Security Risks, Low-tech User Interfaces, and Implantable Medical Devices: A Case Study with Insulin Pump Infusion Systems

Nathanael Paul
University of Tennessee/Oak Ridge National Laboratory

Tadayoshi Kohno
Univ. of Washington
Same circle displayed for low pump reservoir and temporary basal
Contributing Factors to User Interface (UI) Security

- **User Interface**: Design tension between safety and security [Clark 2011]
- **Authentication**: Done through physical control of hardware [Cornelius 2012]
Main idea: Change Stored Data to Affect Patient

• Delayed patient effects
• Non-lethal security breaches
• No technical sophistication required
• Targeted
Case Study: Insulin Pump Systems

**Precedent**: Inject injection without detection

**Our Study results**

- 20 specific settings that could negatively impact patient
- 50% of the identified issues pose a greater amount of risk
Hyperglycemia

Normal

Hypoglycemia
What Can Happen in 30 Seconds

• Less-risk
  – Force a change to a new reservoir (large UI change)
  – Add additional BG reading (little UI change)

• More risk
  – Change permanent basal rate (no UI change)
  – Change insulin-to-carbohydrate ratio (more significant UI change – likely ignored)

More risk if patient just ate.
More risk if multiple BG readings added.
More risk if exercising/sleeping.
Example: Lunch-time Security Issue

Requirement:
• Lunch-time food – predictable.

Target blood glucose reading before lunch:
• Change ratio of insulin for food intake
• Adjust correction for high blood glucose

One can issue a command to bolus 400+ units – more than double the insulin reservoir contents.
Potential Mitigations

• User-interface
  – Change interface: Up to 24 hours after critical setting change

• Authentication & Authorization
  – Fail closed: Can duplicate settings in other device
  – Measure important patient events (e.g., sleeping)
  – Time-based: Stop undesired behaviors during these events
  – Proximity-based: Allow changes when in same area

• Auditing
Questions?

http://web.eecs.utk.edu/~pauln/