

Mare and Foal Bonding and Problems

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A number of specific behavioral responses have been identified in mares and foals as the presumed behavioral interactive sequences supporting bonding. With the exception of the severely physically compromised foal, most failures of the mare foal bond appear to result from inadequate behavior of the mare. Six distinct forms of maternal behavior problems include ambivalence of the mare toward her foal, fear of the foal, nursing only avoidance of the foal, extreme protectiveness of the foal that becomes problematic in domestic confinement, savage attack (true rejection), and stealing or adoption of an alien foal. Management of maternal behavior problem cases in which the pair cannot be salvaged include foster (or nurse mares) and hand-rearing methods. Also presented are current practical resources related to managing certain types of inadequate maternal behavior and for rearing the orphaned foal.

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Problems with maternal behavior and mare-foal bonding, although relatively rare, typically require rapid assessment and decisions regarding whether or not to attempt to maintain the pair. This requires an understanding of the specific types of behavior problems, usual interventions, and potential outcomes. In addition to addressing cases of inadequate bonding, the veterinarian can serve the horse-owning public by educating owners in prevention of mare and foal bonding problems and answering questions about normal and abnormal foal and mare behavior. The purpose of this article is to briefly review normal mare and foal bonding behavior and to outline specific types of problems with discussion of assessment, intervention, and prevention. Particular detail is provided on rearing the orphan foal that often results from certain types of inadequate maternal behavior. Finally, current practical related resources are summarized.

Normal Mare-Foal Behavior

Maternal behavior in mares includes attention to fetal fluids and membranes and attention to and protection of the foal (Figure 1). Attention to fetal fluids and membranes during and immediately after parturition include sniffing, licking, nuzzling, and flehmen response. Ingestion of fetal membranes (placentophagia) is not typical in horses, with estimates in domestically managed mares in one survey of lower

than 1%.¹ Attention to the foal during and immediately after delivery includes nuzzling, licking, scraping with teeth, avoiding walking or lying on the neonate, allowing and facilitating nursing, and protecting the neonate from intruders by positioning herself between the neonate and intruders and even attacking or driving away intruders. Behaviors believed to support the bonding process include attention to the fetal fluids, nose-to-nose nuzzling with sniffing of each other's breath, and the mare nuzzling of the foal's perineum, particularly when the foal is nursing. These behaviors are most intense in the first hours and continue with diminishing frequency through the first 3 days until the selective bond (specific mare to specific foal) appears to be well-established.

The foal appears to play an active role in eliciting maternal behavior and bonding. Even before standing, the foal may squirm toward the mare's head and appear to seek nose-to-nose contact. The foal may vocalize and respond to the vocalizations of the dam. After standing, the foal actively seeks the udder. Udder seeking in the foal appears to involve attraction of the foal to follow along any horizontal ledge, which under natural conditions would most likely be the dam's abdomen only. In stalls and paddocks, foals may follow a fence rail or other horizontal feature as if seeking the udder. After the first nursing and rest, foals typically have one or more periods each lasting one to several minutes of locomotor activity circling around the mare. This is first at a walk, and then at the trot, and sometimes faster gaits. It often appears to be a compulsive exercise with bursts of energy. Within the first minutes to first hour after standing, most foals show the tendency to linger near and return to the mare if separated. Some neonates may follow any moving animal or human for the first 24 hours, after which they normally follow only the dam.

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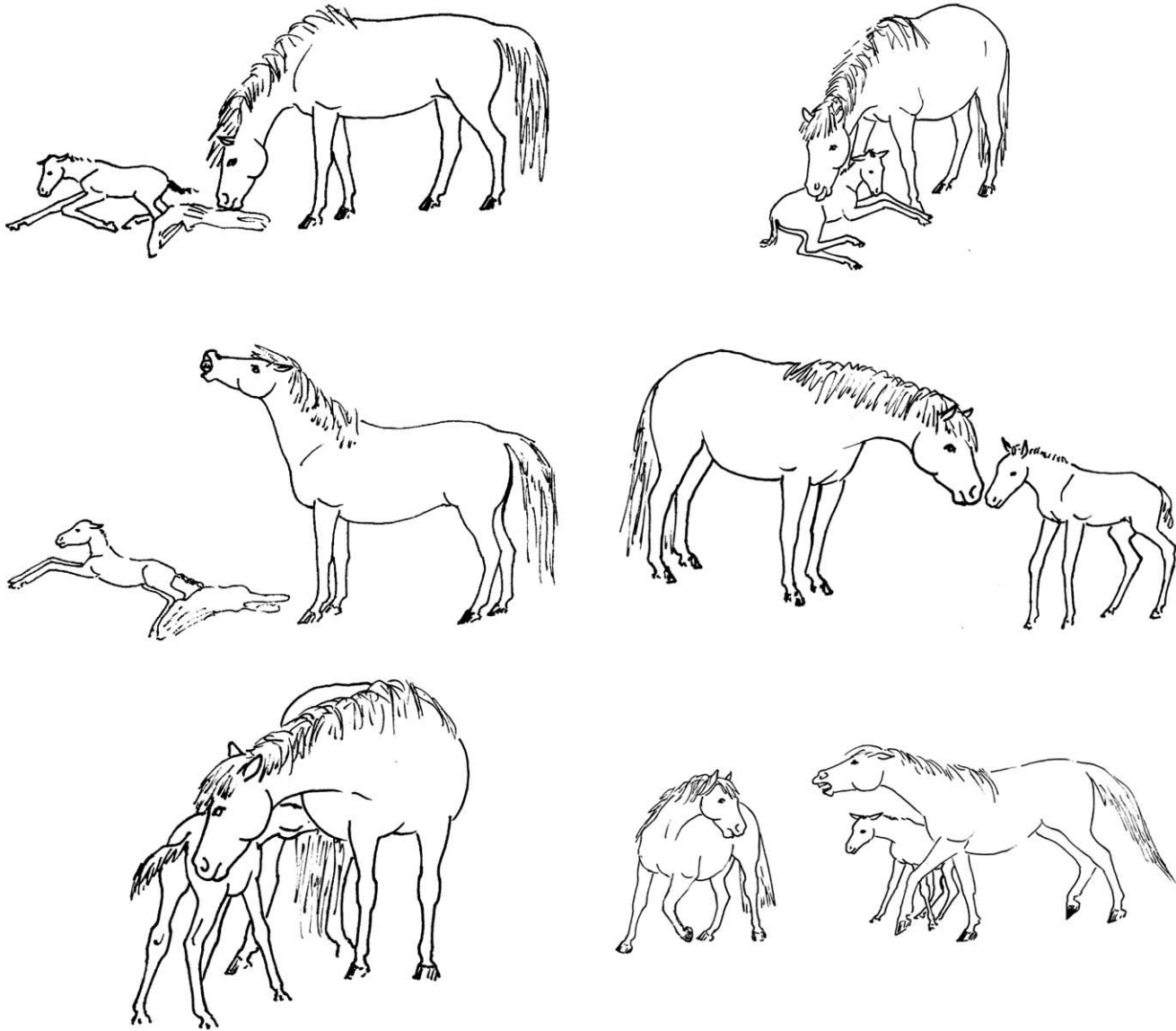


Figure 1 Early maternal behavior in the mare includes sniffing, licking, and flehmen response to fetal fluids, membranes, and the fluid covered foal, as well as protection of the foal.

Under natural social conditions, both the dam and harem stallion defend the foal. Dams when threatened by non-harem members soon after parturition typically circle around the foal keeping their head and chest at the foal, while kicking toward the threats. The dam also steps between the foal and any close conspecifics, maintaining the nearest contact to the foal, presumably to prevent the foal from following others before the selective bond is formed.

Observations of both domestic and feral mare and foal pairs that have bonded normally suggest that, even before the first nursing, it is typical for many mares to step away from the foal while it is seeking the udder. This seemingly paced stepping away appears to elicit following behavior of the foal. It has been proposed that this interaction may serve to “teach” the foal to follow the mare.² Owners who observe this behavior sometimes question the quality of maternal behavior. They may intervene to restrain or discipline the mare. The authors’ experience suggests that discipline may be counter-productive. We recommend understanding that a certain amount of stepping without aggressive kicking or biting at-

tempts represents this normal mare behavior. Positive restraint of the mare, although usually not necessary, is usually not harmful. Foals that go immediately to the udder without this experience adequately follow the mare.

There are some general trends to normal maternal behavior over the period of lactation that have been observed and reported for various groups of horses and ponies that are relevant to understanding domestic mare and foal behavior. First, it is normal for mares to terminate nursing bouts. New Forest Pony,³ Camargue horse,⁴ Welsh pony,² and Belgian draft horse⁵ studies all report that, in the early part of lactation, the dam terminates significantly more nursing bouts than in later lactation. For 90% of observed mare-terminated nursing bouts, the dam simply walked away while the foal was still nursing.^{2,3,5}

Normal maternal behavior also includes moderate aggression directed at the foal. Normal aggression occurs almost exclusively during bunting of the udder and nursing, and less than 1% occurred outside of nursing behaviors.⁵ In almost all cases, it appears to be elicited by vigorous activity of the foal

that would not be present in neonates. And, in fact, these studies all reported a significant increase in maternal aggression during nursing bouts later in lactation (ranging from 11 to 40 weeks after parturition). Agonistic behaviors of the dam directed toward the foal include: head threats with ears pinned, squealing, swishing the tail, pushing the foal with the head, bite threats (most common⁵), “smacking,” which may be a modified bite threat which includes a more auditory signal, biting (second most common⁵), kick threats, and kicking.² Although most maternal aggression occurs during nursing, Barber and Crowell-Davis⁵ found that foals showed no response to the aggression in most (66%) instances. The usual interpretation of this normal aggression during nursing and the increase later in lactation is that it is related to udder discomfort as milk is depleted^{2,3,6,7} and results in natural weaning of the foal by the dam.^{2,4}

Inadequate Maternal Behavior: Types, Evaluation, and Management

At least six distinct forms of inadequate or problematic maternal behavior have been identified in mares. Understanding of the specific type is the first step in evaluation. Although it is believed that any of the six types can occur in either primiparous or multiparous mares, all forms are believed to be more common in primiparous mares.⁸ Table 1 is a sample list of history questions that may be helpful in gathering information to discern the specific type of problem.

Ambivalence

Probably the most common form of inadequate mare–foal bonding is simple ambivalence of the mare toward her foal, with a lack of attention, bonding behavior, and protective behavior. This is most commonly seen with sick, weak, or medicated dams and/or foals, or in dams and foals that have been separated or over-manipulated during the neonatal period. Normal maternal–foal interaction may commence as the strength of one or the other returns. So it is recommended to keep the pair together with minimal disturbance necessary for supportive health care.

If the normal maternal behavior does not resume and both animals are healthy, a momentary separation of foal and dam has been recommended to evaluate and/or stimulate maternal behavior.⁷ Normal maternal behavior when separated from the foal includes: pacing, circling, pawing, and vocalizations. The foal may exhibit these same behaviors, which may stimulate the mare to respond. Threatening the dam has also been suggested as a method of evaluating maternal behavior. This can be done with a leashed dog. Care must be taken that the dam is not threatened to the point that she may accidentally trample the foal. Normal maternal response to such a threat includes: head threats, strikes or kicks directed at the dog, circling around and moving the foal, and positioning herself between the foal and the threat. Healthy animals can also be turned out with or in pastures adjacent to other horses and closely monitored.⁹ Dams may be stimulated to be protective of their foals with the threat of other horses approaching, even if they are in adjacent pastures.

Table 1 Sample Patient History Questions for Mare–Foal Bonding Problems

Mare’s foaling history
Primiparous or multiparous?
Age at first foaling?
Number of foals?
Any mare-foal bond problems with previous foals?
Is the mare typically very protective, moderately protective, or not protective of her foals around humans? Around other horses?
Mare history
Is the mare food aggressive?
Is the mare herd bound or does she show separation anxiety when separated from herd?
Is the mare acclimated to human handling?
Is the mare acclimated to her current environment?
Current mare-foal bond
Was delivery normal?
How long did it take?
Did humans intervene during or after parturition?
What did they do?
How did the mare react?
Did the mare investigate fetal membranes/fluids?
Were the fetal membranes/fluids removed from the stall? How long after parturition?
Did the mare lick/nuzzle/sniff the foal?
Did the foal seek the udder?
Did the mare allow and/or facilitate the foal nursing?
Did the foal stay near/follow the mare?
Does the mare move towards or away from the foal when it approaches?
When the foal attempts to nurse?
When the foal is in recumbent rest?
When were signs of a possibly abnormal mare-foal bond first observed? Explain?
Were there any interventions (ie restraining the mare, helping the foal to the teat)? Explain?
Has the pair been moved at all?
What behaviors does the mare display that are abnormal or disruptive to mare-foal bond?
head threat with ears pinned, charge or lunge, kick threat or kick, bite threat or bite, lifts leg and/or walks away during nursing attempts
When do these behaviors occur?
How does the foal react to the behavior of the mare?
Is the aggression stopping nursing?
Does the mare appear painful for any reason?
Does the foal look healthy and normal?

Fear of the Foal

Fear of the foal is most common in young primiparous mares. Bonding and protective behavior are not present in this type of inadequate maternal behavior. The fearful dam typically moves away from the foal whenever it approaches and may show explosive fear behavior which could endanger the foal.^{7,10} Moving the pair to a larger area allows the mare to avoid the foal without injuring herself or the foal.¹⁰ The techniques of separating or threatening the pair suggested for ambivalent mares have also been suggested as a diagnostic for a dam which is fearful of her foal.^{7,9,10} Gradual desensitization to the foal may also be applied by rewarding the mare for calm behavior as the foal is brought closer and closer. Tranquilization of the mare can be beneficial. The goal is to

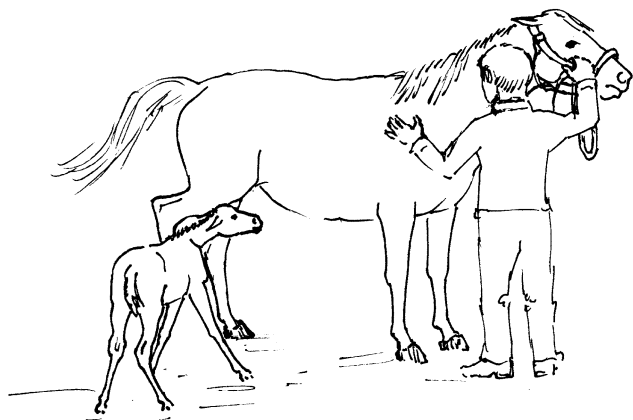


Figure 2 Nursing only avoidance in the mare.

achieve sedation adequate for acceptance of the foal without compromising the mare's ability to learn and without transferring significant tranquilization to the foal. It has been suggested that acepromazine is typically superior to xylazine for this purpose.⁷ It has also been suggested that the anxiolytic diazepam is effective for ameliorating fear in mares.⁷

Nursing Only Avoidance

For some mares, avoidance of the foal and aggression are clearly limited to nursing (Figure 2). Houpt⁹ suggested this type of inadequate maternal behavior to be the most common type. Positive bonding behavior and protectiveness may remain normal. Discomfort in the dam is the most likely cause. Common causes of pain that disturbs normal nursing behavior are a retained placenta⁷ and udder discomfort, which may include the foal bunting the udder, the foal biting the teat, a very distended or engorged udder, udder edema, mastitis, or unknown pathology of the mammary system.^{7,9} For mild nursing avoidance or mild aggression, nursing supervision with physical restraint of the mare under halter, in general, seems to work better than tranquilization. Mares that are not tolerant of a foal sucking are often more tolerant of hand milking. These mares can be milked and the foal fed from a bottle held in the mare's inguinal region and then the foal can be eventually transferred to the mare's teat.^{9,10} Restraint of the mare in a nursing chute provides the foal access to the udder with some protection from kicking. For some mares, a "live-in" tie-stall chute can be made in which the mare can be restrained continuously for nursing without an attendant (Figure 3). The simplest version reported is a padded pole at the height of the mare's stifle to create a straight stall along a wall so that the mare cannot spin around to kick or bite at the foal. Her forward and backward movement can be limited by additional poles or tether length. The mare can receive positive reinforcement (food or scratching) for allowing the foal to nurse.^{8,9} A blindfold or blinkers can be used to reduce the visual stimulus of the foal at the udder and also reduce the precision of the mare's aim.^{11,12} Restraint is usually required for 3 days to a week before the mare no longer resists nursing.⁷⁻⁹ As with the mares that are fearful of the foal, tranquilization may be beneficial. It has been suggested that acepromazine is typically superior to xylazine for this purpose.⁷ The long-acting phenothiazine-based tranquilizers, such as reserpine and fluphenazine as well as the benzodiaz-

epine derivatives, have been tried with anecdotal evidence suggesting mixed results. Again, precautions must be taken to avoid adverse effects on the nursing foal. Since, in many cases, the mare shows rapid spontaneous recovery when not treated, it is difficult to assess the effectiveness and adverse effects of these drugs on behavior.

Extreme Protectiveness

Although not abnormal behavior under natural conditions, extreme protectiveness is important to distinguish from savage attack of the foal. Aggression toward humans or other animals, especially in confinement, can lead to foal injury. While rushing to interpose herself between the foal and perceived threat, the mare may trample or push the foal into man-made obstacles. The intensity of protectiveness typically subsides over the first few days, but may persist for weeks in some mares. Management aimed at avoiding evoking protectiveness when the foal is in a position where it might be trampled, coupled with deliberate training of the mare to accept necessary intruders usually are adequate solutions. Injuries to the foal may be less likely in a large stall or paddock free of obstacles. Even when directly witnessed, protective behavior can be easily misinterpreted as attack of the foal. In open spaces, these mares rarely injure the foal, so diagnosis may be facilitated by moving from a stall to a large paddock.

Savage Attack

Savage attack of a foal is relatively rare, and is usually life-threatening to the foal. The mare attacks the foal offensively, seemingly unprovoked, with a lowered head and opened mouth biting or grasping at the withers, neck, or back of the foal (Figure 4). The dam may lift, shake, toss, or stamp and hold the foal to ground. Savage attack of foals is not well understood and can take place soon after parturition or some days later. There may or may not be normal bonding behavior, depending on when the mare became aggressive toward the foal. Savage mares may still show some elements of good maternal behavior, for example the "tending or recumbency

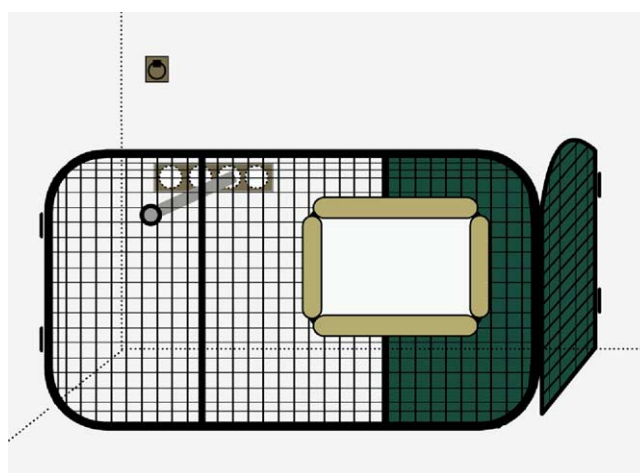


Figure 3 A nursing chute made from metal gates. Size can be adjusted based on materials available and the mare's size. The bar at the chest can be positioned to accommodate a range of lengths in mares. The opening for the foal to nurse through should be very well padded. Additionally, padding or stall mats can be added to the rear of the chute for a mare that kicks out.

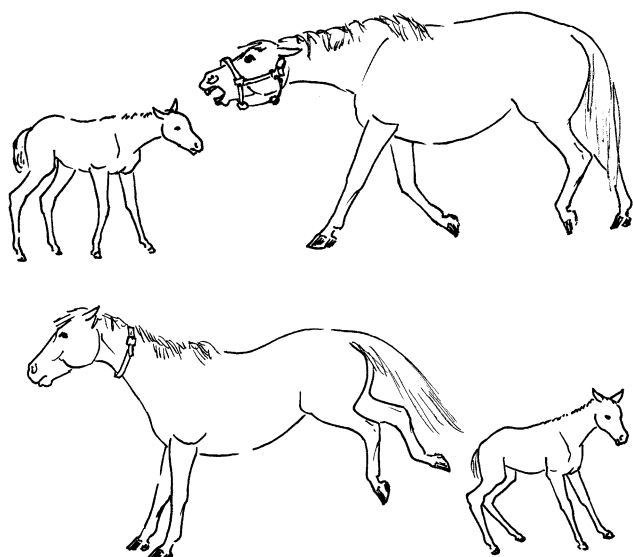


Figure 4 Mare savagely attacking her foal.

response.” It has been noted that attacks are not often to a recumbent foal.⁹ Tranquilization and restraint can be attempted, but relapses are typical.¹⁰ It has been suggested that there is a potential genetic and/or hormonal basis to this behavior, but it is still most common in primiparous mares.^{8,9}

There are instances in which a dam redirects aggression aimed at nearby horses, which are visible but cannot be contacted, toward her own foal.^{7,10} Similarly, sometimes a mare with a tendency for food-related aggression will threaten her foal away from her grain bucket.⁹ Both of these are considered forms of displaced aggression. The aggression usually consists of head or bite threats, and occasionally kick threats that are typically momentary and usually not life-threatening.

Stealing or Adoption of Alien Foals

Although rare in horses compared with some species, stealing of a neonate from its dam by another mare does occur.¹⁰

Prevention of Mare–Foal Bonding Problems

A general recommendation for preventing mare–foal bonding problems is to allow mares to foal undisturbed as much as possible.^{7,8} It is believed that this is especially important for mares that are naïve or fearful of human interaction.⁸ Houpt⁸ recommends allowing the fetal membranes and fluids to remain with the mare for several hours, and allowing the mare to have at least visual contact of the foal during any necessary medical procedures.

Although it is prudent to limit disturbance of mare and foal pairs during parturition and the neonatal period, experience of neonatal intensive care facilities suggests that many mare–foal pairs bond fairly normally despite necessary brief separations and intensive care. The principles employed by these facilities include maintaining pairs in close proximity, minimizing disturbance of olfactory interaction, and hand-feeding foals from a bottle held in the mare’s inguinal region whenever possible.

The truly savage mare is not well understood. Houpt⁸ recommends not re-breeding mares that have savagely rejected their foals.

Inadequate Foal Behavior

The only type of inadequate foal behavior that is detrimental to the mare–foal bond is simply lack of vigor from considerably compromised foals. The usual behavioral standard for vigor for domestic horse foals born in stalls is to stand approximately 1 hour after parturition, begin seeking the udder soon thereafter, and nurse by 1.5 to 2 hours.^{11,13} Jeffcott¹⁴ observed somewhat quicker times for domestic pony foals: standing at 30 minutes and nursing at approximately 1 hour. Our laboratory’s studies of behavior under more natural conditions suggest a more rapid progression of behaviors than foals born under domestic confinement. Table 2 summarizes a Neonatal Equine Development (N.E.D.) Scoring Inventory based on 12 marker behaviors developed in our lab at the University of Pennsylvania.

Occasionally, owners and managers of foals interpret cer-

Table 2 Neonatal Equine Development (N.E.D.) Scoring Inventory*

Behavior	Slower than Usual = 0	Average to Low Normal = 0.5	High Normal = 1
Sternal Righting	>5 min	3-5 min	<2 min
Shake Response (head or body)	>10 min	3-10 min	<3 min
Attempts to Stand Begin	>30 min	10-30 min	<10 min
Stand Successfully (with steps)	>60 min	30-60 min	<20 min
Standing-Udder Seeking	>10 min	3-10 min	<3 min
Suckle	>90 min	45-90 min	<45 min
Locomotor Burst of Speed	>2 hr	1-2 hr	<1 hr
Circle Dam at Speed	>2 hr	1.5-2 hr	<1.5 hr
Organized Recumbency	>3 hr	2-3 hr	<2 hr
Autogrooming	>3 hr	2-3 hr	<2 hr
Organized Gates (walk, trot, plus)	>4 hr	2-4 hr	<2 hr
Retreat from Approaching Human	>4 hr	2-4 hr	<2 hr

Total score of greater than 10 is high normal, 4–6 is average to low normal, and less than 4 is slower than usual.

*From the Equine Behavior Lab at the University of Pennsylvania.

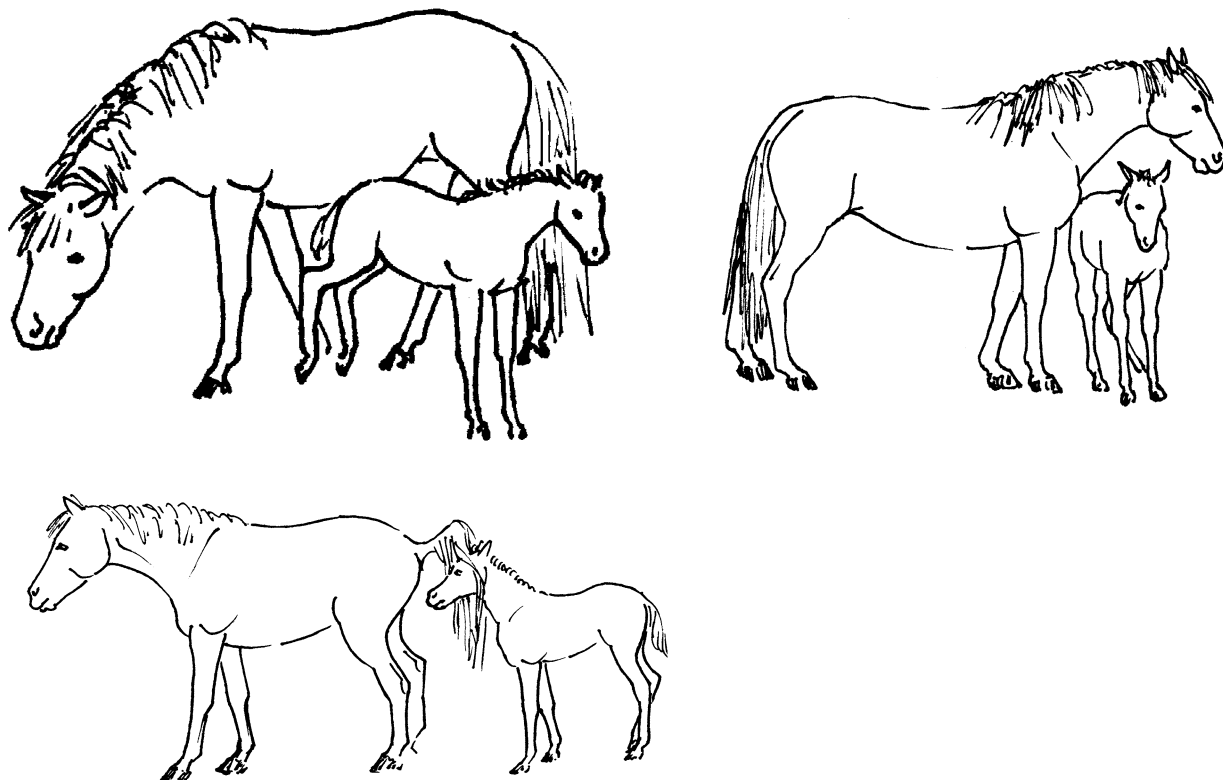


Figure 5 Kick up, blocking, and sexual behavior are all normal foal behaviors.

tain normal foal behaviors as potentially harmful to the mare–foal bond. For example, a common normal behavior of foals involves backing into the mare and kicking up with both hind legs toward the abdomen or udder. This behavior, known as kick up,¹⁵ is believed to signal the mare to stop moving forward to allow nursing. In this regard, the behavior is similar to blocking. In addition, young foals, both male and female, normally show sexual behavior and mounting of their dam. Although this typically emerges days after the neonatal bonding period, owners and managers not familiar with this behavior may question the nature of the bond (Figure 5).

Under natural social and environmental conditions, mares usually linger with a weak nonambulatory foal as long as the harem stallion allows. In the case of dead foals, it appears that the dam lingers for a variable length of time, usually not more than several hours. The mare may sniff, nuzzle, paw, or otherwise appear to investigate and encourage the foal to rise. In domestic situations, owners seek advice about the best practice for removing the foal, with the welfare of the mare in mind. When the dead foal is removed immediately, the mare usually vocalizes and may show signs of separation stress for a brief period. This is typically less severe the longer the dead foal remains. In a pasture situation, the mare usually moves away within 1 to 3 hours.

Preparing Nurse Mares and Fostering Techniques

Foaling Mares

Foster or nurse mares are commercially available in some regions. Professional nurse mare services typically deliver the mare with trained staff that knows the individual nurse mare,

fostering techniques that have worked best with that mare, and have necessary equipment and supplies to ensure acceptance of the foal. These mares are usually experienced mothers with good milk production, who have had their foal removed immediately before transport to the orphan. The nurse mare is usually leased by the user and returned pregnant to the nurse mare farm. With the cost of commercial nurse mares and growing concern about the early weaning of foals born to the nurse mares, other options may be considered or may be desired. Internet and breed-based organizations have developed nurse mare/orphan foal networks that link owners of mares that have lost a foal with owners of orphans in need of a nurse mare (Table 3). Mares from this type of service may be less reliable in their disposition and willingness to accept a foster foal, but certainly good matches can be made.

Nurse mares of either type should be as close as possible in size/breed and stage of lactation to the foal's dam so that milk production is appropriate in amount, composition, and easily accessible. Ideally, a nurse mare arrives accustomed to being restrained, having the udder palpated, and standing in a straight stall. If not, acclimation to these procedures before attempting to introduce the foal will make acceptance of the foal more efficient. Various stimuli from the mare's own foal can be used to facilitate the fostering of the new foal. These can include the foal's skin (in the case of a dead foal), a blanket worn by her foal, or milk from the mare applied to the foster foal.^{9,11} It has been observed that mares with still-born foals or foals that had not nursed may be less likely to accept an alien foal.¹¹ Foals that have been bottle or bucket fed for long periods of time or have never nursed a mare may not accept a nurse mare.¹¹

Table 3 Resources**Colostrum**

Cyberfoal
www.cyberfoal.com
Hagyard-Davidson-McGee Pharmacy, LLC
4250 Iron Works Pike
Lexington, Kentucky 40511
1-888-323-7798
www.hagyardpharmacy.com
National Colostrum Network
651-647-8391
<http://academic-server.cvm.umn.edu/NCN/>

Serum and IgG Sources

Endoserum
IMMVAC, Inc.
6080 Bass Lane
Columbia, MO 65201
1-800-944-7563
www.immvac.com
Equine Coli Endotox
Novartis Animal Health US, Inc.
1447 140th Street
Larchwood, IA 51241
1-800-843-3386
www.livestock.novartis.com
HiGamm-Equi
Lake Immunogenics, Inc.
348 Berg Road
Ontario, NY 14519
1-800-648-9990
<http://lakeimmunogenics.com>
Polymune and Polymune-Plus
Veterinary Dynamics, Inc.
1535 Templeton Road
Templeton, CA 93465
1-800-654-9743
Seramune Equine IgG
Sera Inc.
1-800-552-3984
www.seramune.com

Milk Replacer

Foal-Gro Performance Milk Replacer
Grober Nutrition
415 Dobbie Drive
Cambridge ON
Canada, N1T 1S9
1-800-265-7863
www.foal-gro.com
Foal-Lac Powder and Pellets
PetAg
255 Keyes Avenue
Hampshire, IL 60140
1-800-323-6878
www.petag.com
Foal Life II
Uckele Health & Nutrition
P.O. Box 160
Blissfield, MI 49228
1-800-248-0330
www.uckele.com

Table 3 Continued**Grow-N-Glow Foal Milk Replacer**

Merrick's Inc.
2415 Parview Road
Middleton, WI 53562-0307
1-800-MER-RICK (637-7425)
www.merricks.com
Mare's Match Foal Milk Replacer and Pellets
Land O Lakes
www.lolmilkreplacer.com
Mare's Milk Plus
Buckeye Nutrition
330 E. Schultz Avenue
Dalton, OH 44618
1-800-898-9467
www.buckeyenutrition.com
Wet Nurse
PMT Inc.
2641 Albert Street N
Regina, Saskatchewan
Canada, S4R 8R7
1-306-721-6066
www.pmtgroup.com

Nurse Mares

Cyberfoal
www.cyberfoal.com
Equine-Reproduction.com
P.O. Box 2876
McKinleyville, California 95519
720-272-5998
www.equine-reproduction.com
National Foaling Bank (Vardon Trust)
c/o Meretown Stud
Newport, Shropshire
TF10-8BX, England
01952 811234
www.piaffe.org/national_foaling_bank/
Standardbred Canada
Nurse Mare Program
2150 Meadowvale Boulevard.
Mississauga, ON
Canada, L5N 6R6
905-858-3060
www.standardbredcanada.ca
THE HORSE
The Horse Source Directory
PO Box 919003
Lexington, KY 40591-9003
email: source@TheHorse.com
<http://sourceoodhorse.com/thehorse/>

Other

Acclimate (odor masking topical)
Exodus Breeders Corporation
5470 Mount Pisgah Road
York, PA 17406
1-877-396-3874
www.exodusbreeders.com



Figure 6 Food, social interaction, and exercise available ad libitum in a kindergarten group of orphan foals at Justaplain Farm in Cochransville, PA.

Fostering relies on fooling the mare's senses that this foal could be her own¹¹ and a foal's willingness to nurse any mare if hungry.¹⁶ Maternal recognition of the foal includes olfactory, visual, and auditory stimuli. Olfactory stimuli seem to be very important when in close proximity and visual stimuli when at a distance.¹⁰ The foal should begin drinking the nurse mare's milk as soon as possible,⁸ but should be hungry (not fed for 2 to 4 hours if healthy) when the first introduction is made. The foal's own scent may be disguised by covering as much of the body as possible (most important are the head and tail) with: the dead foal's skin, amniotic membranes/fluids, a blanket worn by the mare's foal, the mare's milk, or mentholated ointments (Vick's Vapor Rub) or Acclimate (Table 3).^{8,11,12,16} When using mentholated ointments or Acclimate, they should also be applied to the mare's muzzle and need to be re-applied every few hours during fostering. If the mare's foal and the alien foal differ greatly in appearance, blanketing the nurse mare's foal before separation and transfer of that same blanket to the foster foal can be beneficial.

Fostering can be accomplished in many ways and is dependent on the specific circumstances, but some techniques are commonly practiced with positive results. Mare and foal are prepared and the mare is restrained by experienced handlers in a stall or behind a pole or nursing chute (Figure 3). Tranquilization may or may not be required for the initial introduction based on the temperament of the mare and many other factors. Rossdale and Ricketts¹¹ suggest the mare be led away, the foal brought in, and the mare returned. The mare is then allowed to sniff the covered or treated parts of the foal, the foal is brought to the udder and allowed to nurse

for about a half a minute, then the foal is removed and the mare is encouraged to follow it and then again sniff the appropriate areas. This is to be repeated regularly until the mare accepts the foal, which they report taking up to 12 hours, after which the chances of acceptance are reduced but more attempts can be made after a separation. Houpt⁸ recommends not allowing the mare to sniff the foal until it has been nursing her for 24 hours, based on the idea that the mare will recognize the foal as her own when it smells like her digested milk. She recommends using a nursing chute with the mare's head tied so she cannot sniff the foal, but it has access to the udder. Tranquilization may be effective in this situation.

Barren Mares (Drug-Induced Lactation and Maternal Behavior)

Induction of lactation and maternal behavior in nonparturient mares has been successfully attempted by Porter and coworkers.¹⁷ Welsh pony mares that had successfully raised at least one foal previously had lactation induced using estradiol, progesterone, and a dopamine antagonist, as well as oxytocin injection and mammary stimulation. When the mare was given vaginal-cervical stimulation while the foster foal was introduced ($n = 8$), the latency to accept the foal was not significantly different from that of control. These techniques may find useful application both in inducing maternal behavior in rejecting mares and in producing foster mares.

Orphan Foals

Hand-feeding an orphaned or rejected foal is sometimes necessary. Bottle and bucket feeding are time consuming, have the risk of aspiration, and may lead to behavior problems in many cases. Tub feeding (continuous supply) has the risk of wasted or soiled milk and less accurate monitoring of individual milk intake, but can provide a constant food supply and, when combined with kindergarten systems, provides for normal intraspecies social behavior.

Colostrum

If a foal does not nurse adequate colostrum from its dam, colostrum should be fed. In the case of rejection, colostrum can be obtained from the dam. In the case of an orphan, colostrum can be obtained from a donor mare or from a colostrum bank. A healthy mare, with a healthy foal, can have up to 250 mL of colostrum harvested after her foal has nursed. It can be hygienically milked soon after parturition and kept frozen for up to a year.¹⁶ If possible, milk from the side the foal did not nurse.¹⁸ Quality colostrum has a specific gravity greater than 1.060.¹⁹ Frozen colostrum can be purchased from private farms or cooperative colostrum banks. Many nurse mare farms and large breeding farms bank colostrum. If colostrum is unavailable, equine plasma can be purchased (Table 3). Foals needing colostrum can be fed 250 mL per hour for the first 6 to 10 hours.^{16,19} A bottle is probably the safest way to deliver the valuable colostrum, and then foals can be introduced to a bucket after colostrum has been delivered.¹⁶ Foals that are weak or ill can be fed colostrum via a nasogastric tube.¹⁶

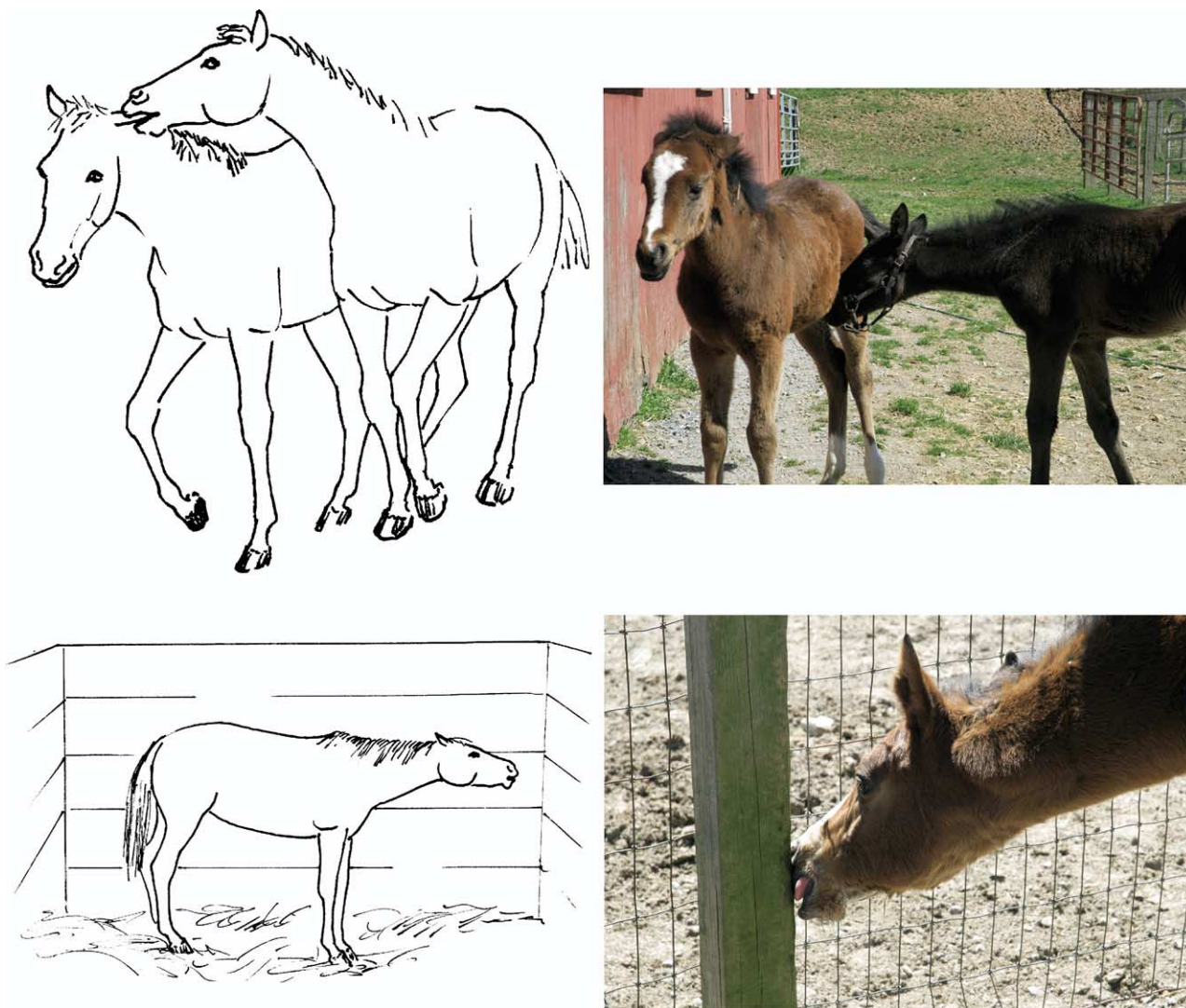


Figure 7 Nonnutritive sucking and tongue sucking behaviors are sometimes seen in orphan foals.

Long-Term Diets

Long-term diets for foals that are unable to be fostered to a mare include: mare's milk from one or more high-producing donor mares, cow or goat's milk, and commercial milk replacers. Using donor mares requires regular hand or machine milking and supplementary creep feeding for the donor mares' foals. Also donor mare's milk may vary in quality and quantity. Cow's milk can be used but must be altered to more closely match mare's milk, which has less fat and more sugar. Goat's milk is more expensive than cow's milk but can be used unaltered and is usually well accepted by foals, but can lead to metabolic acidosis and constipation.¹⁹ There are now many brands of commercially available milk replacers that are specially formulated for foals. They range in price and quality but are viable options when mare's milk is unavailable. A combination of mare's milk replacer (50%) and goat's milk (50%) has been successfully used by Magdesian.¹⁹

Foals fed large doses of milk replacer tend to get diarrhea. Such foals can be monitored for fever to distinguish diet-related diarrhea from illness.¹⁹ Foals on milk replacer that is fed in infrequent concentrated meals are prone to constipation and dehydration.¹¹ It is recommended that feedings be less concentrated and more frequent than many label direc-

tions, especially when first introducing milk replacers,¹¹ while maintaining the product label's recommended daily dry matter intake.¹⁶ Regardless of diet, most foals experience a period of mild to moderate "foal heat" diarrhea, at 1 to 2 weeks of age.¹⁹

It is recommended that milk be warmed to 37.5°C for initial feedings,¹¹ but the temperature can gradually be reduced to ambient temperature.²⁰ With any method of feeding, care must be taken to maintain good hygiene of materials and equipment.

It is recommended that records be kept of daily milk intake and weekly weight gain.¹⁸ Daily weight gains cited for foals of light horse breeds range from 1 to 1.6 kg, and 1.4 to 1.5 kg for draft foals.^{19,21} Regular free exercise and turnout to pasture is recommended.^{16,19}

Creep feeding is recommended to commence as early as several days of age. Fresh grass, hay, grain, and milk substitute pellets as well as water (in moderation) should be provided fresh daily.^{16,19} A salt block should be available. It is recommended that hand-fed foals be supplied with fresh feces from a healthy adult equine for normal coprophagy.¹⁹ Weaning can begin at 2 months if creep feed intake is adequate, but should be delayed to 3 to 4 months if possible with a gradual reduction in the number and volume of milk feedings.^{11,16}

Bottle, Bucket or Tub, and Automatic Calf Feeding Machine

For bottle feeding, a lamb nipple¹⁶ or human baby bottle nipple works fairly well. The opening in the nipple should be small enough that milk does not run from the nipple.¹⁹ It is recommended that the bottle be positioned to mimic the natural nursing posture.¹⁸ This can be accomplished by standing next to and facing in the same direction as the foal, with the foal's head held under the arm. The bottle should be held at the height of the shoulder of the foal. Gentle touching of the rump, tail, and anal area may strengthen the suckling reflex if needed.^{16,18}

Most foals can be trained to drink from a bucket or tub. This can be accomplished by drawing the foal's muzzle into shallow pail of milk, with a finger or nipple in the foal's mouth.^{11,16} In healthy foals, withholding feedings for several hours before bucket feeding attempts may increase appetite and acceptance.¹⁹ Groups of foals have also been successfully fed using an automatic calf feeding machine, which provides a constant supply of fresh milk replacer through a nipple mounted on the wall.²⁰

Social Considerations

Observations indicate that hand-fed foals have a strong tendency to become overly "human-bonded." Signs of overly human-bonded foals include following people as a dog would, attempting to suckle clothing, vocalizing to humans as a foal would when separated and rejoining its dam, and initiating play (rearing, bucking, circling the human, mounting) with the human as if it were a horse. As the foal matures, it may have mild to severe handling problems associated with what appears to be interaction with people as if they were a horse, including playful and serious aggression and sexual interaction. Mild forms are described as "dull to discipline," "bargy," and "ill-socialized with horses." To avoid over-bonding to people, it is recommended to limit human interaction, and particularly to disassociate human presence with meal time. To ensure normal intraspecies socialization, equine companions are considered essential. This is often best accomplished in a tub/kindergarten feeding system, where feeding and equine companionship is available ad libitum (Figure 6). Adult or juvenile horses, ponies, or donkeys can also provide opportunity for normal equine interaction and behavior as well as stimulate exercise.^{16,19} Mares with or without foals, geldings, and even stallions, as a rule, are good caretakers of orphan foals (McDonnell, personal observations). Equine companions of foals typically take on the parenting tasks of lingering near the foal, particularly when it is recumbent, intervening between the foal and perceived threats, and particularly geldings and stallions may play with the foal. Before openly exposing a foal to a particular potential companion group, their response can be fairly well assessed along a safe fence line, or with the foal confined initially to a safe enclosure within the pasture group. A goat can be used if no equine companions are available.¹⁹

Orphan foals have a tendency for nonnutritive sucking,

either sucking on their own or other's body or on inanimate objects, and tongue sucking (Figure 7).¹⁵ Solitary foals that suck on themselves are sometimes given human pacifiers.¹⁸

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