CareAware iBus Bedside Medical Device Integration and CareAware VitalsLink on AWS Overview

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Abstract

This whitepaper outlines how [CareAware iBus® for Bedside Medical Device Integration](#) (BMDI) and [CareAware VitalsLink](#) can improve the accuracy and timeliness of clinical documentation through integration of medical devices with the electronic health record (EHR). CareAware iBus BMDI is an EHR-agnostic, vendor neutral platform intended to help health systems easily integrate medical device data into their clinical documentation. Many healthcare organizations rely on staff to manually document observations in the patient record, introducing unnecessary latency and increasing the opportunity for transmission error. CareAware VitalsLink helps solve this by enabling clinicians to document captured vitals in the patient chart, directly from a supported device at the time of capture. CareAware BMDI and CareAware VitalsLink can reduce or eliminate latency and errors, enable timely decision support, and informed patient care.

Introduction

Healthcare organizations are constantly challenged to provide more efficient and effective care, while delivering improved outcomes, shorter length of patient stay, and reduction in the overall cost of care delivery. Achieving these goals relies on a clinician's access to timely and accurate patient data.

CareAware iBus BMDI and CareAware VitalsLink were created to streamline documentation of patient observations by directly acquiring device-based observational data and injecting it into the clinical workflow. In the past, this was a tedious, error-prone, manual effort which often lacked the timeliness necessary to provide valuable insight to clinicians in the course of care delivery. One study observed error rates as high as 18.75%, and mean latency that was 7.6 times greater (38.53 min vs 5.06 min) for vitals first captured on paper and transcribed into the EHR, as compared with those downloaded electronically into the medical record[1].

CareAware iBus BMDI and CareAware VitalsLink offer a simple solution to these challenges using the following features:

- **EHR Agnostic, Single Point of Integration** – Instead of implementing numerous proprietary point-to-point interfaces between devices and your EHR, CareAware iBus serves as an aggregation point for ingestion of data from all connected devices, with the ability to share that data with multiple downstream systems via industry-standard interop protocols.

- **Extensive Device Support** – CareAware iBus BMDI comes with driver support for an extensive library of nearly 1,000 patient care devices, with support for additional devices added regularly.

- **Plug and Play Connectivity** – After an appropriate driver is configured and deployed, newly connected devices are automatically discovered, and data begins flowing immediately. For devices with limited connectivity options, CareAware iBus enables communication via the CareAware Connectivity Engine and programmable device adapters.

- **Normalized Concept Mapping** – Rather than needing to maintain device-specific mapping for a multitude of clinical concepts sourced from a variety of connected devices and vendors, CareAware iBus normalizes acquired data to a standard nomenclature that can be mapped once in the destination EHR, or other clinical system.

- **Real-time Access –** Data captured from connected devices by the CareAware platform can be made immediately available for documentation in the EHR, or used as input to clinical decision support processes and early warning systems for conditions such as sepsis.

- **On-Device Charting –** In addition to the features above, CareAware VitalsLink further enables clinicians to perform positive patient identification and send validated vitals directly from a supported device to the patient's chart, without the need to use another device or to launch the EHR.

Once organizations have completed the process of on boarding their device population, clinicians can start benefitting from the streamlined workflow, reducing latency, and the potential for transmission error.

- Data is acquired by CareAware in real-time from the connected device(s).

- Acquired data is normalized by CareAware and enriched with additional contextual information.

- Data is subsequently transmitted to the EHR .

- Observational data is correlated to the relevant patient and can be committed directly to the patient's chart. This provides ready visibility to other clinicians and enables timely decision support.

Service description

CareAware iBus BMDI provides a streamlined mechanism for the integration of medical devices at the point of care, enabling the timely and error free documentation of observational data immediately into the patient record. CareAware iBus runs on [Amazon Elastic Compute Cloud](#) (Amazon EC2), providing a highly scalable, reliant, and cloud-based event-driven architecture. CareAware iBus supports bi-directional interfaces with a large variety of predominant medical devices. The product allows plug-and-play device connectivity via numerous communication protocols (proprietary and industry standard) and produces normalized observational data with consistent terminologies. The data acquired from the medical devices are published over standard and secure internet protocols.
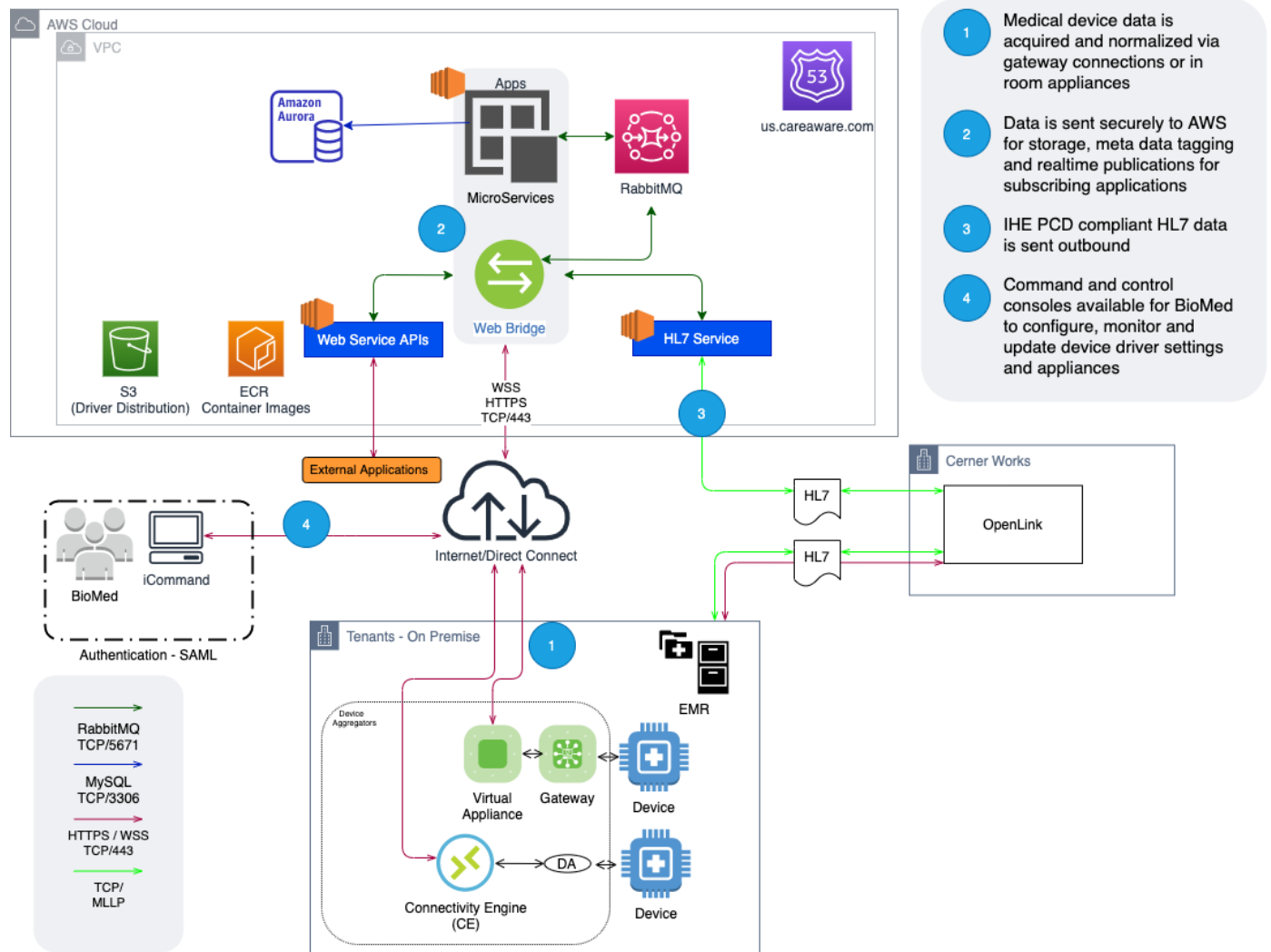
CareAware iBus Cloud Architecture

Note: AWS Direct Connect between the hospital facility's data center and Amazon Web Services (AWS) is recommended for an added layer of security in addition to standard TLS encrypted traffic.

The CareAware iBus supports medical devices that can produce a variety of different types and categories of data. A separate application programming interface (API) is implemented for each category of device which enables the device to publish data to the CareAware iBus, and subsequently allows external applications to subscribe to receive that data. For CareAware iBus BMDI, the following general categories of data are supported:

- **Discrete Data** – Measurement data captured at a discrete moment in time, for example a continuous physiologic monitor which samples heart rate
- **Infusion Data** – Telemetry generated by the continuous infusion of fluids, such as through an intravenous (IV) line.

CareAware iBus supports several additional categories of data applicable to other use cases, including:

- **Waveform Data** – Continuous waveform data produced or recorded by a device over a period of time, such as electrocardiogram (ECG) lead waveforms.

- **Event and Alerting Data** – Event notifications or alerts produced by a device, such as infusion pump occlusion alerts or tachycardia alarms.

- **Laboratory Device Observations** – Outcomes-based results produced by any static lab analyzer after processing a sample, such as processing patient blood samples.

By categorizing devices in this manner, external applications can receive device data in consistent formats, regardless of device manufacturer, and apply the data to the record of interest. Because many of these devices publish data at a high frequency (with sampling rates often less than one second), CareAware iBus offers the ability to throttle the rate for downstream publication. This avoids overwhelming the EHR with too much data, while allowing all published device data to be retained within CareAware iBus for broader research and analysis.

Many medical devices will fall into more than one category, referred to as multi-category devices, and can integrate with CareAware iBus according to each of the individual categories they support. For example, a sophisticated patient monitor may integrate with CareAware iBus to transmit discrete, waveform, event and alert data simultaneously.

Some medical devices are capable of connecting directly to the CareAware iBus. For devices that can't connect in this manner, they must connect through the use of a device aggregator. Aggregators come in several forms:

- **Device Gateway** – An external system or server that connects to medical devices through (typically) non-public protocol and then makes that data available to CareAware iBus. Device Gateways are often provided by individual device manufacturers as a way to connect to existing manufacturer-specific networks. For example, it is common for newer infusion pump models to communicate wirelessly to a manufacturer-provided gateway server, which then exposes device data to CareAware iBus.

- **Virtual Appliance** – A virtual and containerized server component that hosts device drivers that are used to communicate with medical device gateways typically in deployed in the same local network. CareAware iBus makes use of [Amazon Elastic Container Registry](#) (Amazon ECR) to store container images which are combined on-demand with device drivers from [Amazon Simple Storage Service](#) (Amazon S3).

- **Device Adapters (DA) -** The Device Adapter is the hardware component that converts RS232 or RJ45 from the medical device into a USB output for the Connectivity Engine or host appliance. It has 64 bytes of programmable memory to give the device a unique identifier on the CareAware iBus during the registration process. The Device Adapter also stores the vendor and model information for the device to facilitate driver identification and instantiation on the Connectivity Engine or host appliance to initiate protocol and data communication to the device.

- **Connectivity Engine (CE)** – A small computing device that provides network connectivity to medical devices that are not network-enabled. This is useful for integrating with many older devices that only have an RS-232 serial port through which data is provided.

In addition to transmitting medical device data, CareAware iBus also provides data storage mechanisms to hold information from, and related to, those devices. This includes information such as the actual data produced by a medical device, as well as contextual information such as associations between patients, type of devices, and their locations. These data stores are backed by **Amazon RDS** using **Amazon Aurora** and are made accessible to external applications through a set of software APIs collectively referred to as CareAware Services.

CareAware iBus exposes a set of APIs that allow other systems and applications access to the data. These APIs are made available to external application developers as web services and include functionality, such as the ability to request or subscribe to

data from individual devices, manage associations between devices and patients, store and retrieve device data, and so on.

The CareAware iBus supports both inbound and outbound HL7 concepts relevant for medical device integration workflows. IHE compliant HL7 data is published to interested systems for use in the EHR. Manipulation of data formats and any other transformation logic can be applied by using the Cerner OpenLink interface engine.

Benefits

CareAware is a workflow-driven, interoperable architecture designed to easily adopt industry standards as they emerge. CareAware iBus BMDI leverages these standards to connect supported medical devices to an EHR, regardless of vendor. Cerner believes interoperability is key to enabling the flow of information necessary to achieve optimal health outcomes. Because of that belief, Cerner actively participates in industry collaboratives, such as Integrating the Health Enterprise (IHE), that focus on improving workflows and communication between medical devices and clinical systems. Through involvement in these organizations, Cerner continuously works to advance interoperability in service to better health outcomes and safer patient care.

A key feature of CareAware iBus BMDI is the CareAware Validation Program for Medical Devices. This program establishes a relationship between Cerner and medical device manufacturers enabling delivery of vendor-optimized, comprehensively supported, device and workflow integrations via the CareAware connectivity architecture. CareAware VitalsLink capable devices are great example of what is possible through the cooperation enabled by this program. With more than 60 validated partners and 1,000+ supported devices, Cerner continuously works with Cerner clients and partners to grow that number further.

CareAware iBus BMDI enables plug-and-play connectivity between devices and the EHR. This simplifies integration efforts and supports clinician workflow by facilitating direct entry of data automatically acquired from connected devices right into the EHR. As a result, transmission errors and workflow inefficiencies decrease, while providing access to a richer set of patient information, improving clinical decision-making and patient outcomes.

CareAware iBus is built on a cloud-based architecture, and is centrally managed and deployed enabling continuous delivery of software updates. By receiving updates automatically as new features are released, the chore of package management and

installation is eliminated. This helps simplify the effort required for clients to remain current, and ensures clients always have the most up-to-date software.

From the beginning, CareAware iBus was built for scalability. As the platform has made its move to the cloud, this has provided even greater elasticity in the underlying computing infrastructure. With multiple client organizations already exceeding 73 million transactions a month from bedside medical devices, the ability to scale has never been more evident. With the added benefits of Amazon EC2, CareAware iBus is able to quickly and comfortably scale to accommodate rapid growth within your organization as well.

CareAware iBus BMDI on AWS provides the added benefit of an enhanced disaster recovery capability through the use of availability zones. In the event of an unexpected interruption, services can be seamlessly transitioned from one zone to another. This offers an uninterrupted experience for client organizations, while eliminating the complexity of managing deployments across multiple of their own data centers.

CareAware iBus has a full complement of APIs, which enables products to talk to one another in the same language and provide services to one another. These APIs make it easy to expose specific services, making them available inside and outside the four walls of the organization. These APIs also enable innovative organizations to build or buy custom applications to fulfill their unique needs.

Use case scenarios

In an effort to provide more efficient, effective care, Imperial College Healthcare NHS Trust (Imperial) implemented near real-time capturing of patient observations/vital signs directly into their electronic patient record. This time savings helped to reduce clinician burnout by releasing an estimated 5,800+ nursing hours to patient care over a 15-month period.

"That time can be used in direct patient care that supports patient outcomes, but actually supports the nurses' well-being as well," said Gerry Bolger, clinical and nursing informatics advisor/consultant, Imperial College Healthcare NHS Trust.

London-based Imperial comprises five main hospitals and a staff of 10,500 who support nearly 1.2 million patient contacts annually.

Due to the high volume of patients and increased demand on clinical staff members, Imperial's leadership team sought a solution to reduce documentation time for vital signs, as well as providing visible near real-time National Early Warning Scores (NEWS)

to release time and boost responsiveness. What they found using Cerner CareAware VitalsLink® and CareAware iBus for Bedside Medical Device Integration (BMDI) was a 53.5 percent reduction in the time it takes providers to document a full set of NEWS — respiratory rate, oxygen saturations, temperature, systolic blood pressure, pulse rate, and level of consciousness.

"It's had a real impact on handovers. We can have a list of our patients up on the screen, and we can go around and individually look at the NEWS scores so there's no miscommunication," said Katie Pritchard, ward manager at Imperial's Albert Ward.

Additionally, automating the calculation of NEWS removes the risk of transmission error that comes with using human transcription. This reduces the opportunity for preventable errors by increasing accuracy of documentation, and immediately triggers alerts if measurements are outside normal ranges — translating to more proactive patient care.

> We have a new opportunity with the digital agenda to do things differently, to do things smarter — sometimes faster, but hopefully more efficiently — that will improve both the working life of clinical staff and the care we give to patients. Patients really are what we're here for first and foremost."
>
> - Gerry Bolger, Clinical and Nursing Informatics Advisor, Imperial College Healthcare NHS Trust

Conclusion

CareAware BMDI & CareAware VitalsLink streamline the clinical documentation process by enabling the integration of observational data sourced from connected medical devices directly into the EHR and clinical workflow. Prompt and accurate documentation are critical, when providing decision support or enabling efficient and effective patient care. If you are interested in leveraging CareAware iBus BMDI or CareAware VitalsLink, you can contact Cerner for help getting started.

Document Revisions

Date	Description
June 30, 2021	First publication

Notes

[1] Fieler, Vickie & Jaglowski, Thomas & Richards, Karen. (2013). Eliminating Errors in Vital Signs Documentation. Computers, informatics, nursing : CIN. 31. 422-427. 10.1097/01.NCN.0000432125.61526.27.