The European Journal of Biomedical and Life Sciences 2025, No 4
ISSN 2310-5674

PREMIER Publishing
ppublishing.org

DOI:10.29013/EJBLS-25-4-19-22

STATISTICAL MODELING OF INTERMITTENT AMLODIPINE DOSING USING MONTE CARLO SIMULATION AND REAL-WORLD BLOOD PRESSURE DATA

Matthew Shang [1]

[1] The Hun School of Princeton (New Jersey, USA)

Cite: *Shang, M. (2025). Discovery of small molecule inhibitors of MAO-B for Alzheimer's disease using pharmacophore-based virtual screening. The European Journal of Biomedical and Life Sciences 2025, No 4* https://doi.org/10.29013/EJBLS-25-4-19-22

Abstract

Hypertension affects over 1.28 billion adults worldwide, yet treatment adherence remains low. Amlodipine, a calcium channel blocker with a long half-life, is commonly prescribed once daily, but many patients self-modify their dosing schedules. This study evaluated the effect of intermittent amlodipine dosing on blood pressure (BP) control using real-world data and Monte Carlo simulation. Blood pressure readings were collected over three months from a patient on varying dosing regimens (once daily [QD], once every other day [QOD], once every 2 days [Q2D], once weekly [Q7D], and once every 10 days [Q10D]). Statistical comparison showed no significant difference in systolic or diastolic blood pressure among dosing regimens. Monte Carlo simulations (N=1000) revealed normally distributed systolic BP values with overlapping distributions across dosing schedules. Predicted proportions of systolic BP exceeding 120 mmHg ranged from 12.2% to 27.2%, while SBP >140 mmHg occurred only twice across all regimens. Coefficient of variation for SBP was <10% in all scenarios. Findings suggest intermittent dosing has limited impact on BP control due to amlodipine's long half-life, supporting flexibility in individualized dosing schedules.

Keywords: *hypertension; amlodipine; intermittent dosing; blood pressure variability; real-world data; Monte Carlo simulation*

Introduction

Hypertension is a major global health burden, affecting an estimated 1.28 billion adults aged 30–79 years, with two-thirds residing in low- and middle-income countries (WHO, 2025). In the United States, nearly half of adults have hypertension, yet only 21% achieve adequate control. Medication adherence remains a major challenge; real-world studies report that fewer than 55% of patients adhere to prescribed antihypertensive regimens (Wogen et al., 2003).

Amlodipine, a dihydropyridine calcium channel blocker, is widely prescribed due to its long elimination half-life (30–50 hours) and sustained antihypertensive effect. The recommended dose ranges from 5 to 10 mg once daily (Wang et al., 2023). However, patients frequently self-adjust their dosing schedules, raising concerns about efficacy

and safety. While amlodipine's pharmacokinetics suggest tolerance to missed doses, systematic evaluations of intermittent dosing schedules remain scarce.

This case study investigates the impact of varying amlodipine dosing frequencies on blood pressure control using real-world data and Monte Carlo simulation. The study aims to determine whether alternative dosing schedules maintain therapeutic effectiveness and support a personalized medicine approach.

Methods

Data Collection

Blood pressure data were collected prospectively over three months from one patient receiving amlodipine 5 mg. The patient followed several dosing regimens: once daily (QD), once every other day (QOD), every 2 days (Q2D), weekly (Q7D), and every 10 days (Q10D).

Measurements were taken using a calibrated home BP monitor (Microlife®). For each assessment, at least three readings were obtained at 3-minute intervals in the morning after 15 minutes of seated rest. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded.

Data Analysis

Observed BP values were averaged per dosing schedule. Comparisons between regimens were conducted using ANOVA. Monte Carlo simulations (N=1000 iterations) were employed to predict distributions of SBP under each dosing schedule, incorporating variability. Primary endpoints included:

- Proportion of SBP readings <120 mmHg and <140 mmHg.
- Variability of SBP (coefficient of variation, CV%).

Results

Observed Data

Comparison of the actual BP data across various treatment schedules did not reveal a statistically significant difference (ANOVA p-value >0.05) in SBP and DBP despite small fluctuations were observed among various dosing schedules (Figure 1 and Figure 2).

Figure 1. *Measured SBP (Orange) and DBP (Yellow) Readings over Time and their Moving Averages*

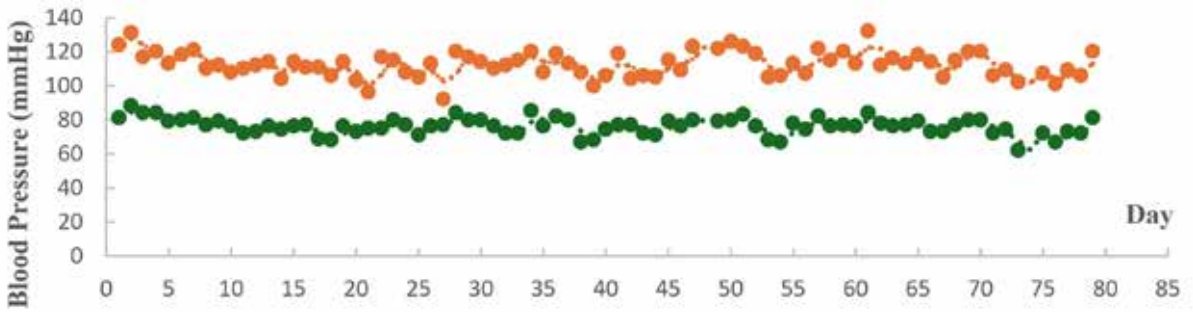
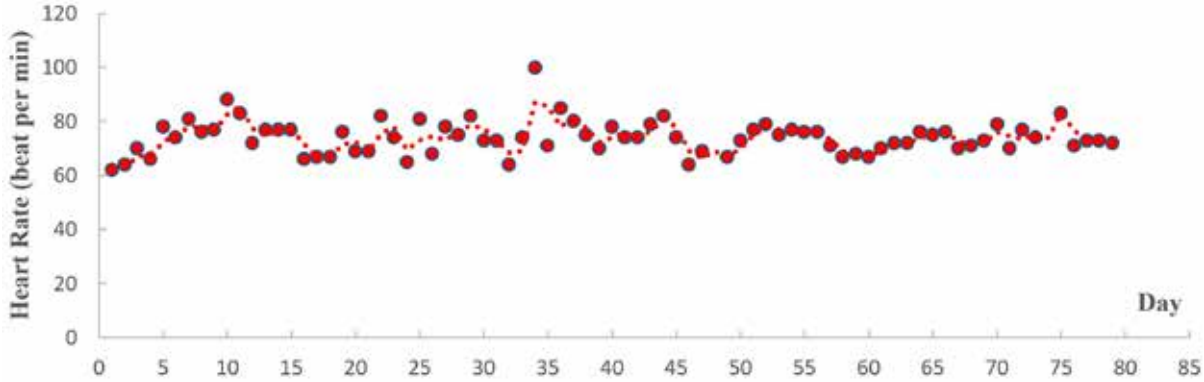


Figure 2. *Measured HR (Red) Readings over Time and their Moving Averages (Dotted Lines)*



Monte Carlo Simulation

Monte Carlo simulations (N = 1000 times) indicated that SBP data had a normal distribution with a central tendency (Figure 3) and overlapping of data distribution among various dosing schedules (Figure 4).

Monte Carlo simulations also showed that the proportion above SBP target (120 mmHg based on the American Heart Association guideline) was comparable, ranging from 12.2% to 27.2% given the inherent variability in BP (Table 1).

There were only two predicted episodes of SBP exceeding 140 mmHg across all dosing schedules.

Descriptive statistics of Monte Carlo simulation results indicated that the SBP data variability was generally less than 10% for all treatment schedules (coefficient of variation [CV]% = 5.1 to 7.0%) (Table 2).

Figure 3. *Distribution of Predicted SBP Values Using Monte Carlo Simulation for various Dosing Schedules*

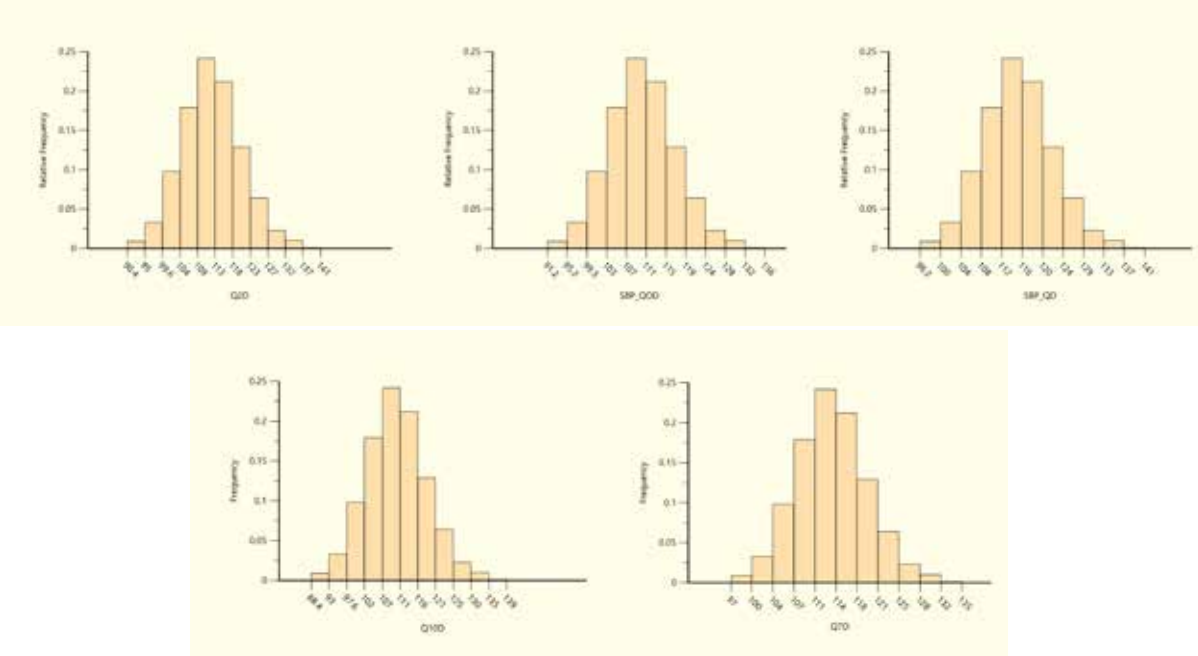


Figure 4. *Box Plots of Predicted SBP Values Using Monte Carlo Simulation for various Dosing Schedules*

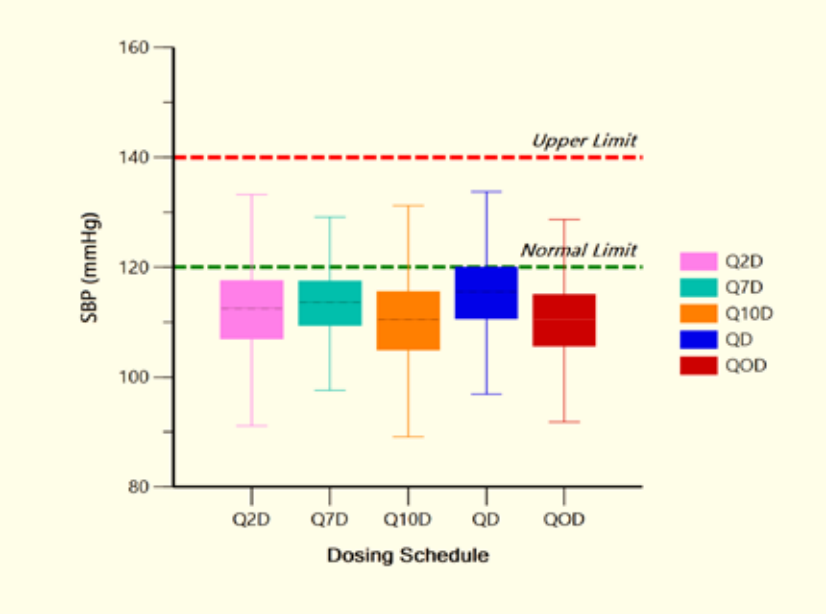


Table 1. *Percentage of Predicted SBP Values for various Dosing Schedules that are over Cutoffs*

% of simulations	QD	QOD	Q2D	Q7D	Q10D
≥ 120 mmHg	27.2	9.8	18.2	15.7	12.2
≥ 140 mmHg	0.01	0	0.01	0	0

Table 2. *Descriptive Statistics of Predicted SBP for various Dosing Schedules Based on Monte Carlo Simulation*

Variable	Dosing Schedule	N	Mean	SD	CV%	Min	Median	Max	Range
SBP	QD	1000	116	6.81	5.89	96	115	141	44
SBP	QOD	1000	111	6.81	6.16	91	110	136	44
SBP	Q2D	1000	113	7.78	6.92	90	112	141	51
SBP	Q7D	1000	114	5.83	5.14	97	114	135	38
SBP	Q10D	1000	111	7.78	7.04	88	110	139	51

Discussion

This case study suggests that intermittent dosing of amlodipine has limited impact on BP control. Due to its long half-life and sustained receptor binding, the drug maintains antihypertensive effects even with missed or delayed doses. These findings align with pharmacokinetic expectations and highlight the drug's forgiving profile compared to shorter-acting agents.

Importantly, results support flexibility in dosing schedules, which may improve adherence for patients who struggle with strict daily regimens. While this study is limited by its single-patient design, reliance on home monitoring, and simulation-based extrapolation, it provides preliminary evidence that alternative schedules may maintain efficacy.

Future studies with larger cohorts and prospective clinical trials are warranted to validate these findings and explore personalized dosing strategies.

Conclusion

Intermittent dosing of amlodipine, including schedules as infrequent as once weekly, did not significantly compromise blood pressure control in this case study. Monte Carlo simulations further support the robustness of antihypertensive effects across regimens. Personalized dosing approaches may enhance adherence and treatment outcomes compared to rigid once-daily prescribing.

References

Wang J. et al. (2023). Amlodipine in the current management of hypertension. *Journal of Clinical Hypertension*, 25(9):801–807.

Wogen, J. et al. (2003). Patient Adherence with Amlodipine, Lisinopril, or Valsartan Therapy in a Usual-Care Setting. *Journal of Managed Care Pharmacy*, 9(5), 424–429.

World Health Organization. Hypertension fact sheet. Available at: https://www.who.int/news-room/fact-sheets/detail/hypertension. Accessed 24 March 2025.

submitted 10.12.2025;
accepted for publication 24.12.2025;
published 30.12.2025

Contact: jenniferkong8@gmail.com