This equation is a reduced form of Equation (2.76) for $t \to \infty$ and $t < \text{lag} + T$. Equation (2.79) has been used by Roberts and Walters [2] to define the desired patch release rate for a number of drugs in vivo from a knowledge of the drug's clearance and desired plasma concentration.

4. A time-dependent transdermal flux best analyzed assuming a model deduced from in vitro absorption kinetics (section 2.1.8) or deconvolution analysis (section 2.5.4).
5. Modeling Diffusion Explicitly with Compartmental Models

   Recently, a compartmental model was developed to simulate typical diffusion processes in the SC [19]. The compartments were modeled and compared to a diffusion model. The permeability between each compartment was developed via the resistance of the membrane:

$$k_p^i = (n+1)\frac{D_m}{h_m}$$

Using the permeability of the membrane, [19] was able to develop the following equation for the concentration of the middle compartments.

$$\frac{dC_i}{dt} = \frac{n(n+1)}{t_d}(C_{i-1} + C_{i+1} - 2C_i)$$

When compared to the diffusion model and experimental data, the number of compartments needed to give an adequate representation of the trend was found to be five to ten compartments. The fewer the compartments required to model the trend, the more applicable it is to pharmacists looking for a less numerically challenging form of solution.

2.5.2 Diffusion Pharmacokinetic Models

In vivo absorption models usually represent the body as one or more compartments with input into the body via percutaneous absorption. Cooper [85] derived an expression for the total amount of solute excreted into the urine after topical absorption. Other models of Guy, Hadgraft, Kubota, and Chandrasekaran (described earlier) have adopted a similar approach in describing either plasma concentrations or urinary excretion rates from one- or two- compartment models. Cooper assumed diffusion through the skin according to Equation (2.19) into the body, represented as a single compartment. When his model is modified to include an SC–vehicle partition coefficient K_m, the plasma concentration, $C_p(t)$, and the amount excreted into urine, $M(t)$, are defined by the equations:

$$C_p(t) = \frac{Ak_pC}{V_c}\left\{\frac{1-\exp(-k_{el}t)}{k_a} + 2\sum_{n=1}^{\infty}\frac{(-1)^n}{k_{el} - n^2\pi^2 / t_d}\left[\exp\left(-\frac{t}{t_d}n^2\pi^2\right) - \exp(-k_{el}t)\right]\right\} \quad (2.80)$$

$$M(t) = Ak_pC_vk_u\left\{\frac{tk_{el} - 1 + \exp(-k_at)}{k_{el}^2} + 2\sum_{n=1}^{\infty}\frac{(-1)^n}{k_{el} - \left(n^2\pi^2 / td\right)}\left(\frac{t_d}{n^2\pi^2}\left[1 - \exp\left(-\frac{t}{t_d}n^2\pi^2\right)\right] - \frac{1}{k_{el}}\left[1 - \exp(-k_{el}t)\right]\right)\right\} \quad (2.81)$$

where k_{el} is the total effective elimination rate constant, k_u is the rate constant for excretion in the urine, and V_c is the total effective volume of the compartment.

The steady-state portion of the $M(t)$ versus t plot from Equation (2.81) yields a slope of $k_uk_pA/k_{el} = f_ek_pA$, where k_p is the permeability coefficient = K_mD_m/h_m, A is the area of application, k_{el} is the