MDIC

REGULATORY SCIENCE SUCCESS STORIES

CM&S in Practice: Re-Engineering Insulin Delivery in Type 1 Diabetes with BD FlowSmart™

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As of 2014, 1.25 million Americans were living with Type 1 Diabetes (T1D), including 200,000 youth.[1] By 2050, that number is expected to rise to five million. Living with T1D requires painstaking meal planning, multiple daily insulin injections, and six or more daily finger pricks to monitor blood glucose.[1]

Insulin infusion pumps automate insulin delivery and have simplified T1D management as compared to manual injections. However, a study has shown that unexplained hyperglycemia may occur in as many as 60% of T1D patients using pumps.[2] One cause is thought to be the blockage of insulin flow through a critical component of the system called the insulin infusion set (IIS). It is believed that body tissue can block the cannula of the IIS to disrupt the flow of insulin, and consequently blood glucose levels, without triggering a system alarm to alert the user.

Becton, Dickinson and Company (BD), a founding member of the Medical Device Innovation Consortium (MDIC), created an IIS with a unique side port designed to provide an additional insulin flow pathway that reduces blockages and stabilizes insulin delivery. BD is the first to introduce a secondary port to reduce the occurrence of flow interruptions in insulin delivery via an IIS. Clinical data show that the BD FlowSmart™ reduces the number of flow interruptions (defined as a continuous rise in inline pressure for at least 30 minutes), as well as the average duration of the interruption in insulin, compared to commercial catheter sets.[3] BD FlowSmart™ received FDA clearance in 2015 and is the component in Medtronic's MiniMed™ Pro-Set™, expected to be on the market by the end of 2016.

Computer Modeling and Simulation's Role in the Design of BD FlowSmart™
Anita Bestelmeyer, BD's Director of Corporate Computer-Aided Engineering (CAE), and her team modeled several elements of BD FlowSmart™ in order to optimize the design performance.

One challenge for BD FlowSmart™ was to design the pencil eraser-sized septum to be tight enough to prevent insulin leakage within the device, but flexible enough to insert the cannula with low force and begin the flow of insulin (Figure 1).

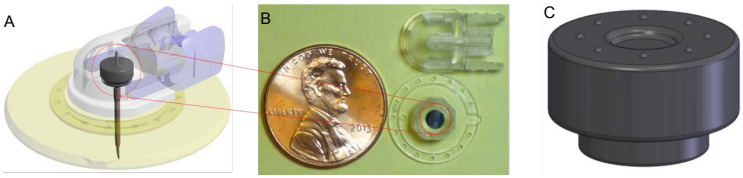

Figure 1. a) CAD rendering of BD FlowSmart™ device, b) Actual size of septum, c) CAD rendering of septum. Source: BD

Creating a Regulatory Pathway for Computer Modeling and Simulation

It was through the MDIC's Computer Modeling and Simulation (CM&S) project team that Bestelmeyer learned about the process for having an open discussion with the FDA outside of a formal product review.[4]

"Because of MDIC, we were able to review our current approach with the FDA and ask how we could move forward together. We were able to show the FDA how we used their draft guidance documents and submission guidelines to streamline the design verification process using CM&S and improve product development efficiency. As a result, we are collaborating with the FDA to determine how to use advanced CM&S techniques for design verification in regulatory submissions and have also taken a prominent role in driving the technical content of the agency co-sponsored Frontiers conference," said Bestelmeyer.

BD's Executive Vice President and Chief Regulatory Officer, Richard Naples, looks forward to the day when CM&S is used in clinical studies to improve the industry's ability to bring safe and effective products to market faster. BD, the FDA, and fellow members of MDIC's CM&S Steering Committee are discerning how modeling can improve the quality of clinical studies, supplement clinical data to predict certain patient outcomes, control the size of trials, and better focus a trial on meaningful endpoints.

More broadly, Naples said that the public-private partnership format of MDIC enables all device stakeholders to open the aperture to new ideas about regulatory science, to test and validate these new ideas, and then solicit the public opinion to constructively challenge these ideas in order to ensure the safety and effectiveness of new technologies.

"FDA and MDIC deserve a lot of credit for creating this forum that not only complies with the administrative procedures of the agency, but also allows the best scientists in the agency and industry to work together to assess challenges and look for opportunities to improve regulatory science," said Naples.

Naples recommends that device companies large and small get involved early with MDIC and come forward with any ideas they have to improve regulatory science.

Reflecting on Success

When asked about her proudest accomplishment in the development of BD FlowSmart™, Bestelmeyer said she is proud of her team and their work, as well as how modeling is improving regulatory science.

In response to the same question, Naples said he is proud to share ideas and concepts with the FDA and to engage in meaningful scientific discussions about how to build transparency, consistency, and predictability into regulatory decision making. Both credit the leadership of BD CEO, Vincent Forlenza, as a "tremendous advantage" for BD's collaboration with MDIC and industry stakeholders to improve public health.

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