Active Ingredient Summary Table
Antibiotic Rectal Absorption

Active Pharmaceutical Ingredient	Studies	Studies in Human Populations	Bioavailability Information	Vehicles Studied
Amoxicillin [1,2]	One study in rabbits compared rectal absorption of amoxicillin from polyethylene glycol (PEG) based suppositories and a hard fat-based suppository, they noted amoxicillin absorption to be 59% and 77.3% with 100mg and 200mg doses respectively in the PEG vehicle, whereas absorption from the hard fat suppository vehicle was noted to be complete. Another in vitro study aimed at developing suppositories for pediatric patients with pneumonia reviewed the release rate of amoxicillin 250mg in PEG and hard fat bases and found similar drug release profiles in both vehicles, similar to drug release profiles in commercially available capsules.	No	The study in rabbits also noted close to 100% absorption with the hard fat base in rabbits	PEG (polyethylene glycol) Hard fat Hard fat bases were noted in one study to provide superior bioavailability
Ampicillin [3,4]	One study evaluated ampicillin in pediatric patients at a dose of 125mg x 4 times daily either rectally or orally. They concluded that rectal ampicillin suppositories possessed similar clinical efficacy and safety as compared to the oral form. One study in adults and pediatric patients evaluation 125mg and 250mg suppositories found bioavailability to be 1.38-1.55 times greater for rectal administration and compared to oral administration	Yes	One study in humans at the same oral and rectal dose noted both the be effective	Characteristics of the suppository base in both studies were not mentioned, other than capric acid 15mg being used as an adjuvant/penetration enhancer
Azithromycin [5,6,7]	One study of PEG solid solution suppositories in vitro estimated bioavailability as 43% as compared to intravenous use, with oral use in humans having a 38% bioavailability Another study in pediatric patients administered a 500mg tablet or a 125mg, 250mg, or 500mg suppository (using a	Yes	In vitro study postulated high bioavailability, but human use study estimated bioavailability to be 20.3% of oral	Both studies used polyethylene glycol type vehicles, the pediatric study also used a fatty acid vehicle

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	solid PEG base or a Witepsol base). The bioavailability of azithromycin in suppository form was estimated to be 20.3% compared to oral administration. The study concluded that the rectal route may be an option for patients unable to tolerate oral administration			Another in vitro study comparing two different rectal gels, PEG suppository base, and hard gelatin capsule found the PEG formulation to be the most promising
Ceftriaxone [8,9]	One study in various animals (rodents and primates) reported between 38-42% absorption using coconut oil mono and diglyceride extracts in a Witepsol (fatty acid) base Another study reported chenodeoxycholate sodium salt penetration enhancer at 125mg amount together with 500mg ceftriaxone in Witepsol (fatty acid base) resulted in 24% bioavailability compared with the injectable product	Yes	Small human bioavailability trial suggested 24% bioavailability compared with injectable product (in the presence of penetration enhancer)	Both human and animal studies used a fatty acid vehicle (Witepsol) with different penetration enhancers
Cefoxitin [10,23]	One study in 6 human subjects evaluated absorption of cefoxitin in different suppository systems with sodium salicylate and Brij 35 (Polyoxyethylene Lauryl Ether), bioavailability was found to be as high as 20% with these adjuvants, and just 3% without. A specific vehicle was not mentioned	Yes	One small human bioavailability trial noted 20% bioavailability in the presence of absorption enhancing adjuvants	A specific vehicle wasn't mentioned in the human study, one study in dogs noted good results with a lipophilic suppository base
Ceftazidime [11]	One study in rabbits evaluated ceftazidime bioavailability from a hard fat suppository base containing sodium lauryl sulfate (SLS) and reported good bioavailability, though there was significant variability	No	One small study in rabbits reported bioavailability of about 65.5%, though, there was significant bioavailability	A hard fat vehicle with SLS as an absorption enhancing adjuvant was utilized
Ciprofloxacin [12]	An in-vitro study on ciprofloxacin HCl 100mg in various lipophilic bases (suppocire AM and CM, Witepsol W35, cocoa butter among others) found good release from these bases. When administered to rabbits, the drug was	No	One study in rabbits reported that the drug was absorbed rectally, but didn't specify bioavailability	The in-vitro and animal study used fatty acid type suppository vehicles

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	rectally absorbed, specific bioavailability data was not reported			
Doxycycline Hyclate [13]	One study in rabbits evaluated doxycycline hyclate 25mg suppositories in PEG and cocoa butter suppositories. They found bioavailability of ~49.12% in the PEG suppository, and about 51.43% from the cocoa butter suppository	No	One study in rabbits reported rectal bioavailability to be 49.12-51.43% depending on the vehicle	Studied in both PEG and cocoa butter suppository bases
Erythromycin [14,15,16]	One study 500mg erythromycin (base form) suppositories (2 administered during test) for management of bronchitis found absorption to be rapid. Therapeutic levels were present in sputum after administration of the antibiotic (information on the vehicle used was not available) Another study in pediatric patients between neaonatal-12 years of age administered erythromycin at 10-15mg/kg twice daily and estimated overall bioavailability to be approximately 28.5-54.2% with improved bioavailability noted in older patients as compared to younger ones (information on the vehicle used was not available)	Yes	Small human pediatric trials suggest a range of bioavailability between 28.5-54.2% with higher bioavailabilities being noted in older children	Specific formulations were not available, one study on erythromycin delivery in general suggested that fatty acid bases may be a suitable vehicle
Gentamicin [17,18]	One study in rabbits administered gentamicin (60mg) with absorption enhancing adjuvants (90mg of either sodium salicylate or sodium caprylate), with these adjuvants, bioavailability of 58-59% was noted, without them, they noted that absorption of gentamicin was not significant without these adjuvants Another study in minipigs using liquid enema formulations and cocoa butter suppositories did not note significant absorption	No	No human bioavailability studies exist, absorption and bioavailability may be highly contingent on adjuvants	Studied in aqueous enema and cocoa butter suppositories with various absorption enhancing adjuvants

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Metronidazole [19,20,21,22]	A study in rabbits found that metronidazole was well absorbed rectally from a hydrophilic (glycerogelatin) suppository form. They found absorption to be fast and similar to oral absorption. Drug released was further enhanced by polysorbate 80 (1%), but reduced in the presence of hydrogenated vegetable oil. One study compared oral tablets to suppositories at 500mg, 1000mg, and 2000mg in 10 healthy adult volunteers. They found the bioavailability of the suppositories was approximately 90% of the corresponding tablet dose as judged by area under the serum curves and amounts excreted in urine. A specific vehicle was not listed	Yes	One human bioavailability study found between approximately 56-80% bioavailability depending on amount given rectally	Studied in a hydrophilic base (glycerogelatin) in rabbits, a specific base was not mentioned in the human study
Penicillin [23, 24]	Little information is available, one study found 6% was absorbed after rectal administration of cocoa butter suppositories, more information was not available as the original study was from 1948 A second study in dogs reported 85% bioavailability of penicillin G in dogs. They used a lipophilic suppository base along with sodium 5-methoxysalicylate or sodium salicylate to enhance rectal absorption, bet ween the two sodium 5-methoxysalicylate was found to be more effective	Yes	Unclear	Cocoa butter was used in one study, a study with superior absorption reported the use of sodium 5-methoxysalicylate in a lipophilic suppository vehicle
Sulfamethoxazole/ Trimethoprim[25]	One case study on a 24yo female patient administered trimethoprim/sulfamethoxazole rectally in a suppository form with 160mg TMP and 800mg SMX every four hours. To formulate the suppository ground tablets were added to a cocoa butter base. The study reported bioavailability for this patient to be 3% for TMP and 19.5% for SMX One in vitro study looked at 80mg TMP and 400mg SMX in Witepsol or PEG suppositories with polysorbate 60 added	Yes	Little data is available, one case study reported bioavailability to be 3% for TMP and 19.5% for SMX	Studied in a fatty acid (cocoa butter and Witepsol) vehicle, one in vitro study noted the benefit of absorption enhancing adjuvants

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	as an adjuvant at 10%, best release was noted with the Witepsol H15 base in combination with polysorbate			
Tinidazole [26,27]	One study found 39% rectal bioavailability (compared with greater than 90% oral bioavailability, and about 10% intravaginal bioavailability) a specific vehicle was not mentioned Another study compared tinidazole release from PEG suppositories, and lipophilic suppositories (Witepsol H-15 and H-35) and found better release from the PEG type bases. Non-ionic surfactants (polysorbate 80 and Span 80) increased release of tinidazole from Witepsol H-15 suppositories	Yes	Little data is available, one study reported 39% rectal bioavailability (compared to 90% oral bioavailability) but a specific vehicle wasn't mentioned	Studied in PEG and fatty acid bases, with better release found from PEG bases. Emulsifiers were noted to improve drug release

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