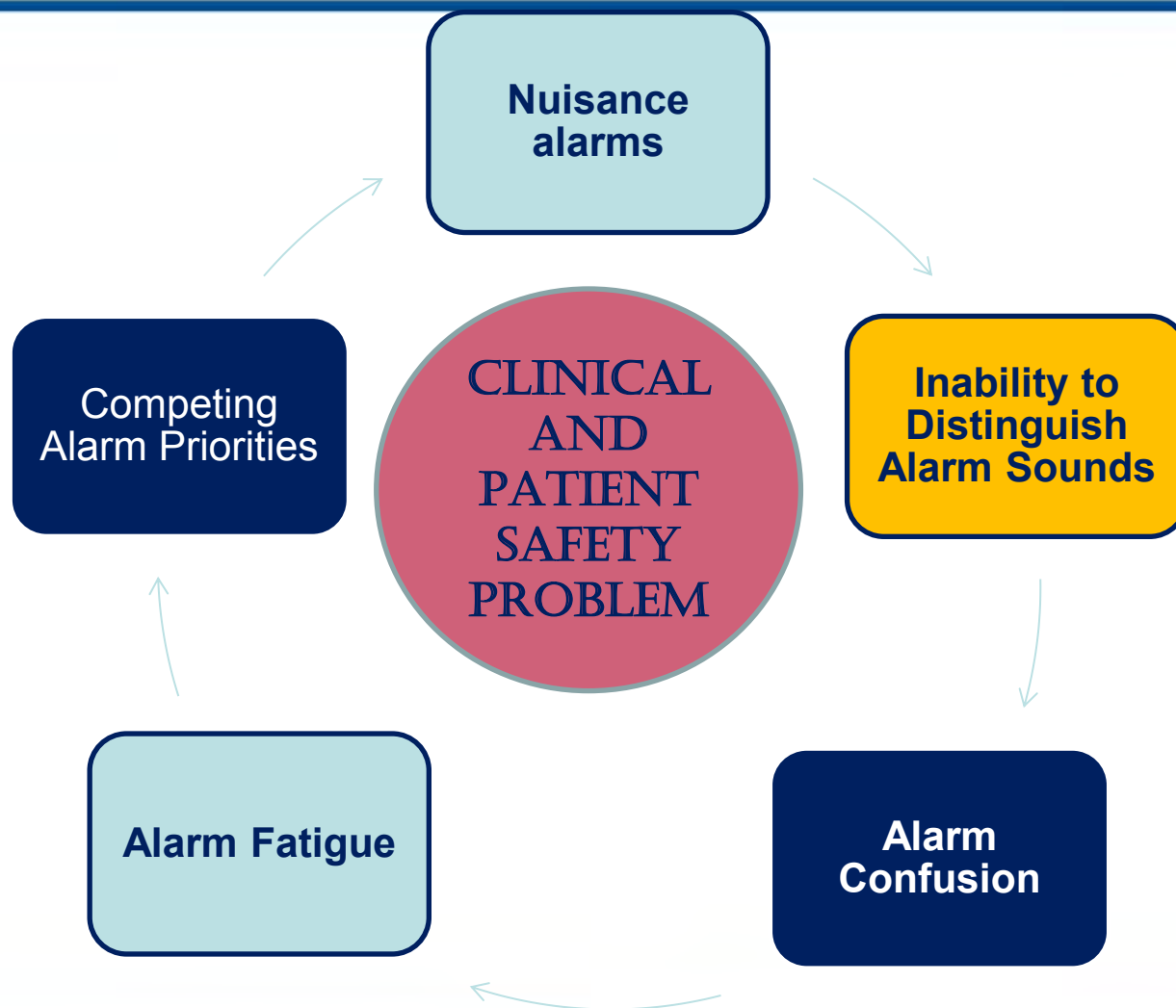




JOHNS HOPKINS  
M E D I C I N E

# The Role of Middleware in Alarm Management

- ✓ secondary means of annunciation or presenting alarm tones
- ✓ provides mobility – allowing the origin of an alert tone to move with a clinician.





CENTRAL  
MONITOR

ECMO

Which  
sound to  
respond to  
first

IV Pump

Bedside  
Monitor

Vent

Pager

Bed  
Alarm

NURSE  
CALL

Wi-Fi  
Phone

Mechanical  
Circulatory  
Support Device

# Middleware

- Allows the unit to develop rules to be followed for sending alarms/alerts wireless communication device
- Rules can be at the alarm/alert level
- Connexall technology used for this work at Johns Hopkins Univ Hospital.

# How Do You Decide How Much Delay To Place On Which Alarms

High-Priority Alarms  
(no delay to provider)  
Medium Priority  
Alarms  
(add delay)

Unit Demographics  
Nurse:Pt ratio  
Unit layout

Device Alarm  
Type  
ventilator/exit  
alarm/ laboratory

Review of alarm  
data to  
determine  
frequent alarms

# The Impact Alarm Delays Have On Total #Alarms/Bed/Day

	Total Alarms No Delay	Total Alarms Delay <10	Total Alarms Delay <15	Total Alarms Delay <30	Total Alarms Delay <60
Crisis-0	585	437	230	222	24
Warning-1	4731	3609	1567	635	247
System Warning-3	2575	1967	1526	920	417
Total	7891	6013	3323	1777	688
Census	22	22	22	22	22
All Al/pt/day	359	273	151	81	31
Ave Alarms/Pt/Day Crises	2	23	1	1	0
Ave Alarms/Pt/Day Warning	18	14	6	2	1
Ave Alarms/Pt/Day System Warning	10	7	6	3	2

**THE CHALLENGE:  
Maintaining a Balance  
Between  
Alarm Management Strategies  
to Decrease Alarm Burden  
and  
Maintaining Patient Safety**



**Decrease  
Alarm  
Fatigue**

**Maintain  
Patient  
Safety**

# Safety Nets

**Device  
Downtime  
Process**

**Patient  
Assignment  
Orphan Check**

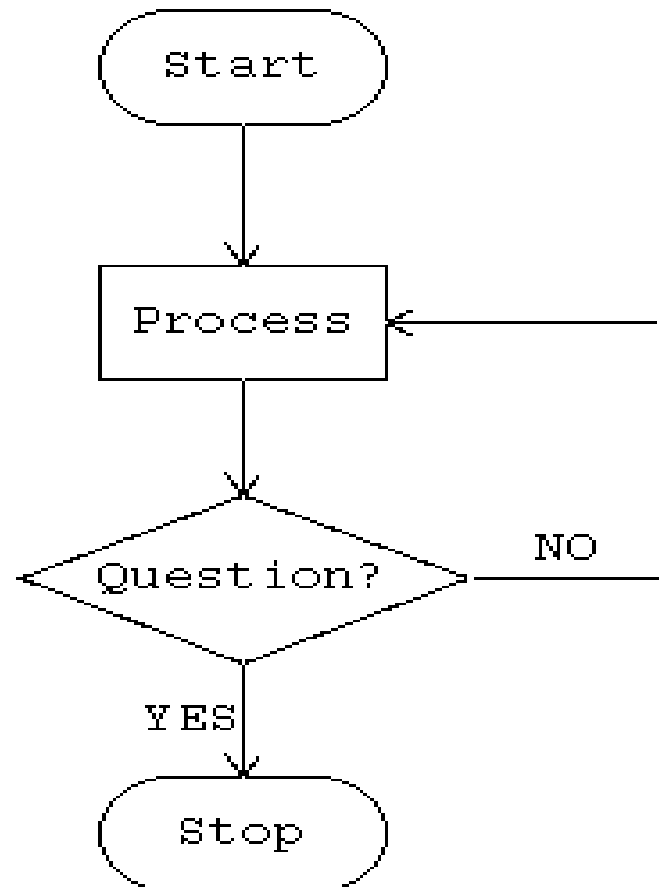
**Workflow  
for Alarm  
Escalation**

**Ongoing Staff  
Education**

**Virtual Call  
Points for  
Notifications**

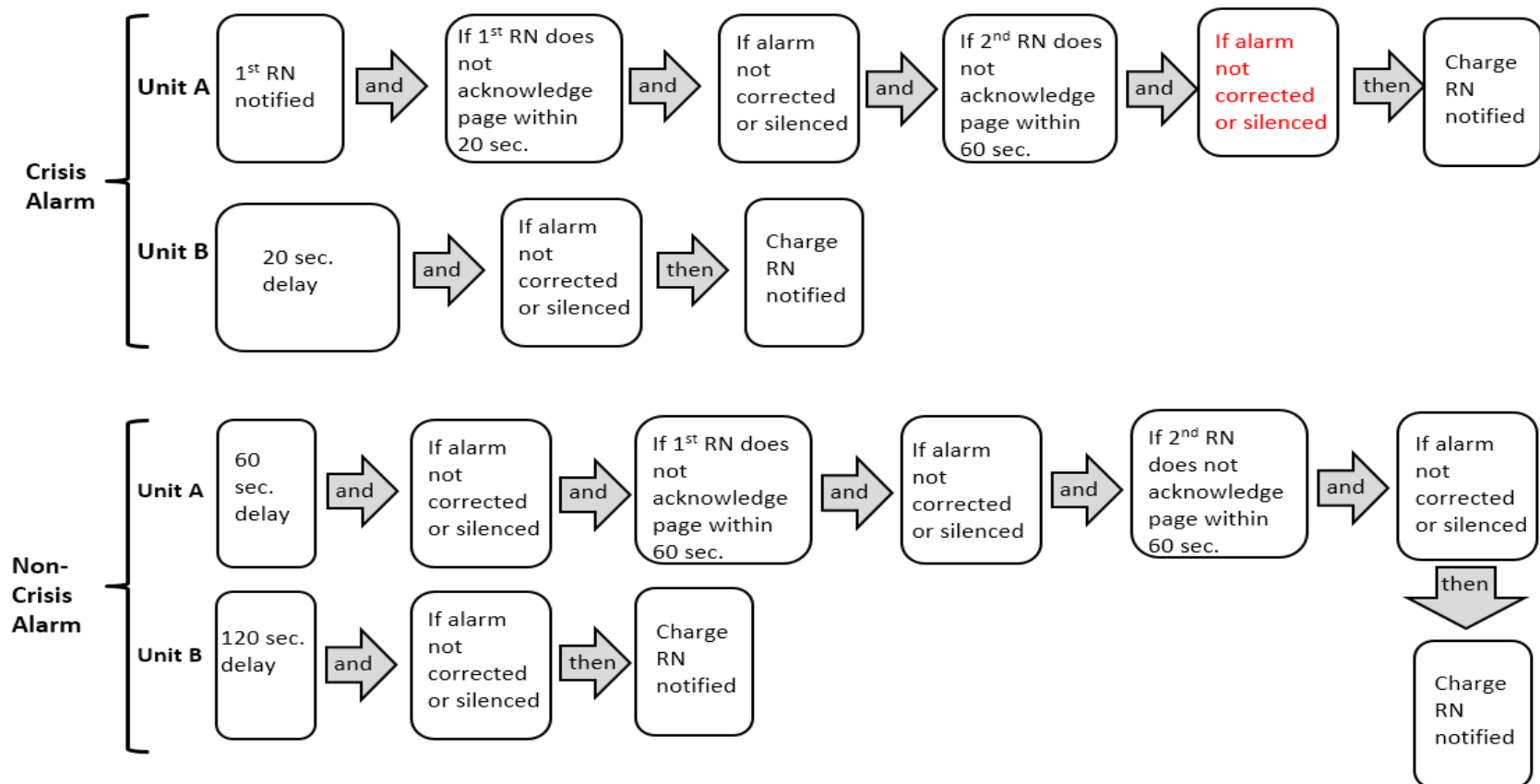


# ALARM ALGORITHMS

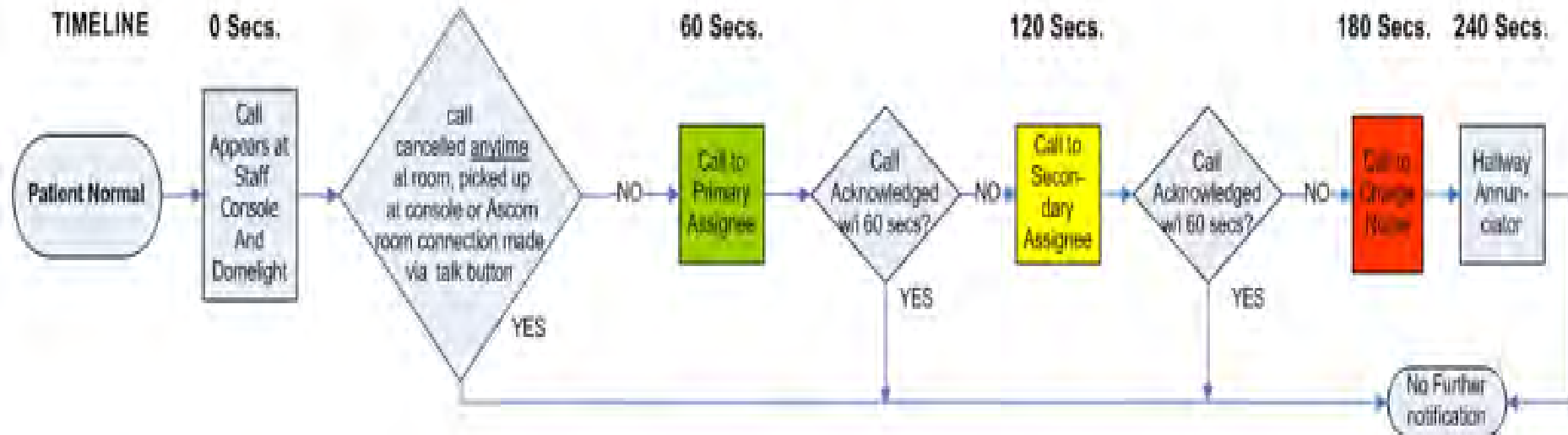


# Monitor Alarm Escalation Algorithms

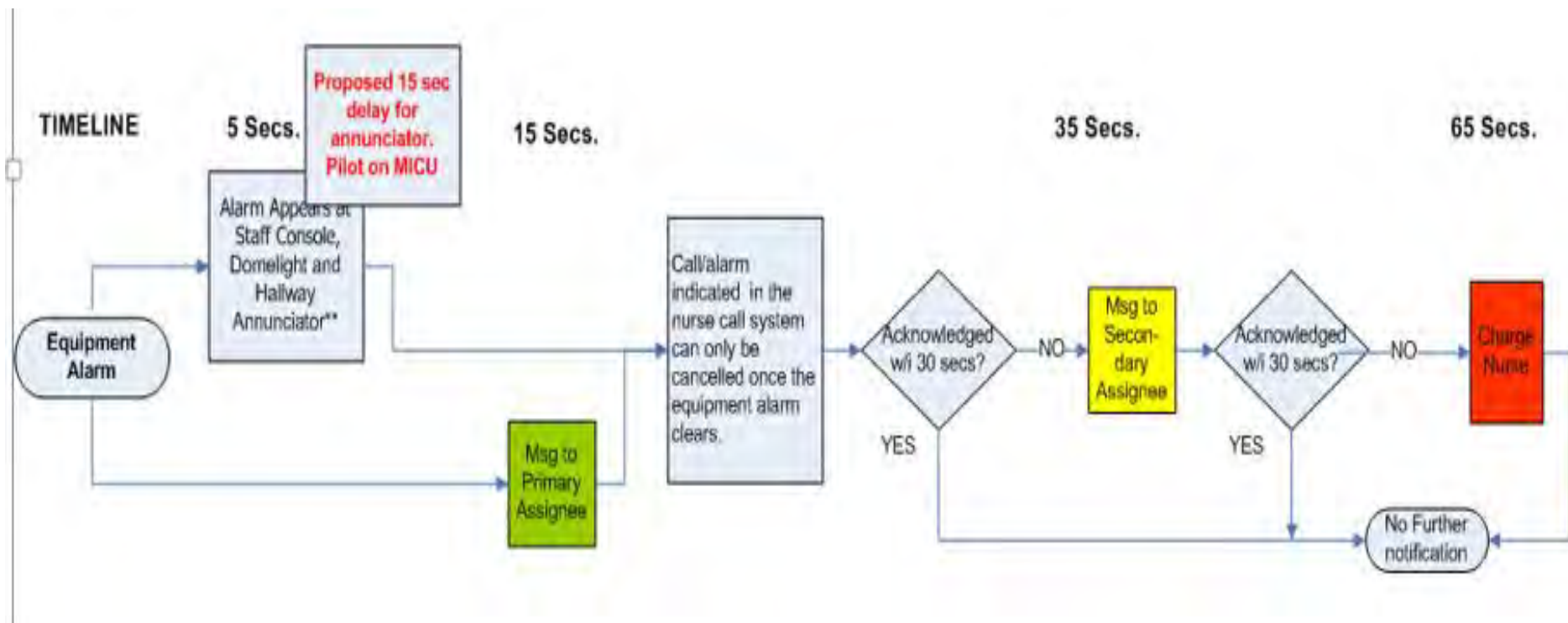
Supplemental Digital Content, Figure 1 : Alarm Escalation Algorithm



# PATIENT CALL ALARM ALGORITHM



# VENTILATOR ALARM ALGORITHM



# Other Benefits of Middleware



- **Time Trigger Alerts** – Alerts that are sent to a wireless device at a certain time of day
- **Virtual Call Points** – Group calls that can be sent by the press of a button

