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Disclosures/Background
- Co-founder, Virta Labs, Inc.
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- Fmr. visiting scientist, U.S. Food and Drug Administration
- Recent research support from NSF, HHS, SRC, DARPA, MARCO, UL, Medtronic, Philips, Siemens, WelchAllyn

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Semmelweis to Software Sepsis

1. Implantable medical devices should be trustworthy
2. Improved security will enable medical device innovation

Physicians should their wash hands.

Doctors are gentlemen and therefore their hands are always clean.

Dr. Ignaz Semmelweis 1818-1865

Dr. Charles Meigs 1792-1869
Implantation of Defibrillator

1. Doctor sets patient info
2. Surgically implants
3. Tests defibrillation
4. Ongoing monitoring

Photos: Medtronic; Video: or-live.com
Privacy

Implanting physician

Diagnosis

Also:
Device state
Patient name
Date of birth
Make & model
Serial no.
... and more

Hospital
Wirelessly Induce Fatal Heart Rhythm

- 402-405 MHz MICS band, nominal range several meters
- Command shock sends 35 J in ~1 msec to the T-wave
- Designed to induce ventricular fibrillation

(Risks mitigated a long time ago)

[Halperin et al., IEEE Symposium on Security & Privacy 2008]
First FDA Cybersec Product Advisory

- Hospira Infusion Pump Vulnerabilities [Billy Rios and more, 2014-2015]

Photos: Wired
First FDA Cybersec Product Advisory

- Hospira Infusion Pump Vulnerabilities
  [Billy Rios and more, 2014-2015]

U.S. Food and Drug Administration
Protecting and Promoting Your Health

LifeCare PCA3 and PCA5 Infusion Pump Systems by Hospira: FDA Safety Communication - Security Vulnerabilities

[Posted 05/13/2015]

AUDIENCE: Pharmacy, Nursing, Risk Manager, Engineering

ISSUE: The FDA and Hospira have become aware of security vulnerabilities in Hospira’s LifeCare PCA3 and PCA5 Infusion Pump Systems. An independent researcher has released information about these vulnerabilities, including software codes, which, if exploited, could allow an unauthorized user to interfere with the pump’s functioning. An unauthorized user with malicious intent could access the pump remotely and modify the dosage it delivers, which could lead to over- or under-infusion of critical therapies. The FDA is not aware of any patient adverse events or unauthorized device access related to these vulnerabilities.

Photos: Wired
First FDA Cybersec Product Advisory

- Hospira Infusion Pump Vulnerabilities

Hospira Infusion Pump Vulnerabilities

[Posted 05/13/2015]

AUDIENCE: Pharmacy, Nursing, Risk Management, and Engineering.

ISSUE: The FDA and Hospira have become aware of seven vulnerabilities in Hospira’s LifeCare PCA3 and PCA5 Infusion Pump Systems. An attacker with unauthorized information about these vulnerabilities, including software command-line interfaces, could allow an unauthorized user to interfere with the pump’s function. Without properly secured user with malicious intent could access the pump remotely and modify the device’s parameter settings, which could lead to over- or under-infusion of critical therapies. The FDA is not aware of any patient adverse events or unauthorized device access related to these vulnerabilities.

Wireless keys stored unencrypted, accessible via telnet/FTP!

Root shell on port 23!

Hard-coded local accounts!

Photos: Wired
Hospitals & Malware
Hospitals Stuck With Windows XP

General System Counts
- Systems with AV: 6398
- Printers: 2074
- Medical equipment: 905
- Misc: 2460
Total Devices: 11837

OS Makeup – Medical
- Windows 95: 1
- Windows 98: 15
- Windows 2000: 23
- Windows CE: 9
- Windows Vista: 0
- Windows XP: 600
- Windows XP SP1: 0
- Windows XP SP2: 15
- Windows XP SP3: 1
Total: 664

Average Time to Infection
- Clinical Systems, 510K, no AV: 12 days
- Systems running AV/Patches: 300+ days

Ideally: FDA 510K is updated to include a requirement for the provision of industry accepted security controls for devices utilizing embedded operating systems or other controllers associated with a medical device.

Alternatively: The FDA issues a clear statement to the community that FDA 510K is not jeopardized by permitting Anti-Virus or Operating System patching to the supporting systems associated with a certified medical device.
Shoot P0wn Foot w/ Software Update

[Photo: Care Fusion, Niels Provos]
Shoot P0wn Foot w/ Software Update
Shoot P0wn Foot w/ Software Update

SAFE BROWSING

Diagnostic page for www.viasyshealthcare.com

What is the current listing status for www.viasyshealthcare.com?
This site is not currently listed as suspicious.
Part of this site was listed for suspicious activity 1 time(s) over the past 90 days.

What happened when Google visited this site?
Of the 291 pages we tested on the site over the past 90 days, 19 page(s) resulted in malicious software being downloaded and installed without user consent. The last time Google visited this site was on 2012-06-24, and the last time suspicious content was found on this site was on 2012-06-13.
Malicious software includes 38 trojan(s), 3 scripting exploit(s).
Malicious software is hosted on 4 domain(s), including nikiju.com/, lilupophilupop.com/, koklik.com/.
This site was hosted on 1 network(s) including AS26651 (CAREFUSION).

Has this site acted as an intermediary resulting in further distribution of malware?
Over the past 90 days, www.viasyshealthcare.com did not appear to function as an intermediary for the infection of any sites.

Has this site hosted malware?
No, this site has not hosted malicious software over the past 90 days.

Next steps:
- Return to the previous page.
- If you are the owner of this web site, you can request a review of your site using Google Webmaster Tools. More information about the review process is available in Google's Webmaster Help Center.

Updated 2 hours ago

Photo: Care Fusion, Niels Provos
Factory-installed malware?

More common than you might think

- Vendors with USB drives
- Vendors repairing infected machines
- Product assembly line
Last Week: Medical Device Security
Royal Melbourne Hospital attacked by damaging computer virus

A virus has attacked the computer system of one of Melbourne's largest hospital networks, causing chaos for staff and patients who may face delays as a result.

Staff at Melbourne Health - the network which runs the Royal Melbourne Hospital - are urgently trying to repair damage to its IT system after a virus infected Windows XP computers.

An email sent to staff today said the virus had hit Melbourne Health's pathology department, causing staff to manually process specimens such as blood, tissue and urine samples instead of computers aiding the registration, testing and entry of results.
Wednesday Jan 20, 2015 in Texas

The Daily Tribune

Virus hits TRMC computers

By MARCIA DAVIS Managing editor

TRMC CEO John Allen said the hospital experienced a network issue that was revealed about 7:30 p.m. Friday, Jan. 15.

TRMC public information officer Shannon Norfleet said a computer ransomware virus encrypted files on several of the TRMC database servers within the health system, which affects the TRMC access to the computer files.
Advisory (ICSA-15-337-02)
Hospira Multiple Products Buffer Overflow Vulnerability

- Hospira manufactures networkable drug infusion pumps
- Remotely accessible buffer overflow via port 5000/TCP
- Difficulty: Low skill attacker

Thursday Jan 21, 2015
FLINT, MI – Hurley Medical Center has confirmed it was the victim of a "cyber attack" a day after hacktivists threatened action over Flint's water crisis.

The hospital confirmed the attack Thursday, Jan. 21, but few details were released.

"Hurley Medical Center has IT systems in place, which aid in detecting a virus or cyber attack," hospital spokeswoman Ilene Cantor said. "As such, all policies and protocols were followed in relation to the most-recent cyber attack on our system. Patient care was not compromised and we are closely monitoring all systems to ensure IT security is consistently maintained."
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Ways Forward

Security should be designed in
not bolted on
Cybersecurity: A Foreseeable Risk

- Biggest risk at the moment:
  - Hackers breaking into medical devices
  - Wide-scale **unavailability** of patient care
  - **Integrity** of medical sensors

- Gaps
  - Don’t interrupt clinical workflow
  - Many security specialists focus on technical controls
  - Many safety specialists focus on risk management
  - Trustworthy medical device software requires both
Archimedes Center for Medical Device Security

Collaboration: Industry, Academia, Government, Clinicians, Health Care Providers

2013

2014

2015

Learn more at…

secure-medicine.org