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Guinea pig and chinchilla care and husbandry

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Guinea pigs (scientific name *Cavia porcellus*) and chinchillas (scientific name *Chinchilla laniger*) are South American rodents. Taxonomically they are placed in the suborder Hystricognathi, one of the two major suborders of rodents, and it is common to see the term "Hystricomorph" (derived from Latin, *hystrix* = porcupine) to describe these rodents. Rats, mice, hamsters, and gerbils belong to the Family Muridae in the other rodent suborder Sciurognathi.

Guinea pigs belong to the family Cavidae containing 14 species of animals commonly known as cavies and Patagonian hares (or maras). Four digits on the forepaw and three on the hind foot characterize Cavidae.

The family Chinchillidae contains six species commonly called viscachas and chinchillas. These are slender bodied, medium-size rodents with short forelimbs and long muscular hind limbs that give the animal a rabbit-like appearance. The head, eyes, and ears are large, and the bullae of the skull are greatly expanded on chinchillas. Members of both Cavidae and Chinchillidae have long gestation periods (65–110 days) and deliver fully furred young with open eyes.

Although guinea pigs and chinchillas are popular both as pets and laboratory animals, few veterinary references describe them in the wild or how they became domesticated. In South America, wild cavies inhabit rocky areas, savannas, forest edges, and swamps from Columbia and Venezuela southward to Brazil and northern Argentina. They live in groups of up to 10 individuals and inhabit burrows that they or other animals dig. They are most active at night, when they forage for a variety of plant materials.

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Domestication of the guinea pig began at least by 900 BCE, and may have begun as early as 5000 BCE [1].

Most people in the Andes refer to the guinea pig by the name *cuy*. In traditional Andean culture cuy are important as a basic foodstuff and are crucial in a variety of socially significant feasting rituals [2]. Cuy have followed Andean immigrants abroad, and finding guinea pigs offered, as food in major North American metropolitan areas is now possible. Cuy are also integral to various Andean religious and ceremonial practices, and have long been used in the traditional medicine (*curanderismo*) of the Andes region [2].

In the wild chinchillas are found in barren areas of the Northern Chilean Andes at elevations of 3000 to 5000 m living in burrows or rock crevices. They are gregarious, and form groups of several hundred animals that are active throughout the year. In contrast to guinea pigs, chinchillas have only recently become well established as a domesticated animal [1]. All domestic chinchillas are descendants of 13 individuals bred for their fur, brought to the United States in 1927 [3]. Fur farming started at the end of the nineteenth century in America and spread to Europe in the early years of the twentieth century. Today, most fur farming takes place in Northern Europe (64%) and North America (11%). Hungary produces 40,000 chinchilla pelts annually, 20% to 25% of world production [4].

Guinea pig breeds and chinchilla coat colors

In the United States, the American Cavy Breeders Association, which is affiliated with the American Rabbit Breeders Association as a National Specialty Club, recognizes 13 breeds that it divides into groups or varieties. The most common breed is the American cavy and was known originally as the ''English'' cavy. Self-cavies are a group of solid colored animals (eg, black, cream, red, lilac, beige, saffron, and chocolate). Non-Self's are a group made up of the coated breeds, the marked breeds, and the ticked or agouti breeds. The coated cavies include the Abyssinian, Rex, Long-haired varieties (Peruvians, Silkies, Shelties, Coronets, and Texels), Crested, Teddy, and Satins. An undercoat and projecting guard hairs make up the normal fur coat of a cavy; the Rex has short guard hairs that do not appear above the level of the undercoat; the Satin breeds have an abnormal hair fiber that produces a sheen; and the Teddy breeds have a ''kinked'' or bent hair shaft that causes the coat to stand erect over the entire body. The marked group contains Dalmatian, tortoise shell, and Himalayan varieties. The term ''variety'' describes a color (eg, steel gray, tortoiseshell) that is not yet a recognized breed. Good images and descriptions of the breeds and varieties can be found at the American Cavy Breeders Association Web site and the UK National Directory of Cavy breeders Web site (see Recommended Reading at end).

Anecdotal evidence suggests guinea pigs homozygous for both the beige (bg) and satin (sa) coat color genes do not thrive. The combination gives

a shiny pearl quality to the coat, an effect sought after by breeders. In mice, we know that when both the bg and sa genes are present in the same animal, their immune response is depressed and they often develop a fatal progressive pneumonitis by 6 months of age [5,6].

Chinchillas come in a variety of colors. There are no recognized ''breeds'' per se, but breeders pay careful attention to coat color. In the wild, the original fur color of the chinchilla was mottled yellow-gray. Through selective breeding, the wild color has been developed into an attractive and appealing blue-gray. Other colors have emerged as mutations of the standard blue-gray color. Eye color may be black, or pink to red due to coat color genes. Recognized colors include Beige (eg, blond, pearl, pastel), White (eg, Wilson white, white mosaic, silver, platinum, pink white, apricot), Sapphire, Violet (eg, Afro violet or Rhodesian violet, German violet), Charcoal (eg, pastel charcoal, sapphire charcoal, violet charcoal), Ebony (eg, brown ebony or chocolate ebony, pastel ebony), and Velvet (eg, black velvet or black, brown velvet, pastel velvet, blond velvet). The colors beige, white, and ebony are transmitted as dominant genes, and sapphire, violet, and velvet are transmitted as recessive genes. Homozygous white or homozygous black combinations are lethal. The German Web site http://www.chinchilla-lexikon.de/index2.shtml has good pictures of different fur colors and a colored table on the genetics of color breeding. However, the site is in German and not English.

Husbandry

As a species, guinea pigs are extremely adaptable to a great range of climates, although as individuals they are highly susceptible to variations in local temperature and humidity. Guinea pigs are nervous animals, and may refuse to drink or eat for a period after any significant change in their location, feed, or husbandry. We find the effect of environmental changes on guinea pigs is minimal or nonexistent when two animals are kept together. If a sick guinea pig must be kept in a hospital, besides a quiet area away from cats and dogs, housing a cagemate with the sick animal reduces stress.

Socially, guinea pigs live in family units centered around an alpha male. Mature males and especially strangers will fight. The dominance problems are generally not encountered if two males are brought up together from a young age or a group of guinea pigs is made up of only nonbreeding females. Social problems are diminished with castration and ovariohysterectomy, but learned behavior in adult males after castration may still make them antisocial.

Polygamous breeding colonies are common among chinchilla fur ranchers, and a system of individual female housing has been devised that allows a single male to serve 12 females.

Housing

Chronic dermatitis (especially of the forepaws) is a common condition usually seen in obese guinea pigs housed on wire or abrasive floors. Poor sanitation is also a predisposing factor. The feet are swollen and hairless with ulcers and scabs 1- to 3-cm in diameter on the plantar surface. *Staphylococcus aureus* is the usual causative agent, and probably enters the foot through a cutaneous wound. Awns and straw in the bedding can also cause foot punctures. The inflammation can progress to osteoarthritis and systemic amyloidosis secondary to chronic staphylococcal infection. Surgical treatment is often unsuccessful, as there is rarely an abscess to be excised or drained but rather a diffuse cellulitis that infiltrates surrounding tissue. Cutting the tissue only results in severe bleeding. Interpretation of biopsies from the foot may be misleading for pathologists who do not routinely examine rodent tissues and the exuberant nature of the chronic-active inflammation may be mistaken for a fibrosarcoma. Treatment involves removing the affected guinea pig to a clean cage with dry, soft bedding and topical or parenteral administration of antibiotics. Unfortunately, the condition rarely responds to therapy.

Cage setup

Compared with rats and mice, researchers have conducted very little experimental work on behavioral preferences of guinea pigs and none on chinchillas. We do know guinea pigs and chinchillas are social animals, and assuming they would prefer to be kept in groups and not singly is reasonable. The minimum living space for a chinchilla (as recommended by the American Mutation Chinchilla Breeders Association) is a floor area of 225 sq in and cage height of 12 inches. The recommended space [7] for a guinea pig is 101 sq in and cage height of 7 inches.

Mackenzie and Illes [8] compared wood shavings and alfalfa hay as guinea pig bedding material over 12 months. They housed groups of one male and nine female guinea pigs in 20 sq-ft pens. Although there was no significant increase in the numbers born and only a slight increase in numbers weaned in pens provided with hay, they found females were in better general condition and they and their young lost less hair from the flanks and abdomen in the pens with hay. Scharmann [9] found that guinea pigs in cages will burrow and hide in hay or straw added to a cage as enrichment material. Kawakami et al [10] examined the preference of guinea pigs for wood shavings or sheets of paper as bedding materials. Their results suggested that guinea pigs prefer different bedding materials under light and dark conditions. Guinea pigs apparently preferred wood shavings in the light, spending much more time resting in them than in paper sheets. However, in the dark, the guinea pigs preferred paper sheets. We do not recommend wood shavings as bedding material because aromatic hydrocarbons present in the shavings may cause respiratory problems, unless owners change the bedding frequently.

Guinea pigs require a constant source of water that must be changed daily. They dirty their water bowls or sipper tubes with food when they drink. They do not lick sipper tubes without training, defecate indiscriminately, and are prone to sit in and soil their food bowls and sleeping areas. However, they are generally good eaters, and not as fussy as rabbits.

Guinea pigs and chinchillas are shy animals and need a place to hide when in captivity. We find guinea pigs like objects in their cage that allow them to hide easily. In the wild, chinchillas will conceal themselves in rock crevices. Polyvinyl chloride plumbing pipes, especially elbows, Y and T sections, make ideal hiding places. The pipes should be 4 to 6 inches in diameter, and are easy to sanitize by placing in a dishwasher. Alternatively, clay pipes of a similar diameter can be used, but are difficult to disinfect.

Chinchillas are very tolerant of cold, but sensitive to heat. A constant temperature of 18 to 22°C (64–72°F) is optimum. Guinea pigs are more tolerant of heat, and a temperature of 18 to 26°C (64–79°F) is recommended [7]. In the laboratory, chinchillas are easily housed on either wire mesh or solid-bottom cages; although solid-bottom cages are recommended for pregnant females about to give birth. Due to their habit of dust bathing, a box containing dust should be placed in the cage daily.

Dust baths for chinchillas

Bathing in dust is necessary for the welfare of chinchillas. When denied dust bathing in captivity the fur becomes matted from oily secretions on the back. Dust bathing often causes irritation of the eyes, resulting in conjunctivitis without clinical signs of upper respiratory infection. Trautwein described experimental pulmonary talcum granuloma and epithelial hyperplasia in the chinchilla associated with excessive dust bathing [11]. Generally, dust consists of a mixture of silver sand and Fuller's earth.

The different types of bathing dust available are:

1. *Fuller's earth* is a type of clay. It is a nonplastic variety of kaolin containing an aluminum magnesium silicate. The name is derived from the ancient process of cleaning or fulling wool, to remove the oil and dirt particles, with a water of earth or clay.
2. *Diatomaceous earth* is a light friable silica containing material derived chiefly from the remains of diatoms (diatoms are any class of tiny planktons or algae that form colonies, and have silicified skeletons, that form diatomite).
3. Talc is a finely powdered native hydrous magnesium silicate.
4. Commercial dust baths such as *Blue Cloud* (Blue Cloud Mineral Company, Saugus, California) and *Blue Sparkle* (Norton, Kansas) are cement byproducts.

Fuller's earth, Blue Cloud, and Blue Sparkle are the most popular (and expensive) dusts with breeders and fur ranchers. More recently, volcanic ash

from Mount St. Helen in Washington State has become fashionable. Some individuals are allergic to the commercial powders, and they make a dust bath preparation consisting of perfume-free talc powder (also known as talcum or French-chalk) and a dietetic grade cornstarch. Dietetic grades of cornstarch marketed as ''Maizena'' and ''Mondamin'' are best. Avoid using soluble-starch that is potato or corn starch treated with dilute hydrochloric acid.

Breeders reduce or eliminate the corn starch with nursing mothers because the babies get it up their noses, and develop rhinitis.

Nutrition

Grasses and hay are important in the guinea pig and chinchilla's diet, and we recommend that owners give both a high-fiber diet. Although we know the specific nutrient requirements for most laboratory rodents (eg, rat, mouse, guinea pig, hamster, gerbil, and vole), the chinchilla is the noticeable exception in the National Research Councils ''Nutrient Requirements of Laboratory Animals'' [12]. Consequently, although commercial chinchilla diets such as Chinchilla Diet (Mazuri, St. Louis, Missouri) and Chinchilla Deluxe (Oxbow, Murdock, Nebraska) are available, in reality they are mixtures of rabbit, guinea pig, and rodent pellets. Commercial chinchilla feed provides a diet supplemented with Vitamin C, lower in protein and fat than standard rodent chow, and equivalent in fiber to a rabbit maintenance diet. However, the pellets are longer than rabbit or guinea pig pellets, and easier for the chinchilla to hold. The accepted formula for chinchilla pellets is 16% to 20% protein, 2% to 5% fat, and 15% to 35% bulk fiber.

Recent work from the Hannover School of Veterinary Medicine in Germany has looked at the ingestion behavior, feed, and water intake of dwarf rabbits, guinea pigs, and chinchillas kept as pets [13–15]. The chinchilla, compared with rabbits or guinea pigs, shows noticeable differences in the rhythm of feed intake and palatability of individual feed ingredients. When offered mixed feed based on native components, chinchillas will select individual ingredients based on high palatability, for example, carob, beet pulp, and sunflower seeds. Rabbits and guinea pigs are not as fussy. Rabbits and guinea pigs eat considerable amounts of food during the day, with maximal feed intake occurring during the late afternoon and evening. Chinchillas intensify their feed intake at night when they eat 70% of their daily feed, with highest activity occurring between 9:00 PM and 7.00 AM.

All three species eat higher amounts of pelleted complete diet than hay when offered both ad libitum. Rabbits eat 1.6 times, guinea pigs eat 1.8 times, and chinchillas eat 2.1 times of the pelleted complete diet. Rabbits eat almost double the hay per day than guinea pigs and chinchillas (rabbits 6.5 g vs 3.5g dry-matter per 100g body weight for guinea pigs and chinchillas). Contrary to popular opinion, each species needs more time for the intake of the pelleted complete diet than hay. Rabbits and chinchillas eat hay 3.6 times faster than pelleted diet, but guinea pigs eat it only 1.7 times faster.

Guinea pigs need a fresh supply of water daily, even if given succulent feed such as carrots or apples, or else they will die [16]. When offered succulent feed such as carrots or apples, rabbits and chinchillas will eat the succulents and decrease water intake. However, while guinea pigs will eat the succulents, they still maintain their water intake primarily from water-sippers or water-bowls. Although rabbits and chinchillas can cope without drinking water when given enough succulent feed to guarantee a sufficient intake, we recommend that drinking water should always be available. During water deprivation feed intake decreases, and the risk of energy deficiency increases with a pelleted and succulent diet alone.

During consumption of a complete diet, the water intake of guinea pigs and chinchillas varies by a factor of 4. Chinchillas drink 1.5 mL/g of diet, rabbits drink 3 mL/g diet, and guinea pigs drink 6 mL/g of diet. However, when offered hay and grass, rabbits, guinea pigs, and chinchillas drink similar amounts of water (2–3 mL/g of diet).

We should pay attention to higher crude fiber content in mixed feed diets for pet rabbits, guinea pigs, and chinchillas. More intensive chewing activity associated with longer time for ingestion affects wearing down the continuously growing teeth [17]. Because guinea pigs eat hay slower than rabbits and chinchillas, and will only consume half the hay per body weight compared with a rabbit, a complete hay diet is inadequate for a guinea pig. Owners must offer them pellets for nutritional balance. Chinchillas must have access to feed at night as they consume most in the evening. Their feed should be high in hay, as too much complete diet results in chinchillas reducing water consumption.

Vitamin C supplementation for guinea pigs

Guinea pigs need approximately 10 mg Vitamin C/kg body weight daily for maintenance and 30 mg Vitamin C/kg body weight daily for pregnancy. Guinea pigs of all ages are dependent on a dietary source of vitamin C to prevent scurvy or hypovitaminosis C.

The stability of vitamin C in diets varies with composition of the diet, storage temperature, and humidity. Dampness, heat, and light reduce the feed content of vitamin C. In fortified diets (ie, diets with Vitamin C well beyond daily requirements), storage above 22°C (71.6°F) for 90 days may oxidize one half of the initial vitamin C. Water in an open container may lose up to 50% of its vitamin C in 24 hours. Aqueous solutions of vitamin C will more rapidly deteriorate in metal, hard water, or heat, and are more stable in neutral to alkaline solutions.

Clinical signs of hypovitaminosis C include thin, unkempt animals; diarrhea, alopecia, and pain from swollen joints. Petechiae on mucous membranes are not always seen although hematuria may be present. Guinea pigs will show signs of vitamin C deficiency within 2 weeks if it is withheld. Serum hypercholesterolemia (>60 mg/dL) and hypertriglyceridemia (>30 mg/dL) is observed in Vitamin C-deficient guinea pigs after an overnight fast.

Vegetables high in Vitamin C include red or green sweet peppers, tomatoes, spinach, and asparagus.

Pellets

Metastatic calcification occurs most often in guinea pigs older than 1 year [18]. Clinically, animals present with muscle stiffness and failure to thrive. Mineralization may be confined to soft tissues around elbows and ribs. Early reports of this syndrome called it "wrist stiffness syndrome" because of the foreleg involvement. Mineral deposition may also be more widespread involving lungs, heart, aorta, liver, kidneys, uterus, and sclera. Dietary factors such as a low magnesium and high phosphorus diet, and high calcium or high Vitamin D intake have been implicated. Feeding commercial high quality guinea pig diets has reduced the incidence of metastatic calcification seen in laboratory colonies.

Hay

Urolithiasis is a common problem in older guinea pigs, especially females, because of the proximity of the urethral orifice to the anus and the high risk of infection with fecal contaminants like *Eschericnia coli*. However, we may see it in guinea pigs of both sexes and all ages. Clinically, the owner sees dysuria, anuria (crying when attempting to urinate), and occasionally hematuria. Diagnosis is by abdominal radiology. The calculi are radio-opaque and usually composed of calcium carbonate or calcium phosphate; calculi can also be composed of calcium oxalate [19]. Obstructive urolithiasis and possible concurrent septicemia can develop if the problem is not treated. Although *E coli* is often cultured from urine samples, Group D salmonella (*Salmonella enteritidis*) has been cultured [20].

Besides sex and age, diet may be related to urolithiasis. Too much alfalfa hay will give a high Ca:P ratio in the diet. In sheep and cattle, leguminous plants such as clover and alfalfa are associated with urinary calculi (known as clover stones) especially when the animals have a high content of legume-only feed in their diet for extended periods. The cause is related to the Ca:P ratio. Legumes have a Ca:P ratio of 4:1, while grasses have a Ca:P ratio of 1.5:1.0. The desired Ca:P ratio in pasture for horses/cattle/sheep is around 1.2 to 2.0:1.0. Therefore, there is a need for a grass + legume balance, for example, 70% to 80% grass + 20% to 30% legume (Table 1).

Treats

We recommend not feeding chinchillas or guinea pigs fresh foods that have too high a liquid content, for example, lettuce. Treats such as grains, dried apples, raisins, figs, hazelnuts, and sunflower seeds should be limited, and never consist of more than one teaspoon a day. In chinchillas and guinea pigs, as most rodents, the intestinal flora is very important, and we should avoid any sudden change in their food pattern.

Table 1
Calcium and phosphorus content of common grass feeds

Forage	Calcium (%)	Phosphorus (%)	Ca:P
Alfalfa hay	1.3	0.2	6:1
Alfalfa meal	1.4	0.2	7:1
Clover hay	1.5	0.3	5:1
Orchard grass hay	0.4	0.4	1:1
Timothy hay	0.5	0.2	2:1

Enrichment items for gnawing and wearing down the incisors are also necessary. Scharmann [9] found that providing caged guinea pigs with autoclaved softwood sticks stopped them from biting and gnawing on cage bars and feed hoppers. Other enrichment items for gnawing include porous stones such as pumice; young branches of trees such as elm, grapevines, maple, birch, and pieces of bark from apple, pear and peach trees, and ash. Advise the owner to avoid branches from poisonous trees such as cedar, plum, redwood, cherry, and oleander.

Coprophagy

Both guinea pigs and chinchillas produce two types of fecal pellets: one nitrogen-rich intended for cecotrophy, and one nitrogen-poor delivered as fecal pellets. Studies in the degu, another South American hystricomorph rodent, show that these rodents balance coprophagy with ingestion of food [21]. When food is continually available, approximately 40% of the feces are reingested, and 90% of this coprophagy occurs at night. However, when food is limited, hystricomorph rodents ingest feces during parts of the day when food is unavailable.

Life span

Pet guinea pigs and chinchillas live much longer than rats and mice. Web-sites of pet guinea pig owners report a few cavies living as long as 12–15 years. There are no reports on the longevity of chinchillas as pets. However data from zoos suggests that they have a maximal life span of 20 years. Pet chinchilla owner web-sites report their pets living 12–15 years (Table 2).

Reproductive characteristics

Hystricomorph rodents share several unusual reproductive physiology characteristics [22]. The most outstanding features are:

1. A long gestation period. Guinea pigs have a pregnancy of 68 days (range is 59–72 days) and chinchillas have a gestation length of 111 days (range of 105–115 days).
2. A long estrus cycle. Guinea pigs have a mean cycle length of 17 days with a range of 13 to 25 days, and chinchillas have a mean cycle length of 39 days with a range of 16 to 69 days.

3. A vaginal closure membrane that is open at estrus and parturition but sealed during anestrus and pregnancy.
4. Lateral position of the nipples. Guinea pigs are the exception, and have only a single pair of inguinal nipples. Chinchillas have three pairs of nipples—one inguinal pair and two lateral thoracic pairs.
5. Nonscrotal (ie, abdominal or inguinal) testes. There is no true scrotum in any Hystricomorph rodent.
6. Penile styles or spicules on the glans penis. The styles are pronounced on guinea pigs, but absent on chinchillas.

Guinea pigs have an average of four young per litter, with a range of 1 to 13, and chinchillas have an average of two young, with a range of 1 to 6. The young of both species are born fully furred and well developed. Young guinea pigs usually nurse for 21 days, although they can survive on solid food alone after 5 days; young chinchillas usually nurse for 6 to 8 weeks, and can survive on solid food after 21 days. Young male guinea pigs reach puberty around 3 months and females at 2 months; chinchillas reach puberty around 8 months of age.

Male hystricomorph rodents possess unusually well-developed and elaborate male accessory reproductive glands. The secretions of the rodent accessory glands form a copulatory plug that remains in the female tract after copulation. In chinchillas, the vesicular gland provides the bulk of the secretions and the fluid hardens to a rubbery or waxy consistency when mixed with prostatic secretions. When very fresh, the plug is white and soft, but on exposure becomes harder and more yellow. The copulatory plug can be quite large in chinchillas, ranging from 2.5 to 3 inches in length. Current hypotheses suggest that the primary function of the copulatory plug is chastity enforcement in polygamous breeding rodents. In guinea pigs and chinchillas, the copulatory plug prevents a second, competing ejaculate from reaching the site of fertilization. The presence of a copulatory plug can be used with rodents to see if mating has occurred. In the chinchilla, the copulatory plug falls out overnight when the vaginal closure membrane is sealing. In the guinea pig, the copulatory plug remains lodged until the vaginal membrane closes, but is not always readily discernable.

Sexing of guinea pigs and chinchillas

Sexing chinchillas, guinea pigs, and other hystricomorph rodents can be difficult. In many texts, the descriptions of external genitalia are cursory, confusing, and at times inaccurate. Furthermore, the distinguishing features

Table 2
Average life spans of guinea pigs and chinchillas

Chinchilla	Guinea pigs
12–20 years	6–8 years

of sexual anatomy in these rodents are different to the more familiar small companion animals such as dogs and cats.

In females, a vaginal closure membrane always seals the vaginal orifice except during estrus and parturition. The vaginal orifice is U-shaped and situated between the anus and the mound-shaped urethral orifice; distinguishing it when closed is difficult, and it is "indicated" by a slightly, raised semicircular area. When its closure membrane covers the vaginal orifice, the urethral orifice can be mistaken as a genital opening. The well-developed clitoris of female chinchillas and guinea pigs can be manually extruded through the urethral orifice and mistaken as a penis. The clitoris consists of paired roots, a body, and glans, is covered by a prepuce, and is the female homolog of the penis. It extends along the ventral surface of the urethra, and to the uninitiated, the clitoris can resemble a penis, albeit vestigial.

The vagina is open during estrus. During these times, the vaginal closure membrane dissolves and then repairs. During estrus there is no vulval swelling—rather, there is a change in perineal color; it goes from a dull, flesh color to a deep red color. Color of the perineum increases dramatically at the time of vaginal perforation and remains intense throughout most of luteal phase of cycle.

Male chinchillas do not have a true scrotum. Instead, the testes are contained within the inguinal canal or abdomen, and there are two small moveable sacs (the postanal sacs) next to the anus, into which the caudal epididymis can drop. Weir [22] has described chinchillas as "facultative cryptorchids." The external appearance of the scrotal sacs is similar to the nonpendulous scrotum of pigs and cats. The penis is readily apparent below the anus, from which it is separated by an expanse of bare skin. The penis can be manually extruded 1 to 2 cm when flaccid. The tip of the erect penis extends to the level of the axilla, a distance of about 11 cm.

As in other rodents, the anogenital distance gives the best initial indication to the animal's sex. In males, the distance is greater. Extrusion of the penis from the urethral orifice will confirm the sex of the chinchilla, if the clitoris is not mistaken for a penis. There are two major differentiating features: the penis is larger than the clitoris, and the extruded penis can be separated and distinguished from the prepuce, while the extruded clitoris tends to evaginate and the clitoral prepuce is not apparent.

Recognizing illness

Nearly all significant reports on infectious diseases of chinchillas over the past 50 years come from colonies of chinchillas raised for fur, and most reports of bacterial disease in colonies are 20 years of age or older. Opportunistic infections by normal bacterial residents of chinchillas will cause frank disease, localized either to one organ (eg, Streptococcus, Pseudomonas, and Colibacillosis) or as septicemia. Affected animals may be immunocompromised through age, nutritional status, or husbandry-related stress.

Hair loss

Alopecia develops to a degree in all guinea pigs in late pregnancy (60–70 days) and during nursing. It is due to reduced anabolism of maternal skin associated with fetal growth. Hair loss usually begins on the back and progresses bilaterally on the flanks and ventral abdomen. Suckling guinea pigs may worsen the condition by pulling hair from their mothers. The alopecia resolves slowly, either after parturition or when the sow stops nursing.

Gerold et al [23] in Germany found more extensive and more frequent fur defects in guinea pigs receiving a breeding diet with a high content of crude protein (23% versus 15.5%), a low level of crude fiber (12% versus 19.5%), and offered limited amounts of hay. The authors found how much hay is offered is very important. In the authors' colony, a group of five breeding animals and their young required 200 g of hay daily to improve their hair coat quality to normal. However, animals receiving less hay had progressively deteriorating hair coat density. Not only how much hay is offered, but also the accessibility of the hay for all animals plays a role in preventing alopecia. In larger cages (twice the usual ground surface area) fur defects were seen when the authors offered the same amount of hay (200 g) in only one central area, rather than spread out evenly throughout the cage. They observed that hair loss was the result of barbering between adult animals kept in the same cage. High-fiber pellets alone may not completely meet the need for crude fiber in breeding animals.

Thinning of hair is common in young animals at weaning. It is associated with a period of transition in which coarse guard hairs of the adult coat are developing and neonatal fur is lost. Ear chewing and barbering is seen in group-housed guinea pigs that develop a social hierarchy. Often younger animals of lower rank develop hair loss from fur chewing by dominant older members. An irregular almost stepwise pattern characterizes the hair loss. Treatment involves separation of the aggressive animal.

Single-housed guinea pigs that become bored may inflict self-barbering. In these cases, areas the animal cannot reach such as the head, neck, and anterior shoulders are not affected. Changing the guinea pig's environment and providing large amounts of fresh hay often prevents boredom and stops this vice.

We may see bilateral symmetrical alopecia in older females with ovarian cysts. Treatment involves ovariohysterectomy. Differential diagnoses for alopecia should include mite infections and ringworm.

Vocalizations and calls

Hystricomorph rodents produce a variety of sounds, both mechanical and vocal, that express to other members of their species, the mood, and level of arousal of the sender. Owners of pet guinea pigs and chinchillas become familiar with the various sounds made by their pet.

Several researchers [24–27] have analyzed guinea pig calls and distinguish between 7 and 11 distinct sound patterns. Although each author gave different names to each unique sound, there is general agreement on at least seven sounds. The description and presumptive functions of each sound are:

1. The "chutts" or "clucks" are brief sounds occurring singly or in pairs, and are emitted during general activity and exploration. They appear to inform another guinea pig of the location and arousal level of the sender.
2. The "chutter" or "tutt-tutt-tutt" occurs in long bouts with an audibly rising and falling frequency. The "whine" or "wheet" often follows the chutter. Guinea pigs emit these sounds in situations of flight, discomfort, or evasion. The clutter induces silence and immobility when heard by other guinea pigs.
3. The "tweet" or "whee-wheet" is a call occurring in multiples with a rising frequency. The young emit this call when the mother grooms their anogenital regions.
4. The "whistle" or high-intensity "wheet" is a two-part call; whistles occur singly or in long bouts. "Low whistles" may precede the "whistle" or they may occur alone. Owners most frequently encounter these calls when providing food.
5. The "purr" is a burst of noise, with as many as 50 bursts per bout. This is the purring call associated with mating behavior and filial behavior. It occurs when a guinea pig allows or seeks contact. Aroused adult males usually produce it to show sexual capacity. Females only make this sound when kept together without males.
6. The "drr" is a short purr composed of brief bursts of noise. Guinea pigs make drr's usually in response to environmental change, especially sudden sounds, and they seem to function as warning signals.
7. The "scream" is comparable to a whistle without the low range and occurs in bouts with very brief intervals between sounds. The cornered participant in a fight typically emits it.
8. The protest "squeal" (strong) or "squeak" (mild) is emitted singly and lacks the ascending pitch of the scream. Guinea pigs emit squeals in response to injury, when handled or groomed by a dominant.
9. The "chirp" is believed to be a low-intensity distress call or perhaps a warning. It is not specific for an eliciting stimulus. and the context in which it is emitted best defines its function.
10. Dominant animals emit the "grunt" when interacting with subordinates or before attack. It appears to signify an intention to attack.
11. "Tooth chattering" is a response to a threat or overt conflict. Chattering animals are often aggressive, and generally confronted with an unknown animal of the same species. It appears to signal readiness to attack by the sender.

Sounds of chinchillas have not been analyzed in any detail. In our experience, all chinchillas make a "click" sound. It seems to function like

a ''chutt'' or ''cluck'' in a guinea pig. A nursing female will often ''click'' at her young if they nip her while feeding. Young chinchillas will emit a ''squawk'' that appears to elicit a grooming response from the mother. The mother then often pushes the young down to nurse.

If a chinchilla is injured, or handled awkwardly, it may emit a shrill squeal. Eisenberg [26] describes an ''eek-eek'' call when a chinchilla is frightened or seized. Animals nearby often leap around their cages in response to this sound. Chinchillas will ''tooth chatter'' when aggressive and confronted with an unknown chinchilla. If a fight occurs, chinchillas often make a rasp-like sound, suggesting a snarl.

Male chinchillas make a ''purr'' after mating. It sounds similar to hiccups and will often last for several minutes. Eisenberg [26] describes an unusual call heard in isolated males who produce at intervals a ''nyak-nyak'' call. The function of this call is not understood.

Unusual aspects of guinea pig and chinchilla anatomy

It is important to be aware of the unusual aspects of guinea pig and chinchilla anatomy and not diagnose these features as signs of disease.

Lymphocytes are the predominant white blood cell in guinea pigs, and range from 45% to 80% of the white blood cell count. Many small lymphocytes are similar in size to erythrocytes. Large lymphocytes contain Kurloff bodies, large intracytoplasmic mucopolysaccharide inclusion bodies. Kurloff bodies occur under normal conditions in guinea pigs and are estrogen dependent. Pregnant females may have 2% to 5% lymphocytes with Kurloff bodies in their peripheral blood; they are present in large numbers in adult females, and numbers fluctuate with the stage of estrous cycle. There are few Kurloff bodies in adult males, and they are rarely seen in newborns. It is important that pathologists are aware of Kurloff bodies and do not misinterpret their presence as a pathologic finding. They can be misinterpreted as lupus erythematosus cells (a phagocytic leukocyte that has engulfed the denatured nucleus of an injured blood cell).

Sebaceous glands are abundant along the dorsal surface of guinea pigs and around the anal orifice. The circumanal region contains a large accumulation of sebaceous glands. The sebaceous glands are testosterone dependent, and in adult males, excessive accumulation of sebaceous secretions occurs in the skin around the base of the spine and the folds of the circumanal and genital region. We see it more often in older, single-housed males. In areas covered by fur, the hair becomes thick, matted, and greasy. These folds must be periodically cleaned to preclude infections and unpleasant smell. Remove the secretions with surgical alcohol or a gel hand cleanser.

Bony spicules may be seen radiologically in the lungs of guinea pigs. Histologically, they are composed of dense lamellar bone with varying degrees of calcification. There is no or minimal reaction in adjacent alveolar septa. We can misinterpret them as inhaled fragments of bone of dietary origin, or associated neoplasia with osseous metaplasia. This is an

occasional, normal finding, and must be differentiated from soft tissue metastatic calcification, a nutritional disorder.

The most common skin tumor of guinea pigs is a trichofolliculoma, a benign tumor of the hair follicle epithelium. From two major surveys, Frank [28] in Germany recorded 66 skin tumors in pet guinea pigs over a 15-year period and found 30 (45%) were trichofolliculomas; Ediger [29], in the United States, observed 79 spontaneous neoplasms in Dunkin-Hartley guinea pigs over a 9-year period and found 29 (38%) were trichofolliculomas. Pathologists may report a trichofolliculoma as a trichoepithelioma or incorrectly diagnose it as a basal cell carcinoma. The tumor presents as a slow-growing oval mass varying in diameter from 0.5 to 7 cm, and located predominantly in the subcutis of the dorsal lumbar or sacral region, the lateral femoral, and lateral thoracic area. Males are affected twice as frequently as females, and the average age at diagnosis is 3 years. Epidermoid cysts arising from hair follicles are often associated with these tumors or may arise independently. Ulcerating tumors and ruptured cysts discharge caseous material. Treatment of trichofolliculomas and epidermoid cysts is surgical excision.

The chinchilla has an eye characteristic of a nocturnal rodent—large cornea, large spherical lens, and extremely sensitive retina. However, paradoxically it likes to bask in bright sunshine in their natural high-altitude environment. To cope, its iris is heavily pigmented and its pupil contracts from a vertical ellipse to a fine slit with a teardrop end, and then finally to complete closure like some nocturnal snakes.

Capture and restraint

Guinea pigs are easy to hold and restrain. Although they do not bite, very young guinea pigs may nip. Guinea pigs can be very vocal when restrained, and we warn owners that it is a normal, healthy response. Sick guinea pigs often remain quiet. Rolling a towel around a guinea pig to restrain its body, while leaving its head out, allows easy examination of the head and mouth.

Most pet chinchillas are easy to hold, and generally do not bite; however, even a well-mannered pet will give warning nips if distressed, and if frightened, will bite. Chinchillas also have an unpleasant habit of spraying urine on enemies at a distance of up to 2.5 ft (75 cm). A hand-tamed chinchilla will come out of its cage willingly; if it does not, when the handler or owner lifts it out of its cage, if not held correctly, the chinchilla will lose a patch of fur (known as ''fur-slip'') over the site where it is loosely grasped. If the chinchilla escapes from the cage and is free in the examination room, it can ricochet off walls like a rubber ball. Never try to catch a speeding chinchilla by the tail or you might be left holding the tail and no chinchilla.

When lifting a chinchilla out of its cage, place one hand either under the abdomen or over the shoulder blades and back of the neck, and with the

other hand hold it by the base of the tail. If intending to walk around with a chinchilla, one hand should always hold the base of the tail in case it wants to jump. To determine the sex of a chinchilla, hold the animal by the base of the tail and suspend it. However, never do this with a pregnant female.

If a chinchilla is known to bite, or it requires an oral cavity examination, two people should hold the animal. One person should firmly restrain the shoulder blades and back of the neck. The other person should hold the chinchilla on a table by the base of the tail with one hand, and under the abdomen with the other hand. The examiner additionally restrains the animal by the occiput and back of the neck.

We emphasize that examiners or handlers should never hold a chinchilla by scruffing the loose skin on the back of the neck as is done in ferrets or cats. If this method of handling is attempted then "fur-slip" will occur, and the individual holding may drop the chinchilla.

Sample collection

Blood collection

Guinea pigs can be difficult to bleed because of the lack of obviously accessible peripheral veins. We use the lateral saphenous vein and the cephalic vein for small amounts of blood. For large amounts of blood, we use the anterior vena cava with the guinea pig under anesthesia. This is a technique that requires practice. If performed incorrectly, there is a risk of death associated with intrathoracic hemorrhage, pericardial hemorrhage, or pulmonary hemorrhage. We always shave the site of venipuncture in guinea pigs for good visualization. We use the same approach for chinchillas.

Fecal samples

Diarrhea or loose stools in guinea pigs and chinchillas usually result from sudden dietary changes. Parasitic enteritis is rarely a problem. However, if diarrhea is chronic or enzootic in a group of animals, infectious causes must be considered.

Fecal floatation using a heavy sugar (sucrose) solution is ideal to examine feces. Always use fresh fecal pellets as old pellets dehydrate making suspension difficult. Detection of nematode eggs in guinea pigs is associated with *Paraspidodera uncinata*, a 1- to 3-cm worm found in the cecum. It is uncommon, and we only see it in guinea pigs housed in outdoor runs. Intestinal nematodes are not reported in chinchillas.

Protozoal oocysts are more likely to be seen on fecal flotations. Fortunately, most protozoa seen in guinea pigs and chinchillas are not pathogenic. Two exceptions are *Eimeria caviae* oocysts in unthrifty guinea pigs with loose slimy droppings; and spherical, nonmotile Giardia cysts in chinchilla fecal pellets. Chinchillas with giardiasis have loose stools or diarrhea, and motile Giardia trophozoites are seen in fresh fecal smears. Stain the smear for easier detection of the trophozoites.

Guinea pigs and chinchillas housed with other animals sometimes eat the other species' feces. Then we may see spurious parasite eggs or cysts on the fecal floatation. Animals may also have objects in their feces that resemble parasites. These include pollen grains, plant hairs, grain mites, mold spores, and harmless plant and animal debris. Always obtain a good history of the pet's home environment and diet to help rule out pseudoparasites.

Preventive care

Chinchillas possess a predator avoidance mechanism known as fur slip. When the animal is fighting or roughly handled, it can release a large patch of fur, thus enabling it to escape. A clean smooth area of skin is left; hair may require several months to regrow. Fur slip should not be confused with the vice of fur-chewing seen when chinchillas chew each other's fur resulting in a moth-eaten coat. A current popular theory suggests that fur-chewing is a behavioral disorder. Mothers often transmit the vice to offspring. Breeders often suggest that the higher incidence of fur-chewing in commercial herds is evidence for maladapted displacement behavior. Eidmann [30] suggested that affected animals suffer from malnutrition and chew their fur for dietary requirements. Multiple food factors are probably involved in this type of malnutrition, and the exact etiology requires further dietary studies. A previous theory for fur chewing suggested fur-chewers might have abnormal endocrine activity, as there is increased thyroidal and adrenocortical activity and another theory proposed a yet-to-be-discovered fur breakage fungus. Eidmann showed that thyroid hyperplasia correlated to the size of chewed fur over the body and interpreted it as a reactive response of the thyroids due to insulation loss following fur removal. Eidmann also concluded that an infectious etiology of fur-chewing was unlikely after she compared fungal and bacterial culture of skin and fur from 39 fur-chewers with 19 healthy chinchillas.

During breeding, bite wounds that abscess often occur in group-housed animals. Culture of the abscesses often yields *Staphylococcus* species. Female chinchillas are larger than males and more aggressive. They are highly selective in their choice of males for mating, and will keep "unsuitable" males at bay by urination, kicking, and biting [31]. Often bite wounds result in the loss of pieces of ears and toes. Killing a young male housed in the same cage is common for older females [32].

Traumatic fractures of the tibia are commonly seen in chinchillas and guinea pigs, and are associated with the animal catching its hind limb in a cage bar. In chinchillas, the tibia is a straight bone longer than the femur and with little soft tissue covering; the fibula is virtually nonexistent. Tibial fractures are either transverse or short spiral, and generally are associated with bony fragments.

Chinchillas usually give birth early in the morning and only rarely after midnight [32]. Dystocia is usually associated with the presentation of

a single, oversized fetus, or malpresentation of one or more kits. Fortunately, chinchillas respond well to Cesarean section.

Male chinchillas that groom excessively, frequently produce small amounts of urine or strain to urinate, and repeatedly clean their penis may have a fur ring [33]. This is a ring of hair around the penis and under the prepuce that eventually stops the penis from going back into the prepuce. In severe cases, an engorged penis is seen protruding 4 to 5 cm from the prepuce, resulting in paraphimosis. The condition is painful, and may cause urethral constriction and acute urinary retention. Chronic paraphimosis may culminate in infection and severe damage to the penis affecting the animal's breeding ability. Getting fur from a female during copulation is the most common cause of fur ring. However, the fur may come from other males or the same animal as the condition is also seen in group-housed and single-housed males not exposed to females. Males should be examined for fur rings at least four times a year; active stud-males should be examined every few days. In some male chinchillas, the penis will hang out of the prepuce all the time and is not engorged. In these males, the cause of this condition is not associated with fur ring, but is due to overexcitement brought on by separation from its mate or overexhaustion due to too many females in the same cage. Fur rings can be cut or gently rolled off the penis after applying a sterile lubricant. Occasionally, sedation or anesthesia of the male may be required to remove the fur ring.

First visit

Complete physical exam. Guinea pigs display many coat types and colors. The short, wire-haired Abyssinian may look unhealthy, as its coat is arranged in whorls or rosettes giving it a ruffled, untidy appearance. The mouth of guinea pigs is small, and examination of the oral cavity is difficult. Healthy guinea pigs feel "dense" and are alert. Fatigue, lack of interest in surroundings, and light body weight are often general signs of illness.

Obtaining a good medical history is very important because the owner knows the behavior of the pet much better than the veterinarian does, simply because chinchillas are such shy animals. Healthy chinchillas have a curled tail that is carried high and a spirited curiosity. Sick animals are indifferent, have a dull coat, and often their perianal area is stained or covered with feces. An animal that flies around the cage in a frenzy when the breeder attempts to capture it has not been socialized to people or other chinchillas, and will be difficult to examine without sedation.

The initial examination should involve observing the animal in its cage. You should focus on its movement, breathing, and rhythm of breathing while in the cage. Initiate the physical examination by measuring the animal's weight. This tells you about the feeding. Now is also a good time to obtain the temperature; because of their tiny size, do not expect to obtain a peripheral pulse.

Next, examine the fur, skin, and mucous membranes. Follow this by auscultating the heart and lungs, and then palpate the abdomen. For this purpose fix the front legs and chest of the chinchilla with your left hand, and arrange the animal to sit on your right hand, with which you can palpate the abdomen. During palpation, you can feel the stomach and the presence and consistency of fecal pellets in the intestine.

After abdominal palpation, the last part of the examination is to look into the oral cavity of the animal because it can be stressful for the chinchilla, and it can become excited. For this purpose, an assistant should restrain the chinchilla during the oral examination. The examiner should hold the chinchilla by the back of the neck and use an otoscope. Healthy chinchillas have yellow incisors (like rodents) due to iron deposition on enamel of incisors.

Dental exam and recommendations. The clinical signs and treatment for malocclusion in the guinea pig and chinchilla are almost identical to the rabbit, but the premolar teeth are more commonly affected.

Importance of spay/neuter

Female guinea pigs have a high incidence of reproductive and breeding problems, and therefore, neutering is recommended if the animals will not be bred.

In entire females older than 1 year, multiple cysts are often present on the ovaries. The cysts, which may be unilateral or bilateral, contain clear, serous fluid and may grow up to 2 to 4 cm in diameter. Clinically ovarian cysts are associated with reduced reproductive performance, cystic endometrial hyperplasia, mucometra, endometritis, and alopecia. Cyst size and prevalence increases with age [34]. A recent survey [35] described 10 guinea pigs with an ovarian cyst that had clinical signs of anorexia, alopecia, or depression. Diagnosis of the disease by plain radiography is difficult because of the similar opacity of ovarian cysts compared with abdominal neoplasms, and trichobezoars. Abdominal ultrasound allows differentiation by imaging the inner structure of the ovarian cyst. Treatment is laparotomy and surgical removal of the ovary and cyst.

Female guinea pigs have a high perinatal mortality. Dystocia and still births are related to large fetuses, subclinical ketosis, and fusion of the symphysis pubis. If females are bred after 6 months of age, the symphysis pubis may have ossified and will not separate during parturition. We often see stillbirths in primiparous females. Pregnancy lasts 59 to 72 days, with an average of 63 days. If a female strains continually for more than 20 minutes or fails to produce young after 2 hours of intermittent straining, consider dystocia. Careful examination of the cervix is necessary to assess how much separation of the symphysis pubis is present. There should be at least the width of the index finger to permit passage of the fetus. If adequate separation has occurred, oxytocin injection (1–2 units intramuscularly) can

be given. If the fetus is stuck, or parturition does not begin within 15 minutes of giving oxytocin, performing a Cesarean section is necessary. The uterus should be opened close to the bifurcation of the horns and cervix, as the guinea pig has a bicornuate uterus with one cervix.

Guinea pigs often develop pregnancy toxemia in late pregnancy. Although the clinical signs are similar, there are two recognized forms of pregnancy toxemia: the fasting/metabolic form, and the toxic form. Affected sows show depression, acidosis, ketosis, proteinuria, ketonuria, and a lowered urinary pH from around 9 to 5 or 6.

Metabolic pregnancy toxemia occurs in obese sows, especially females in their first or second pregnancy. A reduced carbohydrate intake and mobilization of fat as a source of energy causes the disease. Changes in feeding routine and stress may precipitate the crisis. Clinically, the sow stops eating and is initially depressed, then becomes comatose and usually dies within 5 to 6 days. Treatment is rarely successful in advanced cases. Aggressive treatment is necessary, and involves the administration of 5% glucose solution either intravenously or subcutaneously; or propylene glycol orally; nutritional supplementation; and Cesarean section. Sows in late pregnancy can be given water within which a small amount of glucose has been dissolved as a preventive measure.

The circulatory or preeclampsia form of pregnancy toxemia is due to uteroplacental ischemia. The gravid uterus compresses the aorta, resulting in significant reduction of blood to the uterine vessels. Placental necrosis, hemorrhage, ketosis, and death follow. If suspected, emergency Cesarean section or ovariohysterectomy are required to save the sow's life.

Grooming

Long-haired cavies such as Peruvians, Shelties, Coronets, and Texels require regular brushing out and as their coats grow, the coat needs to be put into wrappers. If the owner wishes to exhibit these animals, they must be shown with the coat complete. Experienced breeders achieve this by keeping the coat in wrappers of cloths or paper to protect it from damage.

Medication and administration

Antibiotic associated dysbacteriosis or "antibiotic toxicity"

We cannot overemphasize the lethal sensitivity of the guinea pig to antibiotic therapy. Antibiotics reported to cause enterotoxemia include penicillin, ampicillin (amoxicillin), bacitracin, erythromycin, spiramycin, streptomycin, lincomycin, clindamycin, vancomycin, and tetracycline. Topical antibiotics have also caused fatal enterotoxemia. Overall, avoid narrow-spectrum antibiotics with antibacterial activity against Gram-positive bacteria. The cause of death is decrease in Gram-positive bacteria and increase in Gram-negative bacteria and bacteremia/septicemia. Paradoxically,

Table 3
Therapeutic doses of antibiotics used safely in guinea pigs

Ceftiofur	1 mg/kg i.m. q 24 h (for pneumonia)
Cephaloridine	12.5 mg/kg i.m. q 8–24 h for 5–14 days
Chloramphenicol	50 mg/kg p.o. q 12 h
Chloramphenicol	30–50 mg/kg s.c., i.m. q 12 h
Ciprofloxacin	10–20 mg/kg p.o. q 12 h
Enrofloxacin	5–10 mg/kg p.o., i.m. q 12 h
Gentamicin	6 mg/kg s.c. q 24 h (use cautiously)
Metronidazole	10–40 mg/kg p.o. q 24 h
Neomycin	12–16 mg/kg p.o. q 12 h
Sulfamethazine	1 mg/mL drinking water up to 60 days p.o.
Sulfadimethoxine	10–15 mg/kg p.o. q 12 h

Abbreviations: p.o., by mouth; i.m., intramuscularly; s.c., subcutaneously; q, every.

clostridial overgrowth (*Clostridium difficile*) has also been identified. *C difficile* is a pathogenic organism, not normally recoverable from intestinal contents.

Table 3 shows therapeutic doses that have been used safely in guinea pigs.

Oral administration and injections

Application of drugs by mouth is possible if chinchillas are offered tablets hidden in raisins; chinchillas will eat them because they are inquisitive. A subcutaneous injection can be injected on the side of the torso; if the owner is concerned about fur-slip from the injection, it can be performed on the inside of the femur, the knee, or neck. Intramuscular injections should not exceed 0.5 mL, and should be given in the hind limbs.

Recommended reading

Books

Refer to the chapter on rats and mice for good multiauthored veterinary books on exotic pets. In addition, the following books are useful:

Morales E. The guinea pig: healing, food and ritual in the Andes. Tucson (AZ): University of Arizona Press; 1995. This book is the most complete and current ethnographic account of the traditional uses of cuy in the Andes, and is the primary source for much of the information presented in the introduction of this article.

Richardson VCG. Diseases of domestic guinea pigs. Oxford (UK): Blackwell Publications; 2000. This is a small book by a UK veterinarian who has bred and exhibited guinea pigs for over 30 years. It has a chapter on Alternative Therapies.

Pet owners manuals

TFH Publications, Neptune, NJ, has several good books (some translated from German) on chinchillas in its catalog. They include

1. Karen Zeinert. All about chinchillas.
2. Egon Mosslacher. Breeding and caring for chinchillas.
3. Horst Kuhner. A step-by-step book about chinchillas.

Web sites

There are few reliable Web sites on chinchillas and guinea pigs. Many are erroneous. We find the best Web sites are:

American Cavy Breeders Association (ACBA)
http://www.acbaonline.com

The UK National Directory of Cavy breeders
http://www.cavybreeder.cjb.net

The Chinchilla Lexikon has excellent images of fur colors, anatomy, and common diseases. However, the site is in German and not English.
http://www.chinchilla-lexikon.de/index2.shtml

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