HDO infrastructure
Departmental structure
HDO size
Inventory management
Network infrastructure
Procurement process
Regulations and policies
Responsible stakeholders
Trend: Increasing connectivity

HDO mitigation actions
Device configuration
Disconnect device
Network-level mitigation
Physical security measures
Processes and policies
Risk management

Challenges for HDOs
Differences across HDO departments
Effortful updating process
HDO's passive position
Incompatibility with existing infrastructure
Long device span and legacy systems
Medical device security lagging behind
Overwhelming inventory management
Software bundling
Unexpected update behaviours
Unsatisfactory vendor contact

Risk perceptions
Hospital/patient data at risk
Lack and/or delay of security updates
Manageable medical device security risk
Medical devices as an entry point
Remotely accessible medical devices

Emergency updates
Prevalence
Installation timeline
Obligatory nature
Safety priority

Patching process steps:

(*i*) Decision-making: Internal vs external
Control over maintenance
Costs of inhouse maintenance
Costs of outsourced maintenance
Ecosystem benefits
Efficiency considerations
Interesting task
Maintenance complexity and safety

(*ii*) Learning about updates
Active checking on vendor platform
Approach manufacturer
By medical device users
Direct notification by authorities
Direct notification by vendor
During external technician visit
During sales meetings
Network surveillance identifies vulnerability
No active checking

(*iii*) Deciding to update
Avoid changes to device
Cost per update/upgrade
Effortful installation process
Inquire with medical colleagues
Inquire with technical colleagues
Non-security aspects
Security and safety updates always
Update scope

(*iv*) Preparing an update
Arrangement with external technicians
Arrangement with medical departments
Back up plan
External testing
In-house testing

(*v*) Installation
Installation location
Installation medium
Installation timing
Patient care during installation
Installation timeline

(*vi*) Handling post-update issues
Manufacturer post-installation support
Post-update issue prevalence
Rollback

Codebook for the interviews with Healthcare Delivery Organizations (HDO) stakeholders.