VANDERBILT UNIVERSITY MEDICAL CENTER

CENTER FOR RESEARCH AND INNOVATION IN SYSTEMS SAFETY

# Quantitative evidence for resilience in responses to patient admissions, discharges and transfers


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# Overview

- Motivation
- Theoretical assumptions about systems
- Method & Results
- Conclusions & Limitations
- Next Steps

# Motivation

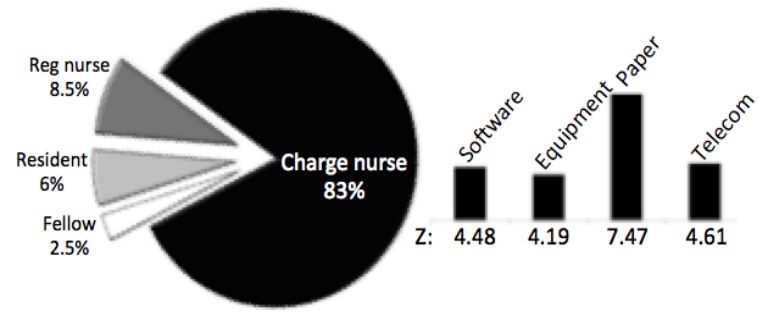
- Patients exposed to shifts with: ↑ADTs ↓RN:Pt ratios have ↑30-day mortality (Needleman 2011)
- ↑RN workload: Care left undone, errors of omission (Kalisch 2009; 2011; 2013; Ball 2013) ➔ calls for increased staffing

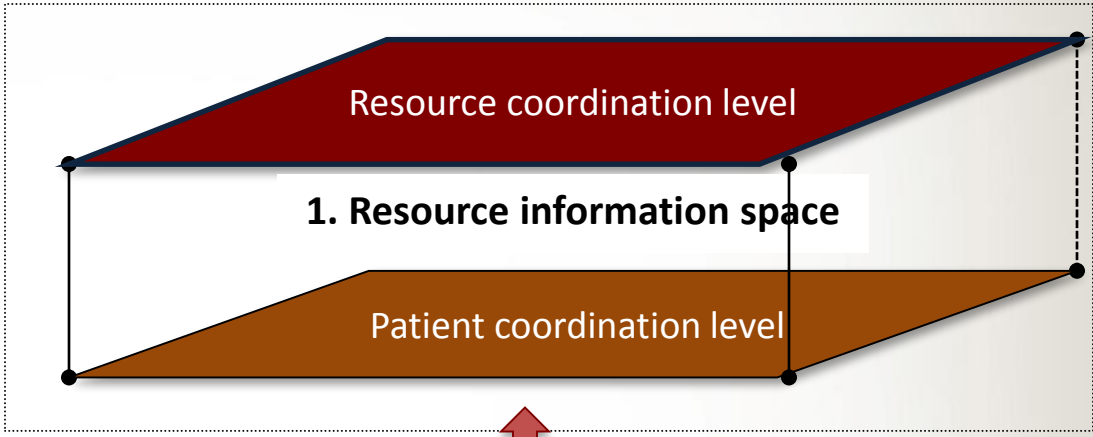
However:

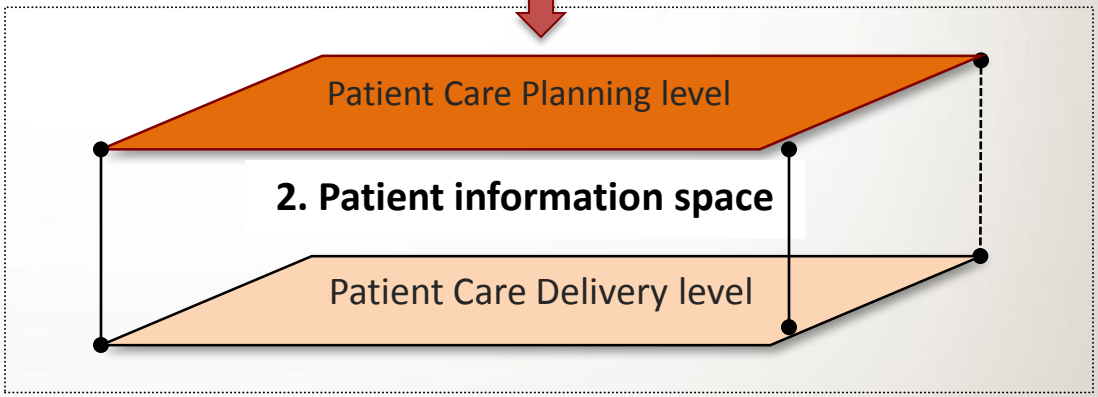
- Demand variation is the issue (Litvak, 2005)
- Sources of variation (Jennings, 2013)
  - Timing & clustering
  - Source of admission (ED; OR)
  - Nature of admission (planned vs unplanned)
  - Nurse to patient allocation
  - Admission, discharge & transfer effort differs

**ADTs have not been investigated from a 'management' perspective**

# Preliminary research

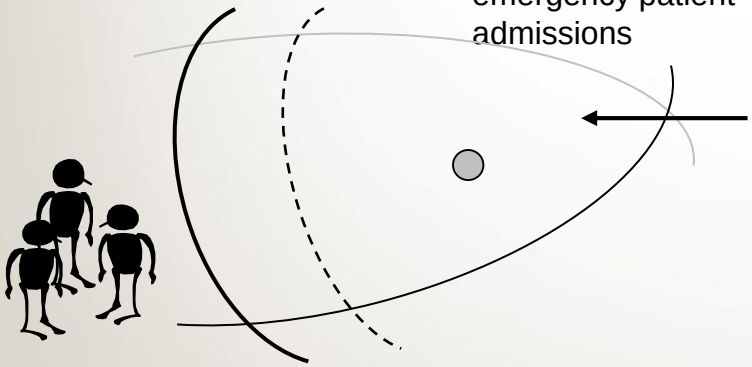



Miller et al, 2010, Human Factors

**Daily** variation in emergency patient admissions



***In-charge nurses and anesthesiologist***

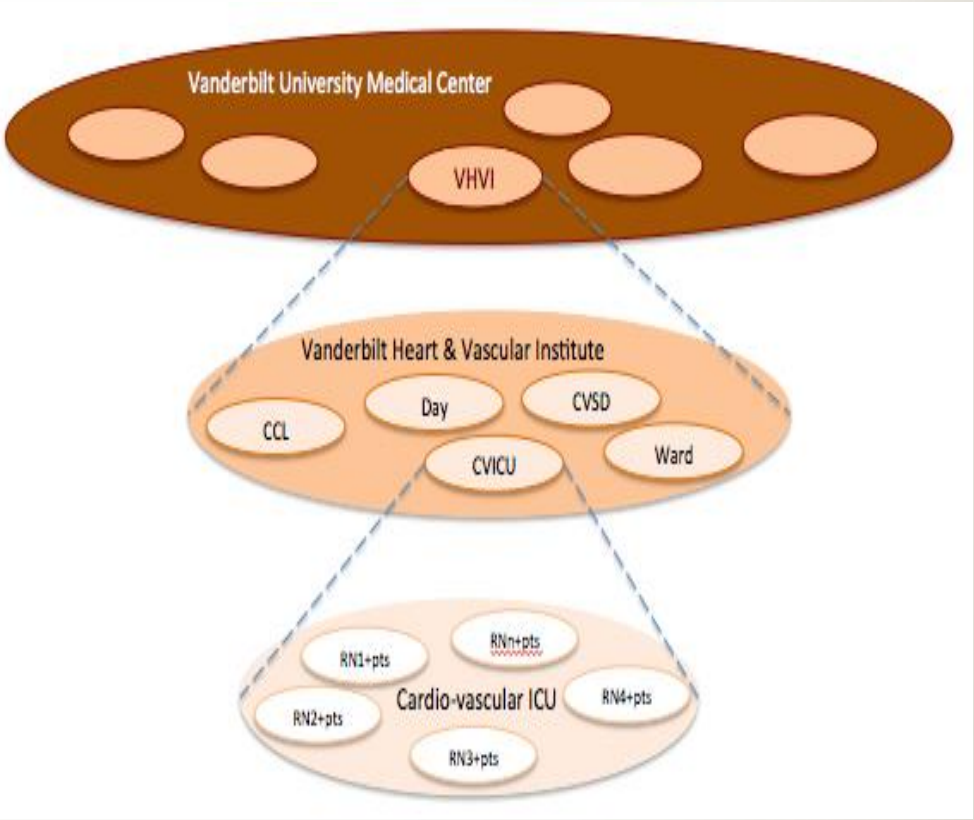
Miller & Xiao, 2007; CTW

# Theoretical Assumptions

## Structural complexity

Self-organizing Holarchic Organizations (SOHOs) (Simon 1962; Koestler 1978; Kay 2000)

1. **Nested hierarchy - All elements exhibit autonomy of wholes & dependency of parts**
2. As wholes - assert identity, through specialist functions
3. Internally self-regulating, self-organizing
4. As Parts are integrative – Share reciprocal relations laterally and vertically
5. Promote stability & cohesion

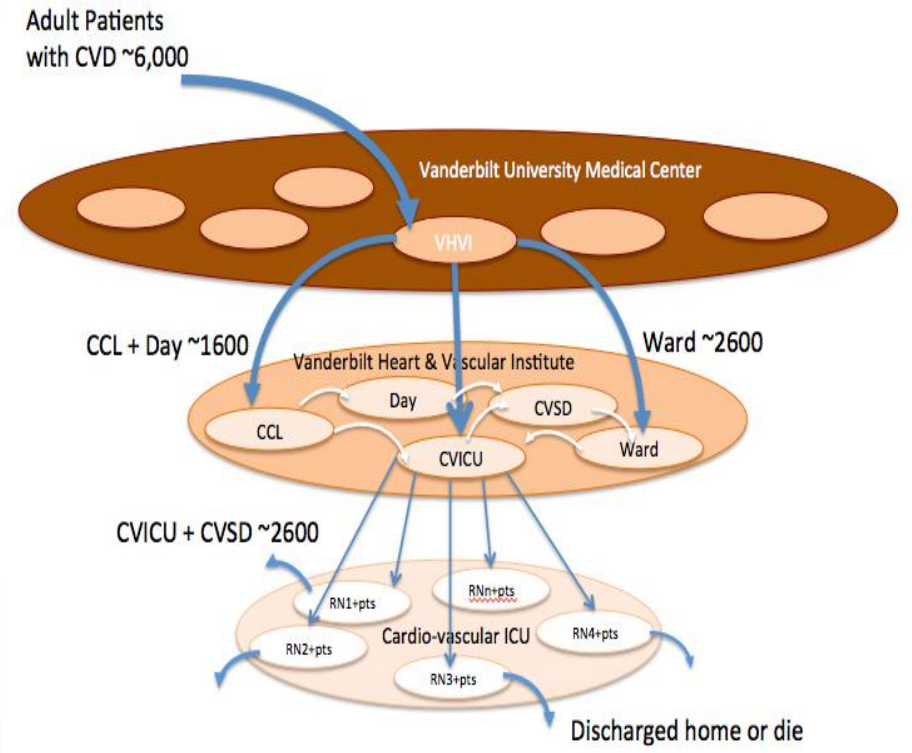


# Theoretical Assumptions

## Functional dynamism

Gradient dissipative structures (GDS)
(Nicolis & Prigogine, 1989; Schneider & Kay 1994)

1. **Gradients are flows of material, energy, information from external environment**
2. Structures are processes of tightly coupled feedback loops that maintain states by reorganizing themselves
3. Reorganization involves reconfiguration to more complex forms - emergent
4. Dissipative in 2 ways:
    1. Without external flows, structures would not exist
    2. Process structures dissipate (distribute) flows

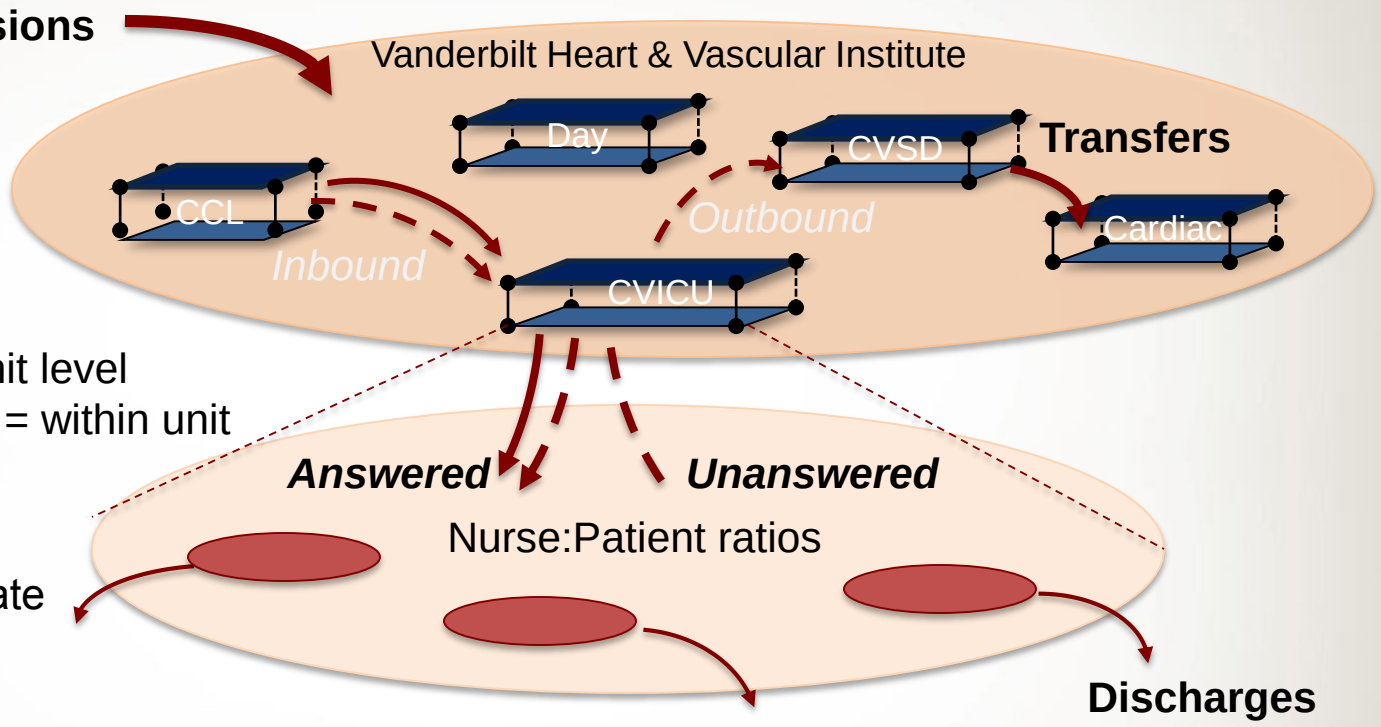


# Research hypotheses

**ADTs** = patient flow

**Information flow**:
Telephone call rates
In- / out-bound = inter-unit level
Answered / unanswered = within unit

**N:P Ratios** =
'Capacity' to accommodate




1. **Telephone call patterns are associated with ADTs and nurse to patient ratios**
2. **In a system of interconnected units (e.g., the VHVI), the patient (ADTs) and information (telephone call patterns) flows in one unit affect flows in other units**
3. **Outlier events expose system strengths and limits**

# Method

**From November 2012 - 2014; for all 5 VHVI units**

- **Hourly Admissions, Discharges & Transfers**
  - **Bed management systems**
- **Hourly telephone call types (inbound, outbound, answered, unanswered)**
  - **Information technology services**
- **Hourly nurse staffing**
  - **Kronos HR system**

**N> 15,000 data points.**

# Results

## H1: Telephone call patterns are associated with ADTs and NPRs

**Inbound calls associated with:**

- **High Admissions** (t=24.7; p<0.000)
- **High Transfers** (t=45.6; p<0.000)
- **Low Discharges** (t=-4.0; p<0.00)
- **Low NPR** (t=-2.2; p<0.00)

**Outbound calls associated with:**

- **High Admissions** (t=10.0; p<0.000)
- **High Transfers** (t=16.8; p<0.000)
- **High Discharges** (t=17.4; p<0.000)
- **NPR** (t=0.8; p=0.424)

**Answered calls:**

- **Admissions** (t=17.3; p<0.000)
- **Transfers** (t=19.0; p<0.000)
- **Discharges** (t=9.6; p<0.000)
- **NPR** (t=2.5; p<0.05)

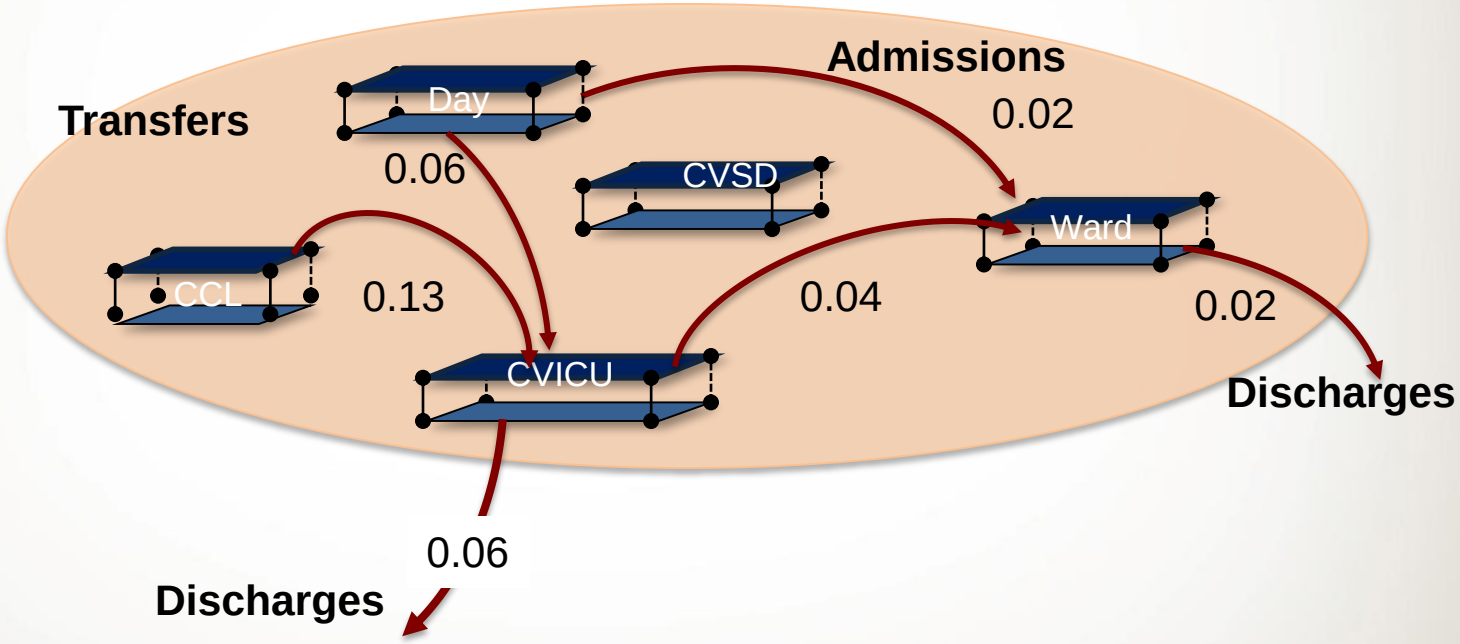
**Unanswered calls:**

- **Admissions** (t=24.5; p<0.000)
- **Transfers** (t=38.6; p<0.000)
- **Discharges** (t=-1.1; p=0.27)
- **NPR** (t=7.8; p<0.000)

# Results

## H2: Patient (ADTs) and information (call patterns) flows in one unit affects other units

Transfers

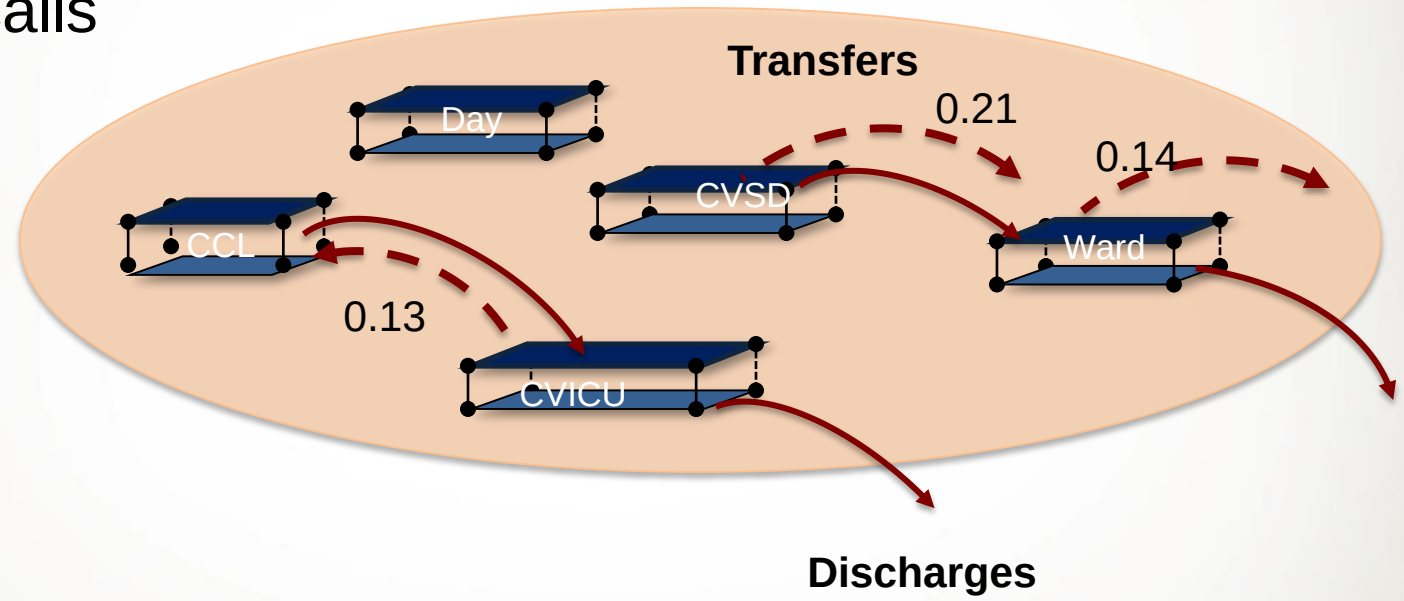



**Patient movement tends to cascade through the system**

# Results

## H2: Patient (ADTs) and information (call patterns) flows in one unit affects other units

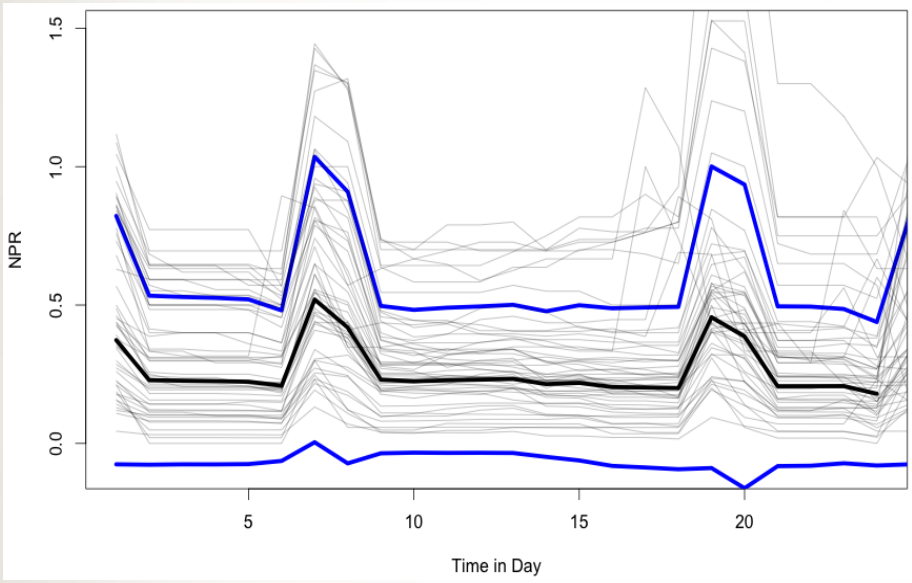
Outbound calls



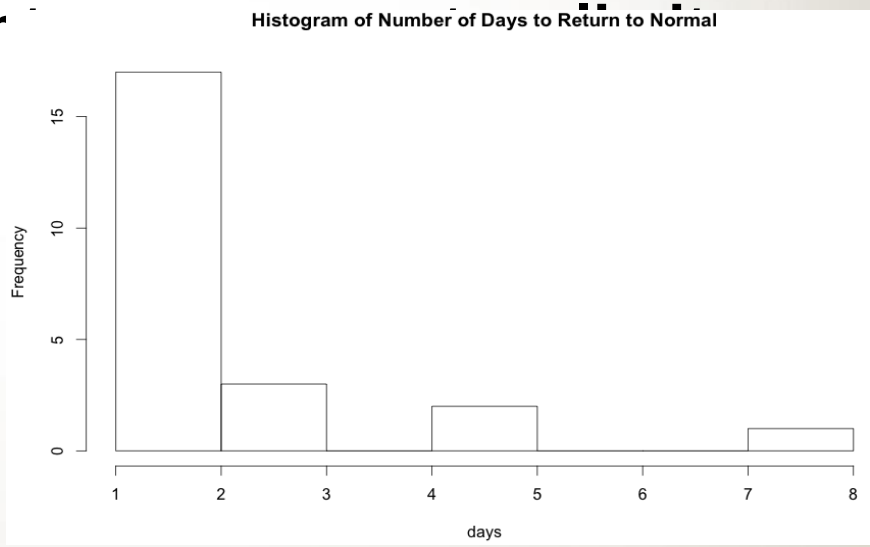

**Outbound requests for information accompany transfers and admissions**

# Results

## H3:Outlier events expose strengths & limitations



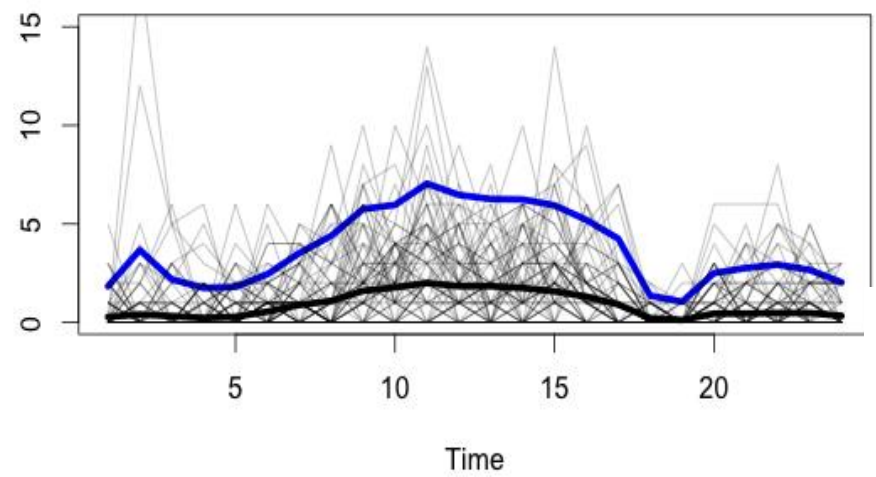

23 (11%) CVICU days had high nurse staffing - NPR approaching 0.8



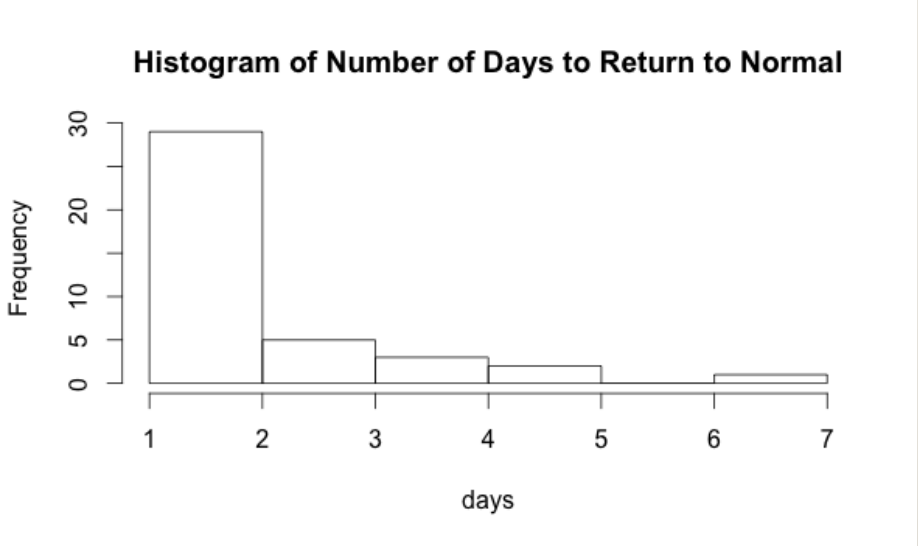

74% of these were sustained for 1 day

# Results

## H3: Outliers expose system strengths & limitations




40 (19%) CVICU inbound call were outlier events




72% of these were sustained for 1 day

# Conclusions

**Overall conclusion is that ADTs management involves the management level**

- **Admissions & transfers associated with significant lateral communication**
- **Patient flow tends to cascade through the VHVI and is associated with significant outbound calls (information requests) more suggestive of proactive behavior**
- **Outlier events tend to persist**

# Limitations

- Quantitative data analysis – 'what' but not 'why'
- No patient outcome data
- Hourly nurse staffing may be inaccurate as nurses do not swipe in and out of units
- No call destination data
- Other telecommunications (text, cell-phone, EHR messaging - asynchronous) not included
- Call content not included

# Next steps

- **AHRQ grant**
  - **Qualitative investigation of ADT management by middle nurse managers including information flows, ADT processing and artifact use (e.g. pagers, instant messaging, cell-phones etc)**
  - **Establish patient safety links between Manager' non-routine events and Bedside non-routine events**
  - **Build a more robust/comprehensive descriptive/predictive model**