant differences between groups in rates of chest tube insertion, changes in well-being according to parents or treating physician (Table 2).

While we found no significant difference in the change in well-being as reported by parents and treating physicians between groups, a significant improvement was observed in the study group before and after the MCs interventions, specifically in the patient's mood (from 6.3 to 7.5, $p = 0.01$) and vitality (from 8 to 9, $p = 0.01$) according to the treating physician, and the respiratory state (from 7 to 8.2, $p = 0.01$) and vitality (from 6.8 to 8.2, $p = 0.01$) according to the parent (Table 3). On the other hand, a similar improvement was noted by the parent in the control group in the patient's mood (from 4.7 to 6.7, $P = 0.01$) and vitality (from 5 to 6.7, $p = 0.04$), with no apparent difference by doctor's perspectives of well-being in the control group.

Regarding vital signs (Table 3), the study group exhibited statistically significant decreases in heart rate (122.7 vs. 112.3 beats/min, $p = 0.03$) and respiratory rate (36.6 vs. 31.3 breaths/min, $p < 0.01$), while in the control group body temperature (37.7 vs. 36.9 °C, $p < 0.01$) and respiratory rate (35 vs. 34.2 breaths/min, $p < 0.01$) decreased significantly between day 1 and day 2.

There were no significant differences between the groups in the change in CRP levels ($p = 0.32$) and the change in WBC count ($p = 0.17$). However, the study group demonstrated a significant decrease in ANC compared to controls, where there was an increase in the ANC (−9.9 vs. 1.9, $p = 0.03$) (Table 2). When comparing day 1 to day 2 in each group (Table 3), a significant decrease in WBC and ANC count was noted in the study group, which was not evident in the control group.

Discussion

CAP remains a significant health concern globally, particularly in children, contributing to substantial morbidity, mortality, and financial burden on healthcare systems. In this study, we aimed to investigate the potential impact of MCs intervention on children admitted due to CAP. Our findings demonstrate that MCs shorten the length of hospitalization, reduce the duration of IV antibiotic treatment, and lower both the respiratory and heart rate as well as WBC and ANC count in pediatric patients with CAP.

The observed mean duration of hospitalization in the study group, where children received 15-minute visits from MCs twice daily in addition to standard medical care, was significantly shorter than in the control group. This result aligns with the broader literature on the positive effects of humor in healthcare settings[9–13,15–22,30], emphasizing the potential for non-pharmacological interventions to influence clinical outcomes. Medical clowning has been shown in recent studies to be a cost-effective, noninvasive method for reducing anxiety and pain in children undergoing invasive procedures[31]. Its cost-effectiveness is further supported by our findings, which demonstrate a reduction in hospital stay duration, a factor that also contributes to lowering the risk of nosocomial infections and alleviating the physical and emotional stress on both children and their families.

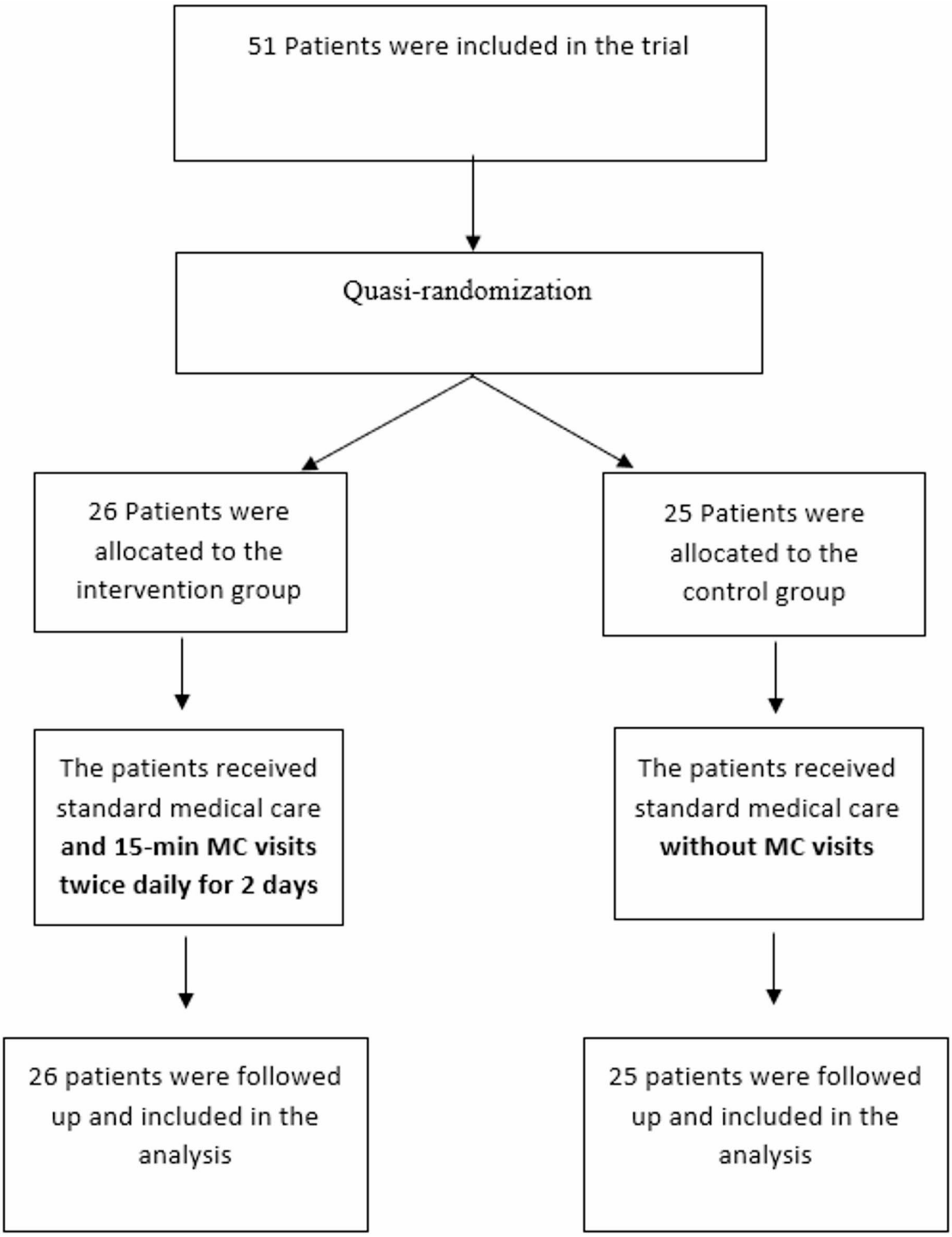

Fig. 1. Trial flow diagram.

The groups were quasi-randomized and showed no differences in baseline demographics, clinical parameters, or medical history. Additionally, there were no differences in disease severity between the groups upon admission, as presented in Table 1. The only difference between the groups was the intervention, with the study group receiving visits from MCs.

The mechanisms by which MCs reduce length of stay are likely multifactorial. Clowns alleviate stress and anxiety which could allow patients to better participate in treatment plans like adherence to oral antibiotics and fluids, allowing for faster recuperation. Laughter and humor may also exert direct physiological benefits by

	All patients (*N* = 51)	Study group (*N* = 26)	Control group (*N* = 25)	*P*-Value*
Age (years)	4.4 ± 3.6	4 ± 2.9	5 ± 4.3	0.31
Gender (Male)	30 (58.8%)	15 (57.7%)	15 (60%)	0.86
Socioeconomic state	(*n* = 50)	(*n* = 26)	(*n* = 24)	0.13
High	3 (6%)	1 (3.8%)	2 (8.3%)	
Intermediate	43 (86%)	21 (80.8%)	22 (91.7%)	
Low	4 (8%)	4 (15.4%)	0 (0%)	
Maternal education (Years)	16 (12–21)	16 (12–19)	15 (12–21)	0.52
	(*n* = 49)	(*n* = 26)	(*n* = 23)	
Asthma	5 (10%)	3 (11.5%)	2 (8.3%)	> 0.99
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Asthma in the family	14 (28%)	8 (30.8%)	6 (25%)	0.65
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Allergies	4 (8%)	3 (11.5%)	1 (4.2%)	0.61
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Allergies in the family	14 (28%)	8 (30.8%)	6 (25%)	0.65
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Domestic pets	9 (18%)	3 (11.5%)	6 (25%)	0.28
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Smokers at home	15 (30%)	8 (30.8%)	7 (29.2%)	0.90
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Number of previous pneumonias	0.44 ± 0.76	0.58 ± 0.9	0.29 ± 0.55	0.32
	(*n* = 50)	(*n* = 26)	(*n* = 24)	
Body temperature at admission^ (^{0}C)	37.4 ±0.9	37.2 ± 0.9	37.7 ± 0.9	0.09
	(*n* = 51)	(*n* = 26)	(*n* = 25)	
Heart rate^ (bpm)	120.2 ± 20.4	120.6 ± 18.8	119.8 ± 22.3	0.87
	(*n* = 51)	(*n* = 26)	(*n* = 25)	
Respiratory rate at admission^ (brpm)	35.5 ± 10.25 (*n* = 48)	36.0 ± 9.7 (*n* = 24)	35.0 ± 10.9 (*n* = 24)	0.75
O_2 Saturation at admission^ (%)				
Awake	96.5 ± 3.8 (*n* = 48)	96.8 ± 2.5 (*n* = 25)	96.3 ± 4.9 (*n* = 23)	0.64
Sleep	95.8 ± 3.1 (*n* = 38)	95.4 ± 3.6 (*n* = 19)	96.3 ± 2.5 (*n* = 19)	0.42
Need for O_2supplementation on admission	7 (13.7%)	3 (11.5%)	4 (16.0%)	0.95
Need for IV fluid on admission	18 (35.2%)	8 (30.7%)	10 (40%)	0.69
Laboratory results on admission				
WBC (k/μL)	17.7 ± 7.9 (*n* = 50)	17.9 ± 8.4 (*n* = 26)	17.4 ± 7.5 (*n* = 24)	0.82
ANC (k/μL)	13.7 ± 7.4 (*n* = 50)	14.1 ± 7.6 (*n* = 26)	13.2 ± 7.3 (*n* = 24)	0.67
CRP (mg/dL)	16.9 ± 12.9 (*n* = 51)	14.7 ± 12.8 (*n* = 26)	19.3 ± 12.8 (*n* = 25)	0.2

Table 1. Baseline demographics, clinical parameters and medical history of participants. Results are presented using the mean and standard deviation (SD) for data with a normal distribution, while the median and interquartile range (IQR) are used for datasets showing skewness or non-normal distributions. Categorical variables are presented as the number of cases and their corresponding percentages. * The P-value represents the comparison between the study and control groups only. ^ Vital signs represent the first measurements recorded by the department staff and were taken after initial treatment in the emergency department. ANC-Absolute neutrophil count, bpm- beats per minute, brpm- breaths per minute, CRP- C-reactive protein, WBC-White blood cell.

reducing air trapping, modulating hormones[32], and enhancing immune function[28]. Specifically, recent research by our group demonstrated that MC shorten length of hospitalization presumably by improving sleep quality and length of sleep with its critical role in health and recovery[30].

The reduction in the duration of IV antibiotic treatment in the study group further supports the potential role of humor and clown interventions in expediting the recovery process. Faster improvement that leads to shorter duration of admission and IV antibiotic treatment in the intervention group may be attributed to the psychological and physiological effects of laughter and stress reduction[23]. It is also reasonable to assume that the one-day reduction in IV treatment is the primary explanation for the 26.5-hour decrease in hospitalization duration (Fig. 2), as tolerating an oral antibiotic regimen was a fundamental part of the discharge criteria. The significance of these findings extends beyond the immediate impact on hospital resources, potentially influencing long-term health outcomes and reducing the risk of complications like line-sepsis and antibiotic resistance associated with prolonged IV treatment.

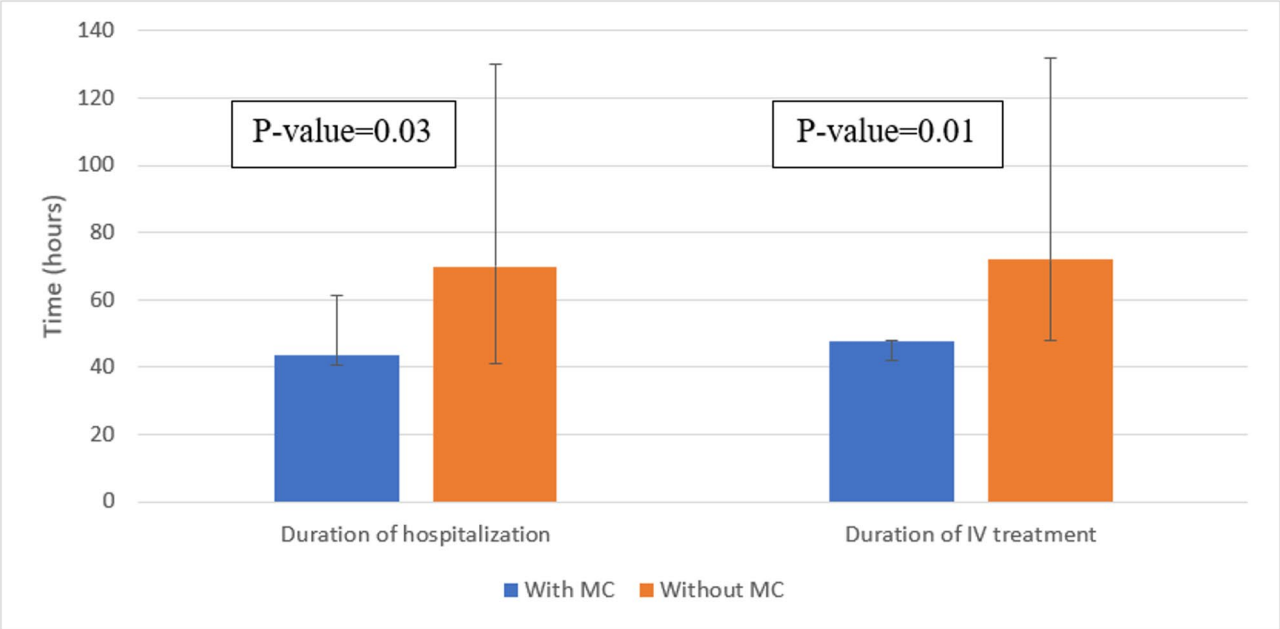

Fig. 2. Duration of hospitalization and IV antibiotic treatment in both groups.

	Study group ***N*** **= 26**	**Control Group** ***N*** **= 25**	***P*-value**
Duration of hospitalization (hours)	43.5 (40.7–61.5)	70 (41–130)	**0.03**
Duration of IV antibiotic treatment (hours)	48 (42–48)	72 (48–132)	**0.01**
Chest tube insertion cases	1 (4%)	4 (19%)	0.14
Well-being Change (according to the parent)	(*n* = 14)	(*n* = 19)	
Respiratory state	1.2 ± 1.5	0.7 ± 1.9	0.52
Mood	1.3 ± 2	2 ± 3.1	0.95
Vitality	1.3 ± 1.8	1.6 ± 3.2	0.67
Well-being Change (according to the treating physician)			
Pain VAS	−0.9 ± 2.7 (*n* = 15)	−0.4 ± 2.6 (*n* = 18)	0.55
Mood	1.1 ± 1.8 (*n* = 16)	0.5 ± 2.9 (*n* = 19)	0.61
Vitality	−1.1 ± 1.5 (*n* = 16)	−0.8 ± 2.6 (*n* = 19)	0.85
Change in laboratory results*			
WBC (k/μL)	−8.1 (−11.6 - −2)(*n* = 6)	2.7 (−7.1–4.6) (*n* = 4)	0.17
ANC (k/μL)	−9.9 (−14.3 - −1.1) (*n* = 6)	1.9 (-4.1–3.3) (*n* = 4)	**0.03**
CRP (mg/dL)	−12.3 (−25.4–5.5) (*n* = 6)	−1 (−7.2–3.9) (*n* = 5)	0.32

Table 2. Primary and secondary outcomes. Abbreviations: ANC- Absolut Neutrophil count, CRP- C-Reactive Protein, IV- Intravenous, WBC- White Blood Cells, VAS- Visual Analog Scale. Well-being change is calculated by Day 2 score minus Day 1 score, when both values are available. * Only for those who had blood withdrawn twice during the first two days of their admission (Day 2 -Day 1). Results are presented using the mean and standard deviation (SD) for data with a normal distribution, while resorting to the median with interquartile range (IQR) for datasets showing skewness or non-normal distributions.

Although our study did not identify significant differences in well-being as reported subjectively by parents and objectively by clinical physicians between the study and control groups, noteworthy improvements were evident within the study group subsequent to MC interventions. Specifically, patients in the study group displayed considerable enhancements in mood and vitality according to treating physicians, along with reported improvements in respiratory state and vitality by parents, yet comparable improvements in mood and vitality were noted by parents in the control group. These findings raise questions regarding the effect of MC on subjective well-being improvement, as such improvements could potentially be attributed to conventional medical treatment rather than the MC intervention alone. However, the fact that the clinical physicians who were blinded to group allocation did objectively rate improved mood and vitality in the intervention group only, supports our hypothesis that MCs improved the children's well-being and recovery rate.

	Day 1	Day 2	*P*-value
Study group			
Vital signs			
Body temperature, ℃ (*n* = 16)	37.3 ± 0.9	37 ± 0.7	0.23
Heart rate, bpm (*n* = 16)	122.7 ± 21.9	112.3 ± 22.4	**0.03**
Saturation, % (*n* = 16)	97.5 (94.2–98.7)	97 (94.2–98.7)	0.62
Respiratory rate, brpm (*n* = 16)	36.6 ± 11.1	31.3 ± 8.3	**0.01**
Well-being (according to the parent)			
Respiratory state (*n* = 14)	7 ± 1.5	8.2 ± 1	**0.01**
Mood (*n* = 14)	6.6 ± 1.4	8 ± 1.4	0.91
Vitality (*n* = 14)	6.8 ± 1.8	8.2 ± 1.3	**0.01**
Well-being (according to the treating physician)			
Pain VAS (*n* = 15)	1 (1–3)	1 (1–1)	0.24
Mood (*n* = 16)	6.3 ± 2	7.5 ± 1.5	**0.01**
Vitality (*n* = 16)	8 (7–9)	9 (8–10)	**0.01**
Laboratory results			
WBC (k/μL) (*n* = 6)	22.7 ± 9.1	14.7 ± 7.4	**0.04**
ANC (k/μL) (*n* = 6)	19.7 ± 8.8	10.6 ± 8.8	**0.02**
CRP (mg/dL) (*n* = 6)	26.3 ± 13.4	17.1 ± 7.4	0.24
Control group			
Vital signs			
Body temperature (*n* = 19)	37.7 ± 0.9 (*n* = 19)	36.9 ± 0.6 (*n* = 19)	**0.01**
Heart Rate (*n* = 19)	119.6 ± 25.2	111.9 ± 22.5	0.10
Saturation (*n* = 16)	97.5 (95–99)	97 (96–99.7)	0.67
Respiratory rate (*n* = 18)	35 ± 11.9	34.2 ± 14.6	**0.01**
Well-being (according to the parent)			
Respiratory state (*n* = 19)	6.1 ± 2	6.8 ± 2.2	0.14
Mood (*n* = 19)	4.7 ± 2	6.7 ± 2.3	**0.01**
Vitality (*n* = 19)	5 ± 2.4	6.7 ± 2.4	**0.04**
Well-being (according to the treating physician)			
VAS (*n* = 18)	1 (1–3.25)	1 (1–1.5)	0.39
Mood (*n* = 19)	6.3 ± 2.3	6.8 ± 2.7	0.3
Vitality (*n* = 19)	7 (6–9)	9 (5–10)	0.12
Laboratory results			
WBC (k/μL) (*n* = 4)	11.5 ± 6.3	11.6 ± 4.5	0.71
ANC (k/μL) (*n* = 4)	8.5 ± 4.1	8.9 ± 4.4	0.71
CRP (mg/dL) (*n* = 5)	27.6 ± 13	26.1 ± 7.2	0.89

Table 3. Vital signs, well-being, and laboratory differences between day 1 and day 2 in each group. Day 1: before encountering the clown, day 2: after clown intervention in the study group. Results are presented using the mean and standard deviation (SD) for data with a normal distribution, while resorting to the median with interquartile range (IQR) for datasets showing skewness or non-normal distributions. Note that data is limited due to a reduced number of patients having completed CRF's or blood samples withdrawn on the second day, due to early discharge or in-necessity according to the judgment of the clinical team. ANC- Absolute neutrophil count, bpm- beats per minute, brpm- breaths per minute, CRP- C-reactive protein, VAS- Visual analogue scale, WBC- White blood cell.

The findings regarding the impact of MCs on vital signs among patients provide valuable insights into the potential physiological effects of humor and interaction in clinical settings. In the study, the intervention group demonstrated noteworthy reductions in both heart and respiratory rate over the course of their hospitalization. Since tachypnea is the sign most associated with CAP[33], ameliorating it is particularly important. These findings are in concert with reduction in respiratory rate and a trend towards reduced heart frequency that were also shown after MC intervention in children with other respiratory pathologies[28]. These reductions suggest a potential calming effect or decreased physiological stress response among patients engaging with MCs. According to the IDSA guidelines[2], patients are not eligible for discharge if they have substantially increased work of breathing or sustained tachypnea or tachycardia, so reduction in both parameters in the intervention group is another explanation for the reduced length of hospitalization. Conversely, in the control group, while there were significant decreases in body temperature and respiratory rate between day one and two, the changes were not as pronounced as those observed in the study group. This suggests that factors beyond routine medical

care may have influenced the vital signs of patients in the intervention group, indicating the potential role of MCs in modulating physiological responses and promoting a more relaxed clinical environment.

Regarding body temperature, it should be noted that the mean temperature was normal on the first day of admission. This is likely because the initial temperature recorded in the department on the day of admission was the first measured by the department staff after patients had already been treated with antipyretics in the emergency department and not the maximal temperature measured that day.

In our study, no significant difference was observed between groups in CRP levels and WBC count from day one to day two of admission. On the contrary, a significant decrease was noticed in the ANC count in the study group compared to the control group. However, a notable finding emerged when comparing day one to day two within each group. Specifically, a significant decrease in both the WBC and ANC counts was observed in the study group, a trend not evident in the control group. These results suggest a potential modulation of the immune response and inflammatory markers among patients receiving MC interventions, warranting further investigation into the underlying mechanisms and clinical implications of such findings.

While our study contributes valuable insights into the potential benefits of MCs intervention in pediatric CAP, several limitations should be acknowledged. This study is limited by its small sample size and being held in a single center. Due to conduction of the study during the COVID epidemic with reduced hospitalization rate, it caused limited recruitment during the epidemic waves and increased the study duration until reaching the required sample size. The study was also unblinded, as it is not possible to create a placebo comparison for MC. We attempted to minimize this effect by separating the clinical staff from the research staff and ensuring that the treating physicians were blinded to group allocation. However, some bias may still have occurred due to the unblinded nature of the study. Furthermore, the practice of MC is not a standardized interaction method that can be quantified and is surely differed between small children to adolescents, yet we tried to minimize this limitation by restricting the number of clowns involved in the study to only three clowns. Additionally, we did not investigate long term outcomes after discharge including rates of readmission or relapse. Further large-scale studies should aim to address these limitations and better elucidate the populations and clinical scenarios where MC interventions are most impactful. Lastly, the specific mechanisms by which humor influences clinical outcomes remain a subject for future investigation.

In conclusion, this study found that integrating MCs into the care team of pediatric CAP led to decreased length of hospitalization and IV antibiotic exposure. Further larger studies are warranted to support these findings, and exploration of the underlying mechanisms could offer valuable insights into the integration of holistic approaches to patient care in healthcare settings.

Data availability

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

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Author contributions
L.K wrote the main manuscript text and prepared the figures and tables. K.Y.B critically revised the manuscript. L.K, I.S.N and M.P.T collected the data. K.Y.B, G.L, N.M, S.S, M.K and M.H.S conceptualized the study. All authors reviewed the manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

Ethics approval and consent to participate
All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Additional information
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