



Weka Smart Fridge improves vaccine management so more people can be protected against diseases

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*Alan Lowenstein, Chief Operating Officer,
Weka Health Solutions*



While vaccines continue to save countless lives, many people never receive this simple form of protection. To inoculate more people against diseases, clinicians need an easier, more effective way to safely store vaccines and manage inventory. Each dosage is fragile and expensive. Standard vaccines can cost \$100, while biologics—vaccines used to treat people with autoimmune disorders—can cost \$10,000 per dose. To avoid spoilage, most vaccines must be stored between 2° to 8° Celsius. However, the commercial refrigerators used by clinicians provide imprecise temperature controls. And because standard refrigerators require reliable electrical power, clinicians are unable to use them to store vaccines in under-developed areas. Plus, clinicians stock and access vaccines manually. This introduces inventory errors and loss due to inadvertent spoilage and theft. To overcome all these storage and inventory challenges, Weka Health Solutions envisioned a Smart Fridge solution that provides automated controls supported by the Internet of Things (IoT) and the cloud.



A refrigerator designed for global clinicians

Weka wanted to provide clinicians with a refrigerator designed specifically to store vaccines. Not only would it include remote monitoring services that ensure vaccines are stored at the right temperature, but also its Smart Fridge would come with automated inventory management services. To bring its product to market, Weka first engaged MDCI Automation to design a physical refrigerator that has cartridges that store each vaccine in its own slot. Each slot is at least 3 inches away from the side of the Fridge, which is required storage protocol by the Centers for Disease Control and Prevention. In addition, people can only stock and access vaccines through a small drawer on the front of the Smart Fridge that measures less than 8 square inches. This design protects vaccines from temperature change by minimizing the influx of warmer, outside air.

Controlling Smart Fridge access and digitizing inventory processes

Weka chose to design the kiosk for its Smart Fridge on a Microsoft Surface tablet running the Windows 10 Pro operating system. Alan Lowenstein, Chief Operating Officer at Weka Health Solutions, says, "We wanted to make the kiosk as friendly as possible, so we quickly honed in on the Microsoft Surface device. We like its form factor. We like that it's commercially available, so it's easy to use and replace if necessary."

Weka worked with Microsoft partner 2B Solutions to develop the inventory management system. After considering an on-premises inventory solution, Weka chose Microsoft Dynamics CRM Online Professional. Brandon Hernandez, Mobile Application Developer at 2B Solutions, says, "We opted to go with the cloud-based Dynamics CRM Online because we knew it would be easily accessible and very easy to scale quickly."

Monitoring any number of Smart Fridges, anywhere in the world

To support automated monitoring services, Weka Health Solutions sought an IoT platform that could collect real-time data from numerous sensors on every Smart Fridge and send it to both Dynamics CRM Online and databases for real-time analysis. "We need to be able to manage 1,000 or more Fridges sitting in 1,000 or more locations around the world," explains Lowenstein. "To ensure robust and scalable messaging, we chose Microsoft Azure. It provides the middleware we need to manage communication between all our components." Hernandez says, "We found that what we get out of the box with Azure makes a very big difference in terms of implementation time and support going forward."

How Smart Fridges talk to the cloud

To develop the IoT solution, Weka Health Solutions worked with Microsoft partner BlueMetal and the Smart Fridge manufacturer MDCI Automation to

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Bob Familiar, Director of National Practice, BlueMetal

Customer Name: Weka Health Solutions
Industry: Health
Country or Region: United States
Customer Website: www.vaccinesmartfridge.com
Employee Size: 10
Partner Name: 2B Solutions
Partner Name: BlueMetal

Customer Profile
Headquartered in Boston, Massachusetts, Weka Health Solutions strives to improve global health by developing innovative, data-driven products and services for life sciences organizations, including physician offices, research institutions, and pharmaceutical companies.

“Clinicians in Africa and other areas where power is unstable or inaccessible can use our Smart Fridge to store and dispense vaccines. And the Fridge is small enough that you can put it in a van. So if you can’t bring the people to the vaccine, you can bring the vaccine to the people.”

Alan Lowenstein, Chief Operating Officer, Weka Health Solutions

ensure sensors would continually monitor temperature, motor health, sensor health, and appliance location. A Raspberry Pi 2 single-board computer running Windows 10 IoT Core Dashboard automatically transmits sensor messages—also known as telemetry data—to Azure IoT Hub. In addition, the Smart Fridge kiosk stores all data from user sessions and sends the information to Azure. Twelve Azure Stream Analytics processes, written by BlueMetal, scan incoming messages and route them to one of the following Azure services:

- SQL Database stores each telemetry data message with a time stamp so analytical processes can monitor the health and temperature of every Fridge and quickly identify any anomalies that indicate a possible appliance issue.
- DocumentDB stores a standard appliance manifest that the Fridge accesses when it is first powered up, and a current snapshot of Fridge inventory. BlueMetal chose DocumentDB to store inventory information because its unstructured format makes it easy to support future business intelligence (BI) solutions.
- Blob storage serves as an affordable historical archive that includes every message every Smart Fridge generates over its lifetime.
- Service Bus supports communication with Dynamics CRM Online.

Centralized data, one messaging library, countless opportunities

BlueMetal developed eight micro-services to facilitate the flow of information between solution components. Services access data stores and Dynamics CRM Online using REST APIs managed by the Azure API Management portal. Bob Familiar, Director of National Practice at BlueMetal, says, “By using a micro-service architecture, Weka Health Solutions can add new features to one service without touching the others. And everyone working on this solution used Visual Studio 2015, .NET Framework, and the C# programming language. That way, the messages that passed between Fridge sensors, Azure, and Dynamics CRM used the same library so all our software solutions easily work with each other.”

Implementing a new Smart Fridge in about 15 minutes

To accelerate solution implementation, BlueMetal automated the provisioning, build and deployment of all the Azure-hosted services using Windows PowerShell. “When a clinician purchases a Smart Fridge and powers it up, scripts automatically configure the appliance’s kiosk to include specific information about the clinic and the product catalog from Azure,” says Familiar. “The process takes about 15 minutes.”

How clinicians use the Fridge

BlueMetal and 2B Solutions also collaborated with the Smart Fridge manufacturer so the kiosk software controls the Smart Fridge. For example, to add or dispense a vaccine, clinicians log onto the kiosk and specify what they need to do. The Smart Fridge then pops open a door with access to a single vial. If they are adding to inventory, they insert the vaccine into the slot; if they are dispensing a vaccine, they remove it from the slot. Once the clinician closes the door, the kiosk sends a message to Azure and then to Dynamics CRM, noting the inventory change.

Minimizing financial losses for clinicians

With the Smart Fridge, clinicians can reduce financial losses. "Physicians generally have \$40,000 to \$60,000 worth of vaccines in their refrigerators," says Lowenstein. "If the clinic suffers a power outage or the traditional fridge fails, they risk losing the entire inventory of vaccines. By using automated processes in Azure and Dynamics CRM Online to manage inventory and deliver proactive alerting, our customers ensure vaccines are stored at the right temperature. We also make sure that the first vaccines in the refrigerator are the first ones that come out, so patients never receive an expired or recalled vaccine. We'll also save clinicians time because they'll eliminate manual processes."

By using a Smart Fridge, clinicians can also save money. Weka Health Solutions estimates that a medical practice that dispenses approximately 400 vaccines per month could reduce human-resource costs by more than \$1,000 per month. Practices can also avoid losing thousands of dollars per month in reimbursements, which happens when staff forget to record vaccines correctly in patient records. In addition, practices can avoid losses due to vaccine spoilage. Weka Health Solutions and clinic employees are notified in real time via email or text message if the temperature of any Smart Fridge begins to change, so the appliance can be proactively serviced.

From the Weka Health Solutions portal, users can also access information about their Smart Fridge from a customized dashboard supported by Azure IoT Suite Dashboard. Clients' dashboards show real-time information about their Fridge including its temperature. In addition, they can view real-time inventory information and an event log that shows when individual vaccines were stocked and dispensed—and by which users.

High availability and support for alternative power sources

The Smart Fridge overcomes the power-related challenges of commercial refrigerators because it works even if there's an electrical or cloud outage. "We architected a three-tiered solution on the Microsoft platform, so every part



can continue to work without the other,” says Lowenstein. “If we lose connection to Azure because of network issues, it doesn’t impact the real-time processes that are managed on the Windows Surface device. It can still dispense. It can still accept new inventory. And all of the data will be sent to Azure once it’s available.”

In addition, the Smart Fridge runs on DC power, which means the unit can run on electricity from a power company or from a backup battery. Lowenstein says, “Because it can run on a battery, our Smart Fridge can also be charged by a solar panel. So clinicians in Africa and other areas where power is unstable or inaccessible can use our Smart Fridge to store and dispense vaccines. And the Fridge is small enough that you can put it in a van. So if you can’t bring the people to the vaccine, you can bring the vaccine to the people.”

Improving the vaccine supply chain and patient health

By choosing Azure as the software foundation for its Smart Fridge, Weka can easily develop new services for clinicians. For example, it can develop BI that shows vaccine usage over time so they can better predict upcoming demand. “With data collected in Blob storage, we can easily pull that into Azure Machine Learning or Hadoop to create more advanced types of analytics,” says Familiar. In the future, Weka could also

grant vaccine manufacturers access to specific types of data through its REST APIs so they can better understand the supply demands specific to each region.

“Our goal is to provide real-time dispensing data, so we can let distributors and manufacturers know if there may be upcoming vaccine shortages at specific clinics or in certain areas,” says Lowenstein. “And if a clinic unexpectedly runs out of a vaccine, we can let it know if there’s a physician’s office a few miles away that has a surplus of that type of vaccine in stock. And while this new insight we gain using Azure and Dynamics CRM Online provides value that can improve the supply chain, from the distributor on up to the manufacturer, the biggest benefit is ensuring patient safety and improving global health by making sure more people are vaccinated against disease.”

Weka’s Smart Fridge is currently scheduled to go to market at the beginning of 2017.

Software

- Microsoft Azure
 - Microsoft Azure API Management
 - Microsoft Azure Blob storage
 - Microsoft Azure DocumentDB
 - Microsoft Azure IoT Suite Dashboard
 1. Microsoft Azure IoT Hub
 2. Microsoft Azure Stream Analytics
 - Microsoft Azure PowerShell
- Microsoft Azure Service Bus
- Microsoft Azure SQL Database
- Microsoft Dynamics CRM Online Professional
- Visual Studio 2015
- Windows 10 Pro
- Windows 10 IoT Core
- Microsoft Surface tablets
- Raspberry Pi 2 single-board computers