Improving Patient Flow at C.S. Mott Children's Hospital

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Agenda

- Patient flow: ED and Inpatient Settings
- Asthma Patients
- Neural Networks

- Ongoing and Future Work

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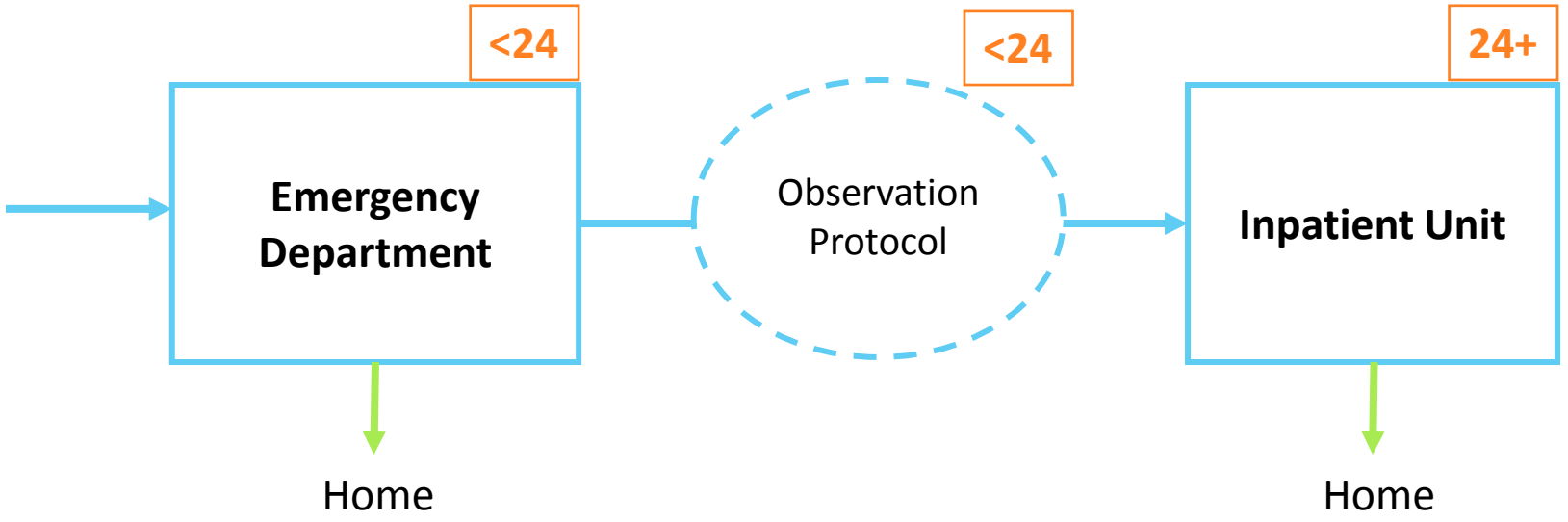
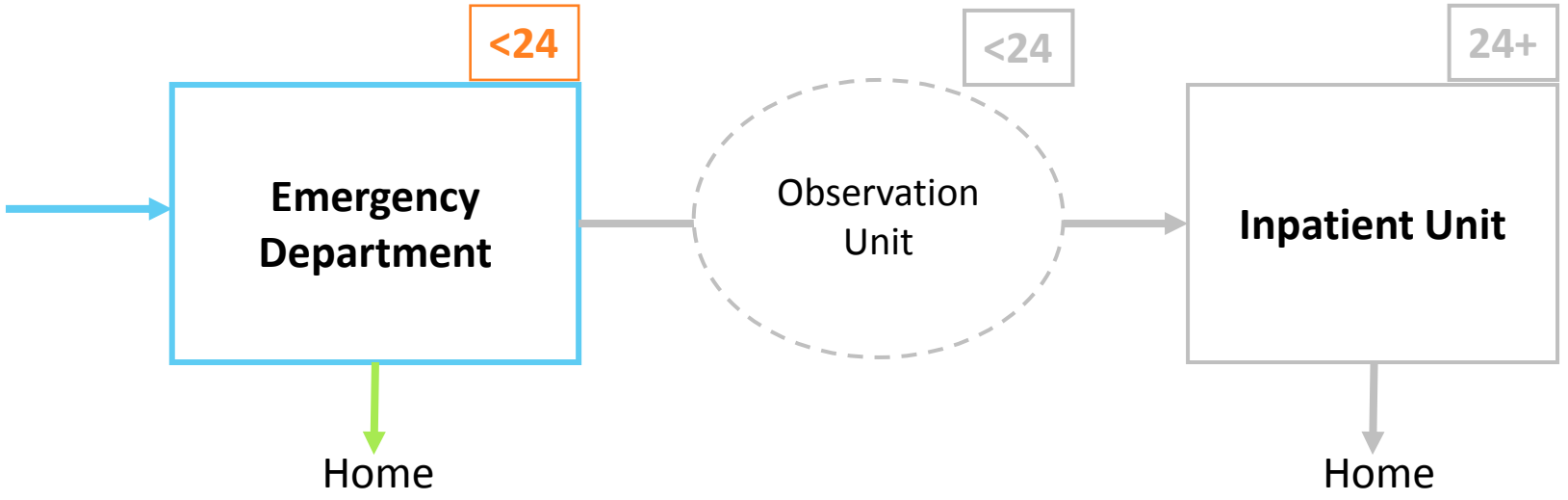
Patient Flow at Mott



Mott ED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Emergency Department
Observation Unit
Inpatient Unit
Home
Home

Patient Flow at Mott

- In the ED patients can stay up to **24 hours**
- So at the 23rd hour latest, the doctor has to make a disposition decision
  - **Admit**: send to the inpatient unit
  - **Discharge:** send them home
- As deadline approaches, it's harder to make the decision for certain patients

Patient Flow at Mott + Our work

- Main issue: Wrong disposition decision can lead to patient ***readmissions*** and ***inappropriate admissions***
- Our work:
  - Help doctors make disposition decisions
  - Use available data to predict disposition decisions
  - Case Study: Asthma Patients

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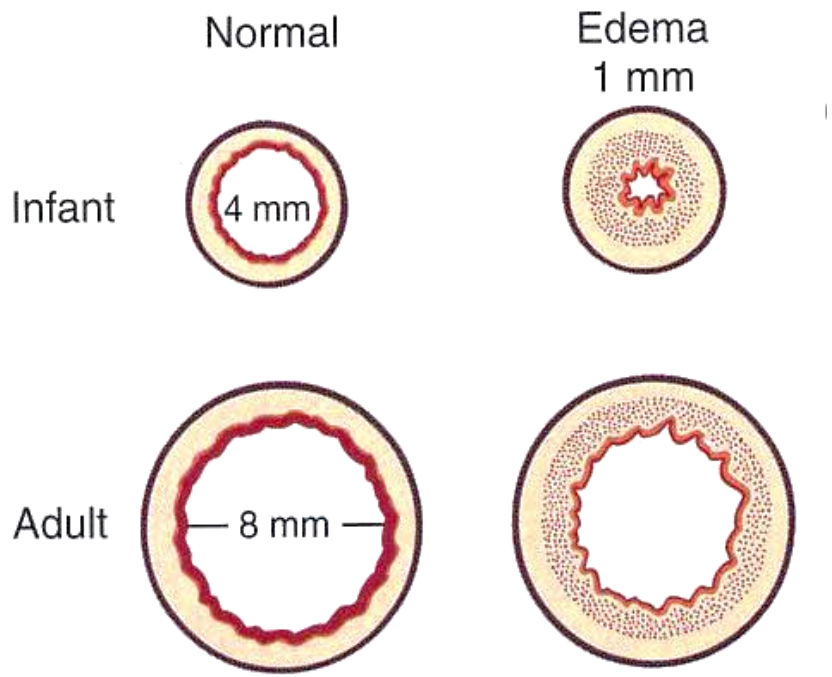
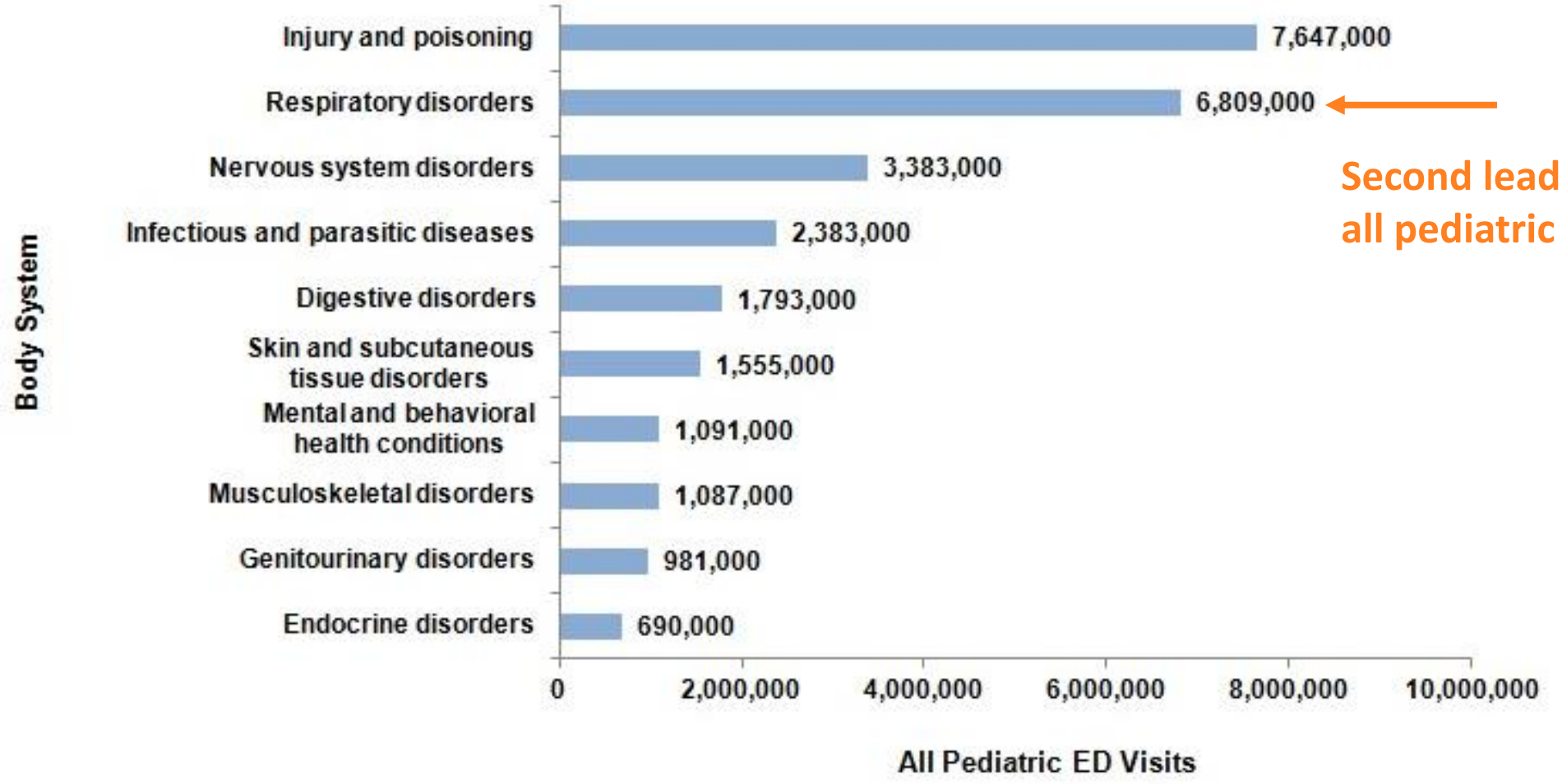
Asthma

Chronic Lung Disorder- airway inflammation and constriction



- Causes: allergens, genetics, viruses
- Characteristics: airway edema, accumulation of mucus in the lungs, and bronchoconstriction
- In Children:
  - more prone to respiratory failure than adults
  - Respiratory arrest often precedes cardiac arrest

Why Asthma Patients?



Second leading cause of all pediatric ED visits

Why Asthma?

- Patients are “easier” to identify
- Patients have straightforward list of treatments
- Patients take longer than standard ED visits, possible observation unit candidates
- Clinical collaborator support of Dr. Michelle Macy and Dr. Allison Cator at UMHS
  - Clinical Insights
  - Access to data

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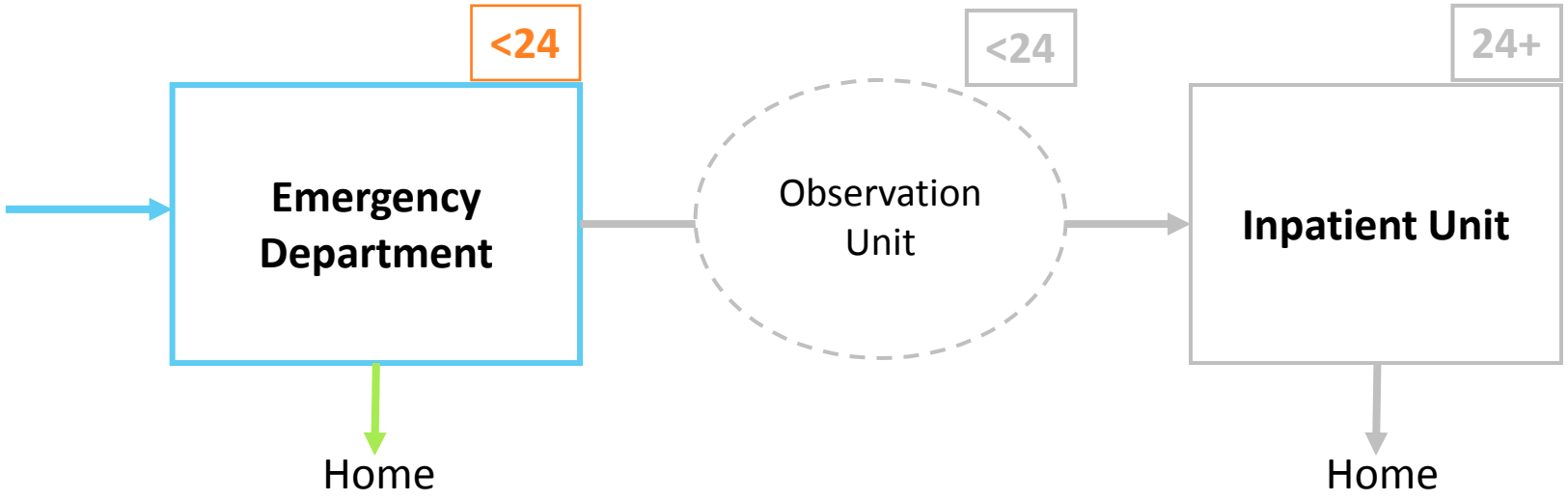
Mott ED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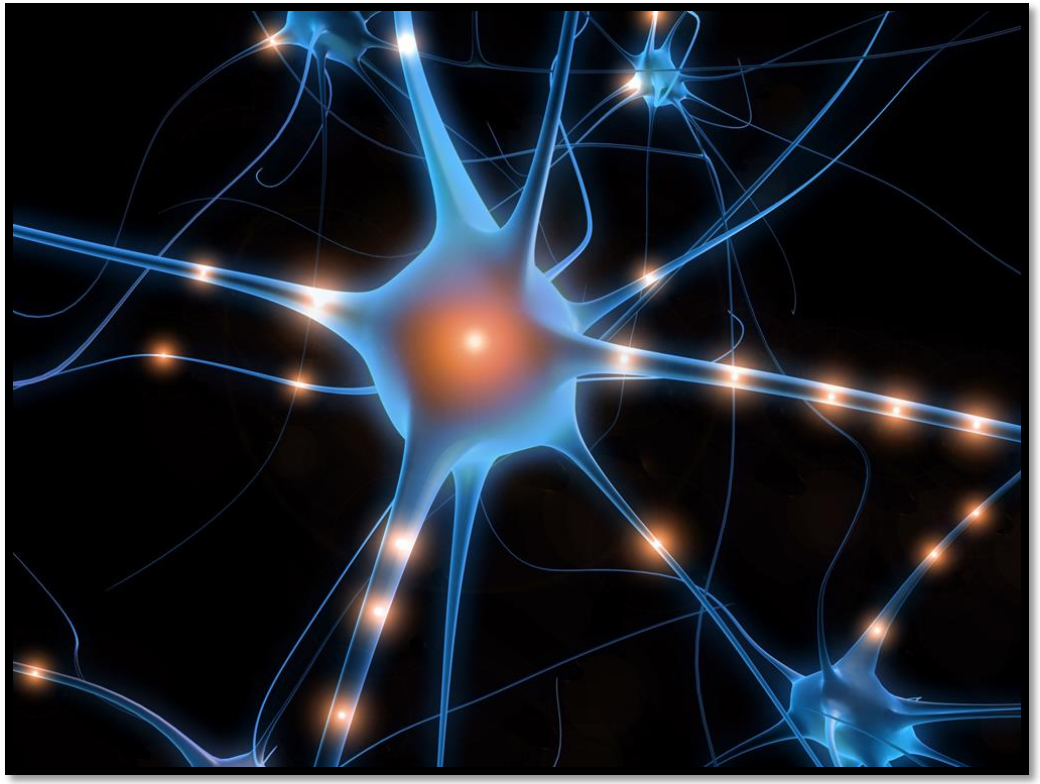
Neural Networks Intro

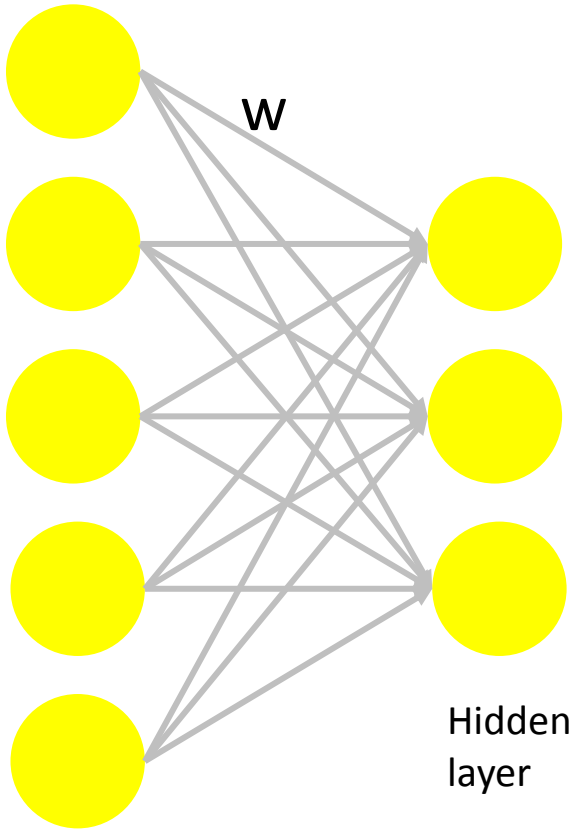


- Mathematical way to model how our brain learns
  - Neuron
  - Synapses
- Supervised Machine Learning
- Captures and represents complex nonlinear relationships

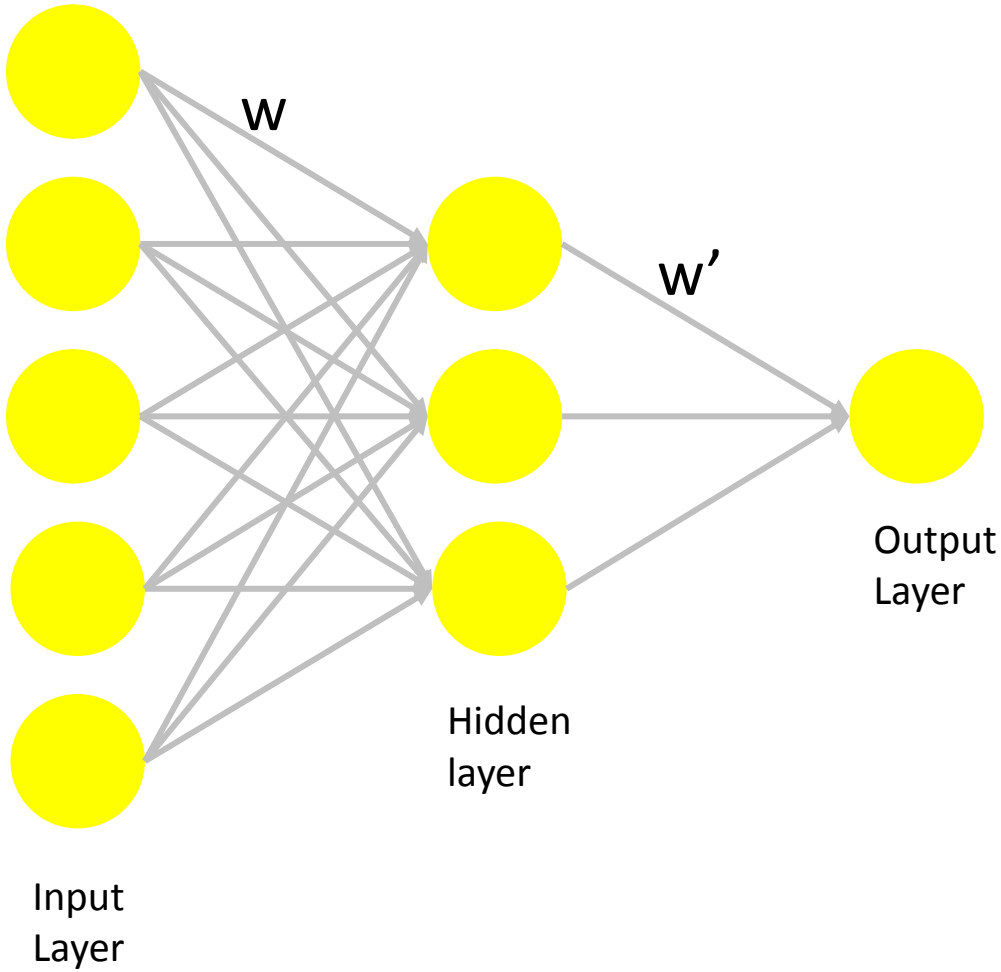
Neural Networks

Input
Layer

Neural Networks



Neural Networks



Neural Networks

- NN toolbox in **Matlab**
  - Training 70% - used for training
  - Validation 15% - stops training once networks learns
  - Test 15%- not used in training, independent set
- Use network to predict outputs of new data set (~300 samples) and compare with actual outputs

Neural Networks: Data

June 2012- March 2013

~2,000 samples of respiratory patients

MiChart Mott ED

Input Variables

- Age
- Sex
- Gender
- Race
- Payer
- Acuity Level
- Time of admission
- Medications given
- Rate of Change of Vital Signs: Pulse Oximetry, Temperature, Respiratory Rate, SpO2

Neural Networks: Data

Output Variable

“Correct” Disposition Decision

- NN predicted values are continuous
- Threshold of 0.5
- Mapped to binary values
  - O- discharge
  - 1- admit

Results: Neural Network

		Neural Network	
		Discharge	Admit
Data "correct"	Discharge	**93.1%**	6.9%
	Admit	55.4%	**44.6%**

Results: Data Analysis

		Doctors	
		Discharge	Admit
Data “correct”	Discharge	**92.6%**	7.4%
	Admit	14.4%	**85.6%**

Results Aggregated

		Neural Network	
		Discharge	Admit
Data "correct"	Discharge	**93.1%**	6.9%
	Admit	55.4%	**44.6%**

		Doctors	
		Discharge	Admit
Data "correct"	Discharge	**92.6%**	7.4%
	Admit	14.4%	**85.6%**

Results

- Doctors are better than our model
- BUT, If model can strongly predict the disposition of the patient, it can aid the admit discharge decision that doctor makes, in real time
- Thus, more appropriate care for the patient
  - Reduce readmissions
  - Reduce inappropriate admissions

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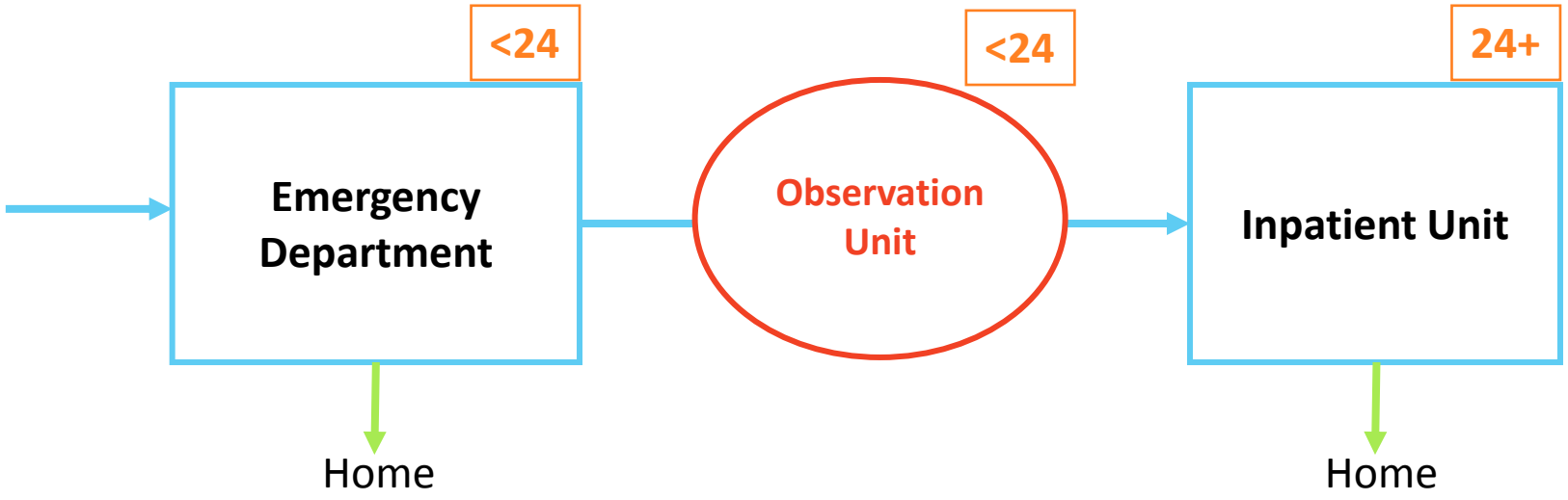
Next Steps: Neural Networks

- Better input variables to fine tune model
- More data
- Validate with different methods:
  - Regression, find significant variables
- Predict Length of Stay (LOS) as output:
  - Better aid to disposition decision ~ observation unit candidates

Next Steps: Simulation Model



Remarks

- Not just for asthma patients, but can look at other populations in the future

Thank you!

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