RESEARCH ARTICLE

Impact of Parental Presence at Infants' Bedside on Neonatal Abstinence Syndrome

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ABSTRACT

BACKGROUND: Despite increased incidence of neonatal abstinence syndrome (NAS) over the past decade, minimal data exist on benefits of parental presence at the bedside on NAS outcomes.

OBJECTIVE: To examine the association between rates of parental presence and NAS outcomes.

METHODS: This was a retrospective, single-center cohort study of infants treated pharmacologically for NAS using a rooming-in model of care. Parental presence was documented every 4 hours with nursing cares. We obtained demographic data for mothers and infants and assessed covariates confounding NAS severity and time spent at the bedside. Outcomes included length of stay (LOS) at the hospital, extent of pharmacotherapy, and mean Finnegan withdrawal score. Multiple linear regression modeling assessed the association of parental presence with outcomes.

RESULTS: For the 86 mother–infant dyads, the mean parental presence during scoring was on average 54.4% (95% confidence interval [CI], 48.8%–60.7%) of the infant's hospitalization. Maximum (100%) parental presence was associated with a 9 day shorter LOS ($r = -0.31$; 95% CI, −0.48 to −0.10; $P < .01$), 8 fewer days of infant opioid therapy ($r = -0.34$; 95% CI, −0.52 to −0.15; $P < .001$), and 1 point lower mean Finnegan score ($r = -0.35$; 95% CI, −0.52 to −0.15; $P < .01$). After adjusting for breastfeeding, parental presence remained significantly associated with reduced NAS score and opioid treatment days.

CONCLUSIONS: More parental time spent at the infant's bedside was associated with decreased NAS severity. This has important implications for clinical practice guidelines for NAS.

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Between 2000 and 2012, in utero opioid exposure increased from 1.19 to 5.63 per 1000 live births in the United States.[1,2] Parallel with this increase, the incidence of neonatal abstinence syndrome (NAS) increased five-fold.[1,2] NAS is characterized by gastrointestinal, respiratory, autonomic, and central nervous system disturbances due to opioid withdrawal.[3] Between 50% to 80% of opioid-exposed infants require pharmacologic treatment of NAS. Infants are typically treated with replacement opioids and then weaned over days to weeks.[3–5] Pharmacologic management of NAS results in prolonged and costly hospital stays. On average, infants are admitted for 3 weeks, with estimated costs per admission ranging from $20 000 for inpatient pediatric ward care to $93 000 for neonatal intensive care.[1,6,7]

Despite the increased incidence of NAS and associated resource use, great variability exists in the management of opioid-exposed infants.[8] Although pharmacologic therapy remains the mainstay of treatment, previous evidence suggests nonpharmacologic therapy decreases the severity of NAS and reduces the need for medication.[8] Rooming-in, defined as allowing parent cohabitation with their hospitalized infants, has been shown to be independently associated with improved outcomes in NAS. Previous studies have demonstrated a decreased length of stay (LOS) by 5 to 12 days, decreased need for pharmacologic therapy by 19%, decreased duration of therapy by 8 to 12 days, and reduced cost of hospitalization by about 35%[7,9–17]

Although previous studies have assessed the effect of a rooming-in model of care across various models of care or at different points in time, the amount of parental presence spent at the bedside has not been studied independently. Therefore, the objective of this study was to examine the effect of the amount of parental presence at the bedside on NAS severity; specifically, the association with 3 main outcomes: (1) hospital LOS, (2) extent of pharmacologic therapy required, and (3) mean Finnegan withdrawal scores.

METHODS

We performed retrospective chart review to identify all infants born at Boston Medical Center (BMC) between March 2015 and April 2016 with in utero opioid exposure. Eligibility criteria included maternal opioid agonist treatment with methadone or buprenorphine during the third trimester of pregnancy and infants with a gestational age ≥36 weeks treated with opioid replacement therapy for opioid withdrawal on a pediatric inpatient unit. Infants were excluded from the study if they were transferred from BMC to another hospital before being medically ready for discharge, or if they required a NICU admission for >48 hours or a prolonged hospital stay for reasons other than NAS (for example, respiratory distress, hypoglycemia requiring intravenous dextrose fluids, or birth weight <1800 g). Infants were also excluded if they did not require pharmacologic treatment of NAS given that these infants are cared for in the postpartum maternity unit for the majority of their hospitalization where their mothers are admitted as patients (Fig 1).

Model of Care

At BMC, each mother–infant pair room together for the duration of maternal hospital admission postdelivery, unless the infant is admitted to the NICU. BMC has practiced this rooming-in model of care of infants with NAS for >15 years. After the mother's discharge (2 days for a vaginal delivery, 4 days for a cesarean delivery), the infant is transferred to the inpatient pediatric unit and monitored for at least 5 to 7 days for signs of withdrawal that would warrant medication treatment. This model of care encourages parents to stay at their infants' bedside and there are no daytime visiting hour restrictions. One caregiver is allowed to stay overnight at the bedside.

During the study time period, infants were scored using the original Finnegan scale every 4 hours.[17] Infants who scored 2 consecutive scores ≥8 or 1 score ≥12 were initiated on first-line treatment with oral morphine (starting at 0.3 to a maximum dose of 0.9 mg/kg per day divided every 4 hours) or oral methadone solution (starting at 0.3 to a maximum dose of 0.9 mg/kg per day divided every 8 hours). During the study period, 80% of infants were pharmacologically treated. Oral morphine solution was routine care at BMC during the study period. Some of the infants were concurrently participating in a randomized double-blinded clinical trial comparing methadone versus morphine (grant ID R01DA032889-03). The infants who participated in the randomized trial received the same Finnegan assessments every 4 hours, with criteria to initiate and escalate medication identical to routine care guidelines and identical total daily dosing of replacement opioids. For all infants with NAS, second-line therapy consisted of clonidine (6 mcg/kg per day) or phenobarbital (5–6.6 mg/kg per day) if the infant reached maximum doses of morphine or methadone with continued elevated Finnegan scores. All infants were weaned off opioids and clonidine as inpatients and completed phenobarbital weans in the outpatient setting. Infants were monitored for 24 to 48 hours off opioids before discharge from the hospital.

Data Collection

For all eligible mother–infant pairs, 2 investigators extracted data from the electronic medical record. Maternal baseline characteristics included age, smoking status, medications, illicit substance use during the pregnancy, and urine toxicology results. Infant data included birth demographics, LOS, total days of postnatal opioid therapy, total opioid dosage, and use of additional pharmacological agents in the treatment of more severe neonatal withdrawal. Additionally, investigators determined breastfeeding status (defined as any amount of breast milk consumed by the infant during the hospitalization) and infant custody status through the infant's hospitalization.

NAS Finnegan scores with a documented corresponding status of parental presence at bedside were extracted from the medical record. Parental presence (biological mother or father) at time of NAS scoring was documented by nursing staff in the patient's 24-hour flow sheet as part of routine care.

Statistical Methods

Descriptive statistics included baseline demographic characteristics of the mother–infant pairs. Independent sample

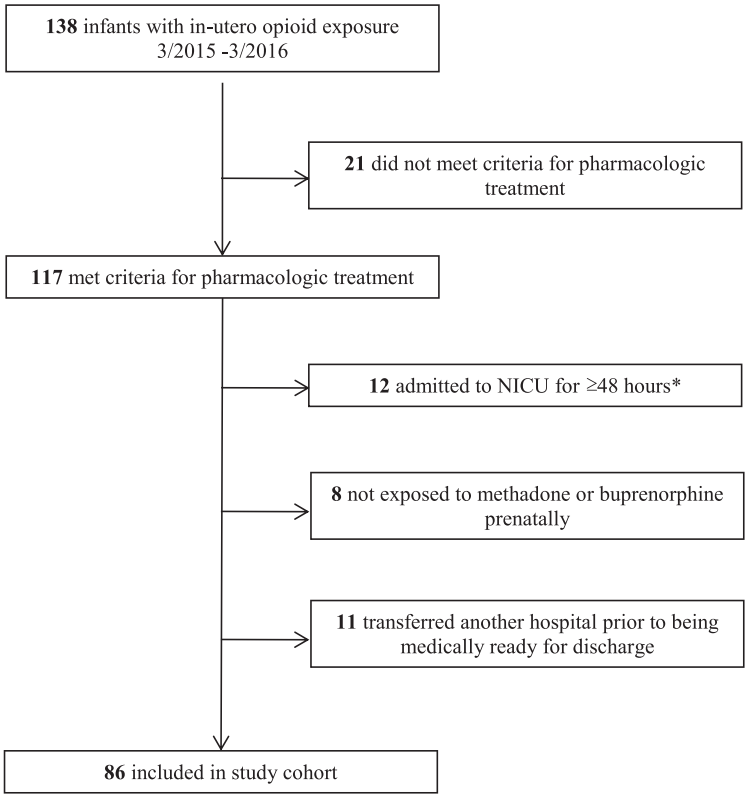

FIGURE 1 Inclusion and exclusion criteria for retrospective cohort. [a] Reasons for NICU admission: gestational age <36 weeks ($n = 9$), hypoglycemia ($n = 2$), congenital heart disease ($n = 1$).

t tests assessed whether parental presence differed across subgroups. We calculated a mean NAS score for each infant using NAS scores abstracted from the medical record with simultaneous documented parental presence. Listwise deletion was performed with missing data such that only scores with documentation of parental presence were included in analyses. Spearman or Pearson's correlation coefficients measured the correlation between parental presence and mean NAS score, LOS, total opioid days, and total opioid dose, in morphine equivalents. Coefficients of determination were calculated from the correlation coefficients to describe the proportion of the variance in the dependent variable that is predictable from the independent variable. We calculated morphine equivalents for the clinical trial participants using a 1:1 conversion for morphine and methadone total daily dosing. A list of potential covariates was selected on theoretical grounds at the onset of the study and examined in relation to parental presence and NAS outcomes. To maximize the ability to identify the effect of parental presence, only clinically relevant variables that were significantly associated with parental presence and/or a specific outcome at the $P = .05$ level in bivariate analyses were also included in regression models.

Multiple linear regression models examined the association between parental presence and the outcome variables, adjusting for the significant covariate of breastfeeding. Clinical trial participation was included as an effect modifier in the models. The difference in NAS outcomes that could be attributed to by maximum (parent present all of the time) versus minimal (parent never present) parental presence was determined. For all analyses, α was set at $P < .05$, and all hypothesis tests were two-tailed. Statistical analyses were performed using SAS statistical analysis software (SAS Institute, Inc, Cary, NC). The study received Boston University Medical Center Institutional Review Board approval.

RESULTS

A total of 86 mother–infant pairs were identified. Table 1 provides the maternal and infant characteristics for the study population. Methadone was prescribed to 55.8% ($n = 48$) of the mothers and 44.2% were maintained on buprenorphine ($n = 38$). Rates of maternal smoking and concurrent pharmacologic exposures are described in Table 1. The average gestational age of the infants was 38.9 weeks (95% confidence interval [CI], 38.5–39.3) and almost half were breastfed (47.7%) during hospitalization. Twenty-three percent ($n = 20$) of infants were discharged from the hospital with their

TABLE 1 Baseline Characteristics of 86 Mother–Infant Pairs

	No. (%), Mean (95% CI)
Mothers	
Mean maternal age, y	29.4 (28.3–30.3)
Maternal opioid	
Methadone	48 (55.8)
Mean dose at delivery (mg/d)	100.1 (89.2–111.1)
Buprenorphine	38 (44.2)
Mean dose at delivery (mg/d)	14.5 (12.9–16.1)
Maternal smoking in third trimester	62 (72.1)
Benzodiazepine use	19 (22.1)
SSRI use	10 (11.6)
Illicit drug use in third trimester	28 (32.6)
Amphetamine	1 (3.5)
Benzodiazepine	3 (10.7)
Cocaine	5 (17.8)
Heroin	11 (39.2)
Oxycodone/acetaminophen	2 (7.1)
Polysubstance use[a]	6 (21.4)
Infants	
Gestational age	38.9 (38.5–39.5)
Male	45 (53.2)
Breastfed	41 (47.7)
DCF custody	20 (23.3)
Clinical trial participation	23 (27.1)
LOS, d	18.9 ± 7.7 (17.3–20.5)
Days of opioid therapy	15.1 ± 6.5 (13.7–16.5)
Total morphine equivalents, mg	15.9 ± 10.0 (13.7–17.9)
Secondary agent	30 (34.9)

SSRI, selective serotonin reuptake inhibitor.
[a] Heroin + cocaine, $n = 3$; heroin + Percocet, $n = 1$; benzodiazepine + Percocet, $n = 1$; heroin + benzodiazepine, $n = 1$.

biological family, and 27.1% ($n = 23$) were included in the concurrent randomized control trial. Across the entire cohort, the average LOS was 18.9 days (95% CI, 17.3–20.5). The average duration of opioid therapy was 15.1 days (95% CI, 13.7–16.5) and the total morphine equivalent dose was 15.9 mg (95% CI, 13.7–17.9). Thirty infants (34.9%) required a secondary pharmacologic agent for control of their withdrawal symptoms (Table 1). Parents were present on average 54.4% (95% CI, 48.8%–60.7%) of the infant's total hospitalization.

In unadjusted analyses, any amount of breastfeeding was associated with a decreased LOS (16.5 vs 21.1 days, $P < .01$) as was clinical trial participation (15.8 vs 20.0 days, $P < .01$). Similarly, breastfeeding and clinical trial participation were also significantly associated with decreased duration of opioid therapy and a decreased total morphine equivalent dose (Table 2). The mean NAS score was significantly lower for infants who were breastfed (5.3 vs 5.7, $P < .01$) and participated in the clinical trial (5.1 vs 5.7, $P < .01$); however, these differences in scores were not clinically significant. Parental presence was higher for infants who were breastfed (65.2% vs 44.5%, $P < .0001$) and infants who were enrolled in the clinical trial (65.0% vs 50.9%, $P < .01$). Conversely, parental presence was significantly lower for infants in Department of Children and Families (DCF) custody (36.6% vs 59.7%, $P < .001$) (Table 2).

In bivariate analyses, 100% parental presence was significantly associated with a 1 point decrease in the mean NAS score ($r = –0.35$; 95% CI, –0.52 to –0.15; $P < .01$), a 9 day decrease in LOS ($r = –0.31$; 95% CI, –0.48 to –0.10; $P < .01$), and 8 fewer days of opioid therapy ($r = –0.34$; 95% CI, –0.52 to –0.15; $P < .001$). Additionally, although nonsignificant, there was a 5.3 mg decrease in the total morphine equivalent dose with increased parental presence ($r = –0.20$; 95% CI, –0.39 to 0.02; not significant) (Fig 2). Across the entire cohort, the mean NAS score when a parent was present was significantly lower compared with when a parent was not present (5.1 [95% CI, 4.9–5.3] versus 6.0 [95% CI, 5.8–6.2]; $P < .0001$).

In the multiple linear regression analysis, adjusting for the confounding variable of breastfeeding, parental presence remained significantly associated with a lower mean NAS score by 0.8 points ($\beta = –0.81$, $P = .02$) and 5.7 fewer days of opioid therapy ($\beta = –5.68$, $P = .03$) with a trend toward shorter LOS by >5 days ($\beta = –5.46$, $P = .09$). After adding in the effect modifier of clinical trial participation, results were attenuated and were no longer statistically significant. DCF custody was not included in the final regression models because it did not significantly influence β values.

DISCUSSION

This is the first study to examine the impact of parental presence at the bedside on the treatment course for substance-exposed newborns on an inpatient pediatric unit encouraging rooming-in. Greater parental presence during the hospitalization was significantly correlated with a decreased mean NAS score, decreased LOS, and decreased total days of opioid pharmacotherapy.

The American Academy of Pediatrics recommends nonpharmacologic care as first-line treatment of infants with NAS, however, few previous studies have evaluated the impact of various nonpharmacologic interventions on NAS outcomes.[5] Rooming-in represents one component of nonpharmacologic care. Compared with previous studies that have focused on a comparison of rooming-in on a

TABLE 2 Association of Covariates With LOS and Parental Presence at Bedside

Covariate	% Parent Present (95% CI)	*P*	Average LOS, d (95% CI)	*P*
Maternal opioid		.12		.13
Methadone	50.3 (43.1–57.0)		20.0 (17.9–22.2)	
Buprenorphine	59.4 (50.3–68.1)		17.5 (15.1–19.9)	
Breastfeeding		<.0001		.004
No	44.5 (36.3–52.4)		21.1 (18.7– 23.5)	
Yes	65.2 (59.8–71.2)		16.5 (14.5–18.5)	
Smoking		.45		.20
No	50.8 (39.4–61.0)		17.2 (14.0– 20.4)	
Yes	55.7 (50.2–64.4)		19.6 (14.1– 17.3)	
Benzodiazepine use		.70		.82
No	54.9 (48.5–60.2)		18.8 (16.8– 20.8)	
Yes	52.2 (40.1–65.3)		19.2 (16.4– 22.0)	
SSRI use		.5883		.41
No	53.8 (47.5–59.8)		19.2 (17.3–20.9)	
Yes	58.9 (39.1–77.2)		17.2 (12.2– 22.0)	
Illicit drug use		.09		.56
No	57.7 (50.4–64.5)		18.6 (16.5– 20.7)	
Yes	47.4 (37.2–57.4)		19.6 (17.0– 22.2)	
Clinical trial participant		.01		.01
No	50.9 (44.1–58.3)		20.0 (18.1–21.9)	
Yes	65.0 (55.6–73.7)		15.8 (12.9–18.7)	
DCF custody		.001		.17
No	59.7 (53.2–65.9)		18.4 (16.4–20.2)	
Yes	36.6 (24.3–48.5)		20.8 (17.8– 23.8)	

SSRI, selective serotonin reuptake inhibitor.

hospital ward versus an intensive care setting,[9,11,15,16] a strength of this study is the evaluation of a cohort of infants who all had the opportunity for rooming-in with their parents. This is also important because many hospitals care for infants with NAS in NICUs, where rooming-in is not possible. Alternatives to caring for these infants on the pediatric inpatient ward or level 2 nurseries, where 24-hour rooming-in is possible, even noninpatient residential settings could be investigated as possible standards of care. As shown in previously published cohorts of infants in Canada, breastfeeding was associated with a significantly decreased LOS in our study.[13] Beyond rooming-in, this study suggests that a focus on parental presence to promote nonpharmacologic care through breastfeeding, skin-to-skin time, and parental–infant bonding is significantly associated with a decreased LOS for infants with NAS.

On average, in this ward-based model of care encouraging rooming-in for infants with NAS, parents were present just over half of the time. Several barriers to parental presence that have been identified through discussions with families at our institution include: transportation, additional child care responsibilities, off-site methadone dosing, residential substance use disorder treatment program requirements, and stigma and guilt experienced by women with substance use disorders watching their infants go through withdrawal. Previously published research supports these barriers in experiences of families with infants hospitalized for NAS.[18,19] Additional research is needed to explore support programs to help eliminate these barriers.

Infants who were placed in DCF custody were found to have a decreased rate of parental presence compared with infants whose parents retained custody. For the majority of the infants at our institution, a decision about custody is deferred until the end of the hospitalization, so all parents have the opportunity to be present at the bedside with their infants. The differences in parental presence observed between those families that did not retain custody and those who were discharged from the hospital with their infants may highlight families who had additional barriers to being at the bedside, or who were actively using illicit substances. This difference is highlighted by a previous study demonstrating an inverse relationship between rooming-in and foster care placement.[13] The percentage of parental presence could be an additional factor to consider in determining custody status or designing specialized programs to support the unique needs of each mother–infant dyad.

During the time period of this retrospective study, BMC participated in a multicenter randomized control trial (R01DA032889-03) assessing the pharmacologic treatment of NAS with methadone compared with morphine. The medication these infants received remains blinded. The infants participating in the trial were more likely to have a decreased LOS and decreased total treatment days compared with infants not participating in the trial. Trial participants were also more likely to have higher amounts of parental presence, although this is unrelated to any requirements of the clinical trial protocol. We included trial participation as an effect modifier in all of our regression models because it is not possible to separate the influence of clinical trial participation versus the impact of receiving methadone versus morphine on NAS outcomes. Previous studies have indicated that clinical trial participation is an independent predictor of improved outcomes, likely due to increased staff vigilance and patient engagement.[19] One previous randomized control trial comparing methadone versus morphine showed a decreased LOS for infants in the methadone group.[20] Conversely, a retrospective chart review showed decreased LOS for infants treated with morphine when compared with methadone.[21] At this point, it is unclear if some of the improvement in the infants enrolled in the trial may be secondary to methadone treatment.

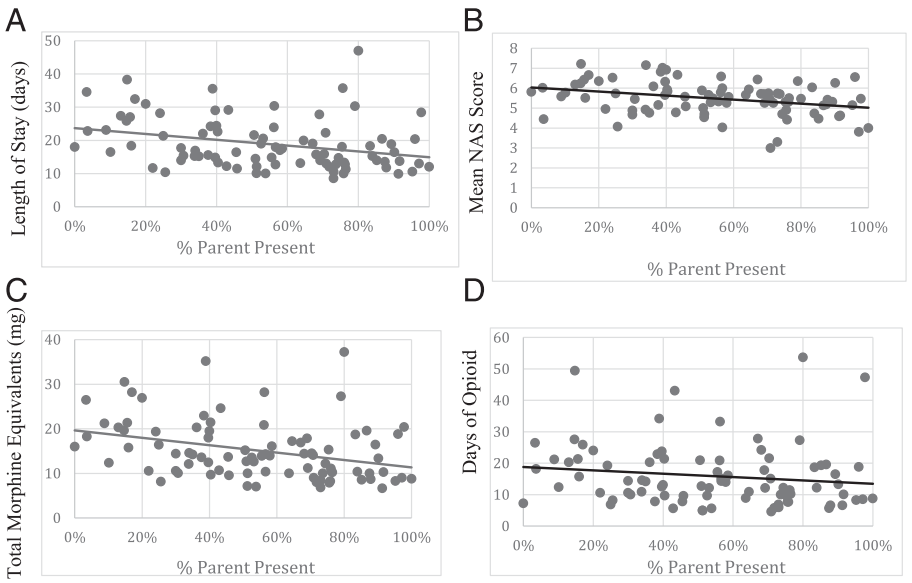

FIGURE 2 Correlation of parental presence and NAS outcomes. A, Correlation of parental presence with LOS (days) ($r = -0.31$; 95% CI, −0.48 to −0.10; $P < .01$). B, Correlation of parental presence with NAS score ($r = -0.035$; 95% CI, −0.52 to −0.15; $P < .01$). C, Correlation of parental presence with total morphine equivalents (mg) ($r = -0.20$; 95% CI, −0.39 to 0.02; $P = .06$). D, Correlation of parental presence with days of opioid therapy ($r = -0.34$; 95% CI, −0.52 to −0.15; $P < .001$).

There are important limitations to this research study. This was a retrospective chart review of clinical data, with parental presence being a new metric for nurses to document after transitioning to a new electronic medical record. As a result, for each infant, parental presence was documented an average of only 68.0% (95% CI, 64%–72%) of the time. Additionally, the way parental presence was documented does not allow us to assess the amount of time spent or the level of parental involvement, only that they were present at the time the scoring took place. Data on which caregiver was present were not available. Infants who did not receive pharmacologic treatment were excluded, because their hospital stays are inherently shorter, and the number of untreated infants in this cohort was too small to separate in a subgroup analysis.

Additionally, our institution has a number of unique factors in caring for infants with NAS that may limit the generalizability of the study. First, our model of care for infants with NAS on the inpatient pediatric ward was developed to maximize parental inclusion and involvement. Second, during the study period, >85% of infants required pharmacologic treatment, which is significantly higher than the national average and may have been secondary to a strict protocol aimed at early capture of symptoms to attempt to reduce LOS. Based on recent research,[7,22] we have since modified our model of care to focus on the functioning of the infant (and ability to eat, sleep, and be consoled), with a 50% drop in our medication treatment rates. Despite these limitations, this study supports the growing body of literature that promoting rooming-in encourages breastfeeding and that the percentage of time parents are present in the hospital contributes to a reduction in LOS for pharmacologically treated infants.

CONCLUSIONS

In summary, this study supports the role of rooming-in and parental engagement in infant care for decreasing withdrawal severity, LOS, and pharmacologic treatment of infants with NAS. Additionally, the strong association of breastfeeding with parental presence suggests that breastfeeding should be encouraged to improve outcomes for infants with NAS. Clinical practice guidelines for the management of NAS should encourage parental presence in the model of care. Future research into the barriers that prevent parental presence at the bedside and interventions to increase parental presence at the bedside are warranted.

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