Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

Prediction of Drug Concentration in Human Bloodstream using Adams-Bashforth-Moulton Method

Farah Liyana Azizan[1,2], Saratha Sathasivam[1,*], Muraly Velavan[3], Nur Rusyidah Azri[1], Nur Iffah Rafhanah Abdul Manaf[1]

[1] School of Mathematical Sciences, Universiti Sains Malaysia, Penang, 11800, USM, Malaysia
[2] Centre for Pre-University Studies, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia
[3] School of General Foundation and Studies, AIMST University, 08100, Bedong, Kedah, Malaysia

ARTICLE INFO

Article history:
Received 5 December 2022
Received in revised form 20 December 2022
Accepted 28 December 2022
Available online 5 January 2023

Keywords:
Adams Bashforth method; Adams Moulton method; Drug concentration; Pharmacokinetics

ABSTRACT

Pharmaceutical drugs are chemicals intended to avoid, assess, heal, or cure a disease. It is also commonly referred to as medication. When medicine is taken, it gets absorbed into the bloodstream, spreads throughout the body, and achieves its maximum concentration. Following this, the medication level gradually decreases as it is removed from the body. The drug concentration according to the time can be predicted using mathematical concepts and pharmacokinetic models. The compartmental model is a fundamental type of model used in pharmacokinetics. The number of compartments required to describe the drug's action in the body is one-compartment, two-compartment, and multicompartment. These models can forecast medication concentrations in the body over time. This paper will focus on the one-compartment model and Adams Bashforth-Moulton method. Adams Method is one of the linear multistep techniques applied to solve numerical ordinary differential equations that contain the predictor method (Adams Bashforth) and corrector method (Adams Moulton). The integrated development environment used for the computation and graphing is MATLAB. The expected result of this report is that we can predict the concentration of the chosen drugs over time and how long a particular person needs to wait before donating blood safely.

1. Introduction

The circulation of medications entering, across, and away from the bloodstream are described as pharmacokinetics [1]. The type of reaction a person gets from a medication is defined by the material's essential pharmacological characteristics at the location of the action. The amount and expanse of absorption of the medication after its administration, the amount and expanse of transmission of the drug to different tissues and the rate of drug removal from the area are all factors that affect the beginning, strength, and length of the reaction. Drugs such as Phenobarbitone, Vancomycin, Aminoglycosides, Methotrexate, Carbamazepine, Tacrolimus, Phenytoin, Valproic Acid,

* *Corresponding author.*
E-mail address: saratha@usm.my

https://doi.org/10.37934/araset.29.2.5371

Digoxin, and Theophylline are frequently monitored in Malaysia [2]. In this research, we will only look at three different drugs: Aminoglycosides, Vancomycin, and Valproic Acid.

Aminoglycosides are antibiotics mostly used to treat aerobic gram-negative bacilli infections and other bacteria such as Staphylococci and Mycobacterium tuberculosis [3]. Severe infections of the abdomen and urinary tract, bacteremia, and endocarditis are treated using Aminoglycosides. It is also a recognised medication to cure infections caused by aerobic Gram-negative bacilli [4]. Aminoglycosides that are primarily used in Malaysia are Gentamicin and Amikacin. The following drug that we will focus on is Valproic acid. The various types of seizures can be treated with Valproic acid. It can also treat mania in bipolar disorder patients and prevent migraine headaches. Valproic acid belongs to the anticonvulsant medicine class. It raises the concentration of a natural chemical in the brain. Valproic acid is usually used as a prescription for emotional state stabiliser and behavioural and emotional dysregulation [5]. The drug is also used for COVID-19 patients with serious mental illness to help them calm while undergoing therapy [6]. The third type of drug that we will focus on is Vancomycin. The microorganisms *Amycolatopsis orientalis* originated from the Borneo tropical forest and was the source of the first Vancomycin isolation in 1957 [7]. Vancomycin is used to treat intestinal inflammation caused by certain bacteria that can occur after antibiotic therapy and is also movement resistant to enterococcal biofilms [8]. Infections of the urinary system, wounds, the dysbiotic gastrointestinal tract, and endocarditis all exhibit enterococcal biofilms [9].

Medications that can degrade the blood's quality or produce ill effects in the receiver have been discovered in the blood of medication-addicted donors [10]. One of the conditions for becoming a blood donor in Malaysia is not to be on any long-term medications. The majority of drugs do not restrict a person from giving blood. Common drugs, such as blood pressure meds, birth control pills, and over-the-counter pharmaceuticals, do not affect eligibility to give blood. A person that wants to donate platelets must stop taking aspirin or any aspirin-containing medicine at least 48 hours before the appointment. Patients who are on antibiotics should finish them before donating. Regardless of the drug used, the person will usually be requested to wait one week before giving blood. This duration, however, is not always ideal for some people. As a result, donated blood or platelets may include hazardous medicines to the recipient. Unless they utilise teratogenic or platelet aggregation-inhibiting medicines, most blood banks ignore these cases and do not postpone blood donation [11]. The duration for the drug to leave the bloodstream differs depending on the type of drug and the person's health. People taking the same dose of medication can have different lengths to eliminate the medication from the bloodstream. Some factors that affect this are age, height, weight, genetics, and metabolism.

The connection involving medication usage and its concentration at the specified location via different components in biological processes is regarded as a critical topic. The dosage, as well as medication input and output in the working areas, have positive and negative impacts on the human body. Pharmacokinetics researchers explored the activity of a given medicine or chemical in numerous divisions of an individual. It aids in the awareness of the links between medication administration, dispersion, and excretion rates throughout the body and the establishment of the intended therapeutic response. In this research, we want to determine how long certain drugs stay in the bloodstream to know precisely when the potential donor can donate their blood safely for both the blood donor and the blood receiver. This problem is chosen because certain drugs in the blood donated have poor quality and may harm the recipient. Determining the exact concentration of the medicine in the bloodstream before donating blood can raise the safety and quality of the blood as required by regulatory guidelines. Moreover, we can eliminate whoever is unable to donate due to medication effects [11].