MetaMonitor: a system for patient monitoring in intensive care units

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Spring 2004


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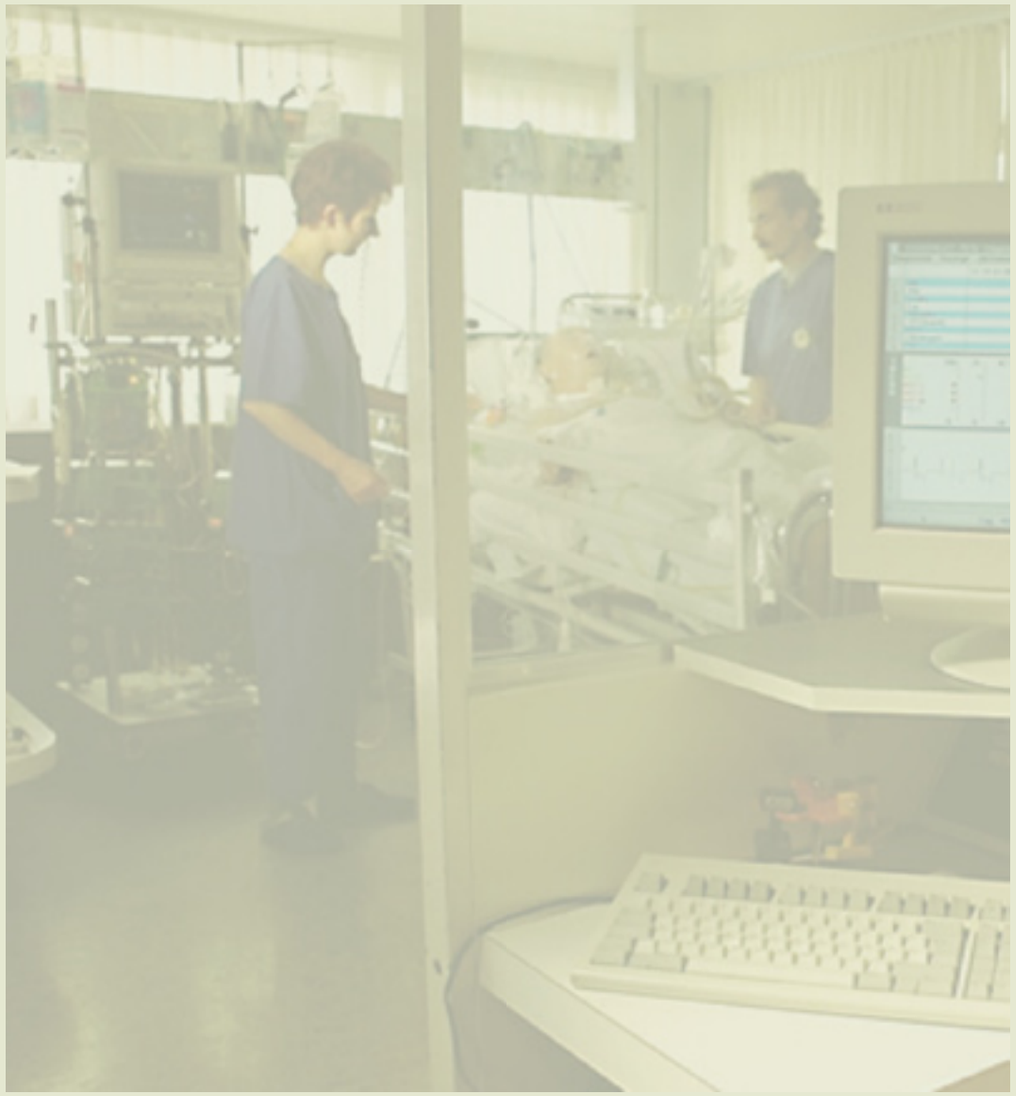
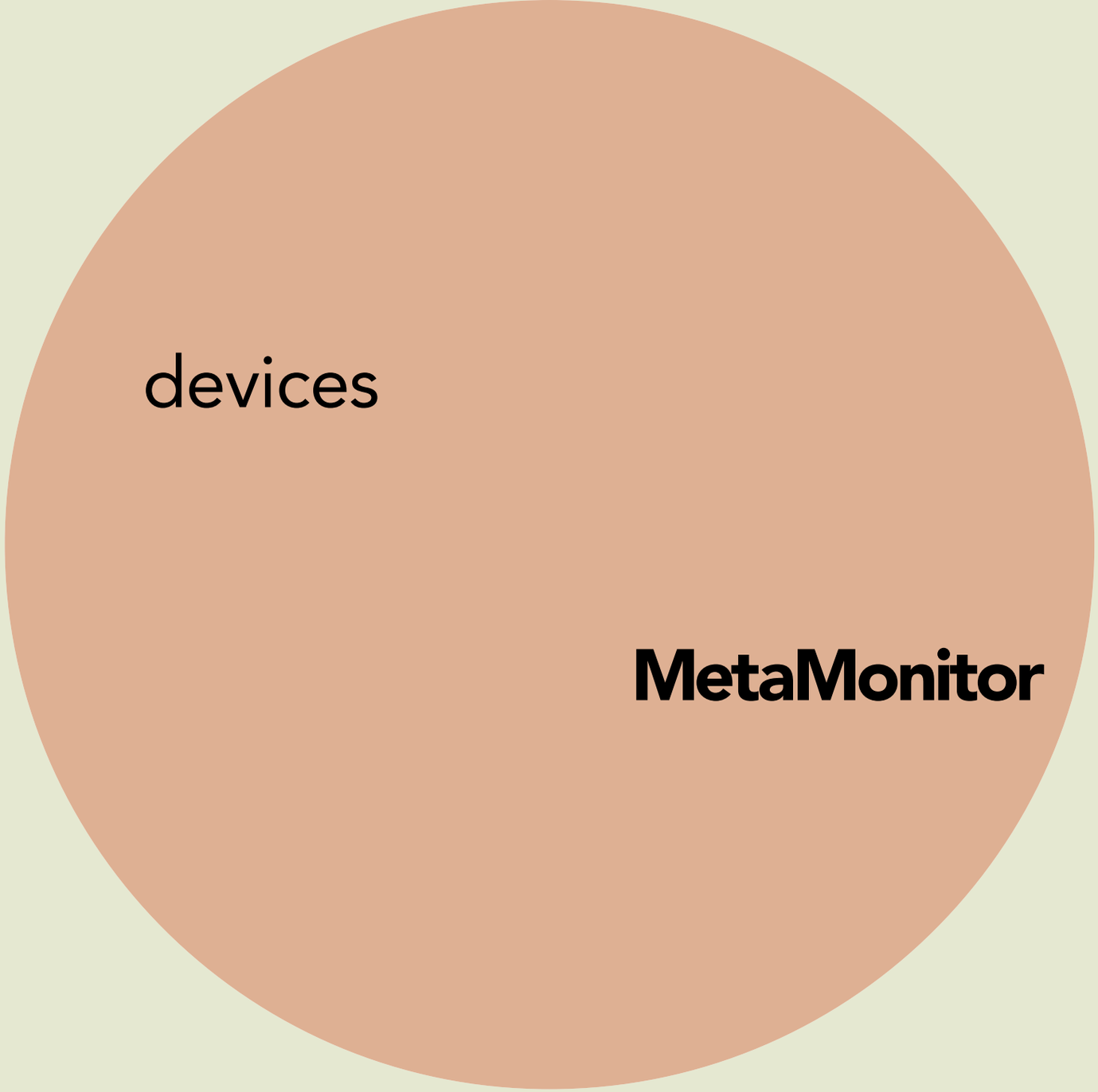


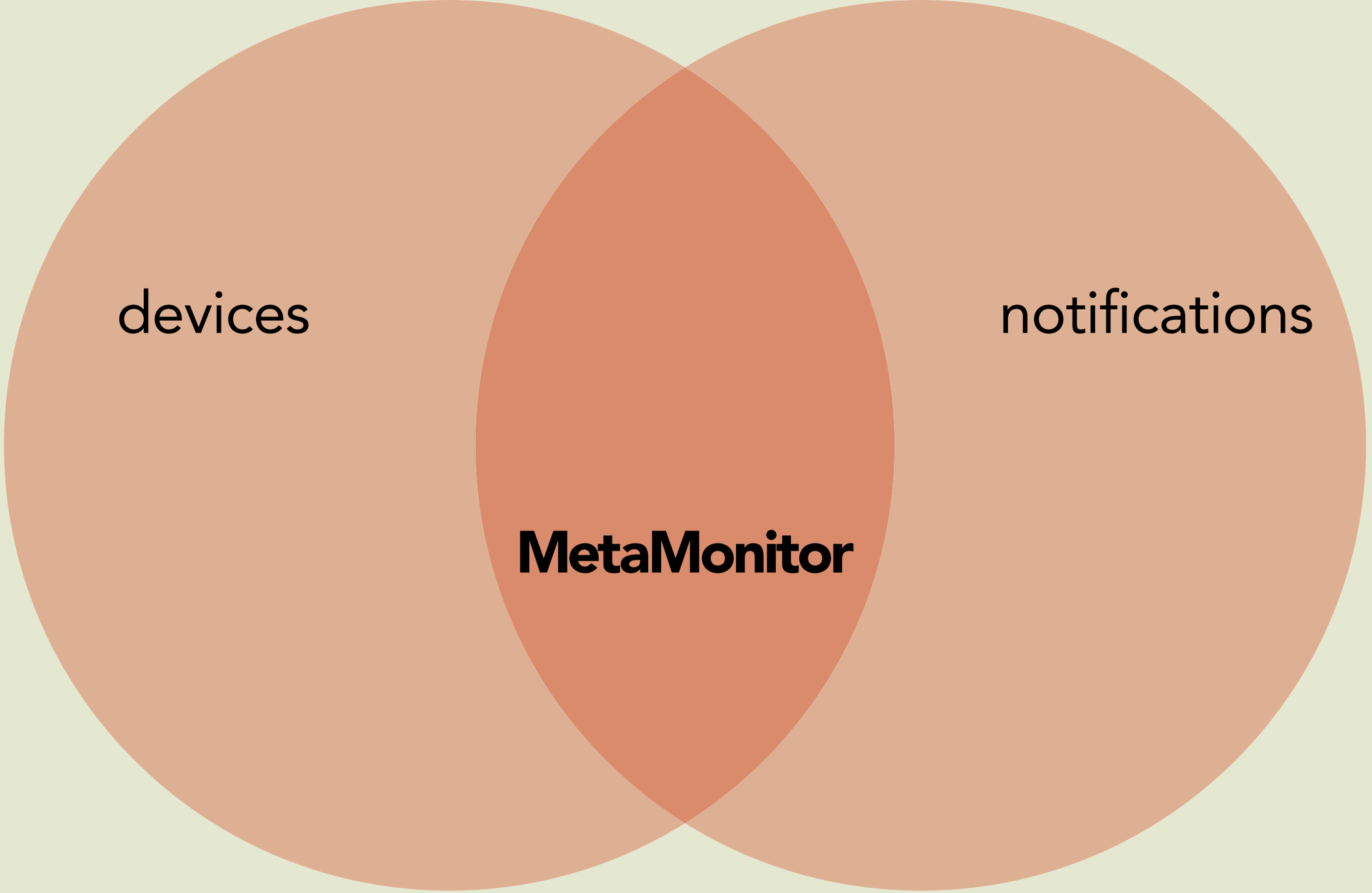
monitoring

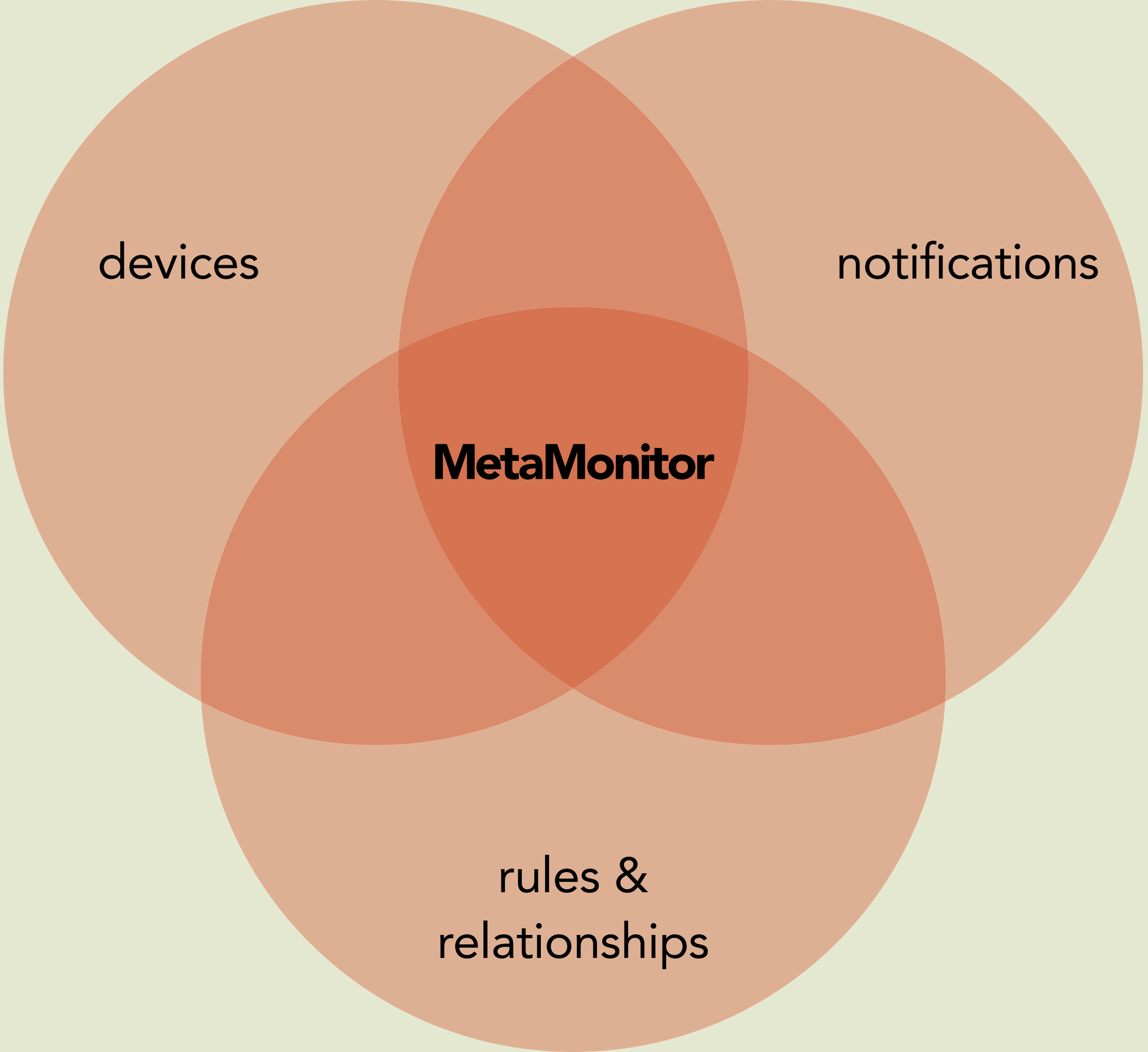
alarm response

MetaMonitor

MetaMonitor creates a coherent, unified system for conveying alarm and patient information from various devices to nurses. By providing easily accessible information and through an awareness of nurses’ actions, MetaMonitor allows nurses to focus on responding to the patient rather than responding to the alarm.


devices
MetaMonitor

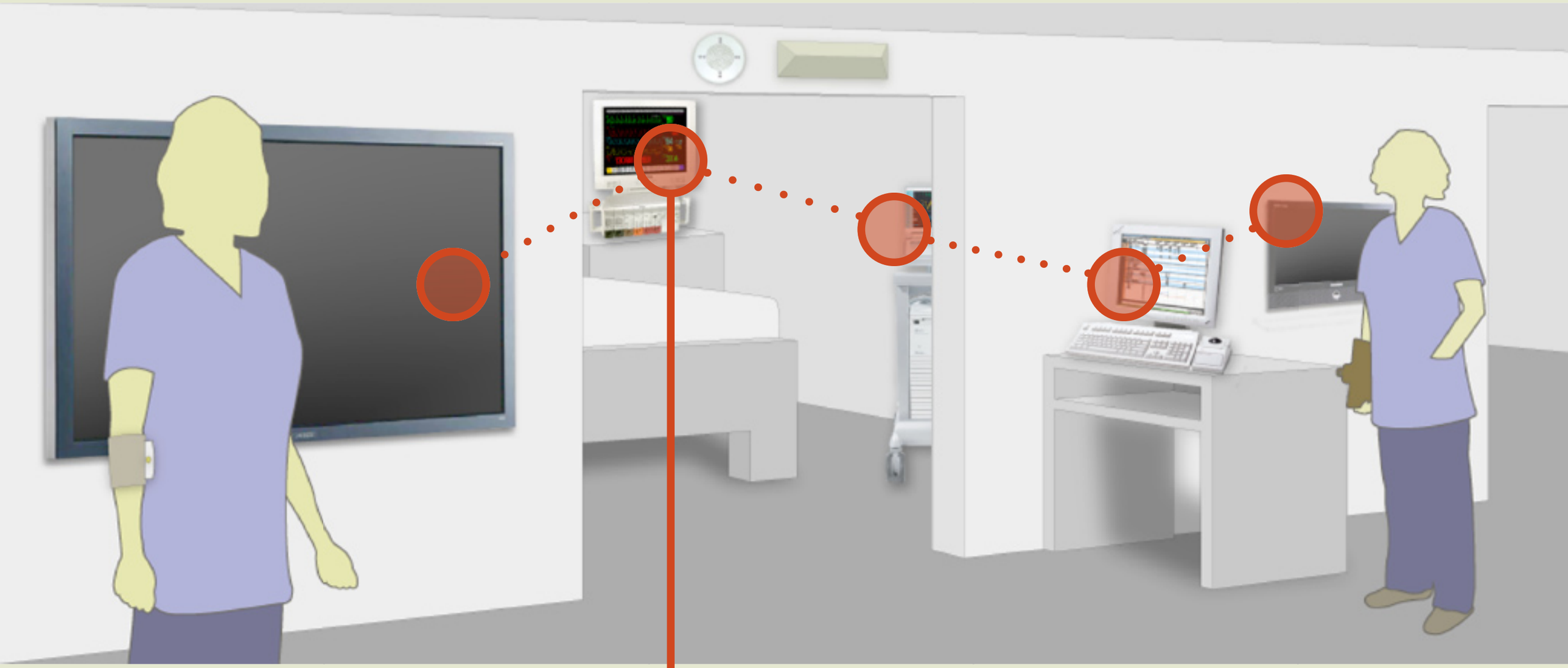

devices
notifications
MetaMonitor


devices
notifications
MetaMonitor
rules &
relationships

devices (current system)

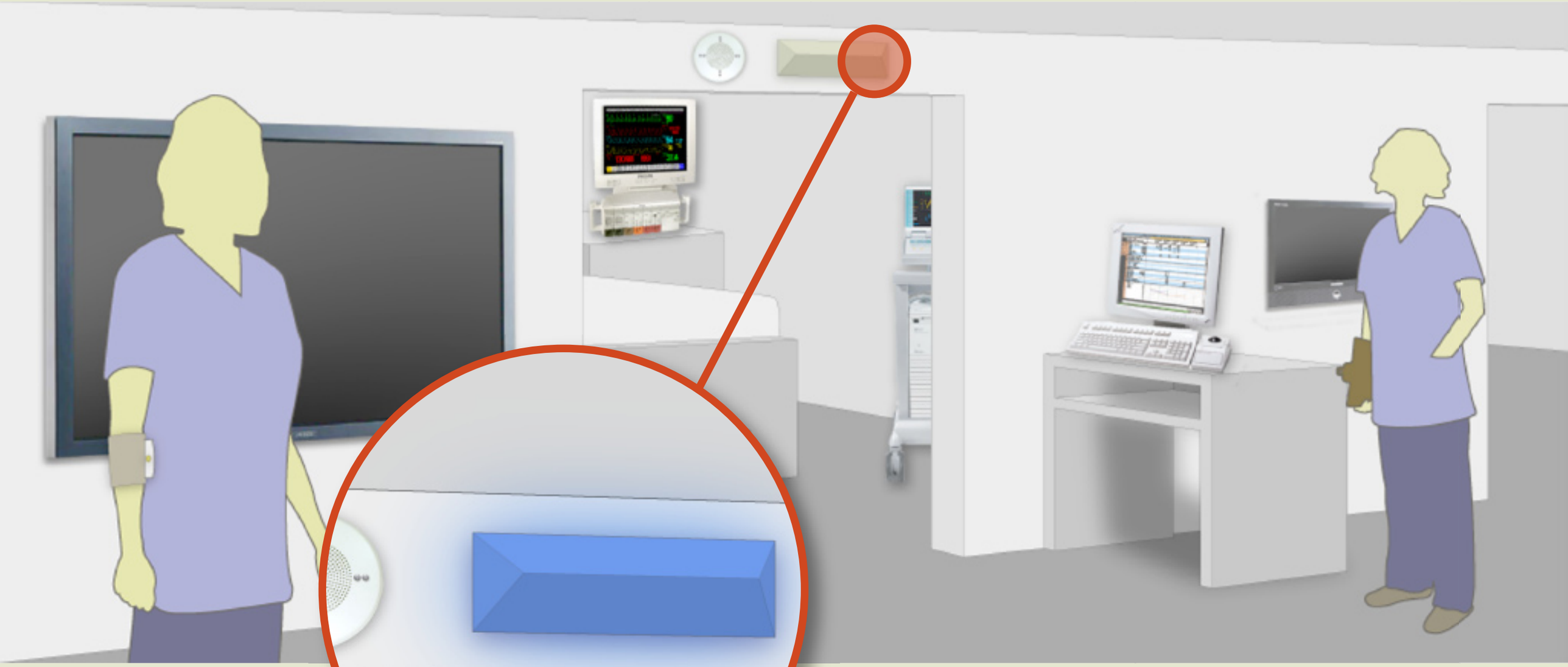
devices (new system)

devices (new system)



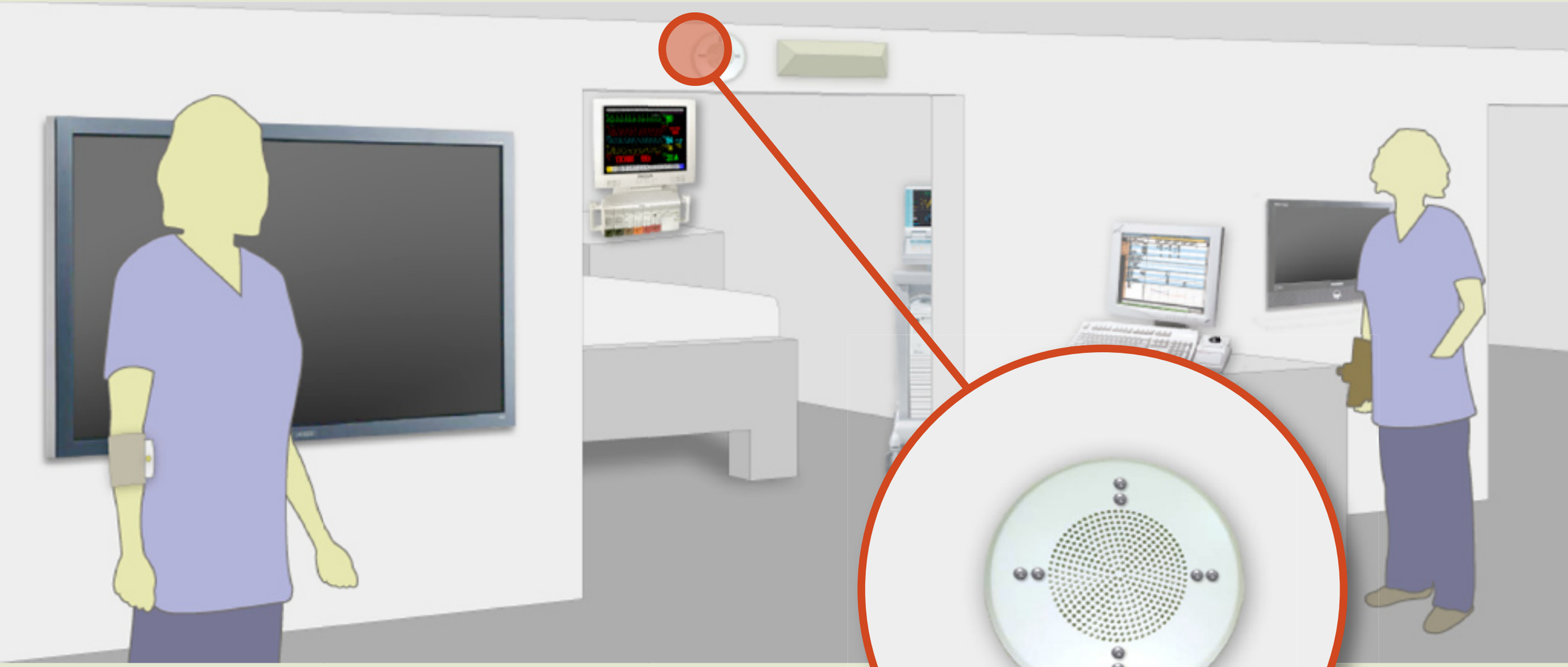
networked **displays** can access any information anywhere in the unit

devices (new system)



lights outside each room flash different colors for different types of alarms

devices (new system)

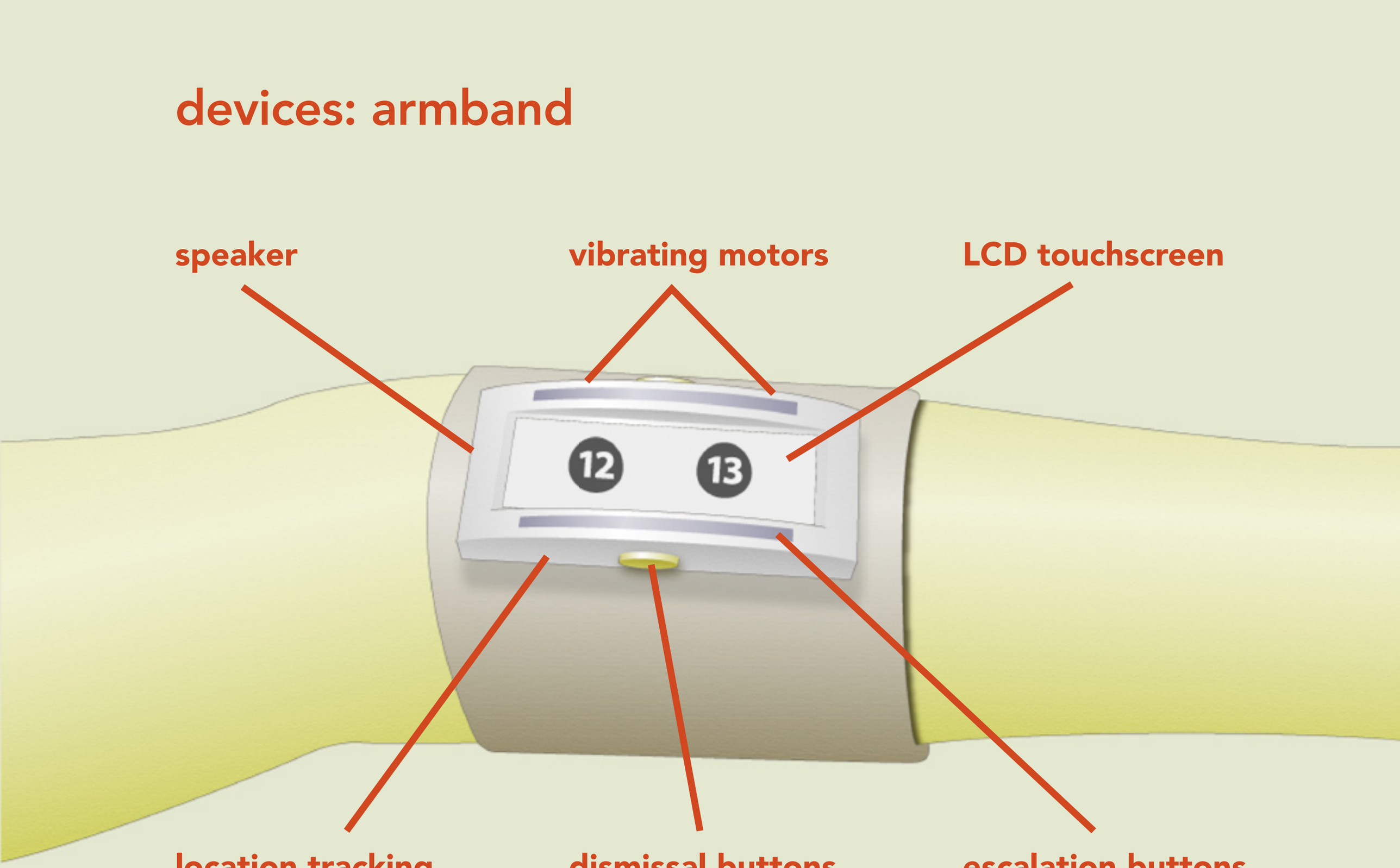


single **speakers** outside each room replace audible alarm on each monitoring device

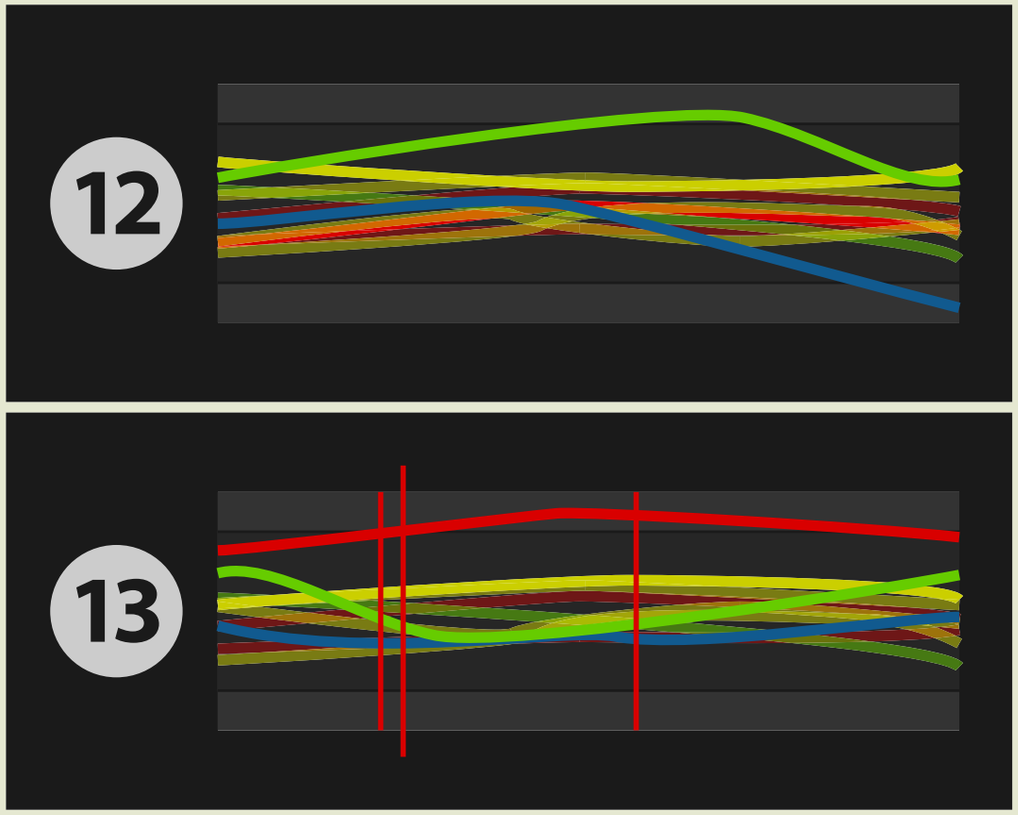
devices (new system)

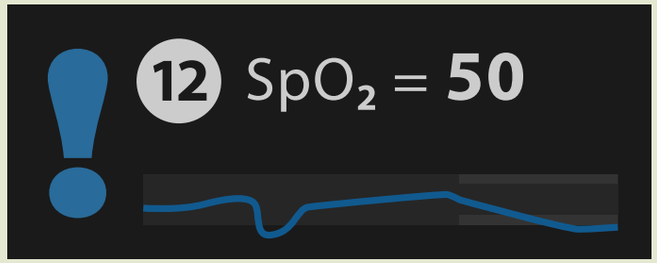
wearable **armband** devices provide individual alarm notification

devices: armband



notifications





12 ! pulse ox
SpO_2 = **50**

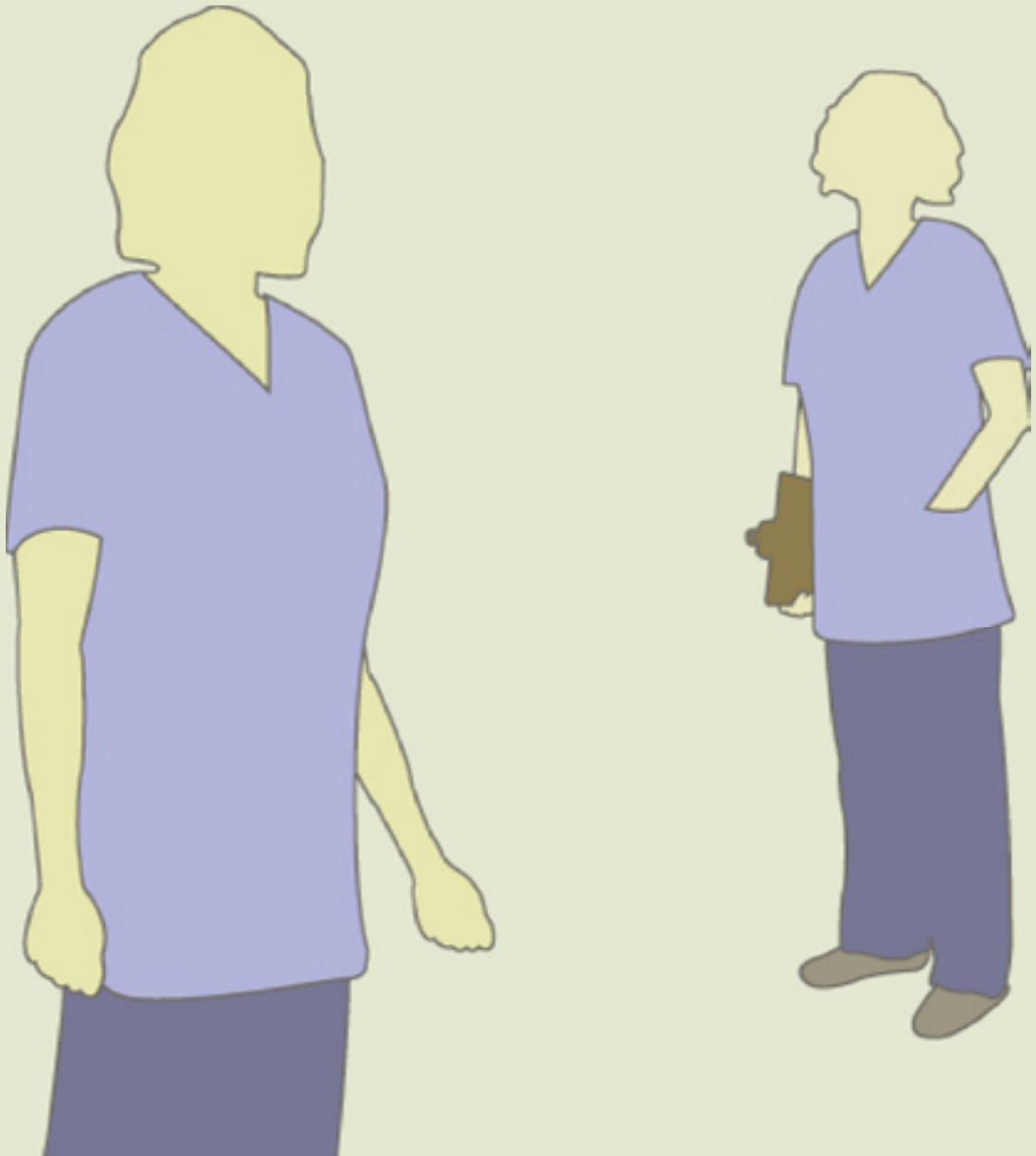
12 ! ABP high
150.120.100

rules & relationships

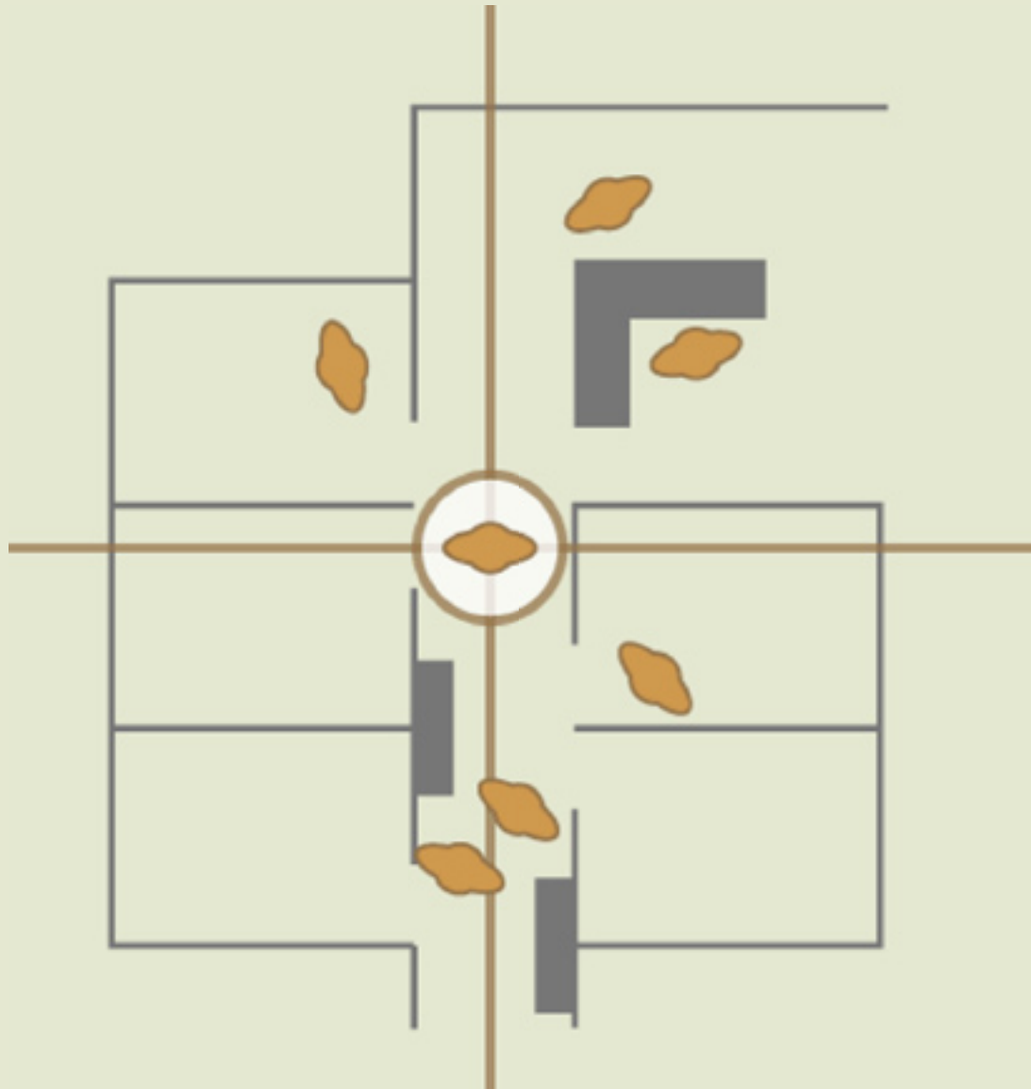
	Description	Examples
Low	Minor condition, not urgent	• Bed deflated • Infusion pump low
Medium	Probably not serious, but should check	• Pulse oximeter
High	Potentially serious, needs prompt attention	• High arterial pressure • Infusion pump empty
Emergency	Life threatening, requires immediate attention	• Ventricular tachycardia • Arterial line disconnect • Apnea
Code	Extreme emergency, requires assistance from specialists	• Asystole

rules & relationships

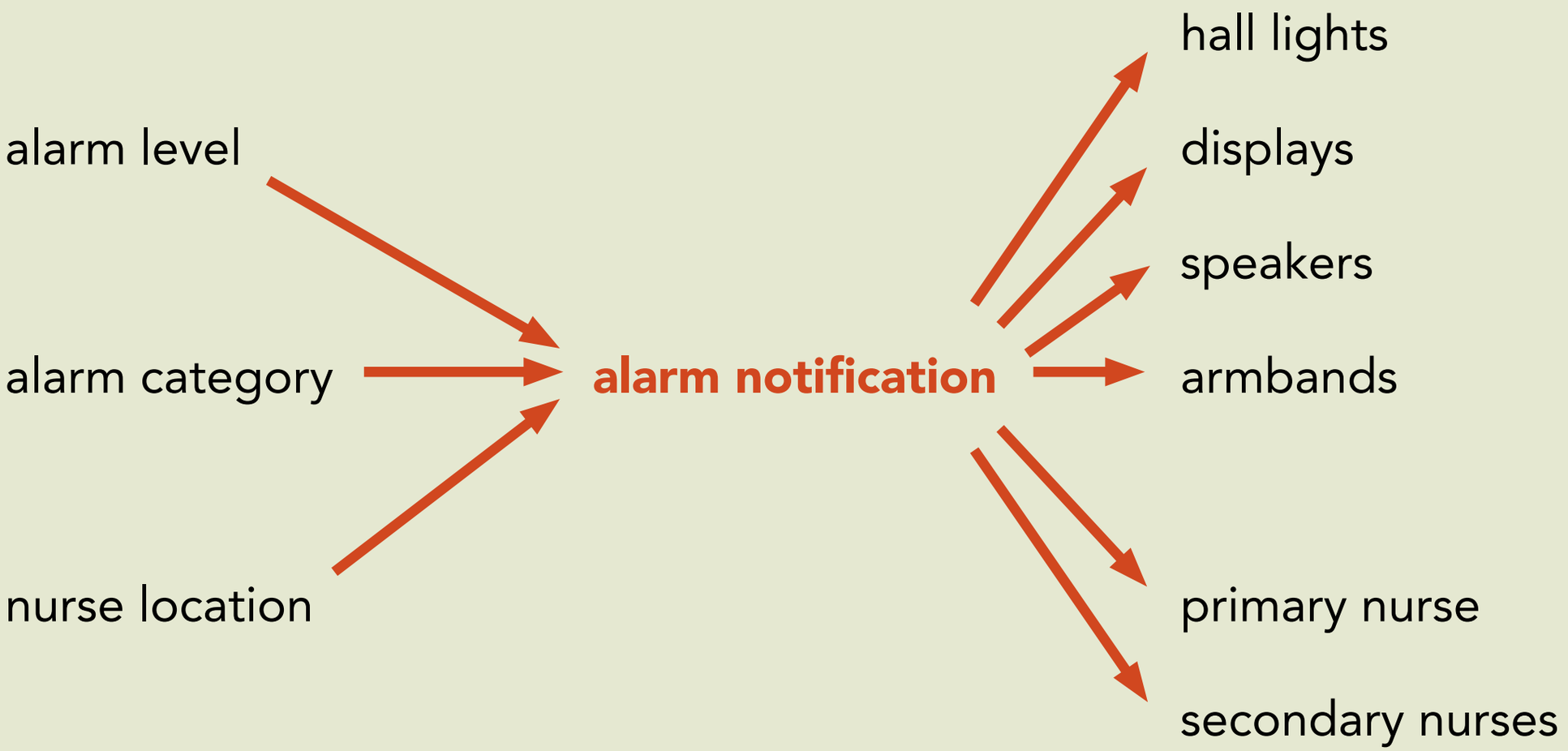
The **primary nurse** (assigned to the patient) and **secondary nurses** (who happen to be nearby) receive different alarm notifications



Location tracking changes the alarm notifications based on an awareness of where nurses are in the unit



alarm notification summary



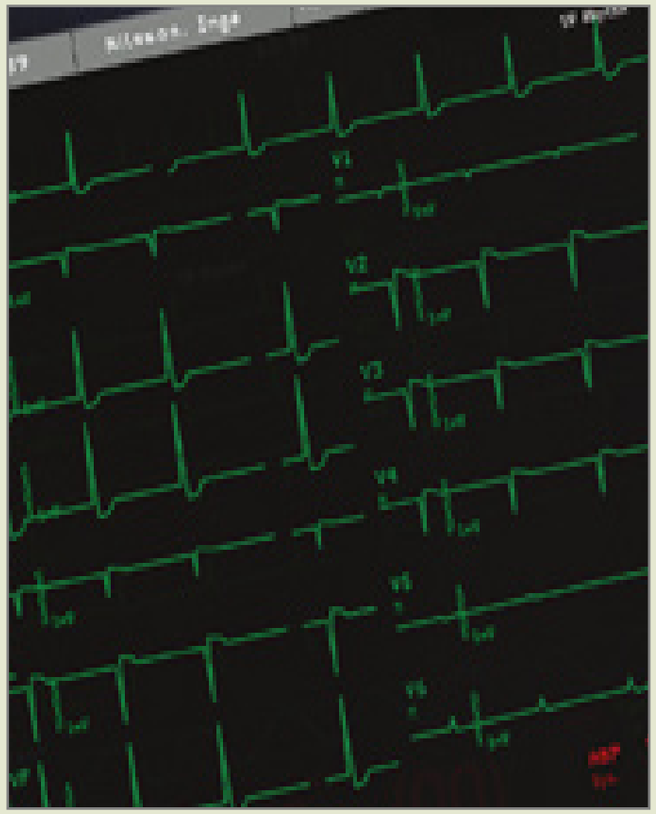
scenario of use

JoAnn is a nurse in a medical ICU. She has two patients today, plus she's covering for another nurse who's out to lunch.

One of JoAnn's patients, Brian, has been having occasional premature ventricular contractions (PVCs) all day. JoAnn is monitoring his ECGs in case he needs medication.

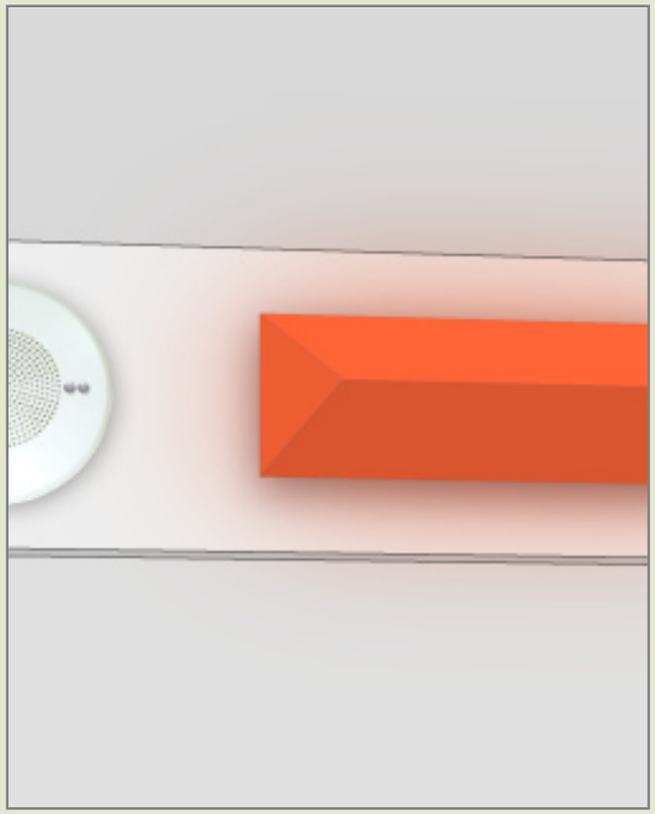
scenario of use

JoAnn is in another patient's room performing an ECG diagnostic.

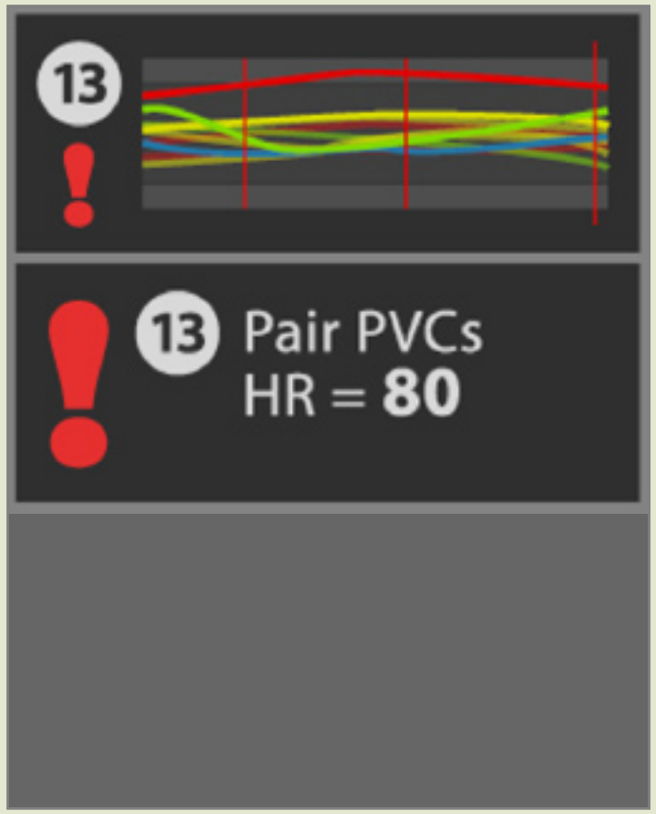


Brian has a PVC, setting off an alarm.

scenario of use



The hall light outside Brian's room flashes red, indicating a heart-related alarm.



The display nearest JoAnn, as well as displays close to Brian's room show an alarm notification.

No audible alarm sounds, because the condition is not life-threatening.

scenario of use

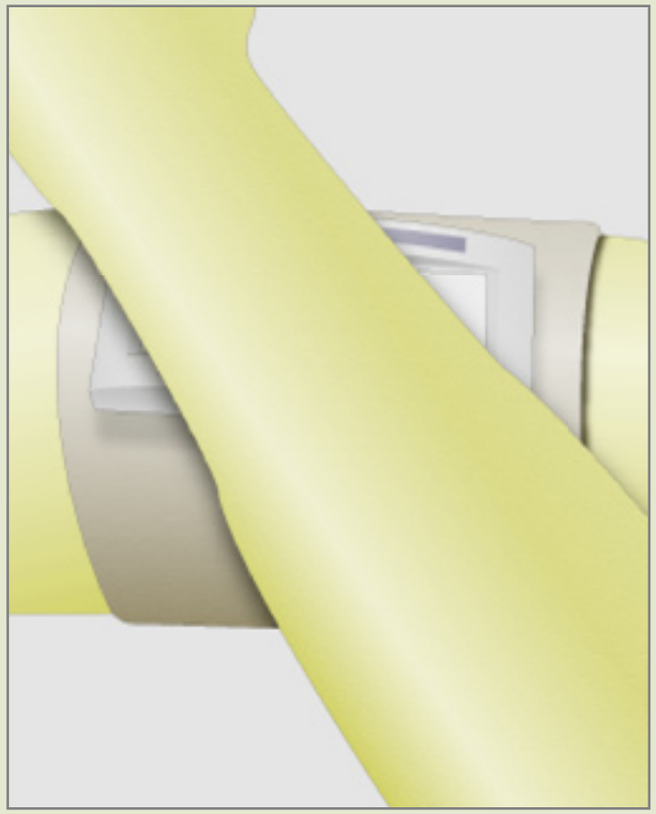
JoAnn's armband vibrates, beeps, and displays information about the alarm.

scenario of use

Other nearby nurses' armbands also vibrate, beep, and display information, but in a less intrusive manner.

scenario of use

Since JoAnn is busy, she can't respond to the alarm right away. She knows the other nurses heard the alarm, but wants to be sure someone checks in on Brian.



JoAnn presses the two buttons on top of her armband. Since her hands are full, she uses her forearm.

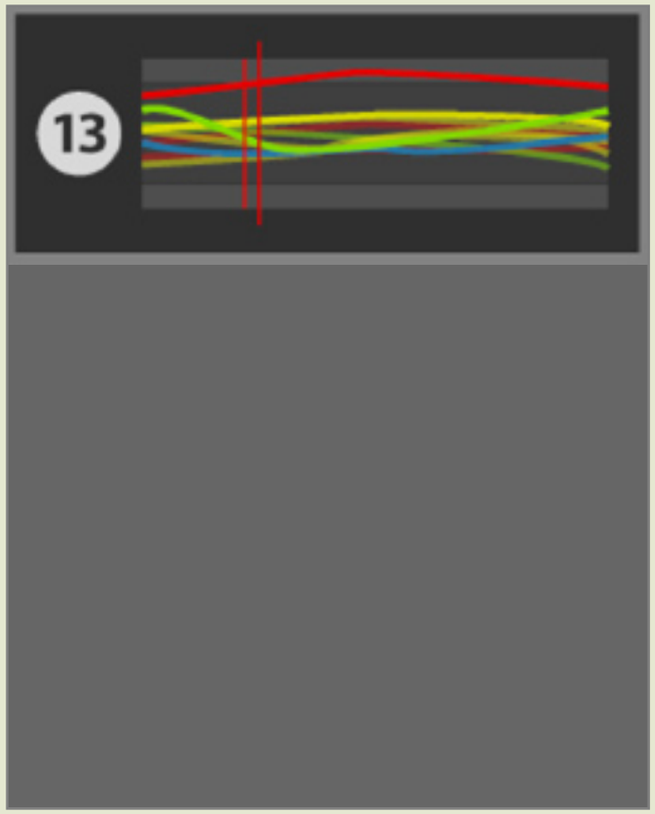
scenario of use

The other nurses receive another notification from their armbands, with a different vibration pattern and beep.

One of the other nurses, Debra, decides to respond to the alarm. She glances up and sees the flashing light outside Brian's room.

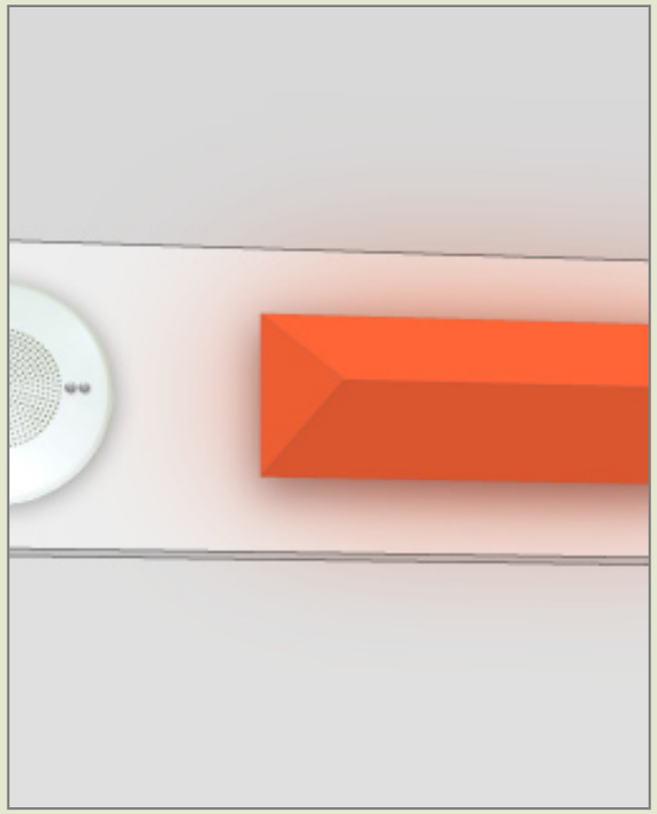
When Debra enters Brian's room, the alarm is automatically silenced.

scenario of use



The alarm notification disappears from all displays except the one in Brian’s room.

All armbands return to standby monitoring view.



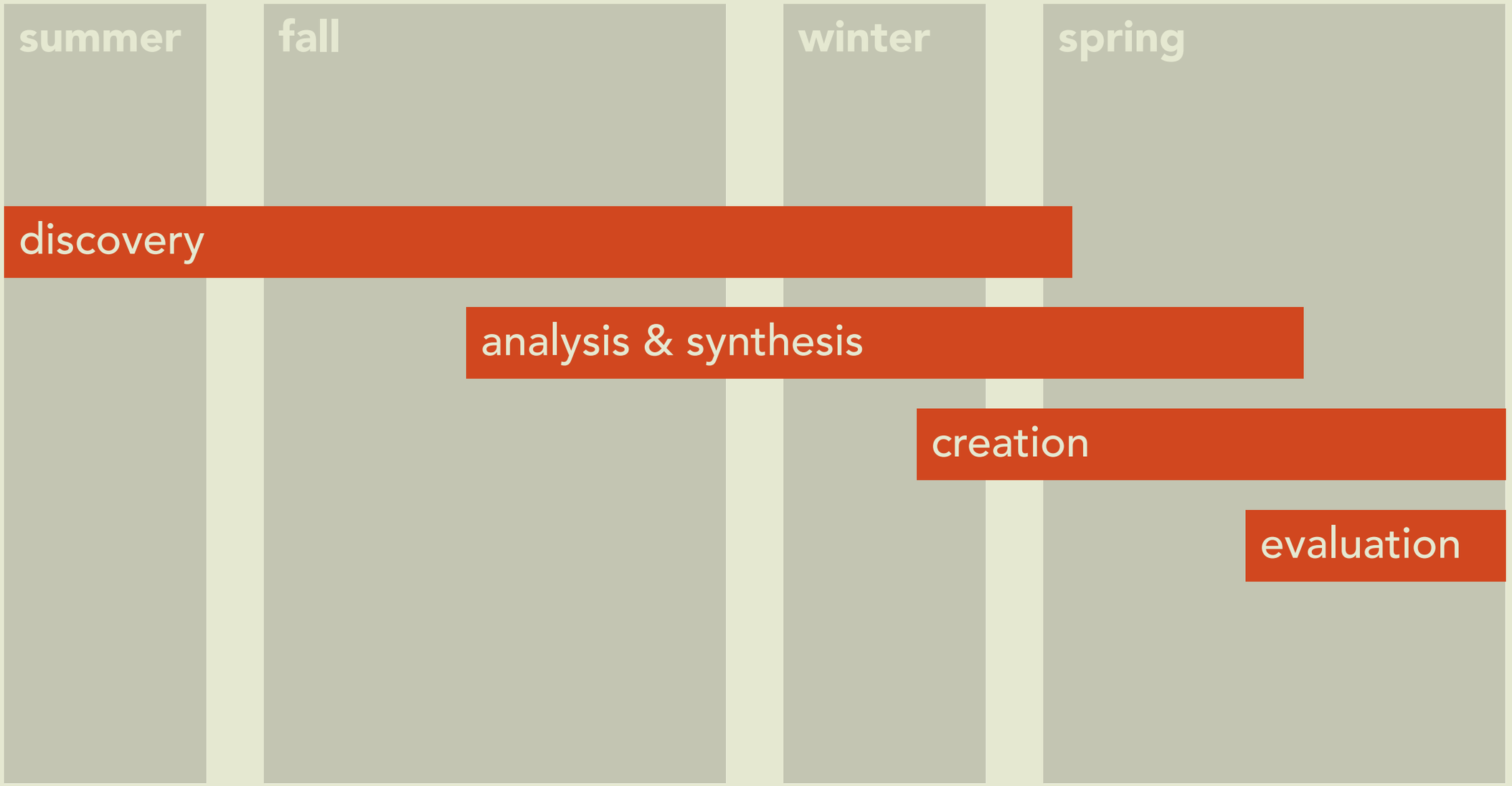
The hall light stops flashing, but stays red to indicate that the alarm condition still exists but is being dealt with.

MetaMonitor benefits

orientation	evaluation	information	action
patient always indicated	consistent language	at-a-glance views	response awareness
integrated with space of ICU	targeted to individuals	information anywhere	
	explicit responsibility	consistent language	

alarm response model

process overview



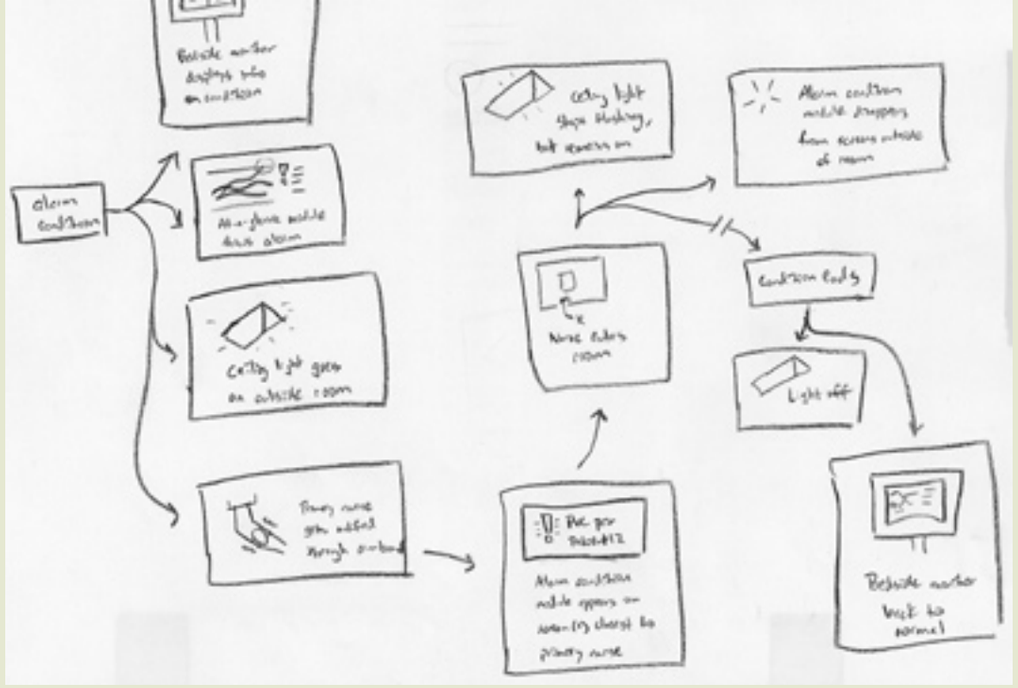
design questions

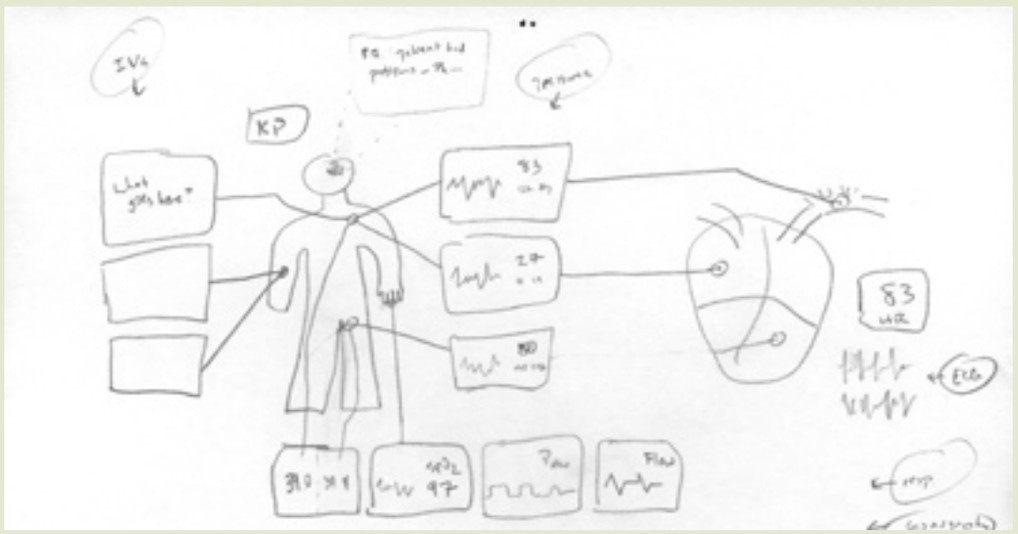
How do I make nurses' jobs easier without deskilling them?

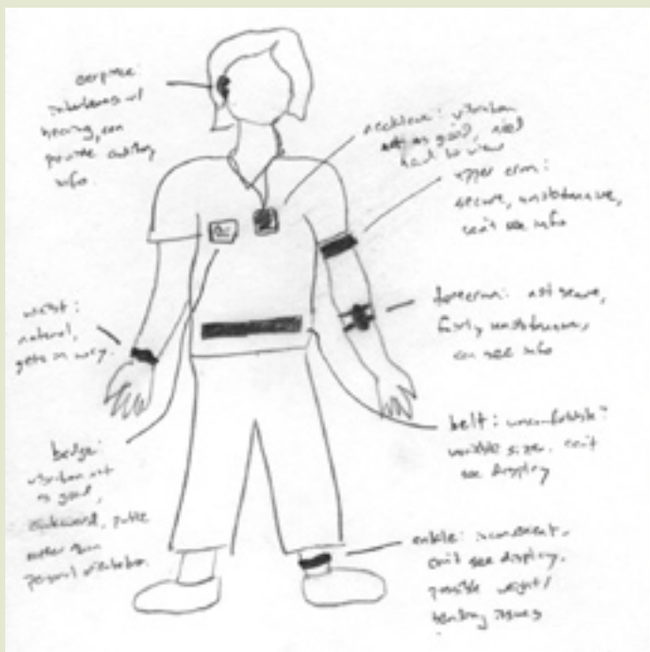
Can alarms be targeted to individual nurses while still maintaining the benefits of working in a team?

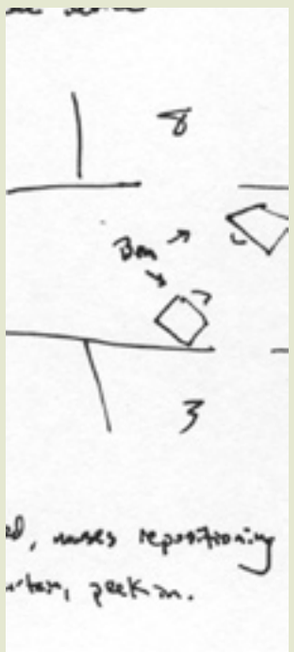
How does the system maintain credibility with so many false alarms?

How much redundancy is needed for patient monitoring alarms?

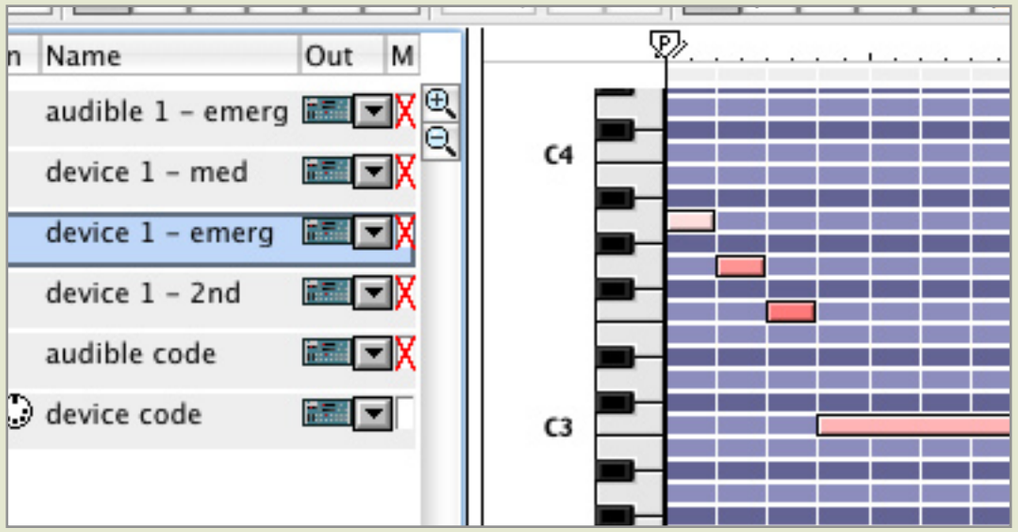


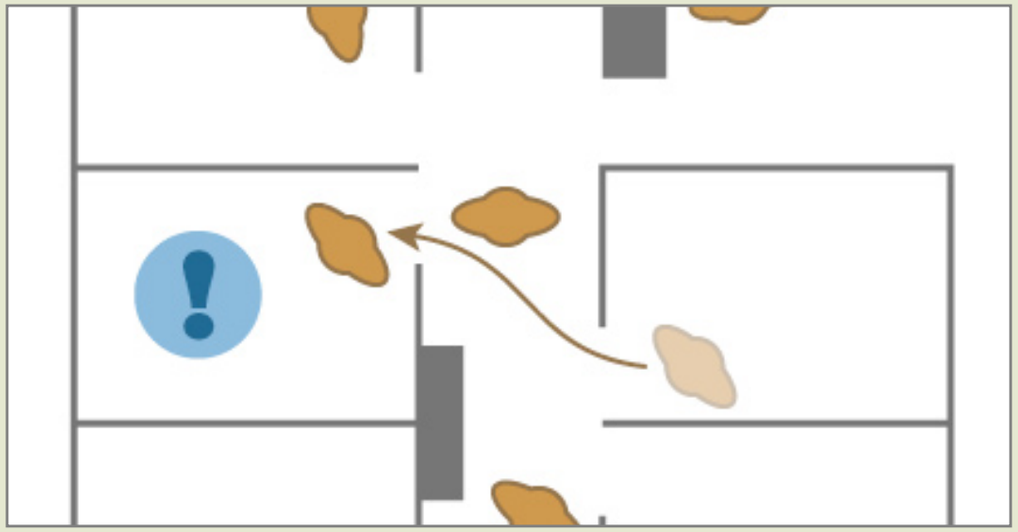






prototypes





```
    repeatcount = 1
  else
    repeatcount = 2
  endif
    do while (repeatcount > 0)
      high motor1
      high motor2
```

thank you

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