Mayo Clinic's IoT Journey

From Asset Inventory to Cybersecurity

MAYO CLINIC

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About the Moderator

Eric C. Aring, MBA

Member, ACCE Education Committee

Eric has worked for Mayo Clinic for 2 years as the Asset Administrator for HTM systems support, previously working at Stanford Children's Hospital as a Clinical Systems Engineer, and UCSF as an HTM technician.

During his time at Mayo Clinic, he has spent extensive time working on collaborative workflow with Information Technology, Clinical stakeholders, and implementation coordinators.

Disclosure

- The focus of the presentation is on securing Healthcare IoT (HIoT) within Healthcare Organizations and should not be construed as an endorsement of any product
- Mayo Clinic has a financial interest in Ordr Inc.

About the speakers

Keith Whitby

Section Head,
Healthcare Technology Management
At Mayo Cliniic

Keith has worked at Mayo Clinic for 23 years in several different support and leadership roles. He is currently the Section Head of Healthcare Technology Management Cybersecurity and Business Operations. Keith has also had several other positions in HTM, starting as a Unit Manager of the X-Ray equipment service group and most recently as the Section Head for Enterprise Lab, Research, and Ophthalmology Service. Prior to his roles in HTM, he worked in Surgical Services as a Core and Prosthesis Supervisor, and as a Surgical Process/Systems Analyst.

During his time at Mayo, Keith has had extensive experience collaborating on several multidisciplinary teams. He has demonstrated a commitment to customer service, strong leadership skills, and experience with process analysis, project management, and technical support. During his tenure in Surgical Services and HTM, he has been exposed to the depth and breadth of medical equipment in a large healthcare organization. This includes the use of, service and support on, and the operationalization of cybersecurity for a wide range of medical equipment and IoT technology.

About the speakers

Greg Murphy

Chief Executive Officer
at Ordr Inc.

Greg joined Ordr as CEO in December 2018. Previously, he was VP Business Operations for the HPE Aruba Group, the 4,000 person networking and IoT business unit of Hewlett Packard Enterprise. In that role, Greg was responsible for leading the business integration of Aruba and HP Networking following HP's $3 billion acquisition of Aruba Networks in 2015. Greg held multiple prior senior executive positions within Aruba, including SVP Business Operations, GM of network management software, GM of outdoor and mesh products and VP of Marketing. Greg joined Aruba in 2008 through its acquisition of AirWave Wireless, a network management software provider that Greg founded and led. Greg received his M.A. from Stanford University and his B.A. from Amherst College.

About Ordr

- Ordr is the leader in healthcare IoT security:
  - Largest market share in healthcare with customers including the top hospitals in U.S. and UK
  - KLAS Healthcare IoT Security Leader 3 years in a row
  - Representative vendor in Gartner Medical Device Security
- Customers in North America, Europe and APJ
- "Whole Hospital Approach" to security:
  - See every device and network connection
  - Know every risk, vulnerability and anomaly
  - Secure via automated proactive, reactive, retrospective policies

Ordr Proven In Top Hospitals/HC Systems

Mayo Clinic | Cleveland Clinic | Fairview | Aspirus | Unity Point Health

Southampton NHS Trust | Cedars Sinai | Nat'l Institute of Health | Sutter Health | Hartford Healthcare

Ordr Recognized as Market Leader

KLAS RESEARCH

Three-Time Healthcare IoT Security Market Leader

Gartner

Representative Vendor

Explosion of Connected Medical Devices

10-15 connected devices per bed including medical devices

20% connected medical devices are running on outdated O/S

50 Billion medical devices will connect to clinicians, health systems, patients, and to one another over the next decade.

Healthcare IoT CAGR growth of 25.9% (2021-2028)

Pain Points for Technology Support Teams

CMMS not up to date. No real-time inventory of medical devices

30-60 mins per person/shift locating missing and misplaced devices

Many vulnerability disclosures. How to scan? Where to focus?

How are devices being used? Need to schedule maintenance and support procurement decisions

Journey from Asset Inventory To Cybersecurity

MAYO CLINIC

2019 → **Today**

~30,000 Medical, Research, and Facilities devices
3 Primary hospitals

500,000+ Connected devices
Enterprise-wide: 100s of facilities

ördr

Visibility and Asset inventory

- Licensed initially by HTM
- Subsequently expanded to all devices
- Automated inventory and classification

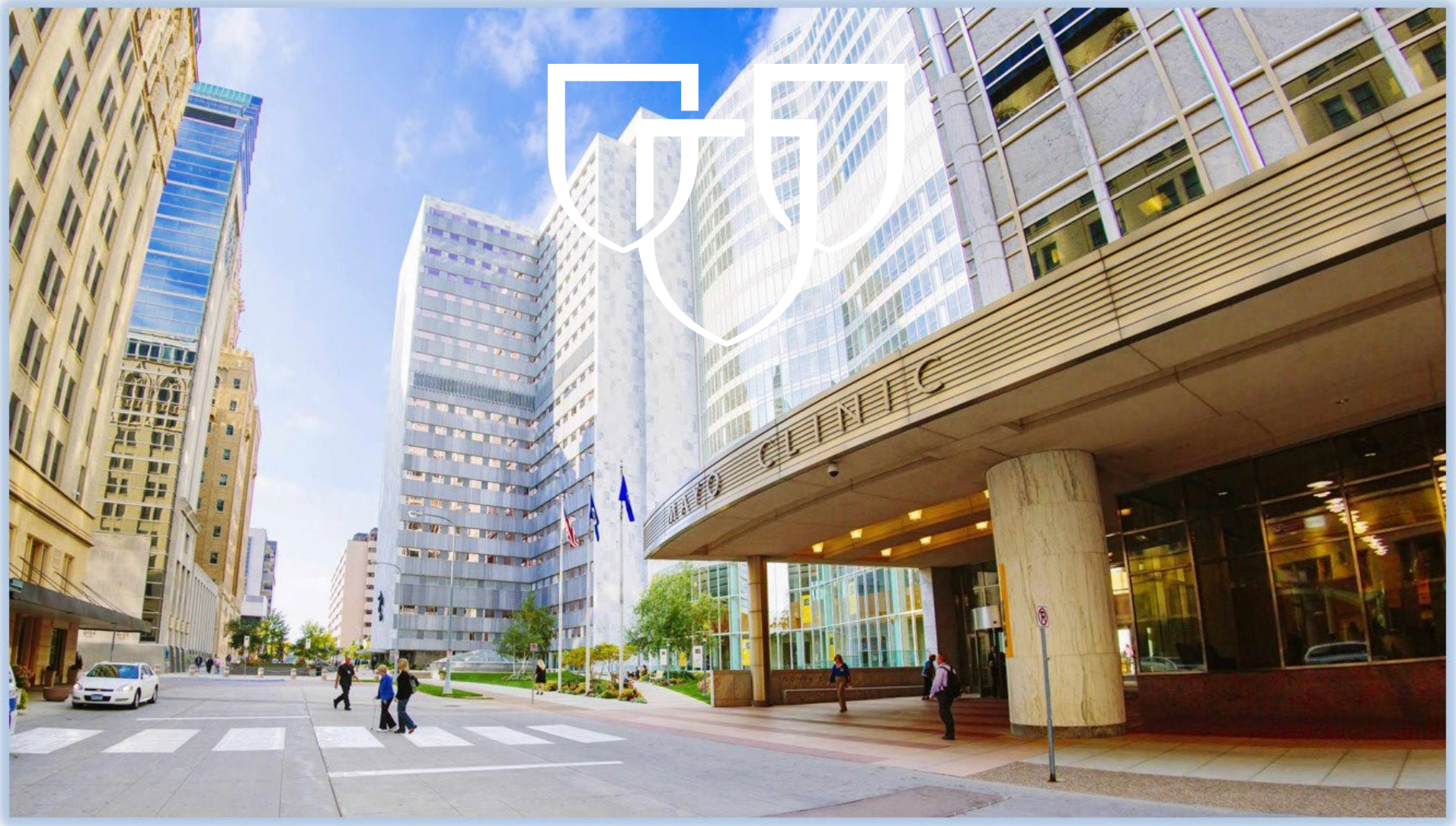
Risk and Vulnerability

- Risk and vulnerability rating for devices
- 9,000+ vulnerable Windows 7 devices (~$600M replacement cost)

Segmentation

- Segmentation policies based on Ordr behavioral baselines
- Integrated with Cisco ISE for policy enforcement

Explosion of Connected Medical Devices



Mayo Clinic – At a Glance

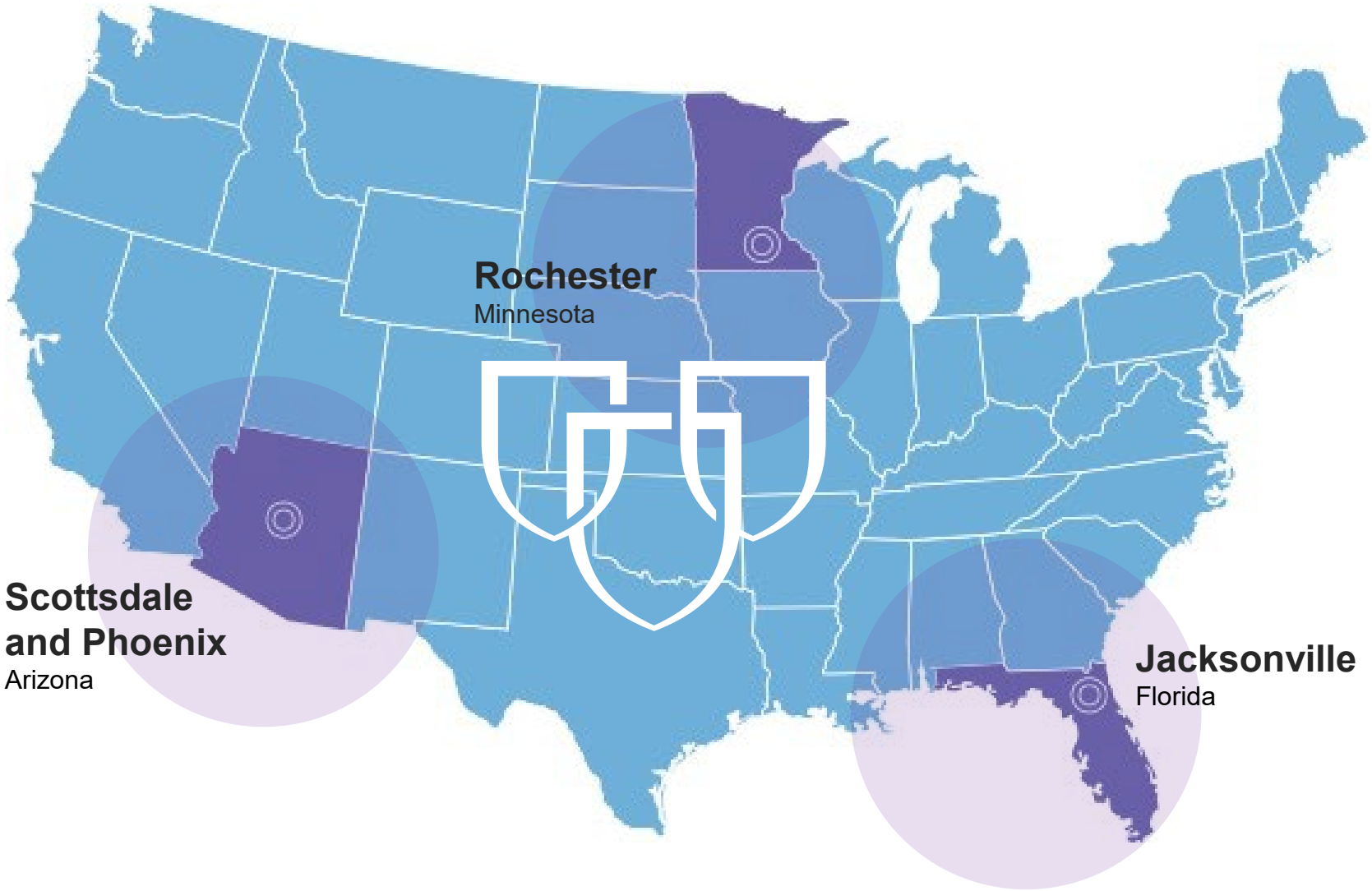
Mission:

- To inspire hope and contribute to health and well-being by providing the best care to every patient through integrated clinical practice, education and research

Primary value:

- The needs of the patient come first

Mayo Clinic Locations



HTM at Mayo Clinic

~350 HTM Staff:
~275 Biomed technicians
~30 Managers
~45 Support staff

26 Shops providing
in over 66 communities, and spanning 5 states

Over 130,000
medical devices and systems inventoried, and valued at over **$2B**

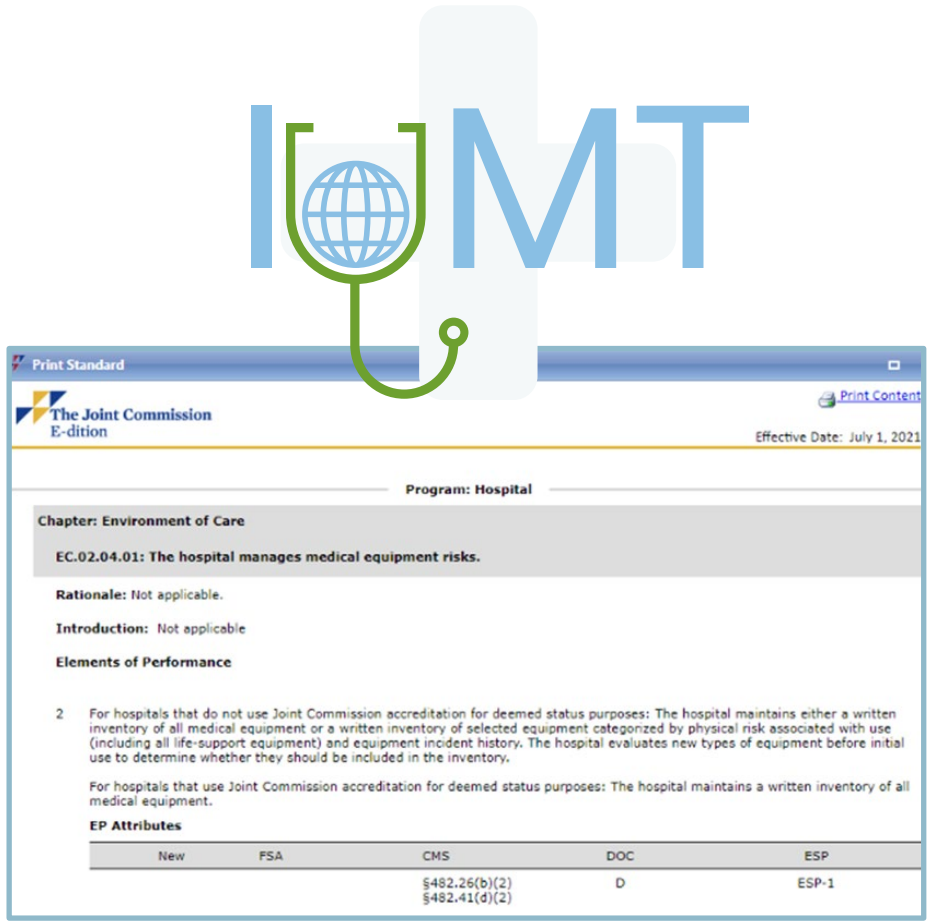
~60k
Network Connectable medical devices/systems

~16k
Facilities IoT devices/systems

Historical Cybersecurity Challenges in the Healthcare Environment

- **Security Efforts**
  - Practices Haphazard and Inefficient
  - Processes Not Automated or Operationalized
  - Risk Response Reactive
- **Equipment Security and Vendor Support**
  - Lack of Receptiveness to Scans, Patching, etc.
  - Slow to Upgrade
  - Support Deficient Through Entire Lifecycle
  - Lack Clarity and Details of Installed Software
- **Legacy Devices**
  - Large Volumes
  - Cost Prohibitive to Replace
  - Unclear Guidelines for Retirement at End of Life

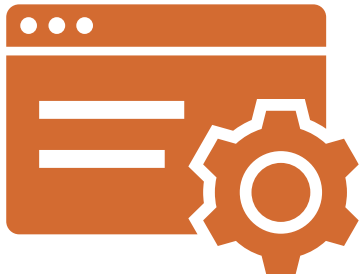
Unique Nature of IoMT



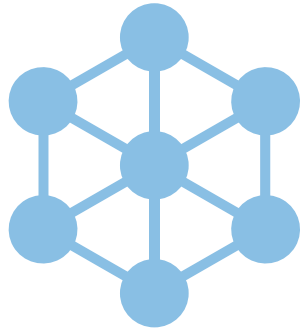
- **Regulatory guidelines (FDA, CAP, TJC)**
  - New Federal guidance with PATCH Act
  - Zero Trust guidelines
  - OIG Report
  - 405d
- **Manual, resource intensive patching process**
- **Lack of "IT" like deployment options**
- **Outdated/Unsupported Devices**
- **Largely unable to scan with standard tools**
- **Unable to load agents**

The HTM Cyber Team Process Challenges

High Knowledge but Limited Resources



Complex Mitigating Control Requirements



Inadequate & Insufficient Tools to Identify Assets

The HTM Cyber Team Organizational Fit

Information Technology

Health Technology Management (HTM)

HTM

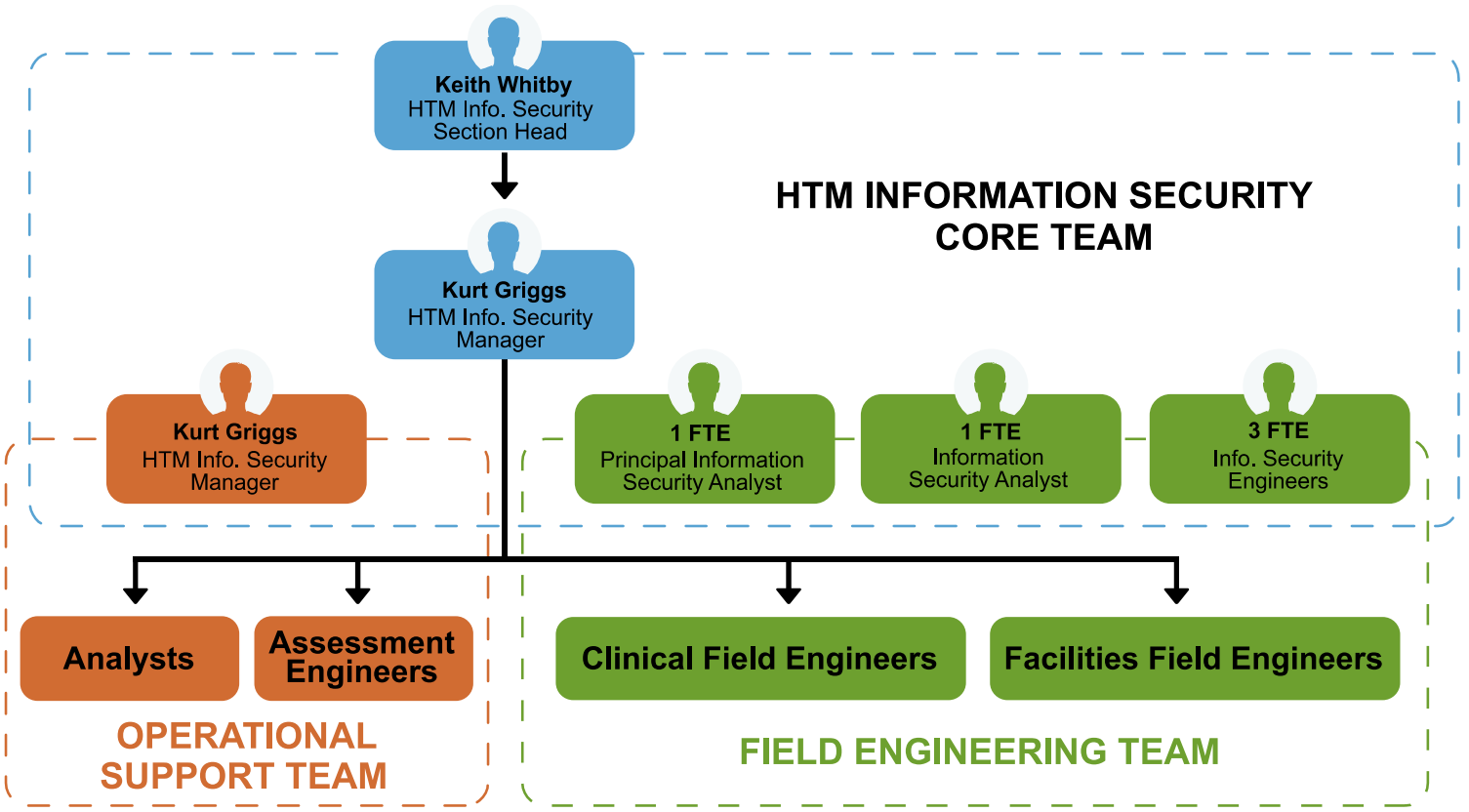
Information Security

OIS

Risk & Service Mgt. and Assurance Services

Office of Information Security (OIS)

HTM Role in Cybersecurity



- **Operationalize Security on Medical Equipment and Systems**
  - Structured
  - Standardized approach
  - Economies of Scale
- **Also….Facilities Operations and HIoT**
- **Accountability through the entire technology lifecycle**
  - Visibility
  - Monitoring
  - Action
  - Disposition
- **Guiding Principle:**
  - Ensure that equipment is functional and optimized in order to meet organizational –patient safety, business continuity, regulatory, and cybersecurity requirements.

Key Operational Tools To Execute and Automate Security Operations

nuvolo

Robust CMMS Solution (Lifecycle Maintenance)

- Enterprise Asset Management Solution
- Flexible and robust work order and workflow engines
- Supports risk scoring and modeling
- Supports vulnerability management
- Provides device profile-based approach for mitigation efforts
- Integrates with CMDB and other Enterprise Security tools
- Provides dashboarding and metrics for asset and security management

ordr

Modern Asset Discovery and Security

- Improves quality of data for Asset inventory
- Capability to detect networked medical devices (including legacy)
- Robust medical device asset classification
- Provides insight into connected device actions
- Supports device security operations
- Integrates with other Enterprise Security tools
- Micro-Segmentation
- Behavior detection and monitoring

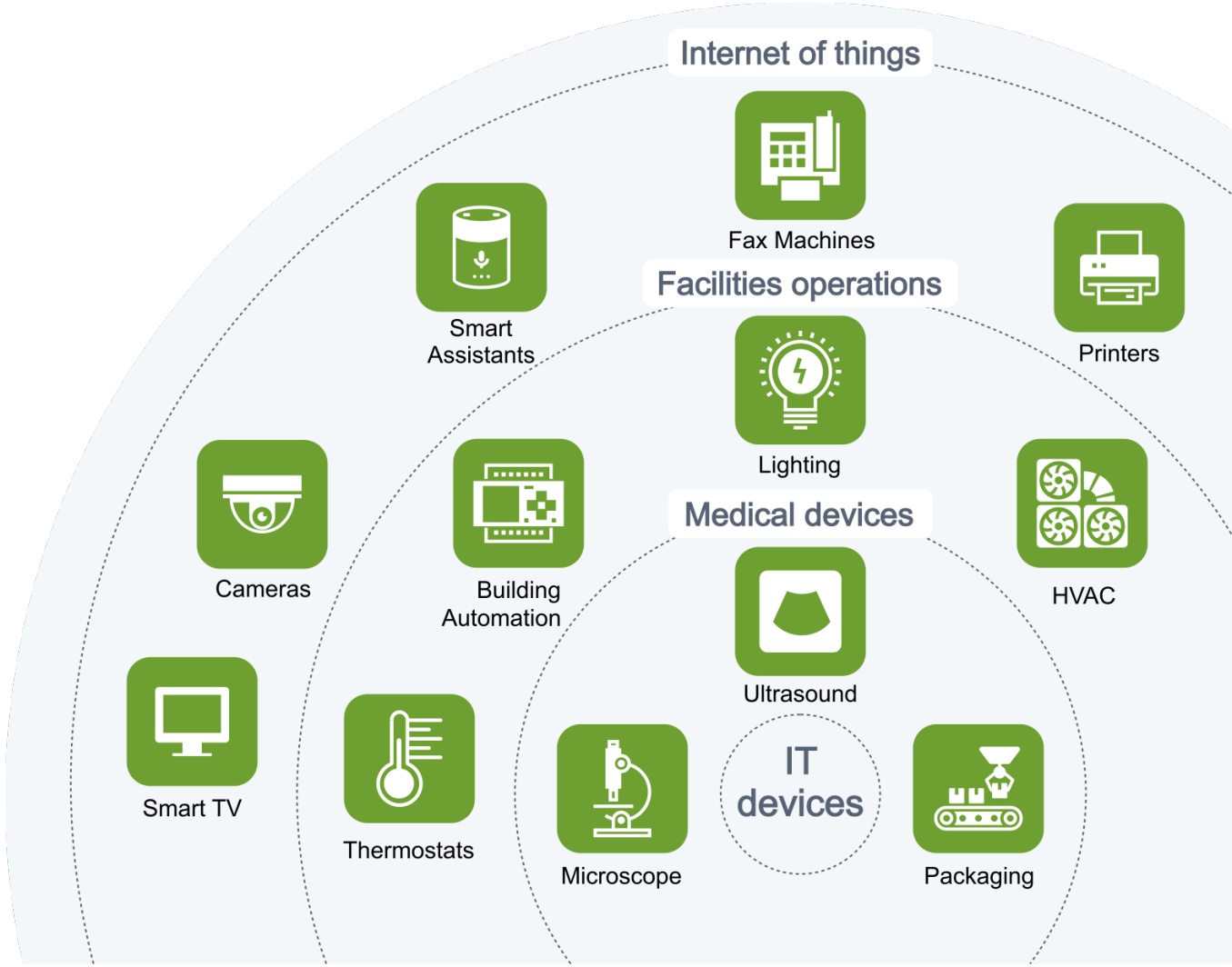
Execution


Policy & Process
Vulnerability Management
Tools Deployment
Lifecycle Profile
HTM Cybersecurity Program
Training & Industry workgroups
Patch Management
RISK
Fleet Risk Assessment
Vendor and Device Assessment

Visibility:
Asset Inventory, CONNECTIVITY AND FLOWS, and Device Utilization

Visibility at Mayo Clinic

- 130,000 connected devices
  - CMDB with specific attribute capture
  - ISE MAC address match
- Ordr identifying devices profiled as medical devices and facilities devices and matching with CMDB
  - Attributes – MAC address, IP address, hostname to clean and complete inventory
  - 570 medical device categories – examples: medical devices/systems, research instruments/systems



Visibility is More Than Device Attributes

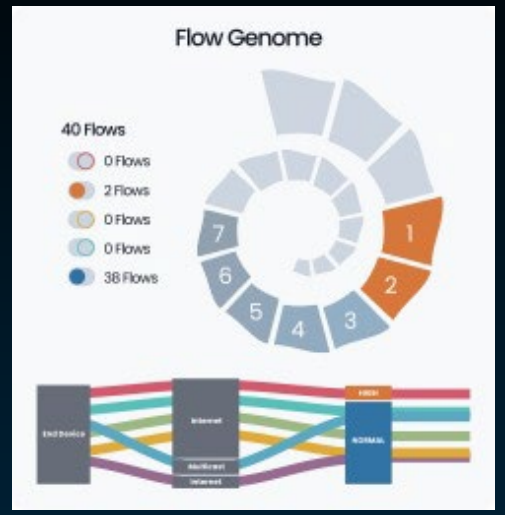
Device information

MAC: 00:18:65:65:8D:8E
Device description: CT Scanner
Manufacturer: Siemens Healthcare Diagnostics Manufacturing Lt
Model Name: Somatom Force
Serial Number: SI38913958
O/S Version: BSP
DHCP
Hostname: somatomforce-537
PHI: NO
Vulnerabilities: Log4J

Connectivity

SCE Sensor: San Jose Office
IP: 10.38.138.202
SUBNET: 10.38.136.0/22
VLAN: VLAN0860
ACCESS TYPE: Wireless
Location: FOURTH FLOOR
Network Device:10.1.24.40 (Cisco-AP-117)
WLAN SSID: CloudPost
WLAN AP: 84:B8:02:62:16:B7
FIRST SEEN: 9/25/20 7:21:49 PM
LAST SEEN: 9/25/21 7:21:49 PM

Network flows



Siemens Somatom Force CT Scanner

- Complete inventory with rich context
- Baseline activity per device and/or category (profile)
- Connectivity and behavior critical to Zero Trust and to identify anomalies

Device Utilization at Mayo

- Leveraged Covid to implement utilization features
- Benchmark tool for ventilators and infusion pumps
  - Volume/Location
  - Special integration with pump infrastructure
  - Capsule Neuron—asset labeling
  - Also used CMMS and RTLS
- Collaboration with Radiology Informatics
  - Developing DICOM reporting

Risks
and Vulnerabilities

Risks of Connected Devices in Healthcare

Healthcare organizations need a comprehensive view of medical device and HIoT risks

Medical Device Overall Risk

Incident Risk

- High Risk Protocols
- Communication Anomaly
- External Communication

PHI Exposure Risk

- PHI presence
- Manufacturer disclosure (MDS2)
- Behavior
- Device Portability
- Encryption at Rest/Transit

Device Vulnerability

- Device Vulnerability
- OS Identification
- Endpoint Security State (MDS^2)
- Software Bill of Material (SBOM)

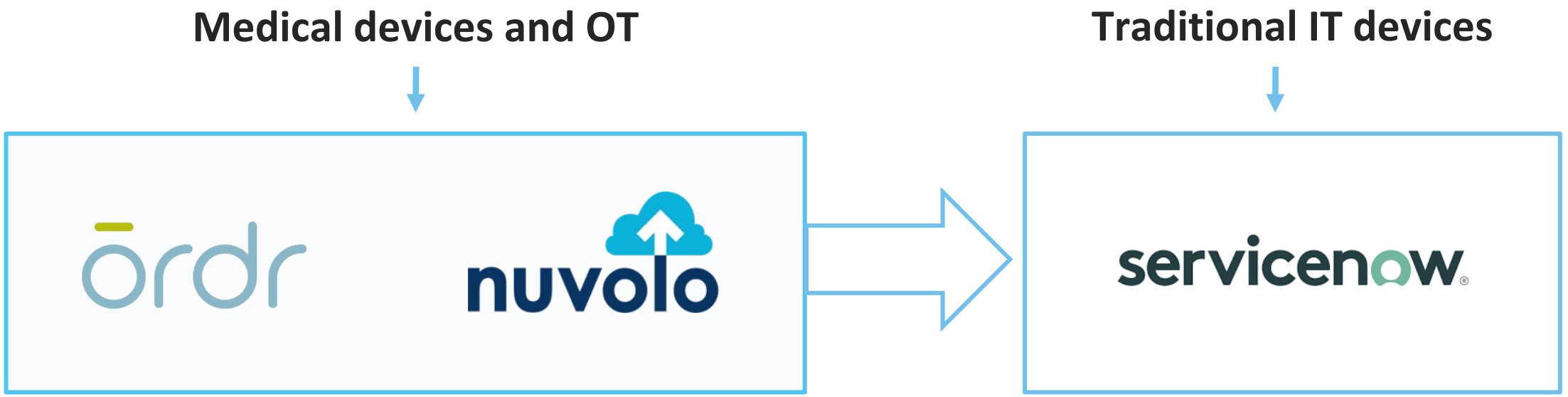
Clinical Risk

- Physical Risk
- Equipment Location
- Mission Criticality (Availability)

Vulnerability Management

- Organizations conduct extensive scanning of traditional IT equipment
- Cannot complete active scanning for most medical devices and OT technology
  - Traditional vulnerability discovery products are using passive tools to "scan"
  - Mayo partnering with Ordr
- Target is a single pane of glass view
  - All vulnerabilities
  - Every connected device in the environment
  - Aggregating vulnerability information and reporting
- Risk-based approach
  - How should organizations prioritize where to start risk mitigation?

Vulnerability Management

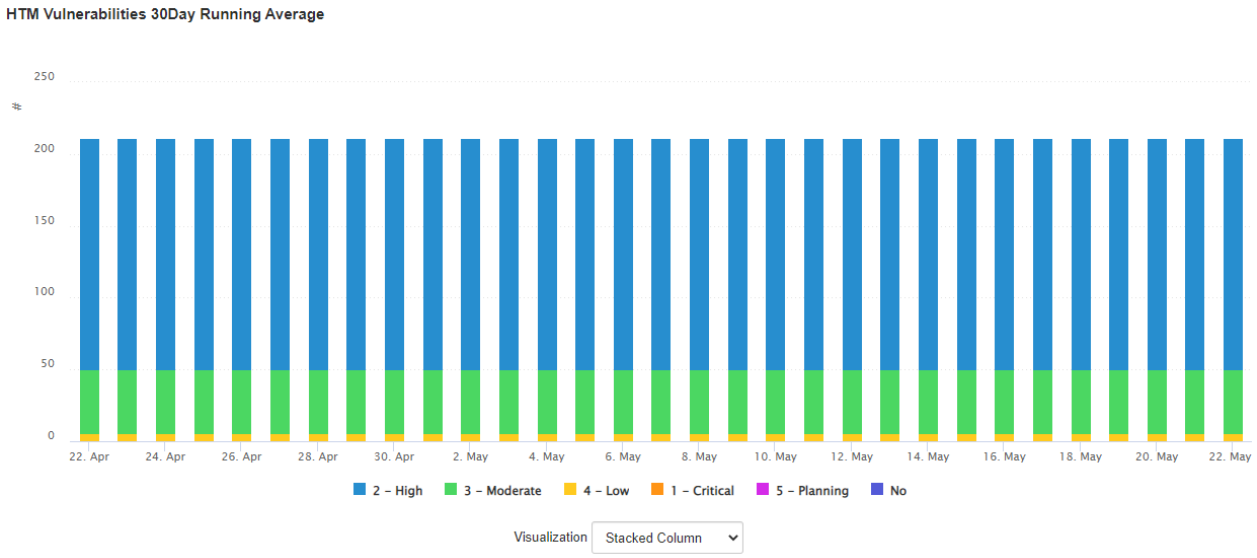


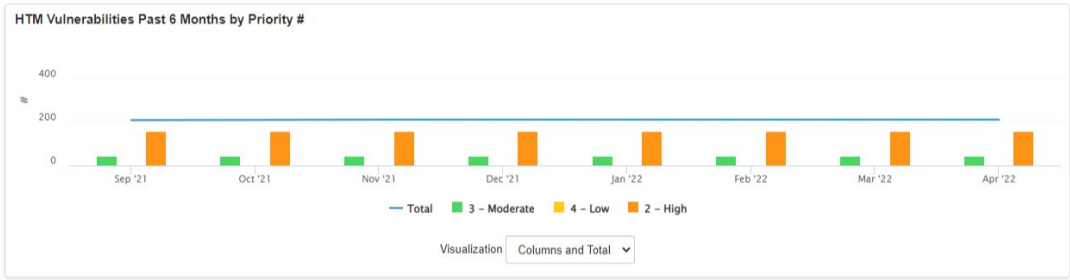
Passive Medical Device Scanning tool delivering vulnerability details

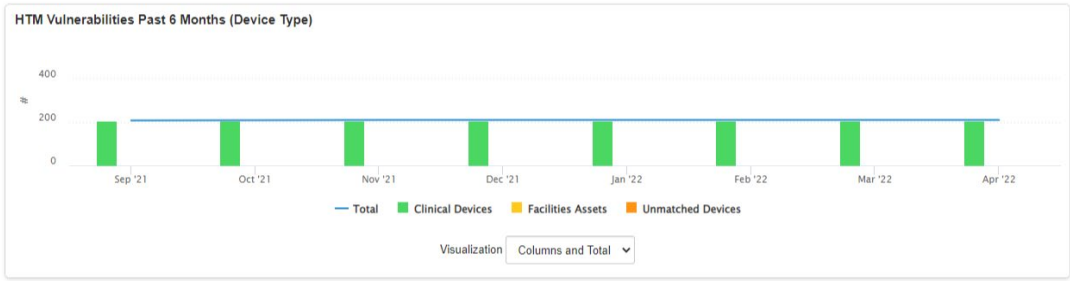
Assets are matched against Nuvolo inventory

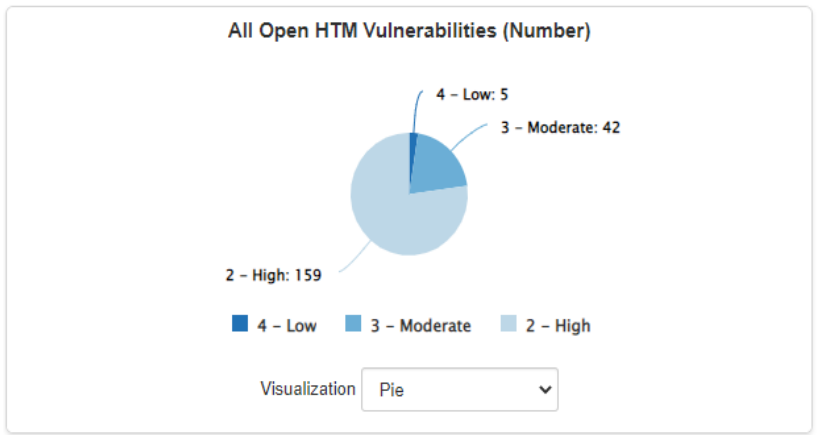
- **IoMT and OT:** Nuvolo Vulnerability Dashboard built on top of ServiceNow
- **Traditional IT:** Dashboard in ServiceNow

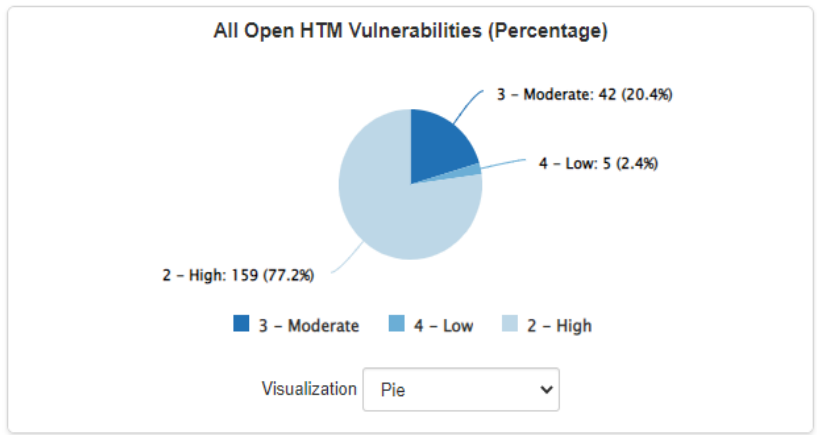
Dashboard Examples



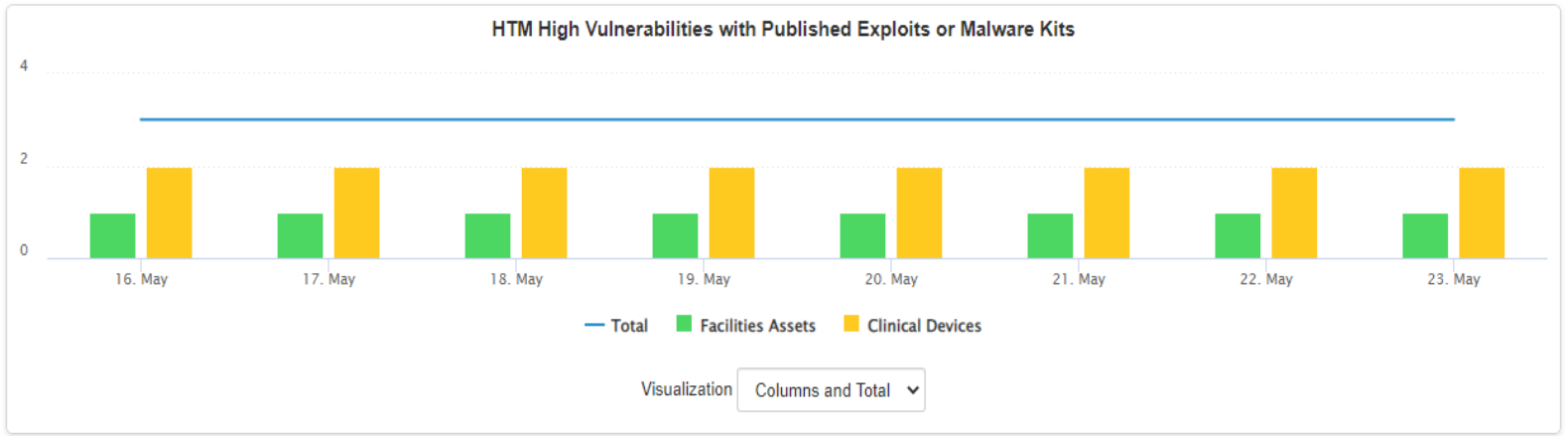


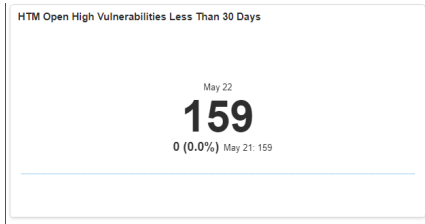


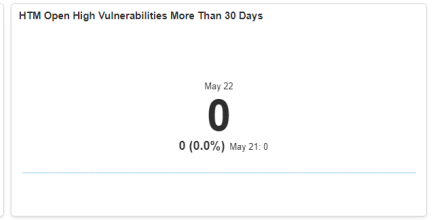


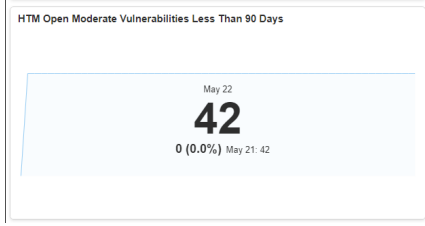


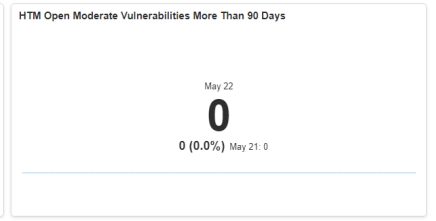
Dashboard Examples

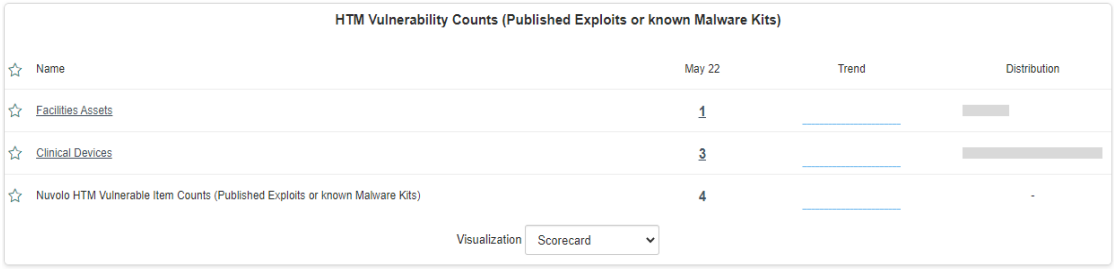


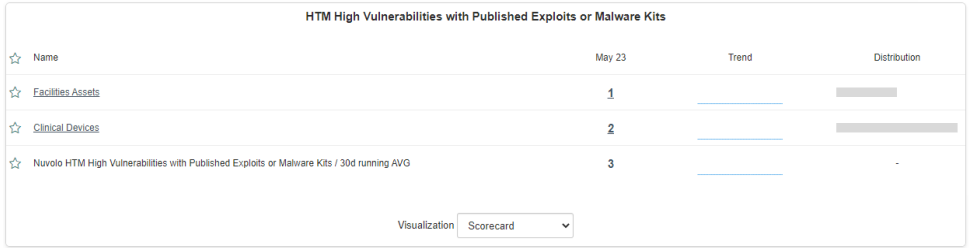


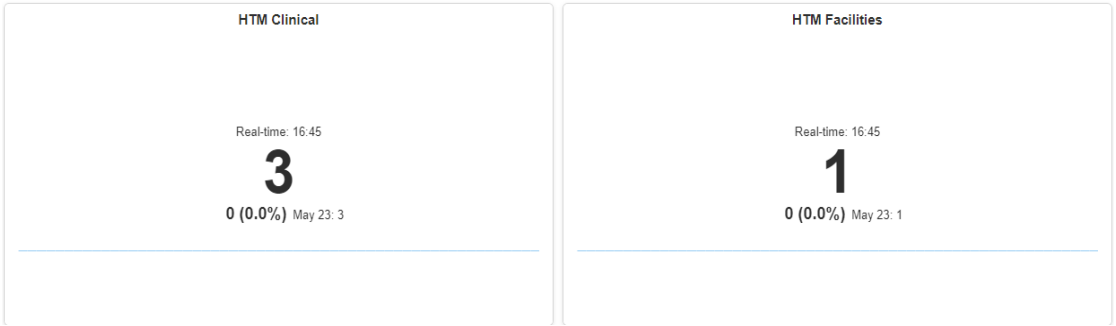


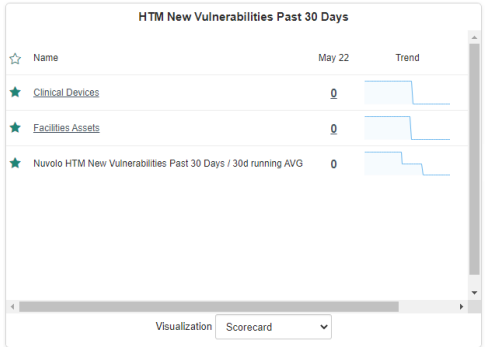


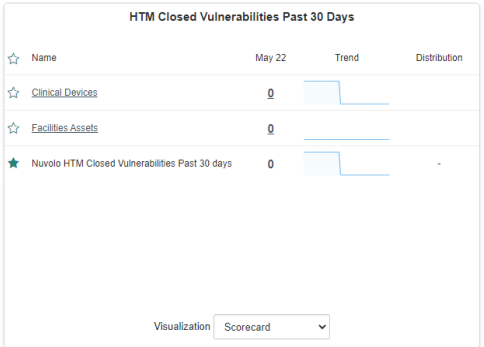












Zero Trust Segmentation - Micro and Macro

Unsegmented Means Unregulated Behavior

- Everything is put into the same enclosure
  - Herbivores
  - Carnivores
  - Omnivores
  - Endangered species
  - Convalescing animals

Segmentation: Setting trust boundaries between all animals

Top Down Segmentation for Scale

Bottom Up Segmentation for Control

Micro Segmentation at Mayo

- Security
  - Microsoft ended general support for the Windows 7 operating system (OS) in 2020
  - January 2020 - Desktop
  - October 2020 - Embedded
  - Medical device inventory also includes other out of support OS's
- Impact
  - Thousands of medical devices impacted
- Remediation
  - Micro-segment devices utilizing capabilities of Ordr tool
  - Successfully created segments and related policy

Visibility is More Than Device Attributes

Approach

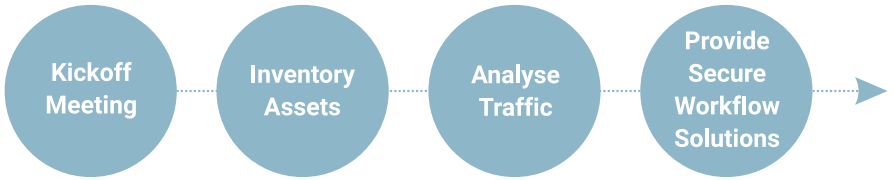
- **Approved to Microsegment Medical Devices with Windows 7 and Older OS's**
- **The project team evaluated several methods to identify device segments**
  - manufacturer, model, device category, sub-category, region, building, floor
- **Preferred Identification method is device category and sub-category (from CMMS)**
  - Based on utilization of existing category/ subcategory classification in HTM management system
  - Estimated 15-20 categories (device groups)
- **Leverage Ordr**
  - Create custom profiles (Category/Sub)
  - Monitor flows and establish baselines
  - Generate ISE SGACL policy

Macro Segmentation – Limiting communications

Approach

- Scoped project to "close" specific business areas
- Closed = nearly zero inter-segment traffic between business area segments
- Systematic assessment to assure correct device membership
- Identified workflows that cross segment boundaries
- Remediate cross segment traffic
  - Enterprise services to perform function (file transfer, e.g.)
- Leverage ISE SGT's to classify devices and apply policy (define permit and deny capabilities)
- Monitor changes

Segmentation Process



Communication throughout the Process

"ORDR Snapshot"

TRAFFIC INTO Sample Segment

dstProfile	IN	
DGT	dstPort	Count of srcIp
ADM_NET_INT (13900)	16403	1
RES_WKS_MAN_TEMP	1947	1
	ANY	2
ADM_WKS_MAN (12120)	ANY	1
ADM (10000)	139	1
	445	1
	17500	1
PRC_WKS_MAN (17100)	445	1
Unknown (0)	1001	2
19310 (19310)	445	1
	1947	1
Grand Total		13

TRAFFIC OUT OF Sample Segment

dstProfile	OUT	
Direction	dstPort	Count of srcIp
ADM_NET_INT (10150)	1026	1
	5200	2
	8018	1
ADM_NET_INT (13900)	80	68
	443	430
	465	1
	993	4
	3478	2
	5223	6
	8080	1
	16384	1
	16386	1

UTILIZED PORTS

	DGT	(Multiple Items)
Out Of Scope Ports	dstPort	Count of srcIp
137	80	68
138	123	2
7680	139	2
	161	1
	443	435
	445	7
	465	1
	515	1
	993	4
	1001	2
	1026	1
	1900	3
	1947	3
	2869	1
	3478	2
	3702	2
	5000	1
	5200	2
	5223	6
	5353	1
	5357	1
	8018	2
	8080	1
	8088	6
	16384	1
	16386	1
	16403	1
	17500	2
	43625	1
	ANY	6
	Grand To	567

Traffic Analysis and Anomaly Detection at Mayo

Use Cases

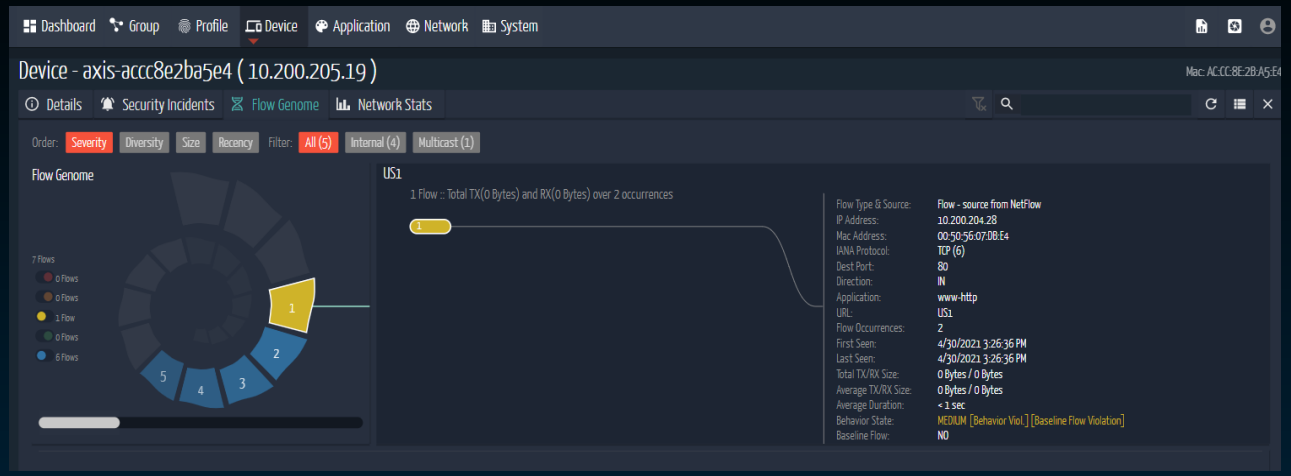
- Specific Patients
- Specific vulnerability signatures
- Fleet

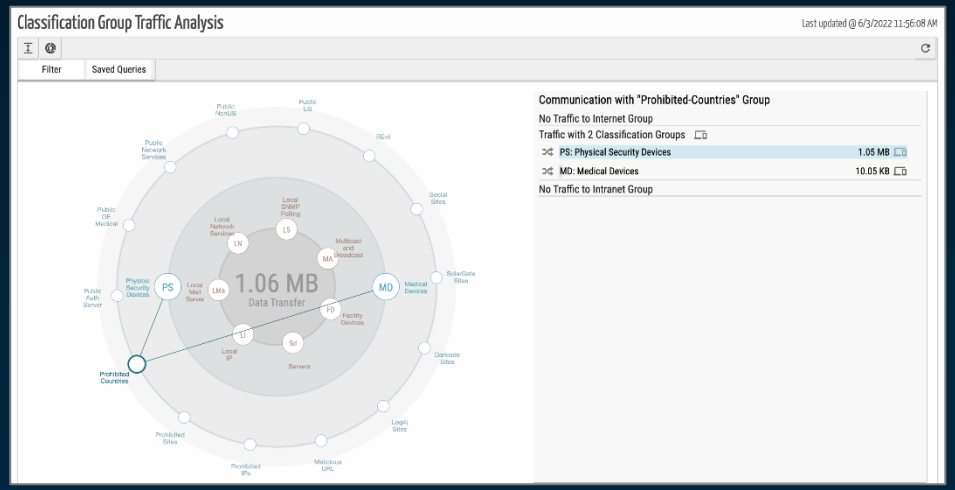
Proactive

- Ordr Profile/Baseline
- Integration with SOC/SIEM

Reactive

- Rules based
  - Specific flows, protocols, services
  - Custom profiles (locations, devices)
  - Custom alerting
  - Specific vulnerabilities





Anomalous Behavioral Detection and Response at Mayo

- VIP patient room = custom profile
- Behavioral baselining
- Alerting when deviation from baseline is
  - Email alert
- Future: automation of segmentation
  - Full integration on SIEM, security response based on log file analysis
  - Automated segmentation policies for devices that behave outside of baseline

Summary

- Medical devices and healthcare IoT (HIoT) pose unique security challenges
- No silver bullet – people, process, technology
- Specialized and focused teams facilitate the operationalization of organizational security efforts
- Need clear goals on what to accomplish
- Leverage tools/automation to:
  - Reduce resource overhead
  - Asset Visibility
  - Workflows
  - Dataflow visibility
  - Segmentation
  - Utilization

Questions?

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Thank You

Please complete the online evaluation/attendance form at

https://www.surveymonkey.com/r/ACCE-Ordr_08-05-22

Or scan the QR code