

Mathematics 136 – Calculus 2  
Discussion 6 – Drug Levels  
April 15, 2014

*Background*

The goal of today's discussion is to show how sequences and sums of sequences (= series) can arise in a very practical question in clinical medicine. Namely, if a patient is taking regular doses of some drug over an extended period of time, *what is the long-term level of the drug that will build up in the body?* For some very toxic drugs, this might limit the dosage that could be given safely!

For instance, we will consider a drug called atenolol, which is usually given in 50mg doses once a day to lower blood pressure.

*Discussion Questions*

A) The half-life of atenolol in the bloodstream is about 6.3 hours. If a dose of  $Q_1 = 50$  mg is given at the start of a 24 hour period, how much will be left after 24 hours have elapsed? Call this amount  $P_1$ , the amount left at the end of the first day.

B)

- 1) Next, a second dose is administered. For simplicity, let's assume it is absorbed into the bloodstream immediately. Call  $Q_2$  the total amount present after the second dose (the new, plus the remnants of the first). Find  $Q_2$ . Similarly, let  $P_2$  be the amount left at the end of the second day. Find  $P_2$ .
- 2) Next, at the start of the third day, a third dose is administered. Call  $Q_3$  the total amount present after the third dose (the new, plus the remnants of the first and second). Find  $Q_3$ . Similarly, let  $P_3$  be the amount left at the end of the third day. Find  $P_3$ .
- 3) Generalizing from what you did here, give formulas for  $P_n$  = amount of atenolol left at the end of the  $n$ th day, and  $Q_n$  = the total amount of atenolol present immediately after the  $n$ th dose.

(If you aren't starting to see a general pattern at this point, it may help to go a few days farther into the process and look for connections with what we discussed in class yesterday.)

C) If we have a patient on a long-term drug regimen, say extending potentially over a period of many years, then we are talking effectively about letting  $n$  = number of days go to  $\infty$ .

- 1) In the drug level problem in parts A and B, say in words what  $\lim_{n \rightarrow \infty} Q_n$  and  $\lim_{n \rightarrow \infty} P_n$  represent.
- 2) Suppose it is not safe for the patient ever to have an atenolol level  $> 70$  mg. Is the treatment regimen described here safe? (Think about what your formula from part C says.)

- 3) Suppose we want there to be  $\geq 10$  mg of atenolol present in the body at all times (even just before a new dose is taken). Is the patient getting enough atenolol so this will be true “in the long run”? Explain.

*Assignment*

Group write-ups due by end of class.