

The Safe and Effective Use of Medications in Pediatric Patient: Pharmacists' Approach

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ABSTRACT

Children are a special and sensitive population that presents difficulties in the management by pharmacists. Pediatrics medicine use needs certain attention. The following are the roles of pharmacists in educating and counselling patients, carers and healthcare workers. Also, pharmacists possess the right knowledge and experience that enables them to enhance the safety of medication use in children. The following is a guide to the nine rights of medication administration when it comes to the safe practices in pediatric medicine.

KEYWORDS: paediatric patients; paediatric medicine; pharmacist.

1. Introduction

This is because improper administration of medicines is one of the most common medication errors being reported [1-4]. A South African study done in a public sector tertiary hospital in the paediatric and neonatal intensive care units revealed that 78% of the patients were exposed to at least one medication error in 2017 [5]. In the United States, it has been estimated that 30% of medication errors happen to children [1]. About 40 % of parents or guardians (hereinafter referred to as 'carers') make a mistake while giving liquid medications to the child [6].

Medication errors are related to the knowledge and experience of health care professionals, patients, and their condition, environment, prescription errors, and lack of information [7]. To enhance the safety of medication management in children, there is a need to have a collaborative strategy. This paper therefore explores the contribution of pharmacists in improving medication safety of paediatric patients and hence improving the patients' outcome [8,9].

Here, we focus on pharmacists' their role ability and to optimise their approach to paediatric medicine and patient care in hospital and community settings.

A 'medication error' is any avoidable incorrect performance that occurs at any stage

of the medication use system, for instance, prescription, preparation, dispensing and administration [10-12]. However, if these errors are not avoided, it may result in adverse events. A paediatric patient in the intensive care unit is more prone to medication errors as they are on many medications for the management of severe diseases. Such conditions need IV therapy and this may require dilution and/or reconstitution [13]. Medications that are commonly associated with errors in children include anti-infectives, electrolytes and fluids, analgesics, sedatives, and proton pump inhibitors [2,14].

2. Pediatric Dose Challenges

Paediatric patients are another group of patients that pharmacists look after and they need more emphasis, watchfulness and consideration due to the difficulties in calculating paediatric dosing [1, 8]. It is important to note that medication administration by carers may be difficult and can be affected by a number of factors. The factors that have been identified include; lack of counselling, incorrect measuring instruments and illiteracy have all been linked with. [6].

Further, paediatric patients require age-appropriate formulations (i.e., formulations that deliver an accurate dose), which are safe and acceptable to children while reducing medication errors. Paediatric-friendly formulations are limited, making safe medicine use challenging. The lack of paediatric-specific formulations often forces healthcare providers to use medicine off-label, resulting in medication errors [11,12]. Preference is given to liquid formulations due to easy administration compared to tablets and capsules. Tablets and capsules present various challenges when administering the prescribed dose to paediatric patients since tablets need to be either crushed or dissolved, and capsules need to be opened and dissolved [11].

3. Nine Rights Principles

There are five important medication prescription errors that have been identified to minimize medication errors (15); however, this could be discussed in more detail. The right principles of prescribing and administering medication could be adapted to the nine rights of medication administration (15, 16):The right medicine and right formulation for the right patient for the right indication at the right dose using the right measuring equipment to administer the medicine through the right route at the right time for the right duration. When assessing the prescription, the pharmacist should assess the nine rights of prescribing medication. The nine rights principles will be explained in a conceptual framework that can be used in analysing a prescription for a child.

3.1. Right Medicine and Right Formula

It is imperative that before a medicine is prescribed, the formulation that is available is considered so that the right dosing can be given. The following is a multi-disciplinary team involving a pharmacist working in the ward or being part of the ward round discussion that may recommend on the best medicinal product and formulation.

Liquid formulations are preferred for pediatric patients because these are easy to give to the child and there is low chance of medication errors [17, 18]. Some of the special purpose medicines include controlled and extended release medicines (for instance, sodium valproate CR) and enteric coated medicines (omeprazole); these cannot be crushed and hence need special attention. The following tablets should not be crushed as they will alter the medication stability and may result in treatment failure. These tablets must not be crushed as this will alter the stability of the medication and may result in early onset of action. Enteric coated formulations are given this formulation because they are not stable in the acidic environment of the stomach. It also leads to potential harm of destroying the content by the stomach acids with potential of causing gastric irritation and onset of action. Extended release products are designed to provide a constant release of the content over a given period and when the tablets are crushed the content will be released instantly with increased risk of toxicity [18]. Based on the medicine to be prescribed, the form of the medicine should be changed to an immediate released tablet (e. g., carbamazepine tablets instead of controlled release tablets), another formulation (e. g., carbamazepine or sodium valproate syrup instead of controlled release tablets) [18], or another medicine which might be safer and more effective. If the recommendations are is not especially feasible, so then with the the appropriate administration methods of of lansoprazole administration capsules should (to be open explained and to dissolve the the caregiver. content This of the capsule in apple juice) and omeprazole tablets (to dissolve in apple juice). To prepare these extemporaneous products, it is also essential to explain to the carer that a fresh solution has to be prepared for each dose as the prepared solution is not stable [18].

Patients may have difficulties in swallowing and this may necessitate that the medicines are given through a NG tube. But medication stability may be an issue when given this way (for instance phenytoin gets adsorbed to the NG tube) [18]. If medications have to be given through NG tube other routes of administration such as the intravenous or intramuscular should be used for medication therapy management. Liquid formulations are preferred but dispersible tablets can also be used depending on the product availability and patient's characteristics [18, 19]. These routes help in minimizing the chances of non-compliance to the treatment. The NG tube should be flushed with 15 to 30ml of water before and after giving the medication in order to avoid clogging of the tube and to ensure that all the medication has been given so as to improve drug delivery system [19].

When preparing medicines, it is important to be vigilant of look- or sound-alike products as this can lead to medication errors [20]. Examples of these products are:

- Adco-Magnesium®, Adco-Metoclopramide®, and Adco-Furosemide®;
- Sandoz Co-Amoxycyclav SF® 250 mg/5 mL and Sandoz Co-Amoxycyclav S® 125 mg/5 mL;
- Ampicillin Fresenius® 500 mg and Ampicillin Fresenius® 250 mg;
- Adco-Ipratropium® and Adco-Fenoterol®.

3.2. Right Patient

It is imperative to check the patient's identity and patient's specific prescription

chart. Appoint at least two identifiers of the patient with the carer/healthcare worker who attended to the patient earlier, for instance, the patient’s name and address [21]. Some of the other patient’s features to consider are; age, weight, allergies, swallowing ability and fluid intake

3.2.1. Age and Weight

The paediatric patient’s administered age to is the neonate, also child. term, important Hence preterm of in the neonate, medicine. order infant paediatric Paediatric-related to paediatric or term terms ensure patient child) has are that also when to by outlined only helps prescribing be checking in age in and stated the neonates, Table appropriate determining determining (i. date infants 1 medicine the the e. of and below. [3]. is formulation right birth. toddlers Age The of dose Liquid and of recommendations the form even the for kilogram product or preschool the hence that drops children. dose the would are Pre-school of weight be ideal and a used of for school paediatric and the preterm children patient could child and prefer are easily is term tablets based be important or on computed when chewable milligram determining tablets per the right dose [22].

Table 1. Definition of paediatric patient terms [23–25].

Term	Definition
Adolescent	Patient between the ages of 12 to 21 years
Child	Paediatric patient between the ages of 2 to 12 years
Infant	Paediatric patient between the ages of 0 to 24 months
Neonate	Paediatric patient from birth to 28 days of age
Preterm	Neonate born before 37 weeks of gestation
Term	Neonate born at 39 weeks of gestation
Toddler	Paediatric patient between the ages of 1 and 2 years

3.2.2. Allergies

It is important to list all the allergies on the prescription to avoid giving the patient drugs that he/she is allergic to. History taking is crucial since the previous allergic response determines the physician’s decision on the next course of action. Also, know the difference between an allergy and a sensitivity of the skin. [26].

3.2.3. Ability to Swallow

Some pediatric patients like cerebral palsy patients may have difficulty in swallowing; therefore, liquid formulations or drops are preferable, may decrease the possibility of medicine administration errors [3], and improve the patients’ compliance.

3.2.4. Fluid Restriction

It is common for pediatric patients to be restricted in terms of fluids for instance preterm infants. In such cases it is advisable to dissolve the prescribed medicines using the minimum volume of diluent than to prepare the diluted formulation (e. g., trimethoprim 400 mg/sulfamethoxazole 80 mg per 5 mL in 75 mL of 5% dextrose) [27] or by using the highest concentration product (e. g., amoxicillin 250 mg/5 mL). These patients require a close monitoring and a regular assessment of the

medication.

3.3. Right Indication

The indication for the prescribed medicine is crucial, especially with antibiotics, and should be noted on the prescription chart [28]. Dose recommendations differ based on the indication, e.g., meropenem is given at higher doses (40 mg/1 kg) in the case of meningitis and at lower doses, 10 and 20 mg/1 kg, for complicated skin and skin structure infections or intra-abdominal infections, respectively [29]. Another example is cefalexin; the recommended daily dosage is 25 to 50 mg/1 kg per day in divided doses, while in severe infections, the dosage should be increased to 75 to 100 mg/1 kg per day in four divided doses [30]. The dose of cotrimoxazole for the prevention of opportunistic infections and the treatment of *Pneumocystis pneumonia* also differs [27]. Medication interactions should be considered with polypharmacy in the paediatric population. Daily review of prescriptions should be part of ward round discussions to reduce adverse effects and medicine interactions and to ensure rational medicine use [12].

3.4. Right Dose

It is therefore important to determine the right dose so as to ensure safe and efficient use of medicine and to avoid the likelihood of subtherapeutic (treatment failure) or therapeutic (toxicity) doses in paediatric patients. Some factors that would help in determining the right dose include the kidney and hepatic functions as well as the weight of the patient. Further, therapeutic drug monitoring helps in enhancing the doses of medication and at the same time avoids the side effects. In order to ensure that the right dose is given when giving intravenous medicines, it is important to have a good understanding of the concepts of reconstitution and dilution.

3.4.1. Reconstitution versus Dilution

Medications in the intravenous form may be given in a bolus dose or as an infusion. Some drugs have to be diluted while others are given without any dilution [29]. All these methods should be specific to the patient and the options for the generic or new products should be reconsidered. Some of the medicines need to be diluted with a diluent and can be given as a bolus dose while the same can be diluted and given as an infusion [29]. This is important so as to avoid giving the wrong dose.

3.4.2. Calculating the Dose

Other aspects that should also be considered includes the right use of measuring equipment and appropriate dosing [17, workers; 31]

- prevent to: or
- help minimize in on easy administration administration errors; for and carers/healthcare
- avoid giving too much or too little of the medicine to paediatric patients.

under If the possible, age liquids of should five be years given instead to of children tablets and if liquids are available [17, 32].

For instance, an infant may have a weight of 4.2kg and the recommended dose is

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30mg/1kg/dose which is to be given every 8 hours. Thus, the equation would be:

$$\text{dosage to be administered (x)} = 4.2 \text{ kg} \times 30 \text{ mg} = 126 \text{ mg per dose} \quad (1)$$

However, amoxicillin is available as a 125 mg/5 mL product; therefore, 5 mL per 125 mg is easier to administer.

The prescriber should be cautious while writing the prescription for the dosage since some references provide the dosage as milligram per kilogram per dose to be given multiple times a day or milligram per kilogram per day in divided doses. Mistakes can be made in a difficult setting. To avoid medication errors, pharmacists should check paediatric patients' doses as a part of their daily prescription review. All the dosages for prescribing or administering should be evaluated and calculated with keen interest. If there is any doubt about the dose to be given the reference should be checked to avoid prescription or administration errors. [21].

When calculating the dose, the active component of the medicine needs to be considered, especially in combination products (e.g., piperacillin/tazobactam and amoxicillin/clavulanic acid) as well as the different strengths of the products available (e.g., 125 and 250 mg/5 mL or milligram per millilitre or milligram per 5 mL). Additionally, it is important to ensure that the dose prescribed and the strength of the product are in the same units (e.g., mg/ μ g/g).

The equations below can be used to calculate the dose of prescribed medicines [21].

$$\text{dosage to be administered (x)} = \frac{\text{dosage prescribed in mg} \times \text{strength of product available in mL}}{\text{strength of product available in mg}} \quad (2)$$

or

$$\text{dosage to be administered (x)} = \frac{\text{dosage prescribed (mg)}}{\text{strength of product (mg)}} \times \text{strength of product (mL)} \quad (3)$$

Table 2 shows common medicines prescribed in infants with calculation pearls.

Table 2. Common medicines prescribed in infants [17,27,29,33,34].

Medicine	Product Concentration	Calculating the Dose
amoxicillin (PO)	125 mg/5 mL	125 mg/5 mL
	250 mg/5 mL	250 mg/5 mL
ferrous gluconate (PO)	350 mg/5 mL	8 mg/1 mL
	(elemental iron 8 mg/1 mL)	40 mg/5 mL
ferrous lactate (PO)	15 mg/0.6 mL	15 mg/0.6 mL
ibuprofen (PO)	100 mg/5 mL	100 mg/5 mL
paracetamol (PO)	120 mg/5 mL	120 mg/5 mL
vitamin D (PO)	200 units/1 drop	200 units/1 drop
amoxicillin/clavulanic acid (PO)	125 mg/31.25 mg/5 mL	125 mg/5 mL
	250 mg/62.5 mg/5 mL	250 mg/5 mL
amoxicillin/clavulanic acid (IV)	500 mg/100 mg	500 mg
	1000 mg/200 mg	1000 mg
piperacillin/tazobactam (IV)	4000 mg/500 mg	4000 mg
trimethoprim/sulfamethoxazole (PO)	40 mg/200 mg/5 mL	40 mg/5 mL
	80 mg/400 mg/tablet	80 mg/1 tablet
trimethoprim/sulfamethoxazole (IV)	80 mg/400 mg/5 mL	80 mg/5 mL

Examples of dosage equations based on different strengths of the available product in milligram are:

Rx amoxicillin/clavulanic acid (Augmentin®) = 375 mg per 8 h

Available product: Augmentin (4)

125 mg (amoxicillin)/31.25 mg (clavulanic acid)/5 mL suspension = $(375 \text{ mg}/125 \text{ mg}) \times 5 \text{ mL} = 15 \text{ mL}$

Rx amoxicillin/clavulanic acid (Augmentin®) = 375 mg per 8 h

Available product: Augmentin (5)

250 mg (amoxicillin)/62.5 mg (clavulanic acid)/5 mL suspension = $(375 \text{ mg}/250 \text{ mg}) \times 5 \text{ mL} = 7.5 \text{ mL}$

Note the strength in milligram per millilitre of the product, e.g., paracetamol is available in 120 mg/5 mL and ferrous gluconate in 8 mg/1 mL.

Equation (6) provides an example of dosage calculation based on milligram per millilitre of product available.

Rx paracetamol = 360 mg per 6 h (6)

Available product: paracetamol (120 mg/5 mL) = $(360 \text{ mg}/120 \text{ mg}) \times 5 \text{ mL} = 15 \text{ mL}$
Rx ferrous gluconate = 60 mg per od

Available product: ferrous gluconate (8 mg/1 mL) = $(60 \text{ mg}/8 \text{ mg}) \times 1 \text{ mL} = 7.5 \text{ mL}$

Equation (7) provides an example of dosage calculation based on the active ingredient in a combination product.

Rx amoxicillin/clavulanic acid (Augmentin®) = 375 mg per 8 h Available product: Augmentin

125 mg (amoxicillin)/31.25 mg (clavulanic acid)/5 mL suspension = $(375 \text{ mg}/125 \text{ mg}) \times 5 \text{ mL} = 15 \text{ mL}$ Dosage based on amoxicillin component.

Rx cotrimoxazole = 20 mg per 6 h (7)

Available product: sulfamethoxazole (200 mg)/trimethoprim (40 mg)/5 mL = $(20 \text{ mg}/40 \text{ mg}) \times 5 \text{ mL} = 2.5 \text{ mL}$ Dosage based on trimethoprim component.

Often tablets need to be crushed and dissolved. Considerations for the dosage calculations include tablet strength if the tablet is scored and the volume of diluent to administer a convenient dose (see Equation (8)).

Rx spironolactone = 3.125 mg per 12 h (8)

Available product: spironolactone (25 mg) (can be halved since it is scored)

Using half, a tablet dissolved in 5 mL = $(3.125 \text{ mg}/12.5 \text{ mg}) \times 5 \text{ mL} = 1.25 \text{ mL}$

Using half, a tablet dissolved in 10 mL = $(3.125 \text{ mg}/12.5 \text{ mg}) \times 10 \text{ mL} = 2.5 \text{ mL}$

3.4.3. Kidney Function

Some drugs that are removed by the kidney may require dosage alteration for

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example amikacin or should not be given if the kidney is considered not when functioning prescribing properly anti-tuberculosis for (TB) instance or ibuprofen. antiretroviral This therapy concept (ART) should be in renal impairment [18,35]. The following is a table which outlines medicines that are cleared by the kidneys (see Table 3).

Table 3. Medicines cleared by kidneys [18,35].

Class	Medicine Name
Antibiotics	amikacin, amoxicillin, cefazolin, cefepime, cefotaxime, cefuroxime, ceftazidime, gentamicin, meropenem, piperacillin/tazobactam, sulfamethoxazole, tobramycin, vancomycin
Anti-fungal	amphotericin B, fluconazole
Anti-hypertensives	enalapril, milrinone, verapamil
ART	emtricitabine, tenofovir disoproxil fumarate, lamivudine, zidovudine
Anti-TB	ethambutol

3.4.4. Hepatic Function

Medicines that are eliminated through hepatic route may need dosage alteration if the patient has liver complications while some medicines should be avoided in such patients including paracetamol for paracetamol poisoning. This should also be taken into consideration when prescribing anti-TB or ART in liver disease [18,35]. The following is a list of medicines which require dose alteration in patients with hepatic insufficiency as presented in Table 4.

Table 4. Hepatically cleared medicine [18,35].

Class	Medicine Name
Anti-epileptics	carbamazepine, phenytoin, sodium valproate
Anti-TB	isoniazid, pyrazinamide, rifampicin
ART	efavirenz, nevirapine
Other	cyclosporine, paracetamol

3.4.5. TDM

Antibiotics such as vancomycin and aminoglycosides require TDM to guide the prescriber to ensure safe and effective medicine use. Other medicines that require TDM to prevent toxicity and to ensure treatment efficacy include anti-epileptic medicines (carbamazepine, phenytoin, and sodium valproate) [18].

3.5. Right Measuring Equipment

To avoid medication errors it is recommended that the right tools for measuring should be used. Cups have been found to be increasingly leading to medication errors [1, 11] than syringes which are easier to use. There are several medicinal equipment such as medicine spoons and syringes used in giving oral drugs. The recommended dose should be taken into consideration when selecting the right measuring tool. A medicine spoon of 5ml is common for children while in neonates and infants a syringe is more appropriate to give the dose and hence minimize on medication errors [17,31].

3.6. Right Route of Administration

Medicines could be given by mouth, through the arm, rectally or subcutaneously or

by nebulisation or NG tube. The way the medicine will be given should be written on the prescription and should also be checked before giving it to the patient. This information should also be given to the carer in detail.

3.7. Right Time

Medicine could be given at any time in a day whether it is 12 hourly, 8 hourly, 6 hourly or even more frequently depending on the product, the half life. All the medicines should be given at the right time so as to ensure that the medicine is used safely and effectively. In addition, it is necessary that the carers understand the implications of the dosing intervals, for instance, 'three times a day' means that the medicine has to be given every eight hours. More details about when the medicine is to be taken should be told to the carer (e. g. whether it is to be taken empty stomach or after eating something). For instance, omeprazole should be given before food whereas amoxicillin/clavulanic acid should be given after food to reduce the incidence of gastrointestinal adverse events.

3.8. Right Duration

Every medicine given should have a duration for which it should be taken. This is especially important in the case of antimicrobials. The pharmacists are the antimicrobial stewards in the hospital and community; they manage antimicrobials in children and promote appropriate use of antibiotics to contain antibiotic resistance [36–38]. In the hospital environment, the prescription charts should be rechecked frequently to ensure that the medicine is still needed. In the community, the prescribed medicines should be reviewed at least on a monthly basis. It is also important that the carers know the duration for which the medicine is to be taken.

4. Medication Storage

The proper storage of medicine is an important factor that helps in the safety of medicines used in children. Some of the products need to be stored at cold temperatures after preparation while others do not require refrigeration after preparation. The information regarding storage should always be obtained from the package insert and the label of the product. The expiry dates of medicines should be verified before giving them to a patient to ensure that the patient is not exposed to any danger that may result from using the medicines [21]. This process can help in avoiding the use of slow moving items that may reach their expiry date before being used.

5. Pharmacists' Role in Paediatric Medicine

The authors stated that pharmacists could enhance the care of paediatric patients regardless of the stage of care, for instance, hospital or community setting [11]. The role of pharmacists has been identified as being capable of performing the above tasks (calculation of doses/dosages, detail-orientated, communication skills, and identifying medication-related errors) and having the knowledge (pharmacology and pharmaceutics) to enhance the use of medication in children.

Pharmacists could prevent medication errors through the practice of certain daily activities [1,8]. Medication reconciliation is a unique service that pharmacists could incorporate in their daily activities when reviewing a paediatric patient’s prescription to reduce medication discrepancies [14]. During this process, previous medicines prescribed should be compared with the current prescription to identify medication-related problems (MRPs) and to optimise medication therapy. Over-the-counter medicine use, e.g., a salbutamol inhaler, should be part of the medication review process as overuse might indicate uncontrolled asthma. The practice of medication reconciliation should be applied at the initial and follow-up visits [14] in both the community and hospital settings to ensure that all prescribed medicine has an appropriate indication.

Pharmacists could optimise medication therapy by reviewing prescriptions in the pharmacy or ward setting; however, the effect could be greater when pharmacists are made part of ward round discussions [3] where medication errors could be identified sooner. Through the medication reconciliation process and prescription review, pharmacists could identify dose omissions and MRPs [3]. An MRP is an undesirable event that includes:

1. An undesirable event or risk of an event,
 2. Medication therapy of the patient, and
 3. A relationship between the undesirable event and medication therapy [39].
- Table 5 summarises the problems related to medicine.

Table 5. Examples of medication-related problems (MRP) [39].

MRP	Example	Identifying MRP
Unnecessary medicine	Patient is receiving unnecessary therapy with paracetamol. Explanation: Patient experiences no pain; thus, not indicated.	Review indication Ensure non-duplication
Additional therapy required	Patient requires additional therapy for the prevention of TB. Explanation: Paediatric patient with family member with TB.	Review indication/current diagnosis
Dosage too high	Ibuprofen dosage prescribed is too high to manage pain. Explanation: Ibuprofen is prescribed at a higher dosage than recommended (5 mg/kg/dose to 10 mg/kg/dose, every 6 h to 8 h).	Review dosage prescribed
Alternative therapy	Patient requires alternative therapy for treating infection. Explanation: Patient requires alternative antibiotic.	Review indication/prescribed medicine.
Adverse drug reaction	Patient requires slower dose escalation of lamotrigine. Explanation: Patient experienced severe skin rash with increase in lamotrigine dose.	Evaluate patient outcome. Determine if adverse effect is due to patient’s medicine.
Non-adherence	Patient requires a liquid formulation of sodium valproate to prevent seizures. Explanation: Patient is unable to swallow.	Evaluate patient outcome. Determine if outcomes are achieved or not. Determine challenges.

Further, medication use could be improved through optimising medication labels [40] for inpatient use (e.g., reconstitution of intravenous therapy and stability once reconstituted) or outpatient use (e.g., being specific in duration of therapy for antibiotics, “store in fridge” if it is required, give 5 mL (1 medicine spoon)).

Counselling and education are vital roles fulfilled by pharmacists [11] that might optimise medication therapy.

Education and Counselling

Pharmacists could educate carers and healthcare workers. Counselling sessions should include indication of the prescribed medicine, administration directions, storage instructions, side effects, and adverse effects [1,11]. Directions for medicine use should be clear and specific. Directions should include the correct dose (e.g., 5 mL = 1 medicine spoon), method and route of administration (crush, chew), frequency of administration (i.e., dosage) (e.g., every 12 h or 8 h), when to administer the medicine (e.g., after a meal for pain and fever), and the duration (e.g., for 5 d) [1,11]. Additional counselling points to include (if applicable) are avoiding sunlight, refrigerated storage, and/or shaking the bottle before use [1,38].

Pharmacists could implement the following in their counselling sessions to empower carers to optimally use medication:

- explaining the instructions to administer the medicines,
- providing a practical demonstration of how to administer the medicines, and
- marking the appropriate dose on the measuring equipment.

Another method is to colour code the medicine, especially when various medication solutions are administered (e.g., with paediatric ART) [11].

The authors recommend that pharmacists should provide information and training to other health care personnel in the management of pediatrics dosing. In hospital environment, the method of preparing iv fluids can be taught by the pharmacists for instance in this case study <http://www.nursinginpractice.com/> In the course of dispensing medicine, the pharmacist should always request for any questions from the carer or health care worker. Furthermore, the pharmacists should also educate the carers on appropriate use of antibiotics to fight against the antimicrobial resistance [41].

It is therefore important that the main carer (parent/guardian) is involved in the care plan of the patient. Medication reconciliation on admission must therefore be done with a lot of attention and any changes, additions or withdrawals of medicines should be communicated to the carer. This is very important if the carer is giving medicines to the paediatric patient when he or she is admitted in the hospital [21].

Thus, proper hand washing should be considered as mandatory when working with medication to avoid the spread of infection. The washing of hands should be done properly and S. H. H. I is the National Hand Hygiene Initiative while “My 5 Moments for Hand Hygiene” is the World Health Organization’s initiative and both should be followed [42]. The “My 5 Moments for Hand Hygiene” approach suggests that one should wash his or her hands with soap and water or use an alcohol based hand rub.

6. Conclusions

The services of pharmacists are very vital in enhancing medication therapy management and safety of the pediatric patients in the community and the hospital. Following the basic principles could lead to safe medication use in paediatric patients and achieve health outcomes

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