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Perspective

Reducing Medication Errors: Rethinking Prescribing Drugs in Standardized Units over Quantities of Ingredients

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Abstract

The prescribers need to memorize the dose and strength of thousands of drugs often with similar sounding names but differing actions, by their weight (strengths), which could lead to significant errors in medication. When prescribing, instead of using amounts in milligrams, a "standard unit" - a universal standard adult dose unit- concept can be employed to minimize such instances of erroneous recollection of dosages. Prescribers would not essentially need to know the composition and actual amount of active pharmaceutical ingredients in prescribed drugs if such a standardized unit prescribing system could be adopted. They could simply resort to prescribing the required number of units of medication instead. The standard adult dose of any drug could be referred to as one adult unit regardless of the amounts by weight. Only drug manufacturers and research scientists would need to know the actual strengths of the medications in milligrams of what would be referred to as a standard adult unit. Implementation of the unit system, along with the incorporation of electronic prescribing, could allow for simple data entry, and easier corrections for lean body weight/BMI, renal function, age, pregnancy, etc., leading to improvements in patient safety and optimal dosage achieved, eliminating difficult calculations. Moreover, a parallel paediatric unit could also be developed. The conceptual study to arouse an interest cannot address all issues and details relating to actual implementations.

Keywords: Prescribing errors; Strength of drugs; Novel method of prescribing; Prescribing in standard units

Background

One of the integral parts of medical care prone to human error is prescribing medicines to patients. It involves a complex process of choosing the most appropriate medication by the doctors considering variables of patient idiosyncrasies and preferences. The rapidly broadening choice of drugs could also add to the complexities and errors of prescribing. The communication with a pharmacist often in illegible handwriting or ticking wrong boxes could add to further errors. Utilizing a prescription for dispensing by pharmacists and administration of medicines by nurses, patients or caregivers is dependent on their language abilities and even their visual acuity. Multiple opportunities arise between each step of this process to make mistakes; when even decimal points, milligrams to micrograms could be misread (e.g., as with 0.625 mg of conjugated estrogen tablets or 0.5 mg of 0.1% adrenaline). It is not uncommon to see mistakes of milligrams being entered instead of micrograms as with thyroxine. The examples could be endless. Healthcare professionals must play a crucial part in the safe and rational use of medicines, not

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merely to avoid litigation which may depend on the dispensers and even the patients' abilities and visual acuity (1).

Medicines are prescribed based on the amount of active pharmaceutical ingredients of each drug. Therefore, prescribers need to remember the strengths and doses of thousands of drugs, many with similar-sounding names at the time of similar class but often of no resemblance except by name (e.g., itraconazole, fluconazole, ketoconazole, econazole and miconazole within the class gets misread or confused with omeprazole, aripiprazole, mebendazole, metronidazole, letrozole, levamisole, carbimazole, etc. with no similarity of action). The correct dose of one could be a toxic dose for a similar-sounding but dis-similar class of drug.

As fallible human beings, any step in the prescribing process can generate errors of omission or commission relating to erroneous dosage and resulting from poor handwriting to fading memory to genuine oversights. The idea emerged when the clinical author encountered many wrong doses of drugs being prescribed at busy outpatient clinics and the pharmacists often ringing back to clarify handwriting and intended doses. In this, we are going to focus on using standard dosage units over the actual strengths and weights of medication raising the question of whether prescribers need to know the composition and absolute amounts of active pharmaceutical ingredients (API) of prescribed drugs. The aim of this exercise would be to make prescribing less arduous, fallible, and hence safer.

Medication errors

Medication errors can occur at any stage of the medication process: prescribing, dispensing, administration, monitoring, and documentation. According to United States Pharmacopoeia, medication errors are any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is under the control of the healthcare professional, patient, or consumer (2). Medication factors (sound-alike drugs), patient factors (impaired cognition, renal and liver function), and healthcare professional factors (abbreviations and cognitive biases) can precipitate medication errors (3). Unintended omissions, errors in dose selection, illegible handwriting, incorrect medication, and giving medication to the wrong patient are some common medication errors (3,4,5). Look-alike and sound-alike drug names, for example, dopamine/dobutamine, vincristine/vinblastine, daunorubicin/doxorubicin, chloramphenicol/chlorpromazine, and prednisone/prednisolone can predispose to medication errors. Strengths can be mistakenly mentioned by the prescribers due to confusion (3,6).

According to the landmark institute of medicine's report “To Err is Human”, medication errors are the cause of 1 of 131 outpatient and 1 of 854 inpatient deaths (3). Annually in the United States, around 7,000 to 9,000 people die due to medication errors. Moreover, hundreds of thousands of other patients experience adverse reactions or other complications. Usually, monetary costs exceed $40 billion each year to treat these patients (7). A study conducted in the USA reported a mean of 6.1 medication discrepancies per patient and medication errors such as omission, commission, and dosing/frequency errors occurred in 82%, 59%, and 50% of medication histories, respectively (8). Even though medication errors are a primary concern in developed countries, their significance is undervalued in developing countries. According to a study conducted in India, a 6.11% of medication error rate was found. Transcription errors constitute 44.1% of the total errors, followed by prescription errors at 40%. The main reasons for medication errors were incomplete prescriptions (50.2%) and wrong doses (22.9%) (9). An Ethiopian study revealed 70.8% of the overall median prevalence of medication-related problems (10). Medication errors can be found with widely varying error prevalence rates reported in different parts of the world (11).

The most frequent medication errors occur at the point of prescribing the medication. Prescription errors contain those related to the act of writing a prescription, irrational prescribing, inappropriate prescribing, overprescribing, under prescribing, and ineffective prescribing. Prescription errors can lead to errors in drug dispensing and administration. Moreover, prescription errors are responsible for 70% of

medication errors that could potentially result in adverse effects. Errors in dose selection occur most commonly and represent more than 50% of all prescribing faults (4).

A study carried out in the USA showed that a total of 20,498 errors were detected within 19,126 prescriptions. From those errors, 19.7% involved prescription directions, 31.9% involved quantity prescribed, and 48.4% were prescriptions written with refills (12). According to a study carried out in Indonesia on outpatients of a government hospital, prescription errors were astounding (99.12%) (2). In the United Kingdom, prescribing errors are estimated to occur in 8.9 to 14.7% of hospital inpatients and discharge medications (13). A study conducted in a tertiary care hospital in Saudi Arabia reveals 34.1% of prescription errors and 13% of these errors occurred due to incorrect doses (14). A retrospective, cross-sectional, and quantitative study which was conducted in Nepal reported 3.4 average rate of prescription errors per prescription (15). According to a Sri Lankan study, non-standard abbreviations were used in 36.5% of the prescriptions, while incomplete units were observed in 51% of the prescriptions (2). There were 1376 (53%) potential drug interactions (466/887 prescriptions). Findings on legibility, completeness, drug duplication, and drug interactions show that there is room for improvement in prescriptions originating from rural Sri Lanka (16). According to a prevalence study in northwest England, a prescription error rate of 8.9% was identified. It was reported that an error rate was 10.3% for foundation year-two doctors, 8.4% for foundation year-one doctors, 8.3% for fixed-term specialty training posts, and 5.9% for consultants. Also, 1.7% of errors were potentially lethal (17). These examples are provided to show that prescription errors are a global issue.

Stressful conditions, heavy workload, difficult work environment, insufficient communication, and not being in good physical and mental condition are the primary causes of prescribing faults. Errors are more frequently made by junior prescribers. Inadequate knowledge or training often underlies these faults. (4) Inaccessibility to the internet will make quick verifications difficult adding to the woes. It is common practice for consultants to voice instructions to juniors on ward rounds, often misheard and rarely re-verified for fear of being considered incompetent or being inattentive.

Reducing prescribing errors using standard units

With the aim of minimizing the occurrence of prescription errors and their consequences, we suggest a novel way of prescribing as a concept. Conventionally, the prescribers are expected to memorize the amount of API/strength of a prescribed drug by the weight of the active ingredient. Drug manufacturers would produce drugs in standard unit-based forms such as tablets, capsules, and or solutions. When writing prescriptions, instead of using the amounts in milligrams, a novel simplified way of prescribing can be employed eliminating the need to memorize a huge number of agents. This method introduces a "standard adult unit" concept. For example, 500 mg of paracetamol can be considered as the standard adult unit of paracetamol (1 AU). One unit of paracetamol is equivalent to 500 mg. Without any difficulty, the prescriber would be able to prescribe 2 units of paracetamol for 1000 mg of paracetamol (1 dose). Any drug could be prescribed in merely one adult unit without recalling the actual quantity of ingredients by weight. Not many would remember the actual amount of codeine in a tablet of Codis (a combination of codeine and aspirin) and would simply say one tablet, why not make it as one unit without struggling to remember the actual amount of contents in a puritan sense of prescribing?

By using the standard unit dose, prescribers do not need to put extra effort into memorizing the amount of API in every pharmaceutical. Insulin can be considered as an instance where the unit system is already applied despite a wide therapeutic range. In a situation to prescribe all types of insulins in the active ingredient format, from human to porcine to bovine to long and rapid-acting preparations. Why not apply this to all drugs? Even where manufacturers use different brand names for the same drug, errors could arise by an unfamiliar novel trade name. Therefore, prescribing in units can reduce the prescription errors made by the prescribers resorting to writing unfamiliar trade /brand names as any error would still be limited to one non-fatal adult dose. The prescribers only need to think of how many units to be

prescribed (half unit, one unit, two units, or more) since the strength of the medication would become universal. Moreover, a parallel paediatric unit could also be developed.

According to a study carried out by Mohan et al., the strength of the drug was missing in a significant number of prescriptions. For example, a tablet of aspirin 75 mg or 150 mg and a tablet of Methylcobalamin 500 mcg or 1500 mcg. The omission of the strength of the preparation will not have much effect on medicines that are available in a single strength. However, some medicines are available in multiple strengths, such as warfarin, which is available as 1, 2 and 5 mg tablets; glimepiride as 1, 2 and 4 mg tablets and atorvastatin as 10, 20 and 40 mg tablets (1). At the time of dispensing, the pharmacist has to reach out to the prescribing doctor again for verification, to circumvent dispensing errors. The prescriber can use the number of units, rather than using strengths to avoid such situations. For such medicines, the standard dose should be in keeping with the most commonly used strengths in current clinical use and any higher number could be specified as in the case of insulin. But only a minority of drugs have such broad dose ranges and higher multiples in units will rarely be required.

The standard unit concept can be adapted to other dosage forms as well. The prescribers do not need to memorize the dose as the nurses and those who administer the medicine administer a standard unit dose as in the case of vaccines. Moreover, drugs where the doses are titrated against blood levels, such as insulin and medicines used in the induction of labor, such as oxytocin are already following an international unit system (IU). Furthermore, vaginal pessaries and suppositories contain standard amounts of active ingredients. Even today, the prescribers prescribe the number of units of these dosage forms, which shows the feasibility of using the standard unit.

The use of an automated prescribing system with artificial intelligence (AI) incorporated is highly recommended as an effective tool to reduce medication errors with this unit prescribing method in any hospital setting (18). Moreover, medication errors could be reduced significantly by using this novel method in the day and age of computers. The clinician would only need to indicate his preferences and the corrections needed for confounding factors. The simple reference to any drug as one or a multiple of an adult unit will make learning pharmacology a less painful exercise by taking out the remembering of endless illogical doses (why has metronidazole got to come in 400 and 500 mg tablets but metoclopramide come in 10 mg capsules?). Only researchers and drug manufacturers would benefit by knowing how much active ingredients need to go into one adult unit tablet or injection. Albert Einstein, when asked what the speed of sound was, replied that he would not burden his memory with such facts found in books but focus on novel ideas not found in books. Memorizing thousands of doses of drugs is hardly an intellectual or rewarding exercise, rarely being a favorite part of anyone's medical education.

This novel unit system can be easily adapted for medicines that need to be calculated according to confounding factors such as impaired renal/liver functions, pregnancy, and extremes of body mass index (BMI) or age. Calculations could be done easier by only remembering an adjustment factor to the standard unit of one. It will be easier to say half or quarter unit than divide 375 by 2 or 4, as in the case of Augmentin.

Any miswritten/misunderstood/misread/mis-entered drug would be less prone to serious toxicity as the dose would still be limited to one adult unit unlike in the case of prescribing by weight. A dose of 500 mg of metronidazole would be 10 times the dose of unrelated but similar-sounding miconazole (50 mg). Other such errors could even be fatal. Extending this to carbimazole would exemplify what could take place. Such disasters and huge overdosing could not happen with the proposed standard unit dispensing where damage control would take effect with just the wrong drug but limited to a standard non-fatal dose.

As the pharmaceutical industry grows exponentially, a plethora of new drugs will be introduced faster than anyone could ever keep up with. This will be more so when prescribing involves only a tiny fragment of the working range as in the case of a busy gynaecologist and an obstetrician. He being a gynaecological surgeon, an accoucheur, a physician, a psychiatrist, a counsellor and an endocrinologist

will still need to treat all medical disorders complicating pregnancy. This requires adjustments to all doses in by gestation confounding matters. A simple correcting factor by trimester could be utilized for such special circumstances if a unit system of medication was adopted.

When implementing the concept, a global shift and harmonization would need to be inevitable and challenging. What is logical is not necessarily adopted for a multitude of reasons. The US still adopts miles per gallon and pounds as a measure defying all rationale and convenience behind going metric. Manufacturing, prescribing, and dispensing processes should be synchronized progressively to implement this novel prescribing method. Furthermore, manufacturers would need to produce the standard units and revise their packages and labeling considering the standard units in the long run.

It is difficult to predict the success of this method at this conceptual stage, and the concept is published to evoke interest and initial response. Therefore, to promote this ideology and to seek the feasibility of widespread adaptation would require further studies of feasibility acceptability, and adaptability. This could be tried in a given setting on a limited scale with an aim to measure the impact of this method which could have been used to minimize medication errors and ease the burden from the prescriber to the dispenser to the data entry operator and even to the patient.

Conclusion

This novel way of prescribing in standard units will reduce prescription-related medication errors for the reasons discussed and therefore improve patients' safety. Even a mis-prescribed medication would not be fatal as it would still be limited to one adult unit only unlike with weight. Prescribers and dispensers will not need to know the composition and actual amount of active pharmaceutical ingredients in an ever-expanding range of often similar-sounding drugs. Implementation of the standard unit system along with the easier incorporation of electronic prescribing could be logically expected to reduce medication and dispensing errors. Learning pharmacology could become a more pleasurable rewarding exercise, devoting time to novel thinking than memorizing a huge number of doses. The concept would need further research before global adaptation to work out logistics and possible snags.

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