# Microcapsule-Based Drug Delivery

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Significant advances in drug delivery technology have been made over the past two decades.  One of the most important of these advances is the development of long acting drug injections.  These long acting drug injections allow for a drug to be continually released for time periods exceeding one month. Future research and advances will allow for drug release to be extended for time periods much longer than one month.  This biotechnology has obvious implications, such as higher patient compliance and the convenience of one dose opposed to multiple doses. The most important benefit of extended release drugs is the ability t achieve a constant drug concentration in the blood stream. Many drugs such as Haloperidol (a psychosomatic drug) and Naltrexone (an opioid antagonist drug) have recently been made available as long acting injections in the form of microspheres.  The benefits of long acting drug injections are so great that many more drugs will soon be made available in the form of long acting microspheres.  Prescribing these long acting medications is no easy task.  Doctors will need tools and methods to aid them in achieving optimal blood plasma drug concentrations (BPDC) in their patients.  This paper outlines a method for prescribing long acting microspheres and a computer simulation that calculates a mass of drug loaded microspheres to achieve a target BPDC.  An economic analysis is also included to assess the profitability of producing microsphere injections, specifically for alcoholism, in the pharmaceutical market.

Excel was used in all of the simulations. The optimizer can be thought of as three different sections; drug release rate, drug clearance rate, and concentration optimizer. First drug release rate was found for many types of microspheres from data in literature. The drug clearance rate was found by fitting drug concentration values to an exponential decay curve, so that the clearance rate can be described as a function of concentration. The concentration optimizer is a combination of the first two sections. It combines the drug release and the drug clearance to predict future drug concentrations in the body. By using solver the program optimizes the masses of each type of microsphere to achieve target blood concentrations in the future. The masses of microspheres found are the prescription that will be injected into the patient.

The drug concentration optimizer produced very promising results. The optimizer was able to achieve drug concentrations very close to the target concentrations. Future improvements could be made by adding more microsphere types to the program. Economics were also investigated and it was determined from net present value calculations that producing Naltrexone microspheres will be profitable over a ten year period.  However, this process is only profitable after at least one year of production.  Enough initial investments will have to be gathered to cover the non-profitable production.  Assuming that enough funding is available, the optimal price of a monthly microsphere injection was found to be $75.  This cost seems very low, and additional market structure analysis is needed to determine if a higher price could produce more profit.  If the market proves to be more monopolistic than expected, then the microsphere manufacturer will be able to charge a much higher price for the microspheres used in extended release injections.