Behavior of stabled horses provided continuous or intermittent access to drinking water

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Objective-To compare quantitative measures and clinical assessments of behavior as an indication of psychologic well-being of stabled horses provided drinking water continuously or via 1 of 3 intermittent delivery systems.

Animals-22 Quarter Horse (QH) or QH-crossbred mares and 17 Belgian or Belgian-crossbred mares (study 1) and 24 QH or QH-crossbred mares and 18 Belgian or Belgian-crossbred mares (study 2).

Procedure-Stabled horses were provided water continuously or via 1 of 3 intermittent water delivery systems in 2 study periods during a 2-year period. Continuous 24-hour videotaped samples were used to compare quantitative measures and clinical assessments of behavior among groups provided water by the various water delivery systems.

Results-All horses had clinically normal behavior. Significant differences in well being were not detected among groups provided water by the various delivery systems.

Conclusions and Clinical Relevance-Various continuous and intermittent water delivery systems can provide adequately for the psychologic well-being of stabled horses. *(Am J Vet Res 1999;60:1451-1456)*

As the agricultural community considers questions -regarding the welfare of domestic animals housed under current farm conditions, it is apparent that little data are available concerning effects of various animal husbandry practices on the physiologic and behavioral well-being of domestic animals. Specific husbandry recommendations for animal care in guides and textbooks often are not made on the basis of scientific evidence. For example, most recent resources on management of horses recommend providing stabled horses with continuous access to water, as opposed to intermittent access.[1-3] This broad recommendation apparently is not made on the basis of supportive data. Instead, this practice is based on satisfactory results obtained for horses in box stalls (also known as loose boxes), a variation of stabling that has become common in the United States and Britain during this century Another common stabling practice for horses worldwide is to tether horses in the corner of a box stall or in group tie stalls (also known as slip stalls or straight stalls).[4-6] For tethered horses, it is common practice to provide intermittent access to water, rather than continuous access. Water continuously within reach of a tethered horse may create practical husbandry challenges. In such a situation, many horses tend to spill their water, soiling the stall and manger. They also tend to soil their water by dropping grain, hay, or bedding materials into the water.[7] Historically, a typical recommendation for intermittent provision of water to stabled horses is to provide freshly drawn water 2 to 4 times daily before or during each feeding and again late in the evening.[5-11] These recommendations also appear to be made on the basis of experience rather than on systematic study of horses housed under current farm conditions.

We recently investigated the physiologic health, hydration status, and hygiene of pregnant mares housed in tie stalls[12] and found that horses provided water continuously or by any of 3 intermittent water delivery systems received similar amounts of water and had similar health and hydration status. Hygiene of the stable was problematic for horses with continuous access to water. In addition to measures of physiologic well-being, the question remains as to whether psychologic well-being is affected by continuous or intermittent access to drinking water. The goal of the studies reported here was to concurrently evaluate the psychologic well-being of these horses. The objective was to compare detailed quantitative measures and clinical assessments of behavior among stabled horses provided water continuously or intermittently by various water delivery systems.

Materials and Methods

Animals and general husbandry-Two studies (1 in each of 2 consecutive years) were conducted at a pregnant mare urine ranch in Manitoba, Canada.[a] In study 1 (November 1995 through March 1996), 39 pregnant mares were used (22 **Quarter Horse [QH]** or QH-crossbred and 17 Belgian or Belgian-crossbred). Horses were randomly assigned to groups after stratification on the basis of body weight, age, and parity. In study 2 (November 1996 through March 1997), 42 pregnant mares (24 QH or QH-crossbred and 18 Belgian or Belgian-crossbred) were similarly assigned

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to continuous or intermittent water delivery systems. Mares were 2 to 4 months in gestation when moved from pasture to the group tie-stall barn in October and 6 to 8 months in gestation at the time behavior was evaluated.

The barn was ventilated to maintain a temperature of 5 to 10 C. Stalls varied from 1.22 to 1.52 m wide and were assigned on the basis of size and weight of each horse. Stalls were 2.44 m long, including the manger, and were separated from adjacent stalls by metal rails that extended the entire length of each stall. The floors were concrete, which was covered with stall mats and bedded with straw. Tethers were individually fitted to allow each horse to lie down and to move back 0.61 to 1.22 m into the alley behind the stall. Horses were fed grass hay 4 times daily (8 AM and 1,4, and 8 PM) and approximately 1.2 kg of oats twice daily (morning and late afternoon). A fortified mineral-vitamin mixture containing 25% salt, formulated to balance or marginally exceed mineral and vitamin requirements, was provided once daily. The exercise program on this farm included moving groups of horses into outdoor paddocks for 3 hours every 4 days. In addition to the procedures described here, horses were subjected to noninvasive routine clinical examinations and collection of blood samples, as described by Freeman et al.[12]

Water delivery systems-In study 1, the water bowl consisted of a rectangular box (43.5 X 19.7 X 17.8-cm deep) with a hinged lid. The water bowl was attached to the far left or far right of the manger, which spanned the entire width of the front of the stall. The top of the water bowl was even with the top of the manger (1 m above the floor). For 19 horses allowed continuous access to water (group C), the lid of the water bowl remained open with the water maintained at a depth of 2.5 to 5 cm, using a float control mechanism. For 20 horses provided intermittent access to water (group I-lid), the lid of the water bowl remained closed except when opened manually for a period of 5 minutes 3 times daily (7:30 AM and 1:30 and 7:30 PM). Water was maintained at a depth of 5 to 10 cm, using a float control system similar to that for group C.

In study 2, all groups had a rectangular curved-bottom water bowl (25.4X 23.3 X 19.7-cm deep) positioned above the top of the manger; top of the water bowl was approximately 124 cm above the floor. The float system for horses in group C automatically maintained a volume of approximately 2 L of water (5 to10-cm deep). Horses provided intermittent access by use of an interval-timer (group I-timer) were supplied with a fixed volume of water at 90-minute intervals from 6 AM to midnight each day. Each water delivery lasted 110 to 120 seconds, and the volume was adjusted for each horse so that the water bowl did not overflow and-some water should remain in the bowl after delivery. Horses provided intermittent access by use of an interval-timer-float device (group I-timer-float) were supplied with water for a 5-minute period 5 times daily (6 and 8:30 AM; 1:30, 5, and 10 PM). This variation was designed to deliver the volume of water consumed during each 5-minute period as well as to provide a residual volume of approximately 2 L (5 to 10 cm-deep) at the end of each delivery period. The I-timer-float variation was designed to provide semi-continuous access to water while minimizing the possibility of spillage or overflow.

Behavior measures-For each study, 1 continuous 24-hour videotaped (real-time recording) sample was obtained for each .horse during February and March (4 to 5 months after beginning of the stabling period). A standard consumer-type VHS video camera and recorder with low-light capacity that met National Televison System Committee standards were used. A super long-play recording mode was used to enable recording of each 24-hour sample onto 3 long-recording videotapes. To minimize disturbance of horses; tapes were changed during routine feeding activities (7 AM and 3 and 9 PM). The camera was positioned on a tripod directly in front of the horse, which allowed a view of the head of the horse, top line of the body of the horse, manger, and water bowl. With this camera position, each swallow of water would be visible to a technician who viewed the videotapes. This allowed recording of actual duration of drinking, as opposed to including time that the lips of the horse were in the water bowl but it was not actually drinking. The camera view also included approximately a quarter of each of the adjacent tie stalls, allowing observation of interactions with other horses. To control for possible inadvertent day-to-day differences in barn activities or schedules, 1 horse in each of the water delivery system groups under study was included on each day of videotaping.

A technician who was unaware of the actual objective of the study viewed the videotapes. A computer-based event recorder[b] was used to record frequency and duration of each of the following behaviors: eating hay, drinking water, standing rest, recumbent rest, interacting with adjacent horse (on the basis of type of interaction [ie, affiliative, aggressive] and role in interaction [ie, initiator or target]), stereotypy (eg, cribbing, head movements), and object chewing **(Appendix 1)**. Unusual behaviors were recorded and described. Specific behavior measures were derived from this record for quantitative analyses.

In addition to analysis of specific quantitative behavior measures, an experienced equine behavior clinician (SMM) reviewed the summary quantitative data (with associated time budgets) and videotapes of each horse to make an overall clinical assessment of behavior. This clinician remained unaware of the water delivery system for each horse. Data for each horse were compared to a set of clinical behavior values **(Appendix 2)** used routinely in our equine behavior referral clinic at the New Bolton Center, University of Pennsylvania. These clinical values were derived from data acquired from similar 24-hour videotaped samples of 137 mares stabled at various private farms and universities throughout North America and Europe. Those horses represented 11 light and draft breeds, and all were considered by their, owners and veterinarians to be healthy and free of behavior problems.

For study 2, the technician who viewed the videotapes additionally completed a standardized subjective assessment immediately after viewing each horse's 24-hour sample. This form included six 10-point-rating scales addressing general behavior and temperament characteristics (1 = calm, 10 = agitated; 1 = calm, 10 = anxious; 1 = calm, 10 = fidgety; 1 = quiet, 10 = active; 1 = aggressive, 10 = nonaggressive; and 1 = comfortable, 10 = uncomfortable). These descriptive terms were not operationally defined for the technician, who was instructed to rate each horse on the basis of the technician's understanding of those descriptive terms as they applied to equine behavior. The procedure provided an overall impression of each horse's general behavior and temperament by an equine health care professional with considerable experience evaluating equine behavior, yet who was unaware of the purpose of the study.

Statistical analyses-For each quantitative behavior measure, differences among water delivery system groups were compared, using independent t-tests, ANOVA, or both. Results for the standardized subjective assessment were compared among groups, using the nonparametric rank-sum test procedure. For all tests, a value of $P < 0.05$ was considered significant.

Results

Study 1

Quantitative behavior-Measures of quantitative behavior for groups C and I-lid were summarized

(Table 1). Frequency and total duration of drinking were significantly greater for group C than for group I-lid. For group I-lid, both measures were within the range considered to be clinically normal.

Additional details of drinking behavior of the I-lid horses at the morning, mid-day, and evening water access periods were summarized **(Table 2)**. For all 3 water access periods, mean latency from lid opening to first drink was approximately 30 seconds. The longest interval between lid opening and first drink was the 12 hours preceding the morning water access period (ie, from 7 PM on the preceding evening to 7 AM). However, mean latency from lid opening to first drink at the morning water access period was the longest of the 3 water access periods (mean ± SEM, 48.8 ±30.7 seconds). Both mean latency from lid opening to first drink and the mean duration of drinking were similar among the 3 water access periods, as determined by use of dependent t-tests. Six of 20 (30%) horses had their longest duration of drinking during the morning water access period, compared with 8 at mid-day and 6 at the evening water accession. These proportions did not differ significantly, as determined by use of the Fisher exact test. Actual drinking time as a percentage of the daily 15 minutes of access to water for I-lid horses ranged from 3 to 52% (mean, 27%).

For group C, most of the drinking was done while eating hay Group-C horses drank with considerable frequency during the night (7 PM to 7 AM; 1.3 drinks/h) but at a slightly lower rate than during the day (1.6 drinks/h).

Standing rest total duration, recumbent rest total duration, recumbent rest frequency, rest total duration, eating hay total duration, and major activity shifts each were similar for groups C and I-lid. Clinically important classic stereotypies were not observed in any of the horses.

Observable aggressive social interaction among horses in adjacent stalls consisted mostly of threats to bite and nip across the stall divider. The amount of this behavior was remarkably low for horses with possible physical contact (overall mean, 5.5 responses for a total of 0.27 minutes during 24 hours). The proportion of horses initiating aggressive interaction and the frequency of interactions did not differ between groups C and I-lid.

Hay dipping or hay wetting was observed at mild to moderate amounts in all group-C horses. These behaviors were not observed in horses in group I-lid.

Table 1-Values (mean ± SEM) for measures of behavior in pregnant mares housed in a stable and provided continuous access to water or intermittent access by use of a manually opened lid (I-lid) delivery system during study 1

Variable	Continuous (n = 19)	I-lid (n = 20)	P value
Drinking			
Total duration (min)	19.5 ± 2.4	3.3 ± 0.5	0.001*
Frequency (No.)	36.4 ± 4.0	7.4 ± 2.6	0.001†
Mean duration/episode (min)	0.54 ± 0.03	0.45 ± 0.05	NS
Recumbent rest			
Total duration (min)	92.3 ± 20.7	84.1 ± 19.5	NS
Frequency (No.)	2.8 ± 0.5	2.2 ± 0.4	NS
Mean duration/episode (min)	31.8 ± 3.9	39.3 ± 4.9	NS
Standing rest			
Total duration (min)	573.5 ± 44.5	625.7 ± 53.2	NS
Resting (recumbent and standing)			
Total duration (min)	665.8 ± 39.8	709.8 ± 45.9	NS
Eating hay			
Total duration (min)	598.9 ± 26.7	601.1 ± 127.3	NS
Major activity shifts			
Frequency (No.)	104.7 ± 8.6	101.4 ± 6.5	NS
Classic stereotypies			
Proportion of horses	2/19	0/20	NS
Aggressive social interactions			
Frequency (No.)	6.3 ± 3.3	4.6 ± 1.3	NS
Proportion of horses	10/19	14/20	NS
Hay dipping or hay wetting			
Frequency (No.)	112.6 (18.3)	0	NS
Proportion of horses	19/19	0/20	0.001‡

*Independent t-test, 19.3 degrees of freedom, adjusted for unequal variances. †Independent t-test, 18.8 degrees of freedom, adjusted for unequal variances. ‡Fisher exact test.
NS = Not significant.

Table 2-Values for 20 pregnant mares provided access with the I-lid system during each of 3 daily water accession periods in study 1

Period	longest duration of drinking (No.)	Mean duration (min)	SEM	Mean access time(%)	SEM	Mean latency from opening until drinking (s)	SEM
Morning	6	0.89	0.18	25.0	0.05	48.8	30.7
Mid-day	6	1.16	0.19	31.9	0.05	16.8	1.7
Evening	6	1.00	0.24	25.5	0.07	28.6	8.4

Clinical behavior-All horses were judged to have clinically normal behavior. Therefore, there was not a difference among water delivery system groups for the proportion of horses judged to have clinically normal behavior.

Study 2

Quantitative behavior-Specific quantitative measures of behavior in study 2 were summarized **(Table 3)**. For group I-timer, drinking total duration was greater than that considered to be clinically normal and was significantly greater than for groups C or I-timer-float. Drinking frequencies of groups C and I-timer were greater than that considered to be clinically normal and were significantly greater than that of group I-timer-float. Drink mean duration did not differ significantly among groups.

Standing rest total duration, recumbent rest total duration, recumbent rest frequency, recumbent rest mean duration, rest total duration, eating hay total duration, and major activity shifts were within the range determined for the 137 clinically normal horses and were similar among groups. None of the horses displayed any classic stereotypy or object chewing. The frequency of aggressive social interaction and the proportion of horses initiating aggressive social interaction were similar among groups. Similar to study 1, the amount of this behavior was remarkably low for horses with possible physical contact. The frequency of hay wetting or hay dipping was greater for group C than for groups I-timer and I-timer-float.

Clinical behavior-All horses were judged to have overall clinically normal behavior. Therefore, there was

Table 3-Values (mean ±SEM) for measures of behavior in pregnant mares housed in a stable and provided continuous access to water or intermittent access by use of an interval-timer (I-timer) or interval-timer-float (I-timer-float) delivery system in study 2

Variable	Continuous (n = 14)	I-timer (n = 14)	I-timer-float (n = 14)	Pvalue
Drinkina				
Totalduration (min)	6.2 ± 1.1'	13.0 ± 1.9b	5.7 ± 0.6'	0.001*
Frequency (No.)	39.1 ± 11.5a	33.9 ± 5.2a	16.0 ± 1.6b	< 0.05'
Mean duration/episode (min)	0.22 ± 0.02	0.44 ± 0.10	0.32 ± 0.04	NS
Recumbent rest				
Total duration (min)	97.0 ± 31.6	85.2 ± 16.0	96.0± 27.3	NS
Frequencv (No.)	3.0. ± 0.4	2.4 ± 0.6	2.8 ± 0.6	NS
Mean duration/episode (min)	37.5 ± 5.4	33.4 ± 7.5	35.9 ± 9.2	NS
Standing rest				
Total duration (min)	354.0 ± 26.2	319.1 ± 24.6	322.8 ± 26.8	NS
Resting (recumbent and standing)				
Total duration (min)	454.1 ± 33.0	410.6 ± 23.9	416.3 ± 29.1	NS
Eating hay				
Total duration (min)	466.6 ± 21.0	440.3 ± 19.9	492.0 ± 19.9	NS
Major activity shifts				
Frequency (No.)	107.3 ± 7.9	98.2 ± 7.2	112.4± 10.8	NS
Classic stereotypies				
Proportion of horses	0/14	0/14	0/14	NS
Aggressive social interactions				
Frequency (No.)	4.7 ± 1.1	5.1 ± 1.0	4.8 ± 0.9	NS
Proportion of horses	4114	7/14	5/14	NS
Hay dipping or hay wetting				
Frequency (No.)	99.5 ± 17.0a	60.9 ± 10.7b	48.3 ± 6.9b	< 0.05†
Proportion of horses	14/14	14/14	14/14	

*Simple one-way ANDVA, 41 degrees of freedom. †Fisher exact test.
abWithin a row, values with different superscript letters differ significantly *(P < 0.05).*

Table 4-Subjective assessment rating* of general behavior and temperament of horses in study 2

	Continuous (n = 14)		I-timer (n =14)		I-timer-float (n=14)	
Category	Mean	Range	Mean	Range	Mean	Range
Calm vs agitated	1.0	1	1.0	1	1.0	1
Calm vs fidgety	1.1	1.2	1.0	1	1.0	1
Calm vs anxious	1.0	1	3.0	1	1.0	1
Quiet vs active	2.7	1-5	1.0	1-5	3.1	1-5
Nonaggressive vs aggressive	1.8	1-6	2.8	1-4	2.43	1-5
Comfortable vs uncomfortable	1.0	1	1.0	1	1.0	1

*Categories were rated by the technician who viewed the videotapes. Scores were determined on the basis of a 10-point scale, with the highest degree for the first term = 1 end the highest degree for the comparison term = 10 (eg, most calm = 1; most agitated = 10). The descriptive terms were not operationally defined for the technician, who was instructed to subjectively evaluate each horse on the basis of the technician's understanding of the terms as they applied to equine behavior. Values did not differ significantly (*P* < 0.05) among groups.

not an effect of water delivery system for the proportion of horses judged to have clinically normal behavior.

Standardized subjective assessment-Results for the technician's 6 subjective behavior rating scales for study 2 were summarized **(Table 4).** All horses were consistently rated as calm (as opposed to agitated, fidgety, or anxious), quiet (as opposed to active), nonaggressive (as opposed to aggressive), and comfortable (as opposed to uncomfortable). Mean ratings did not differ among groups for any of the 6 scales.

Discussion

Results of these studies, including quantitative and clinical data, were interpreted to indicate that horses provided water by various delivery systems and schedules all had behavior typical of clinically normal horses housed in a stable. There were no differences attributable to water delivery system that indicated difference in psychologic well-being of the horses. Overall this herd of horses had a remarkably low prevalence of stereotypies and abnormal behavior. Similarly, horses appeared calm and appropriately acclimated to the housing and husbandry routine, with behavior patterns and time budgets for eating, standing rest, and recumbent rest similar to that of mares housed in box stalls (Appendix 2) or on pasture. These results are consistent with findings of the concurrent study[12] in which these horses were assessed to be physiologically healthy and appropriately hydrated.

The total durations and frequencies of drinking for horses provided continuous access to water in study 1 and horses provided access to water via an interval-timer in study 2 were greater than what we considered to be clinically normal for stabled horses and were significantly greater than for horses provided water by the other delivery systems with which they were compared. On the basis of results from our concurrent study[12] that indicated similar amounts of water were delivered to all groups, we believe that these 2 groups had a longer duration of drinking to ingest similar amounts of water. This may have been caused by differences in depth of the water in the water bowl among the systems. The water bowls for group C in study 1 and group I-timer in study 2 had more shallow water (2.5 to 5-cm deep) than the other systems (5 to 10-cm deep). Shallow water may have forced horses to take smaller sips and, thus, caused a greater drinking duration for similar volumes of water ingested. The behavior values for clinically normal horses used in this study were based on observations of horses provided water continuously in 16-L buckets or automatic water bowls, both of which rarely would have a water depth of < 15 cm. Horses have likely adapted to drinking from numerous types of water delivery systems with varying physical configuration and depth of water.[13]

Among the 5 water delivery systems used, the I-lid system in study 1 provided the least access to water in terms of frequency and duration. The lid to the water bowl was open for a period of 5 minutes 3 times daily (ie, 15 min/24 h). On average, the actual duration of drinking for horses in that group was less than one-third of access time. The morning access period followed the longest interval (12 hours) without access to water. Nonetheless, latency from opening of the lid to first drink in the morning was almost 1 minute. In fact, of the 3 daily access periods, the longest latency from opening of the lid to first drink was at the morning access. Similarly, the duration of drinking was less for the morning than mid-day or evening access periods. These observations suggested that the horses did not have an urgent need to drink after the nightly 12-hour interval without access to water. This observation also may have been associated with the feeding schedule, because most drinking by animals fed dry forage is during and after consumption of meals.[5,6,14-16]

It was evident from these studies that horses readily adapt to various water delivery systems and schedules. All horses drank similar daily quantities[12] without behavior suggestive of psychologic deprivation or polydipsia. At the time behavior was evaluated, horses had been housed in the current husbandry conditions for 4 to 5 months. It would have been interesting to monitor behavior beginning immediately after horses had been moved from pasture to the stable (ie, during the transition from pasture to stable) to evaluate behavioral adaptation. Interestingly, early textbooks on husbandry practices for horses describe behavior patterns for horses provided with several water delivery systems and schedules, indicating that horses adapt quickly and appropriately to various domestic water delivery systems and schedules.[5,8,11,17-19] Equids have likely evolved to be physiologically and psychologically adaptable to variations in access to water. Studies of feral horses indicate that access to water is highly variable and rarely continuous.[13] A particular horse's interval for access to water appears to depend on a number of social and ecologic variables, including dominance among and within bands of horses, interspecies competition for limited resources, distance between foraging and watering sites, and seasonal climatic conditions. In pastures and nonconfinement situations, most horses typically drink once or twice per 24-hour period, except for periods of high heat or in which there is extremely dry forage. In some populations, herds have been observed to routinely drink only once every 2 days.[20,21,c]

Dipping of hay into the water bowl and hay wetting were observed at mild to moderate amounts in all horses that had open water bowls (ie, groups C, I-timer, and I-timer float). These were observed in study 1 in which the water bowl was even with the top of the manger as well as in study 2 in which the water, bowl was positioned above the manger and had a narrower opening. This behavior was consistent with the corresponding hygiene conditions for horses and the stable reported in the concurrent study.[12] In that study, open water bowls (ie, continuous access to water) were associated with greater forage soiling of water bowls as well as wet mangers and stalls. Hay dipping and hay wetting are common in horses, particularly when hay and water are positioned within close proximity.[d]

In summary, quantitative measures of behavior did not differ significantly between horses provided continuous or intermittent access to drinking water. In addition, clinical assessments indicated clinically normal behavior for all horses, without differences attributable to water delivery system. As a herd, the horses appeared calm, comfortable, and acclimated to their husbandry conditions. Analysis of these results indicated that the psychological well-being of horses was not affected by widely varying schedules and durations of access to water, ranging from continuous access to access provided for 5-minute periods 3 times daily.

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[a]Linwood Equine Ranch, Carberry, MB, Canada.
[b]ER-1 Key; customized computer program created by SM McDonnell and MC Garcia, University of Pennsylvania School of Veterinary Medicine, New Bolton Center, Kennett Square, PA 19348.
[c]Pellegrini S. Home range, territoriality and movement patterns of horses in the Wassuk range of western Nevada. Master's thesis. Department of Biology, University of Nevada, Reno, Nev, 1971.
[d]Waring GH. Behavioral adaptation of feeding in horses (abstr). J Anim Sci 1974;39:137.

Appendix 1

Definitions of specific measures of behavior for use in quantitative analysis

Drinking total duration-Cumulative No. of seconds drinking during a continuous 24-hour sample. A drink was defined as placing the lips to the water and swallowing D 1 time before lifting the lips from the water. Drinks typically are in episodes of 2- or 3-minutes' duration, consisting of D2 drinks separated by 10- to 30-second intervals.
Drink frequency-No. of drinks during a continuous 24-hour sample.
Drink mean duration-For each horse, calculated mean duration for each drink during a continuous 24-hour sample (ie, drinking total duration divided by drink frequency).
Standing rest total duration-During a continuous 24-hour sample, cumulative No. of minutes standing quietly in a restful or sleep-typical posture without eating, drinking, grooming, or interacting socially.
Recumbent rest total duration-Cumulative No. of minutes in sternal or lateral recumbency during a continuous 24-hour sample.
Recumbent rest frequency-No. of periods of recumbency during a continuous 24-hour sample.
Recumbent rest mean duration-For each horse, calculated mean duration of each episode of recumbent rest in a continuous 24-hour sample (ie, recumbent rest total duration divided by recumbent rest frequency).
Rest total duration-During a continuous 24-hour sample, cumulative No. of minutes of standing rest and recumbent rest.
Eating hay total duration-No. of minutes eating hay during a continuous 24-hour sample. Eating hay was defined as taking hay from the manger or from behind the manger into the mouth, chewing, and swallowing it.
Major activity shifts-No. of transitions from 1 major activity to another (eating, resting, social interaction, drinking) during a continuous 24-hour sample.
Classic stereotypies-Weaving was defined as shifting weight between the forelimbs with side-to-side movement for D 3 consecutive rhythmic cycles. Repetitive head movements included head-bobbing, shaking of the head, or tossing of the head for D 5 consecutive rhythmic movements. Cribbing was defined as 1 classic sequence of arching the neck and gulping air with or without oral contact with a surface.
Aggressive social interaction frequency-During a continuous 24-hour sample, No. of attempts to bite, nip, threaten to bite, threaten to nip, or threaten to kick a horse in an adjacent stall.
Hay dipping or hay wetting frequency-No. of hay-dipping or hay-wetting episodes during a continuous 24-hour sample. Hay dipping was defined as a horse using its mouth to move hay from the manger into the drinking water while actively eating hay. Hay wetting was defined as a horse using its mouth and lips to move water from the water bowl to the hay in the manger while actively eating hay.

Appendix 2

Definition of clinically normal behavior for horses housed in box stalls or tie stalls (based on study of continuous 24-hour videotape samples of 137 mares of light and draft breeds)

Typical behavior patterns during a continuous 24-hour sample

Major activity shifts	30 to 110 activity shifts/24 h; 20 to 60 min/activity
Standing rest	10 to 30 episodes/24 h; 5 to 120 min/episode; total duration, 8 to 12 h
Recumbent rest	0 to 6 episodes/24 h; 10 to 80 min/episode; total duration, 0 to 6 h
Eating*	10 to 30 episodes/24 h; 5 to 120 min/episode; total duration, 4 to 12 h
Standing alert	10 to 30 episodes/24 h; 5 to 30 min/episode; total duration, 2 to 6 h
Drinking	2 to 8 episodes/24 h; 10 to 60 s/episode; total duration, 1 to 8 min
Urination	4 to 15 urinations/24 h
Defecation	4 to 15 defecations/24 h

*Horses were fed hay 2 or 3 times daily or had hay available continuously.

Responsive to environmental and social stimulation

Interested and typically reactive to events such as feeding, turning the lights on or off, movement of other horses or people, disturbances (noises) in the stable; typical anticipatory behavior (alert,focus attention on routine procedures) associated with care and feeding.

Relatively free of abnormal behavior

Stereotypies

No cribbing or self-mutilative bites; < 5 cycles of weaving; < 1 min of pacing or circling; < 5 repetitive head movements; < 1 min of pawing; < 5 seemingly unprovoked kicks/24-h sample.

Other abnormal behaviors or indications of discomfort

Prolonged (> 15 s) or seemingly unprovoked anxious or agitated states; atypical physiologic posture or movements (eg, leaning against walls, sawhorse stance, tilted head); indications of physical pain (eg, shifting weight on limbs, looking or kicking toward abdomen, lifting or circular swishing of the tail).

Typical behavior of clinically normal stabled horses associated with feeding

When small consumable portions of hay are provided 2 or 3 times daily, most eating of hay is immediately after feeding. When hey is available continuously, but additional fresh hay is added 2 or 3 times daily, addition of fresh hay is typically followed by a lengthy episode of eating hay. Almost all drinks are taken during or soon after episodes of eating hay.

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