

Systems of Systems Issues

Order of Presentations

- Frank Block, Jr., Anesthesiologist
 - Clinical case vignette
- Dick Moberg, Engineer
 - Engineering issues
- George Samaras, Engineer
 - Human factors issues in device development

Clinical Vignette

- Burn patient in ICU Room 1
- Connected to Multi-Parameter Monitor (MPM)
- Patient is “Admitted” to the MPM
 - Name
 - Medical Record Number
- MPM is connected to:
 - Central Station
 - Several bedside devices

Bedside Devices

- Standalone cardiac output monitor
- Electronic bed scale
- Electronic urine output monitor
- Infusion pump with closed-loop controller

Everything is Fine ...

- Data from MPM and the bedside devices are recorded and trended on the MPM
 - And also at the Central Station
- System has been working well for several months
- Recent software upgrade
- Today, it worked fine for several hours ...

And then the caregiver notices ...

- That the MPM has stopped communicating with the bedside devices
- Infusion pump continues at most recent rate
- Other bedside devices work, but are not communicating to MPM
- Old trend data are still available
 - MPM and Central Station

Caregiver Troubleshoots

- Turns bedside devices off and back on
- Unplugs and re-plugs each bedside device
- Unplugs all bedside devices and re-plugs, one at a time

- Still not working

Only one other MPM available on unit ...

- ... that is not connected to a patient
- MPM in ICU Room 2
 - Made by a different company

Caregiver moves the MPM from Room 2 to Room 1

- Connects it to patient while old MPM is still connected
 - So as not to lose any monitoring

- Unplugs all the bedside devices from the old MPM
- Connects all the bedside devices to the new MPM
 - They are now working again
- And now the old MPM stops working
 - Completely dead

Trends are lost

- Previous trends are no longer available on the new MPM
- Old trend data from bedside devices is not reloaded onto new MPM

Caregiver tries to “Admit” the patient on the new MPM

- Error message: Patient already admitted
- Need to discharge the patient from the old MPM, which is now completely dead

Meanwhile, at the Central ...

- The Central Station still thinks that the new MPM is still in ICU Room 2.
 - Patient data are displayed in wrong location
 - Central Station thinks that all the bedside devices have been moved from ICU Room 1 to ICU Room 2
 - And thus the Central Station thinks that all the bedside devices have been removed from the patient in ICU Room 1

Reconfigure the MPM

- Nurse Manager goes to the MPM to try to configure its new location
 - MPM will not accept a new location while a patient is connected

Caregiver has an idea

- Uses the “Admit” function to enter a patient with the same name and a different medical record number

Patient trend data cannot be merged

- Central Station thinks there are two patients
- Old trend data on Central Station cannot be downloaded to the new MPM
- Hospital Medical Records Office will soon be screaming

Chaos!

- Dozens of issues contained in this one scenario
- The next presentations will focus on just a couple of these issues
- Other issues for the discussion periods