**Journal of Prescribing Practice**

**A-Z of Prescribing for children**

This series is going to be focusing on aspects of prescribing for neonates, children and young people, from A to Z. Aspects of pharmacokinetics will be considered, alongside legal considerations, consent, and medications in schools.

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**A – Absorption**

It is commonly stated that children are not just small adults: yet, with this in mind, most paediatric medication doses are still calculated from studies in adults (O'Hara 2016). Having a knowledge of physiological differences between children and adults is imperative to have a thorough understanding in differences in pharmacokinetics.

Unless administered intravenously, drugs need to cross semipermeable cell membranes before they finally reach the systemic circulation. There are many other ways in which drugs are administered by extravascular routes, such as via the gastrointestinal (GI tract), topical or transdermal, and through the lungs being the most common routes (van den Anker, Reed et al. 2018). Most drugs in children are administered **Orally.** The taste of medications is an important factor (see **T** in the series), as children will naturally reject bitter or foul tasting medications. However, once successfully taken, drugs will enter the stomach, and gastric pH needs to be considered.

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A chart of a color scale

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Gastric pH is neutral at birth, but falls to very acidic levels of 1-3 up to 48 hours after birth. By the time the infant is a week old, the pH will return to neutral, and finally will reach adult values around 2 years of age (Lu and Rosenbaum 2014). This higher pH will have an effect on acid labile drugs, and may account for higher bioavailability (the extent to which the drug becomes ‘available’ to its intended destination) of beta-lactam antibiotics, such as penicillin. Conversely, weak acid drugs, such as phenytoin or phenobarbitone, will have a reduced bioavailability.

Gastric emptying time is also a factor: it can take up to 8 hours in neonates and young children, which can result in an increased absorption of some drugs, due to reduced motility. Other GI differences include biliary function, resulting in a reduced ability to make lipophilic drugs more soluble (Sage, Kulczar et al. 2014), and a reduced bowel length, resulting in a smaller absorptive surface.

**Rectal** administration is an option, if oral administration is not possible. The rectum has a rich blood supply, but absorption time in children is variable (Skinner 2008), and young children have more frequent large muscle contractions, so expulsion of the suppository is a potential issue. Emergency medications such as rectal diazepam may not be perceived as socially acceptable within the school setting (Butler, Boucher et al. 2020).

In order to bypass hepatic first pass metabolism, **Mucosal** administration may be considered, through the oral / buccal or nasal mucosa. The bioavailability of midazolam, for example, is 57% when given intranasally, compared to 30% when administered orally (Skinner 2008), and is seen as an effective sedative in children (Mayel, Nejad et al. 2020), as well as dexmedetomidine (Mason and Lerman 2011). Fentanyl and ketamine provide effective analgesia via this route, with the benefit of no histamine release, avoiding nasal itching and congestion in ketamine (Pansini, Curatola et al. 2021). ‘Dripping’ the medication into the nose is the most basic method of administration, but a compliant child is needed, so often, the mucosal atomizer is used (Sorrentino 2015).

Absorption of **Inhaled** drugs for the lungs (for example, inhaled or nebulised salbutamol for asthma) might be more dependent on technique rather than physiology (Jones 2022), such as smaller respiratory tracts and lower inhalation flow rates (Kwok and Chan 2014).

Considering developmental changes is also important when considering **Topical** medications: absorption may be higher in newborns and babies due to enhanced hydration of the epidermis, enhanced perfusion of the subcutaneous layer of the skin, and also the larger total body surface area ratio, in comparison to adults (Lu and Rosenbaum 2014). Caution also needs to be taken in alcohol based preparations and topical corticosteroids, as this can result in toxic effects.

**Intramuscular** injections obviously have a high bioavailability, but due to the pain, these should be avoided where possible in children (Skinner 2008). Absorption may also be delayed in neonates due to the reduced blood flow to their skeletal muscles (Lu and Rosenbaum 2014).

If given **Intravenously (IV),** drugs are directly entering the systemic circulation: IV administration is the preferred route for severely ill neonates, but care must be taken regarding fluid volumes. Placement of lines are also challenging (Linakis, Roberts et al. 2016).

Administration of medications overcome a variety of barriers prior to optimal absorption (Sage, Kulczar et al. 2014). An understanding of developmental changes during rapid growth in infancy and childhood is imperative, as it is evident that this can affect the pharmacokinetics of different medications (O'Hara 2016). This first A-Z article has demonstrated an insight into the various aspects that need to be considered in Absorption in neonates and children.

*(775 words)*

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