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## LONG-ACTING ANTIBIOTICS IN ZOO ANIMALS - WHAT DO WE KNOW?

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### Abstract

Zoo veterinarians deal with animal species wherein each single treatment event may imply logistical challenges and health hazards for the animals (e.g., remote injection, immobilization). Long-acting antibiotics meet the need of providing antibiotic cover in species that are difficult to medicate on a regular basis. For domestic animals, new long-acting antibiotics were developed recently, but the question is what can be used in zoological and wildlife medicine?

With cefovecin, the very long half-life in dogs and cats allows a dosing interval of 14 days.<sup>14,15</sup> However, species differences in pharmacokinetics are highly relevant and likely preclude the use of this antimicrobial agent in non-evaluated species.<sup>17</sup> For cattle, pigs, and horses, a sustained release ceftiofur suspension (ceftiofur crystalline free acid, CCFA,) was developed. Pharmacokinetic studies are underway for other species. In reptiles, other cephalosporins allow a long dosing interval (e.g., ceftazidime).<sup>13</sup> Tulathromycin is a long-acting macrolid antibiotic used in domestic animals with the potential of evaluation for zoo animals. Long-acting tetracyclines, and doxycycline formulations have been utilized in practice for a longer time. Other modes of administration may be employed so that antibiotics are administered at a less frequent interval (e.g., ballistic implants, impregnated beads).

In Table 1, we compile a list of long-acting antibiotics that may be useful for the zoo veterinarian. Examples of pharmacokinetic data of several long-acting antibiotics are included, as well as, examples wherein long-activity is not achieved

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**Table 1.** Examples of pharmacokinetic data of long-acting antibiotics for different species.

Antibiotic (reference)	Species	Dose; Route	Half-life (hr)	Interval recommended	Remarks
Amoxicillin, Controlled release, degradable implant	Domestic goat <sup>10</sup> ( <i>Capra aegagrus hircus</i> )	implant	130.03 ±39		implant produced by authors
Cefovecin	Domestic cat <sup>15</sup> ( <i>Felis sylvestris catis</i> )	8mg/kg s.c.	166 ±18	14 day	
	Domestic dog <sup>14</sup> ( <i>Canis lupus familiaris</i> )	8mg/kg s.c., i.v.	133	14 day	
	Squirrel monkey <sup>12</sup> ( <i>Saimiri sciureus</i> )	8mg/kg s.c.	2.6 ±0.1		not long-acting
	Cynomologus macaques <sup>12</sup> ( <i>Macaca fascicularis</i> )	8mg/kg s.c.	6.3 ±1.8		not long-acting
	Rhesus macaques <sup>12</sup> ( <i>Macaca mulatta</i> )	8mg/kg s.c.	8.0 ±0.6		not long-acting
	Rhesus macaque <sup>2</sup> ( <i>Macaca mulatta</i> )	8mg/kg s.c.	6.6 ±1.0		
	Scarlet ibis <sup>16</sup> ( <i>Eudocimus ruber</i> ); African grey parrot <sup>16</sup> ( <i>Psittacus erithracus</i> ); Blue-fronted Amazon <sup>16</sup> ( <i>Amazona aestiva</i> ); Russian tortoise <sup>16</sup> ( <i>Testudo horsfieldi</i> ); Spur-thighed tortoise <sup>16</sup> ( <i>Testudo graeca</i> ); Russian ratsnake <sup>16</sup> ( <i>Elaphe schrenckii</i> ); Boa constrictor <sup>16</sup> ( <i>Boa constrictor</i> )	10mg/kg s.c.			not long acting, preliminary study
	Chicken <sup>16</sup> ( <i>Gallus domesticus</i> )	10mg/kg s.c.	0.9 ±0.3		not long-acting
	Green iguana <sup>16</sup> ( <i>Iguana iguana</i> )	10mg/kg s.c.	3.9		not long-acting
	Ring tailed lemur <sup>4</sup> ( <i>Lemur catta</i> )	10mg/kg		>5 day	
	Geoffroy's spider monkey <sup>4</sup> ( <i>Ateles geoffroyi</i> )	10mg/kg		<48 hr	
	Domestic goat <sup>4</sup> ( <i>Capra aegagrus hircus</i> )	10mg/kg		<24 hr	not long-acting

	Soemmering's gazelle <sup>4</sup> ( <i>Nanger soemmerringii</i> )	10mg/kg		<24 hr	not long-acting
	Rheem gazelle <sup>4</sup> ( <i>Gazella subgutturosa marica</i> )	10mg/kg		<24 hr	not long-acting
	Speke's gazelle <sup>4</sup> ( <i>Gazella spekei</i> )	10mg/kg		<24 hr	not long-acting
	Domestic pig <sup>4</sup> ( <i>Sus scrofa</i> )	10mg/kg		>5 day	
Ceftazidime	Loggerhead sea turtles <sup>13</sup> ( <i>Caretta caretta</i> )	20mg/kg i.v.	20.59 ±3.24	72 hr	
		20mg/kg i.m.	19.08 ±0.77	72 hr	
Ceftiofur crystalline free acid	Domestic goat <sup>6</sup> ( <i>Capra aegagrus hircus</i> )	6.6mg/kg s.c.	36.9		
	Alpaca <sup>5</sup> ( <i>Vicugna pacos</i> )	6.6mg/kg s.c.	44.7		local reactions after multiple administrations
	Helmeted guineafowl <sup>18</sup> ( <i>Numida meleagris</i> )	10 mg/kg i.m.	29.0 ±4.9	3 day	
	American black ducks <sup>9</sup> ( <i>Anas ribripes</i> )	10 mg/kg i.m.	32	3 day	
	Ball python <sup>1</sup> ( <i>Phython regius</i> )	15mg/kg i.m.	64.31 ±14.2	5 day	
Oxytetracycline	Loggerhead sea turtle <sup>7</sup> ( <i>Caretta caretta</i> )	41-82 mg/kg then then 21 mg/kg i.m.	61.9 then 66.1	72 hr	
Oxytetracycline, long-acting	Tammar wallaby <sup>11</sup> ( <i>Macropus eugenii</i> )	20 mg/kg i.m.	19.35 ±11.07		long activity questioned
	American alligator <sup>8</sup> ( <i>Alligator mississippiensis</i> )	10 mg/kg i.m.	131.23	5 day	
Tulathromycin	Domestic goat <sup>19</sup> ( <i>Capra aegagrus hircus</i> )	2.5 mg/kg s.c.	110 ±19	once	
	Domestic pig <sup>3</sup> ( <i>Sus scrofa</i> )	2.5 mg/kg i.m.	75.6	once	