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Incorporating a Generic Model of Subcutaneous Insulin Absorption into the AIDA v4 Diabetes Simulator

2. Preliminary Bench Testing

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Abstract

Background:
The AIDA interactive educational diabetes simulator has been available without charge for over a decade via the Internet (see www.2aida.org). Part 1 of this report [J Diabetes Sci Technol. 2007;1(3):423-35] described the model components to be integrated to enhance the utility of the software, with the aim being to provide enhanced functionality and educational simulations of regimens utilizing insulin analogues, as well as insulin doses greater than 40 units. This report provides some preliminary subcutaneous insulin absorption bench testing results for the updated modeling prototype.

Methods:
An analysis has been done of the spatial distribution of insulin in the region of the injection site for different classes of insulin preparations and times after the administration of a set insulin injection. Demonstrations of the proportion of residual insulin in depot versus time after a subcutaneous bolus have also been simulated for different insulin injection volumes and concentrations, as well as to show the proportions of hexameric, dimeric, and bound insulin over time after an injection.

Results:
Some early bench testing results are highlighted following subcutaneous injections of a rapidly acting insulin analogue (such as lispro/Humalog or aspart/NovoLog), a short-acting (regular) insulin preparation (e.g., Actrapid), intermediate-acting insulins (both Semilente and neutral protamine Hagedorn types), and a very long-acting insulin analogue (such as glargine/Lantus). The transformation, dissociation/association, and absorption processes by which insulin moves from the subcutaneous injection site to the plasma are also illustrated.

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Abbreviations: (IU) international units [of insulin], (NPH) neutral protamine Hagedorn

Keywords: absorption, computer, diabetes, insulin, model, simulation, software

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Abstract cont.

Discussion:
This report demonstrates how enhanced capabilities may be added to AIDA once a new model of subcutaneous insulin absorption is incorporated. The revised approach, once fully implemented, should permit the simulation of plasma insulin profiles for rapidly acting and very long-acting insulin analogues, as well as insulin injections greater than 40 units.

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