

# Title: Facilitating Patient Flow in a Health Care Delivery Chain

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Research Group: MIT Lean Advancement Initiative, VHA New England Health Care Engineering Partnership

Thesis Advisor: Prof. D. Nightingale • Committee: Prof. J. Benneyan; Prof. S. Graves



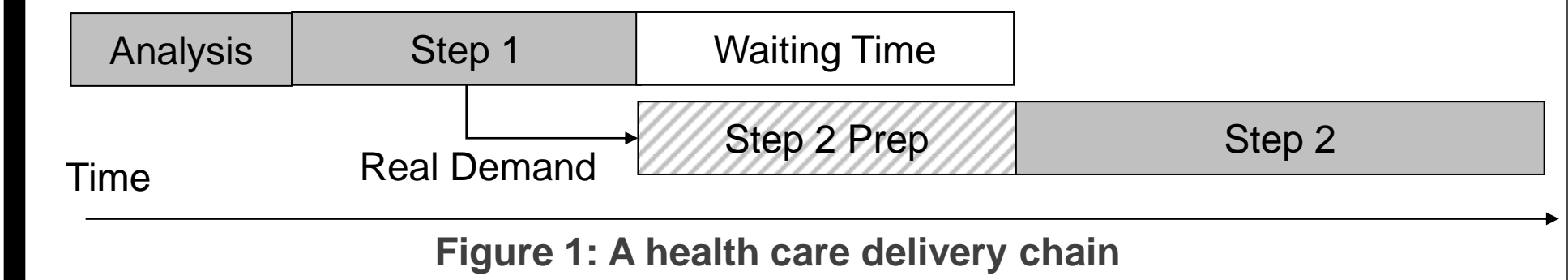
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LAI MIT ENABLING ENTERPRISE EXCELLENCE

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## Problem

- **Motivation:** Fragmentation → Cost driver in U.S. health care system (Lee & Mongan 2009)
- **Potential Solution:** Reduction of cost via fewer operational inefficiencies (e.g., excess waiting times)
- **Research Purpose:** To improve flow (e.g., rate, variability, waiting times) through health care delivery chain (Fig. 1)
- **Research Design:** Study of a cross-departmental chain from Emergency Dept. (ED) to Inpatient Unit using prediction of patient flow paths
- **Implications:** “If one can predict earlier in the course of an evaluation whether the patient will likely be admitted, then one may improve timeliness of inpatient placement or discharge planning” (Yen 2007)



	Step 1	Step 2
In Department Level	Doctor Exam	Testing (Ex. CT Scan, XRay, Blood Test, etc.)
Cross Department Level	Emergency Department	Inpatient Unit
	Inpatient Unit	Long Term Stay
Cross Organizational Level	Generalist	Specialist

## Methodology

- Predictive Methods Explored: Expert opinion, Bayesian networks, other statistical tools
- Interviews conducted with ED nursing staff to understand critical factors for inclusion in statistical tools
- Interviews conducted with Inpatient Unit staff to understand potential responses to predicted information and how uncertain data will be interpreted
- Mathematical and simulation models developed to study optimal response decisions based on information accuracy and timeliness

## The Research

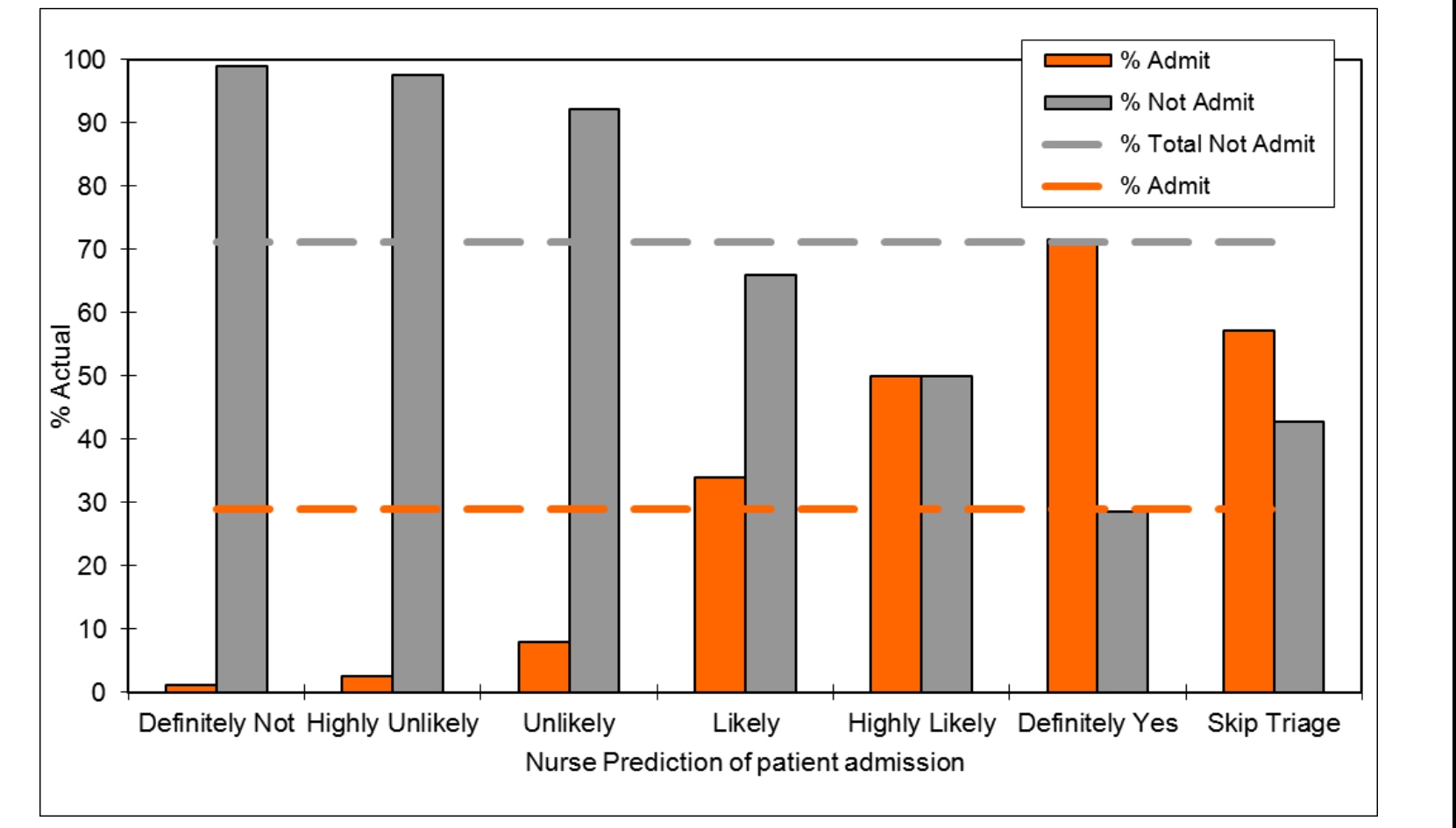
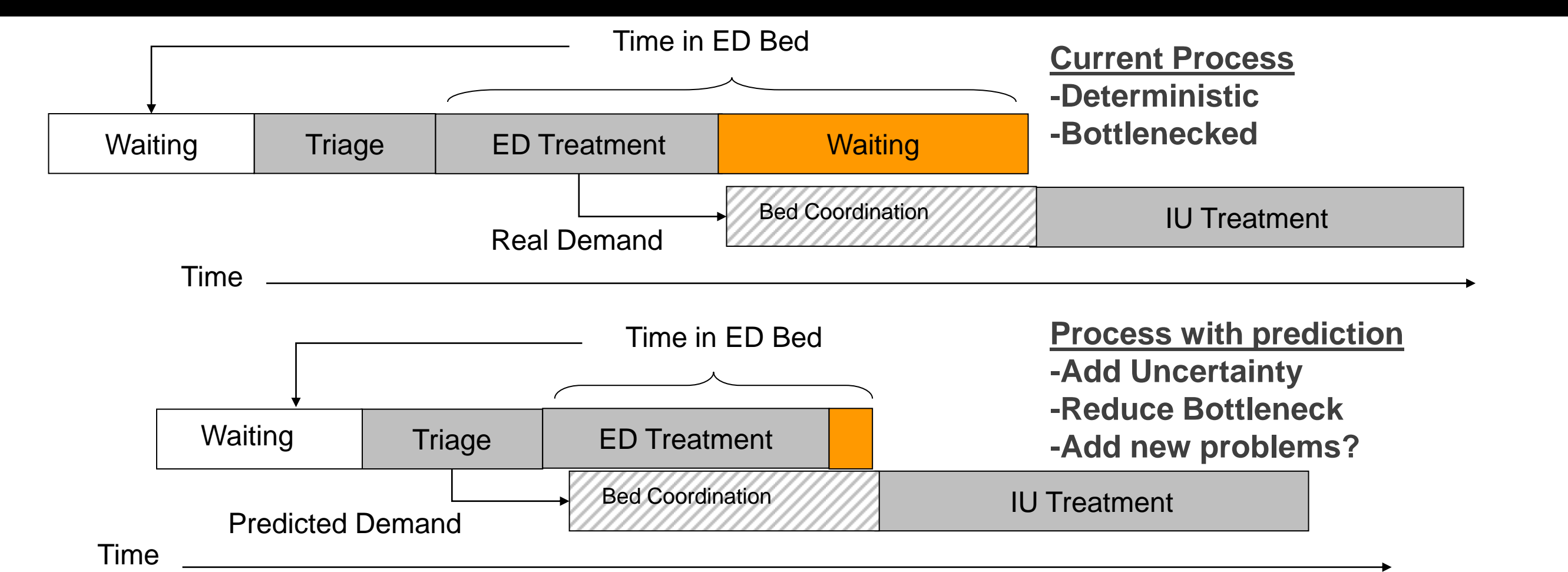


Figure 3: Nurse prediction of patient admission

## Remaining Research

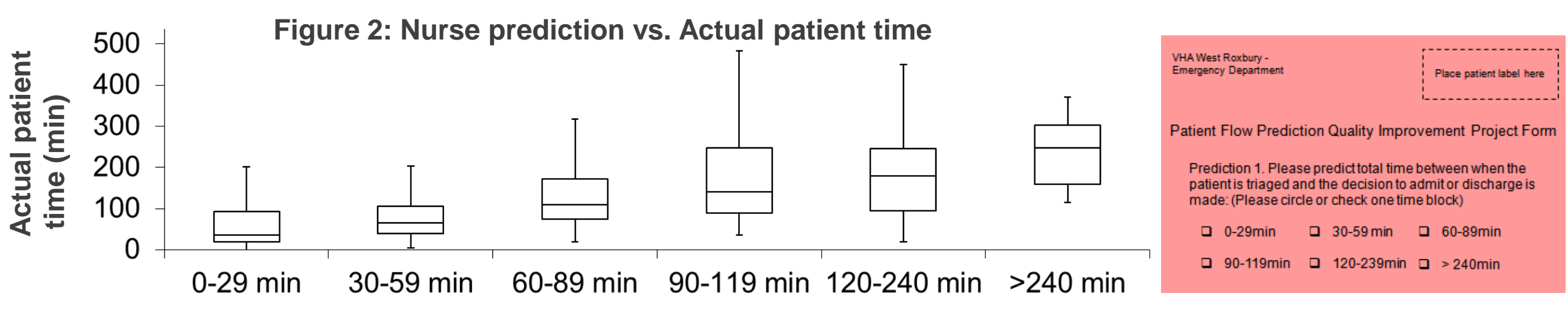
- Preliminary Conclusions:** Potential for the use of expert opinion for making predictions about patient flow
- Future Work:**
- Statistical prediction tools will be developed and compared to the expert opinion.
  - Modeling of how the predictions can be used on the inpatient unit side in order to improve hospital flow.
  - Additional research to establish the generalizability of the results

## Key Questions

1. What predictive methods work best to predict downstream demand in this context?
2. Given advance demand predictions, what possible adaptive actions can the hospital system take to improve flow?
3. What specific responses and control actions are optimal or worthwhile improvements given (a) perfect and (b) imperfect downstream demand prediction?
4. How portable or robust are these solutions (questions 1-3) to multiple contexts?

## Preliminary Results

- For one month at the Veterans Health Administration hospital, West Roxbury ED, all triage staff were asked to complete a questionnaire (sample at bottom right) to predict patient flow at triage
- Figure 2: Nurses Prediction (X-axis) and Actual Patient Times (Y-axis) with significant variability
- Figure 3: The results of the admission prediction show clear expert predictability



VHA West Roxbury - Emergency Department

Patient Flow Prediction Quality Improvement Project Form

Prediction 1. Please predict total time between when the patient is triaged and the decision to admit or discharge is made. (Please circle or check one time block)

0-29min  30-59 min  60-89min  
 90-119min  120-239min  >240min

## Thank You!

My Committee - Professor Deborah Nightingale, Professor Stephen Graves, Professor James Benneyan.

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Lean Advancement Initiative and ESD Staff and Students.