Prescribing for children – a nursing perspective

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Introduction

Although a formal scope of practice for specialist prescribing nurses has yet to be finalised by the South African Nursing Council (SANC), many nurses are already prescribing medicines for both adult and paediatric patients, in both the private and public sectors.[1] In the public sector, nurses are guided by the Standard Treatment Guidelines (STG) and Essential Medicines List (EML), and specifically the document that is intended for Primary Health Care (PHC).[2] Prescribing nurses in the private sector work in such areas as occupational health, and are guided by their employer's policies as well as the details of their permits.

However, in addition to the guidance provided, nurses who prescribe, dispense and administer medicines for children need to consider the specific clinical needs of this group and the challenges these entail.

Pharmacokinetics and pharmacodynamics

Safe and responsible use of medicines in children relies on sufficient knowledge of the pharmacokinetics ("what the body does to the drug") and pharmacodynamics ("what the drug does to the body") of each particular medicine. The paediatric population is, however, far from homogeneous. It represents a continuum of maturation from the preterm newborn infant to the child, the adolescent and the young adult. Ontogeny refers to this process of development, from fertilisation to maturity, in relation to the development of organs, their function and physiology. Critically, this process is both non-linear and dynamic. Table I summarises some of the key anatomical and physiological changes that occur at different stages of development. A good summary of these changes was published by Kearns et al.[3]

The impact of these changes over time can be considerable and complex to predict. They may also operate in different directions. For example, the relative achlorhydria seen in the neonate would increase absorption of medicines that are usually destroyed in a more acidic environment. However, those medicines, which are more lipid soluble and rely on absorption from the larger surface area of the intestine, would be absorbed more slowly in infants in whom gastric emptying is delayed. Overall, the time to peak plasma concentration would be expected to be longer in younger than in older children. Topically applied medicines would be expected to penetrate the thinner, more hydrated and better perfused skin in the newborn than in adolescents or adults. However, the less effective blood–brain barrier in newborns would lead to greater penetration of medicines usually excluded. Although rectal administration is often touted as uniquely suited to the paediatric population, the increased number of high-amplitude pulsatile contractions in the rectum would lead to rapid exclusion of such products in infants and toddlers. Perhaps no area is more complex than trying to understand the impact of ontogeny on metabolism of drugs in the liver. Most enzymes responsible for drug metabolism are expressed at negligible or low levels in the foetus, but expression to mature levels occurs within a few weeks to one to two years after birth. In some cases, mature levels are only attained later, such as post-puberty.

Dosage forms and dosing information

Although in the past the default position was to develop medicines for children as oral liquid dosage forms (syrups, solutions and suspensions), these are often more expensive, less stable (for example, requiring refrigerated storage) and inconvenient to transport (heavy and liable to break if dropped). An increasing number of medicines for children are being developed as divisible oral solid dosage forms, that can be adjusted for the patient's body weight, and are easy to administer. Examples include granules, dispersible tablets (which dissolve in a small amount of liquid) and oro-dispersible tablets (which quickly dissolve in the mouth).[5]

Table I: Some anatomical and physiological changes in childhood

Characteristic	Preterm newborn (born before 36 weeks' gestation)	Term newborn (born after 36 weeks' gestation, aged 0 to 27 days)	Infants and toddlers (aged 28 days to 23 months)	Children (aged 2 to 11 years)	Adolescents (12 to 16–18 years; dependent on region and cultural norms)
Body composition	High body water content; very low body fat and muscle mass	Rapid growth in body weight and body surface area	Slow decline in body water; decline in body surface area: weight ratio Increasing body fat	Slower growth rate; slim body habitus; increased muscle mass	Pubertal growth spurt; changes in body habitus, especially feminisation in girls
Circulation	Persistent foetal circulation; high cerebral blood flow with reduced plasma protein binding				Rise in heart size and systolic blood pressure especially in boys
Skin	Increased skin permeability, hydration and perfusion, even more so than in term infants	Increased skin permeability, hydration and perfusion			Decreasing skin thickness, perfusion and hydration
Gastrointestinal tract	Immaturity, peristaltic dysfunction and failure of sphincter control (oesophageal, stomach, intestinal)	Rapid increase in intestinal weight and mucosal mass; neutral gastric pH; slow gastric emptying; poor biliary function	Slow increase in gastric hydrochloric acid production; increased intestinal motility; variable intestinal colonisation	Adult level gastric pH by age 2 years	

Adapted from a variety of sources[4]

Nonetheless, in some cases, adult dosage forms need to be manipulated to enable their administration to a child. This process, which constitutes extemporaneous compounding, needs to be done with extreme care, taking the stability of the medicine into account. Simply crushing tablets or opening capsules, and diluting those in a liquid, is not an option. In particular, adult tablets that are enteric coated or formulated with sustained release characteristics cannot be crushed. Tablets which are film coated may be masking products that are unpleasant tasting and would also not be suitable for administration to children in solution or suspended form.

A key challenge for any prescriber is to access accurate and up-to-date medicines information, specifically on the dosage of children of different ages. The use of simplistic 'rules', such as Clark's, Young's, and Augsberger's, that have been proposed to express a paediatric dose as a function of the dose suitable for an 'average' 70 kg adult are not encouraged. Instead, prescribers are encouraged to access sources such as the British National Formulary for Children (BNFC).[6] The South Africa Medicines Formulary also provides clear and updated information.[7]

It is imperative that prescriptions for children be specific and detailed. Where calculations have to be done by others before administering medicines, a high risk of errors has been demonstrated.[8]

Recommendations

Although the legal processes to enable nurse prescribing have remained contested and incomplete for far too long,[9] South Africa's health system relies on nurses to a great extent, especially at PHC level. While advocating for clarity and finality on this issue, nurses can also take the opportunity to upgrade their skills in prescribing, and particular in prescribing for children. An accessible resource is the 6th edition of *Child Health for All*, published in 2021. Nurses can also take responsibility for ensuring they have access to online and mobile resources that can be used in the consulting room and at ward level. Remaining uninformed is not an option.

References and notes

1. Nurses in the private sector mostly rely on section 22A(15) permits issued in terms of the Medicines and Related Substances Act (Act 101 of 1965), whereas nurses in the public sector rely on section 56(6) permits issued in terms of the Nursing Act (Act 33 of 2005). Section s22A of the Medicines Act allows for the listing of substances in the Schedules that could be prescribed by nurses, but the SANC has yet to engage with the South African Health Products Regulatory Authority (SAHPRA) in this regard. Revised regulations to accompany section 56(6) have not been issued, so nurses remain bound by the 1984 regulations issued to accompany section 38A of the 1978 Act.
2. The PHC STG/EML was last issued as a complete volume in 2020, but individual chapters are now being updated and can be accessed at https://www.knowledgehub.org.za/elibrary/primary-healthcare-phc-standard-treatment-guidelines-and-essential-medicines-list-south. The STG/EML for paediatric hospital care was last updated in 2017, but individual chapters have also been released as they have been finalised, and can be accessed at https://www.knowledgehub.org.za/elibrary/hospital-level-paediatrics-standard-treatment-guidelines-and-essential-medicines-list. They can also be accessed via the EMGuidance mobile application at http://onelink.to/sy896k.
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5. Gray AL. Access to essential medicines and technology. In: Westwood T, Saloojee H, Shung-King M, editors. Child Health for All - A manual for Southern Africa. 6th ed. Cape Town: Oxford University Press Southern Africa; 2021.
6. Gray A, Jeena P. Optimal prescribing in the resource-poor setting. In: Sharland M, Turner M, Barker C, editors. Prescribing medicines for children: from drug development to practical administration. London: Pharmaceutical Press; 2019.
7. The 13th edition of the South African Medicines Formulary is available in print form, but an updated mobile application has also been launched (https://samf-app.com/) and is accessible on subscription.
8. Gokhul A, Jeena P, Gray A. Iatrogenic medication errors in a paediatric intensive care unit in Durban, South Africa. S Afr J Med. 2016;106(12):1222-9. https://doi.org/10.7196/SAMJ.2017.v106i12.10940.
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