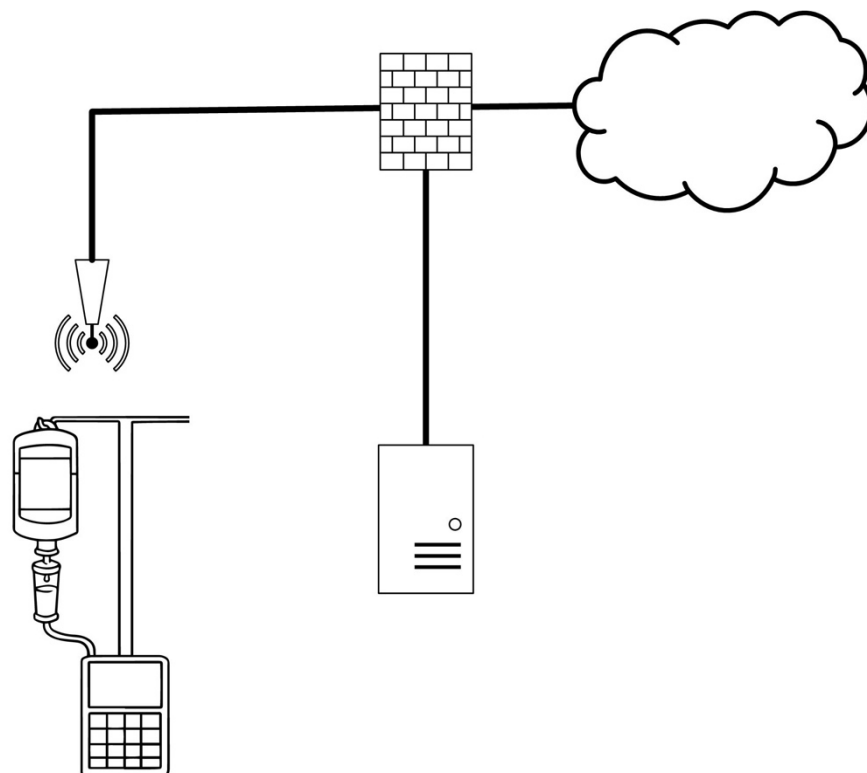


INFUSION PUMPS ON HOSPITAL NETWORKS

Evaluation criteria with scores



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Introduction

Infusion pumps have evolved from stand-alone mechanical devices to a fully integrated networked application. Technological complexity and associated misunderstandings may pose difficulties during the evaluation and selection process for hospitals.

It is **not the intent** of this document to provide a deep dive on clinical use or security. Publications from AAMI, ECRI, NIST, and others, offer considerable material on cybersecurity and clinical use. Purpose of this document is to provide an assessment with accompanying scores developed by the author, Dan Pettus, to measure real-world features, maintainability, and ease-of-use when integrating infusion pumps on a complex hospital network infrastructure.

The term 'pump' means any infusion modality including large volume, syringe, PCA, and others. Criteria for successful network implementation and sustainability is virtually the same no matter what infusion modality is under evaluation. Criteria questions assume the pump being evaluated supports wireless connectivity.

Method

Each criterion is described with an associated score. Scores are weighed based on the author's expertise and experience. Totaling scores may be used to identify what vendors and devices provide the best overall proficiency with integration on hospital network infrastructures. Do not solely rely on these criteria. Use this document as a foundation for infusion pump network connectivity evaluation.

Open access – Crowdsourcing

The author encourages other experts to modify and submit additional criteria questions as needed. The author requests edits are shared with others so they can also take advantage of these updates.

Pump under evaluation

Pump Vendor: _____ Model number _____

LVP___ Syringe ___ PCA ___ Other _____

Date _____ Total Score _____

Pump Technology Design and Architecture

Criteria Description	Point Value	Notes	Score
Separate and isolated pump processor system and communications controller	2	Isolating the pump main processing subsystems from network connectivity can help maintain current-state infusion status in the event of a communications breach or network error	
Number of communication ports required to operate pump on the network	1 port = 2 2 ports = 1 > 2 ports = 0	Reducing the number of network ports can simplify maintenance and improve security controls	
Pump Telnet (terminal, FTP, etc.) disabled	1	Disabling unnecessary operating system functions can enhance security	
Pump operating system and pump applications (firmware) remotely updated using wireless capability	3	Wirelessly updating operating system and pump applications has the potential to reduce time and cost to install latest versions. <i>Attention: review pump vendor's workflow on this capability</i>	
Pump network credentials including encryption certificates downloaded remotely using wireless capability	3	Ability to change network credentials remotely can simplify hospital policy requirements and improve security	
All current hospital supported WiFi bands (802.11 a/g/n/ac/ax)	1	Basic WiFi connectivity in the 2.4GHz and 5GHz spectrum should be considered standard	
Pump architecture can support mobile LTE or 5G connectivity	Currently available = 2 Future upgrade = 1	Future proof current pump investment.	
Pump architecture can support 60GHz (802.11 ad/ay) connectivity	1	Ultra-fast millimeter wave radios	
Pump supports WiFi WPA2 V1 enterprise	2	Minimum security standard both shared and enterprise supported	
Pumps supports WiFi WPA2 V2 enterprise	1	New enhancements to current WPA V1. <i>However, many hospital networks do not yet support V2</i>	
Pump vendor can remote in for diagnostic and repair	1	Partnering with the pump vendor on problem resolution	

Criteria Description	Point Value	Notes	Score
Fast roaming. Ability to re-associate AP in 5 seconds or less	2	Infusion pumps are mobile devices. Long delays in roaming AP access may result in surveillance gaps	
Pump communications protocol published	3	While the pump communication payload can be encrypted or proprietary, the handshaking protocol should be published allowing hospitals to utilize device management system applications for surveillance and security	
FIPS 140-2 Level 2 security policy	2	Certain markets require FIPS 140-2 wireless security. While not mandated in most commercial markets, the ability to support FIPS 140-2 indicates a high level of wireless encryption security	
Battery life of 3 hours or more with full wireless communications enabled	2	Many patients are encouraged to be mobile with their pump. <i>Attention: some pumps can support multiple pump channels concurrently. Minimum battery life still applies</i>	
Aggregate (all online pumps) network bandwidth required to maintain pump communications including full bi-directional EMR auto programming.	< 20K/min = 3 20-40K/min = 2 40-60K/min = 1 > 60K/min = 0 *K = 1024 bytes	Hospital environments may have 100's or even 1000's of pumps communicating on the network. Low bandwidth assures minimal disruption during peak usage	
Updated drug library can be downloaded wirelessly while infusing on a patient	2	The ability to download updated drug libraries without stopping current infusions can save time and reduce the need for manual intervention	
Offline store-and-forward	> 12 hours = 5 6-12 hours = 4 3-6 hours = 3 < 3 hours = 0	The pump's ability to store transactional data during network outage (for any reason) and automatically re-synchronize when network is restored	
Pump makes IP address and MAC address available to hospital IT (from device, server, or gateway)	2	Ability to share IP and MAC may provide a simple method for location tracking (with limitations)	

Pump Server and Gateway Interface Design and Architecture

Criteria Description	Point Value	Notes	Score
Pump server/gateway deployed in the cloud or on premises	Cloud = 5 On Prem = 0	Cloud deployment is the future. Most pump vendors offer only partial or no cloud deployment. The balance of pump server section will assume either on prem or cloud deployment	
Number of concurrent connected pumps (channels) per single server	>10,000 = 3 <10,000 = 0	A single server deployment is advantageous with maintaining transactional and analytics data structures in a single environment	
Pump server/gateway offered with fault-tolerant failover functionality	Active/Active = 5 Passive/Active = 4 Offline recovery = 1 None = 0	Pump integration with the EMR provides a new level of safety and efficiency. Single-point failures may cause major disruption if not able to failover gracefully and timely	
Pump server/gateway supports multiple environments concurrently including Production, Pre-Production, Test, Training, Others	Multiple = 1 Single = 0	Ability to synchronize databases across multiple environments allows for training and pre-deployment testing without taking down production	
Pump server/gateway is Active Directory (LDAP) compliant	1	Credentials to manage the pump server should utilize the hospital's current user authentication services	
Server/gateway may be deployed in existing hospital domain or in a separate domain	1	The ability to support a flexible domain environment based on the hospital IT preferences	
Pump vendor can remote in for diagnostics and repair	1	Partnering with the pump vendor on problem resolution	
Server/gateway patching adheres to hospital policy with ordinary patches available 30 days or less and emergency patches in 48 hours or less	2	Although the pump vendor may perform patch validation due to regulatory policies, delays with distribution should be avoided	
Server/gateway operating system, database engines, and pump applications can be installed (updated) remotely	3	Ability to stay current with minimal disruption to hospital staff	

Criteria Description	Point Value	Notes	Score
Hospital has access to pump server OLTP transactional data (using an interface or direct DB access)	2	Hospital may have a requirement to store all pump related transactional data in an enterprise data repository	
Single pump server/gateway platform can support multiple hospital infrastructure	3	Multiple hospital systems are common. (IDN) Offering a multiple hospital environment support from a single platform reduces complexity and increases security	
On prem virtual server deployment	VM only = 1 MS only = 1 VM + MS = 2 Any vendor = 3 None = 0	Pump vendor ability to support hospital virtual deployment requirements	
Pump server/gateway offline store-and-forward.	> 12 hours = 5 6-12 hours = 4 3-6 hours = 3 < 3 hours = 0	The pump server ability to store transactional data during network outage (for any reason) and automatically re-synchronize when network is restored	
Pump server interface gateway performance	> 4K msg/min = 3 3K-4K msg/min = 2 2K-3K msg/min = 1 <2K msg/min = 0	The pump server gateway interface engine should provide adequate performance to ensure timely integration with the EMR or other systems	

Pump Vendor Remote Management Services

Criteria Description	Point Value	Notes	Score
Pump vendor offers a non-VPN remote management service	4	Vendor offers remote management services for regulated devices (pump and pump server)	
Remote management services offered	Remote Access = 1 SSO = 2 Audit = 2 7/24 Monitoring = 3 Chat = 1	Tools necessary for remote authentication, access control, patch management, and audits. Sum the point values together for a subtotal score	
Secure remote management service is HIPAA compliant	3	Maintain chain of patient data security and privacy	
Secure remote management is compatible with third-party systems	SecureLink = 3 Solarwinds = 3 Other = 3 None = 0	Integration with hospital existing remote management services reducing the need for a one-off or redundant solution. Sum the point values together for a subtotal score	

Interoperability

Criteria Description	Point Value	Notes	Score
Pump architecture supports IHE connectivity standards	PCD 01 = 2 PCD 10 = 2 PCD 03 = 5 PCD 04 = 3 PCD 05 = 3	IHE specifies the patient care domain message schema for infusion pumps. Sum the point values together for a subtotal score	
Ability to synchronize CPOE IV med orders to pump safety software library when implementing IHE PCD 03 auto programming including multi-ingredient and secondary infusion orders	4	IV orders are complex. A mismatch from CPOE IV order to pump order may expose errors and gaps. The ability to organize all IV CPOE orders to match the pump library assures continued use of safety limits with automated PCD 03 orders	
Pump interoperability can support multiple EMR hosts from the same or different vendors (e.g.: EPIC and Cerner) under one unified platform infrastructure (pump, server, and gateway)	One EMR environment = 0 Multiple same EMR vendor = 3 Multiple different EMR vendors = 5	Some large hospital systems may include multiple EMR environments from the same or different EMR vendors	
Full commercially available bi-directional auto-programming (IHE PCD 03, PCD 01, PCD 10) with the EMR vendors	EPIC = 7 Cerner = 7 AllScripts = 7 MediTech = 7 Other EMR = 7	Auto programming infusion pumps provide an extra level of safety and efficiency. Sum the point values together for a subtotal score	
Full commercially available Alarms Management (IHE PCD 04, PCD 05) with the top Alarms Management vendors	Spoke = 6 Vocera = 6 Other = 6	Remote Alarms notification provides a new level of workflow safety and efficiency. Sum the point values together for a subtotal score	

Enter Total _____