Transdermal Drug Delivery System

(Ultrasound Transdermal Delivery System
and the Insulin Patch)

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Transdermal Drug Delivery Systems utilize the skin for the delivery of drug molecules from the surface of the skin, through its layers, to the circulatory system. Transdermal Systems are a noninvasive alternative to drug delivery through injection or by mouth.

TDD systems exist as passive or active systems. The passive system uses a simple concentration gradient to diffuse the blood through the skin to the bloodstream. The Transdermal patches on the market (such as the nicotine patch), are passive systems. The molecules administered through these patches are small. The Stratum-Corneum (outermost layer of skin) has low permeability to larger molecules. The active systems employ a physical mechanism to force the larger molecules across the skin. One such mechanism is the ultrasound. Low-frequency (20 kHz) ultrasound can increase the permeability of human skin to high-molecular-weight -drugs. Ultrasound causes cavitation, or growth and oscillation of the air pockets in the skin's keratin fibers. The stratum corneum (outer skin layer) consists of cells called Keratinocites surrounded by lipid bilayers. Low frequency ultrasound generates microbubbles in the tissue. Researchers suggest the bubbles disrupt the lipid bilayer and allow water channels to be produced within the bilayer. The disorder in the stratum corneum facilitates the crossing of a larger molecule. This process is of particular significance to the delivery of insulin to diabetics. Insulin protein is too large to permeate the skin without use of the active transdermal system.

A team of researchers completed an Insulin patch prototype in October of last year. This device provides needle free delivery of insulin via a wearable patch. It has been tested to safely administer effective dosages of insulin in rats. Down the road researchers hope to devise a patch delivery system that will detect glucose and administer insulin.