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ORIGINAL ARTICLE

Analysis of Novel Methods to Determine the Accuracy of the OmniPod Insulin Pump: A Key Component of the Artificial Pancreas System

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Abstract

In this issue of *Journal of Diabetes Science and Technology*, Zisser and collegues describe two inexpensive methods for accurate measurement of dosage delivered by OmniPod insulin pump. The first method is based on imaging a meniscus movement in a micro-pipette and using simple image analysis; the second relies on using a digital microscope to measure the volume of a dispensed droplet while it is still attached to the cannula tip. Both methods produce accurate measurements for doses >0.2 U, and the latter method is especially appropriate for doses <0.2 U, with accuracies down to 0.9%.

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Miniature infusion pumps play a critical part in many current and emerging drug delivery systems.[1] These systems are targeted to allow patients maximum flexibility in their daily activity by leveraging state of the art electronics, microfabrication, and sensing technologies.[2-4] With shrinking dimensions, the portable infusion systems must be able to deliver small drug dosages at high accuracies. This is a particularly challenging task at volumes of smaller than 10 μl.[5] With no commercially available flow/mass sensor than can measure such small volumes at high accuracies, most investigators in academia and industry rely on indirect methods such as measuring meniscus movement in capillaries or weighing the dispensed drug with a sensitive scale (if evaporative errors are minimized). Even the most precise commercially available analytical scales with readabilities as low as 1 μg may be inadequate for characterizing dosages smaller than 1 U. This leaves measurement methods that are mostly home-brewed and lack standard protocols. In this issue of *Journal of Diabetes Science and Technology*, Zisser and collegues[6] describe an inexpensive method for accurate measurement of dosage delivered by OmniPod insulin pump using nothing but pipettes, digital microscope, and software (Adobe Reader). They describe two different methods, one based on imaging a meniscus movement in a micro-pipette and using simple image analysis software to measure insulin dosages from 0.05 to 6 U with accuracies down to 0.9%. This is a standard method commonly used for characterizing microfluidic devices, as it is reliable for volumes larger than 1 μl. The second method, more accurate at lower dose levels (<0.2 U), relies on dispensing a small spherical droplet from the tip of the OmniPod's cannula and measuring its volume while still attached to the tip using a digital microscope. For the scale of these dosages, this method of droplet measurement is very appropriate; the insulin droplets are small enough to maintain a very spherical form while attached to the cannula, but they are large enough to exhibit no more than a negligible amount of evaporative loss of insulin during the time

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required for imaging the droplet. The high resolution images acquired by this method allow for a much more reliable volume characterization for the lowest dosage levels. This measurement method could become the new standard for evaluating the bolus dose accuracy of future drug delivery patches.

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