Simulated Geographical Co-location of Patients Admitted to an Inpatient Internal Medicine Teaching Unit

Potential Impacts on Efficiency and Physician-Nurse Collaboration

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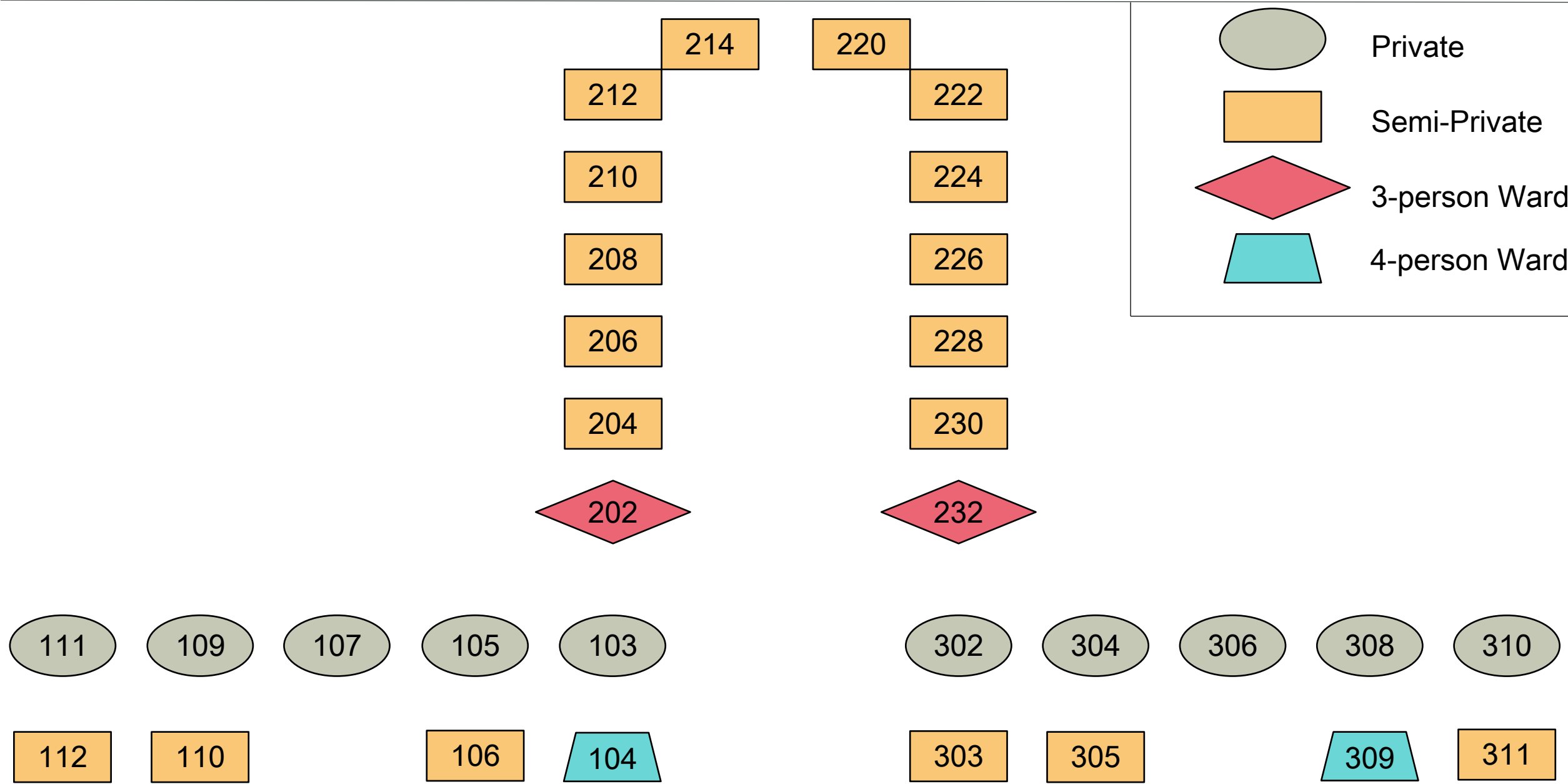
OVERVIEW

HOSPITAL UNIT

London Health Sciences Centre
University Hospital Campus
Internal Medicine Inpatient Teaching Unit

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HOSPITAL UNIT

	Private
	Semi-Private
	3-person Ward
	4-person Ward

214
212
210
208
206
204
202

220
222
224
226
228
230
232

111 109 107 105 103

302 304 306 308 310

112 110 106 104

303 305 309 311

HOSPITAL UNIT

	Three Physician Teams	Nursing Staff
Day Shift	1 attending physician	4 patients assigned to each nurse
	1-2 senior residents	
	2-4 junior residents	
Night Shift	1 attending physician	6 patients assigned to each nurse
	1 senior resident	

DEFINITION OF PROBLEM

Goal 1

Reduce the number of physician team members that a nurse must interact with when reporting on their patients.

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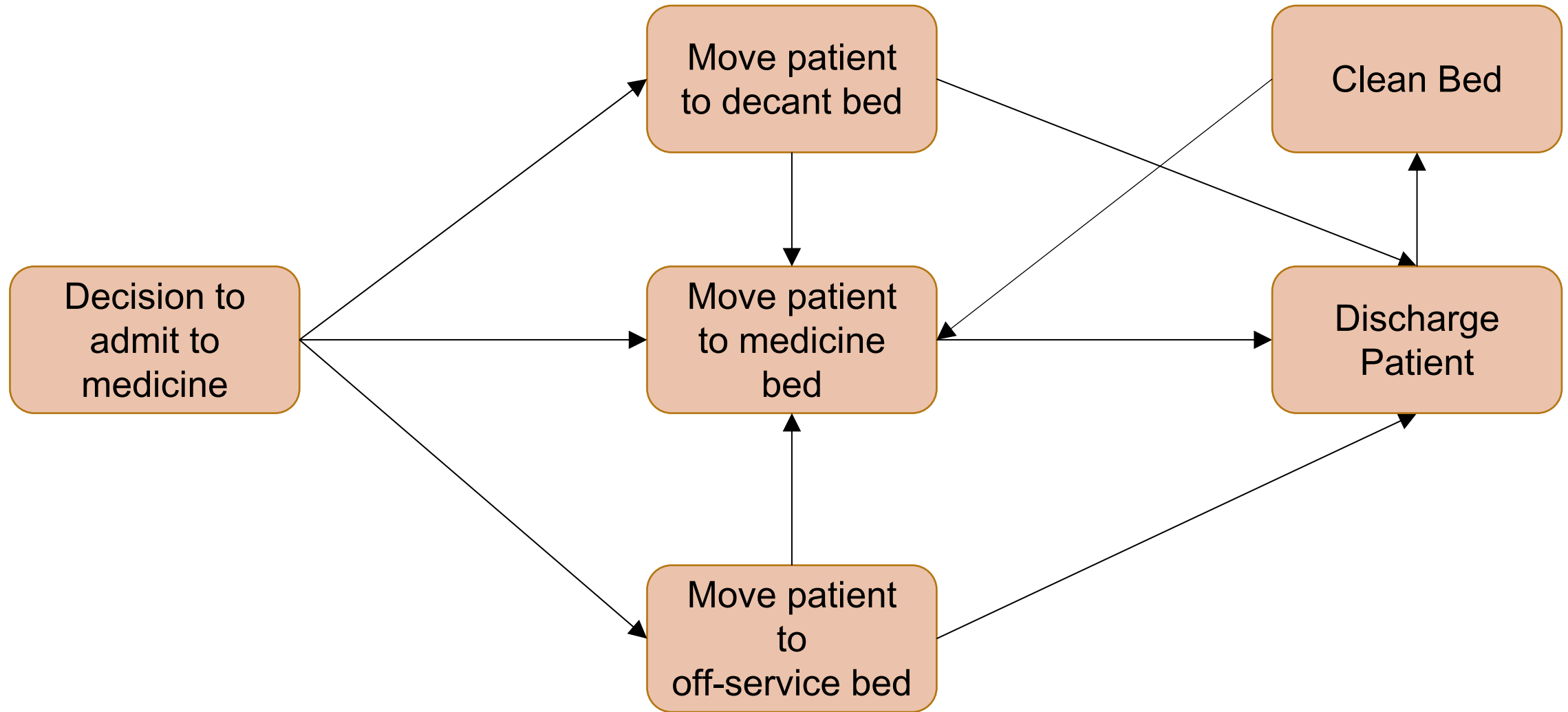
Goal 2

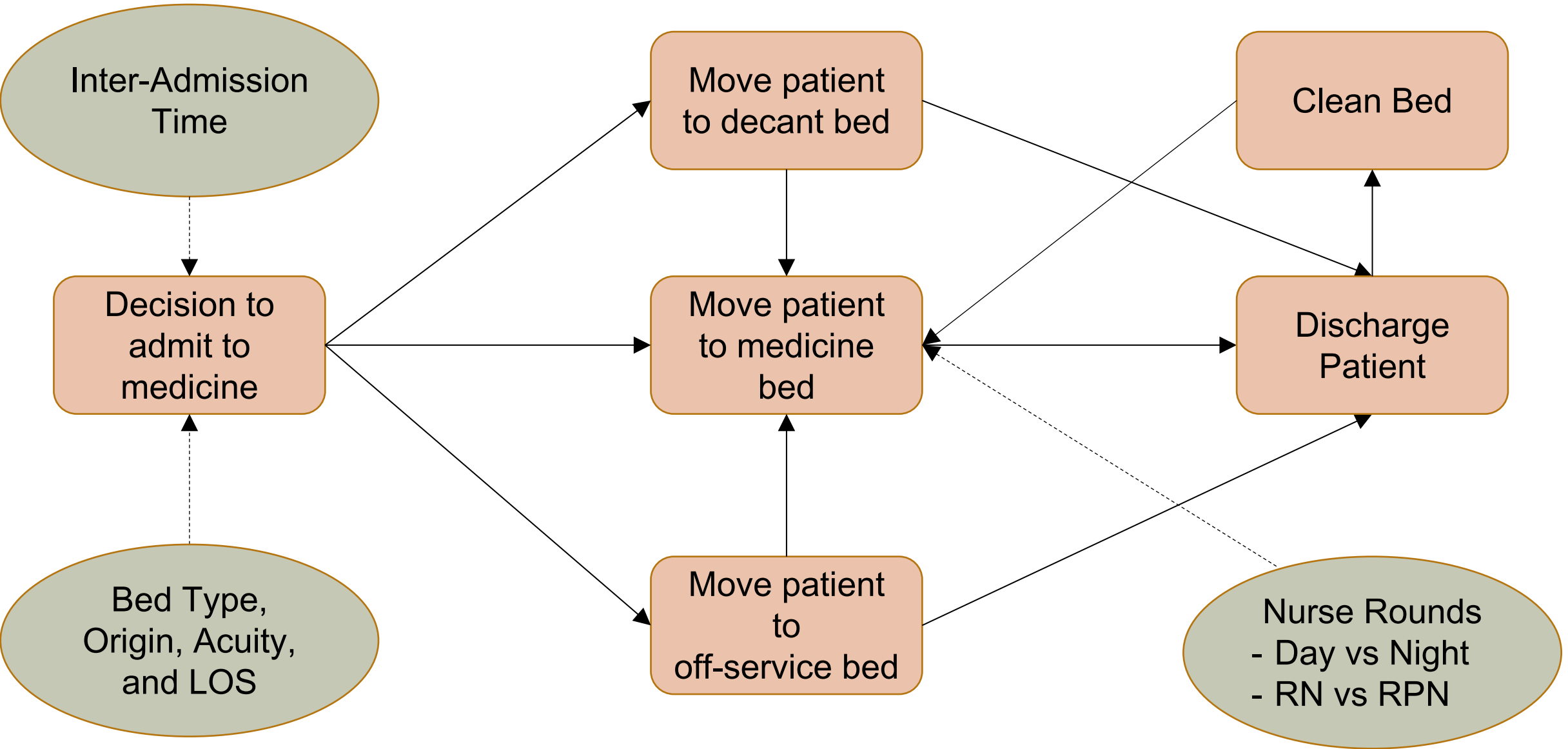Reduce variance in the number of patients between the three teams at daily census times.

Constraint

Avoid a significant impact on patients in the emergency department while maintaining current staffing levels.

PATIENT FLOW

MODELLING PATIENT FLOW

REFERENCE SIMULATION

Performance Averages

Metric	Observed Value	Reference 95% CI (Sim.)	
		Low	High
Floor Utilization	94.8%	94.4%	95.1%
Medicine Utilization	83.5%	82.2%	83.1%
Number of Admitted Patients Waiting	3.4	3.0	3.3
Waiting Time	6.4	6.7	7.4

Patients Per Nurse (PPN)

$$PPN = \frac{\text{\# Patients assigned to team}}{\text{\# Nurses assigned to those patients}}$$

- A measure of the number of nurses each physician team interacts with, normalized for the number of patients the team has.

- Optimally want to maximize this value for each team.

NEW METRICS

Patients Per Nurse (PPN)

Metric	Reference 95% CI (Sim.)	
	Low	High
PPN Start Day	1.49	1.51
PPN End Day	1.46	1.48
PPN Start Night	1.80	1.82
PPN End Night	1.84	1.87

NEW METRICS

Team Census Variance

$$\text{Variance} = \frac{\sum_{Physician\ Teams}(\text{Team\_Census} - \text{Avg\_Census})^2}{3}$$

- A measure of how equally the patients are distributed among the teams.

- Optimally want to minimize this value.

NEW METRICS

Team Census Variance

| Metric	Observed Value	Reference 95% CI (Sim.)	
		Low	High
Team Census Variance	7.36	6.02	6.71

PROPOSED CHANGES

Bed Assignment

- Each bed is assigned a team, and may only hold patients from that team.
- Once a patient is assigned a bed, they must remain there for the duration of their stay.

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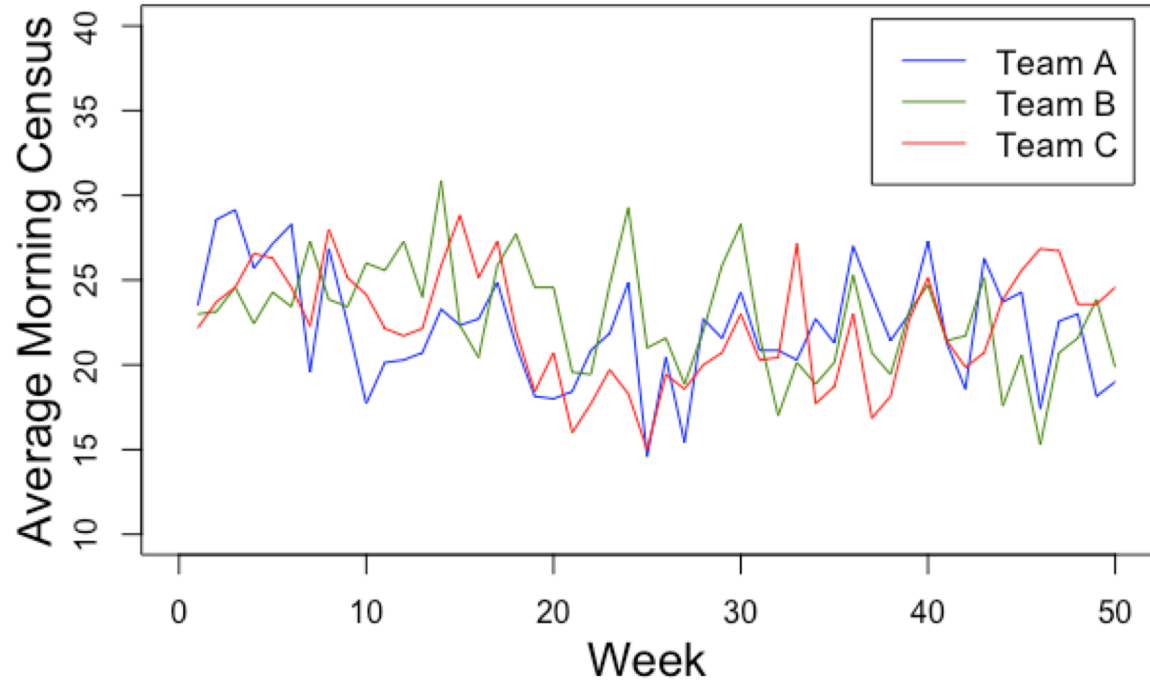
Team Assignment

- Primarily, patients receive the first available bed.
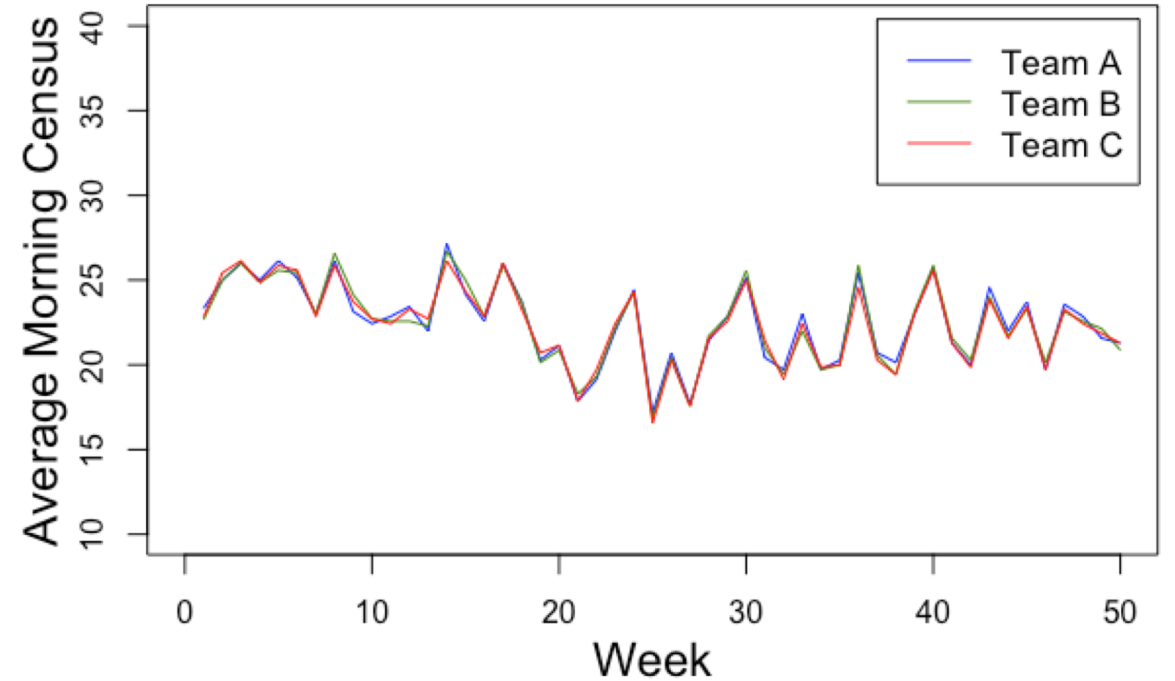- Secondarily, patients are assigned to the team with the least number of patients.

BED ASSIGNMENT
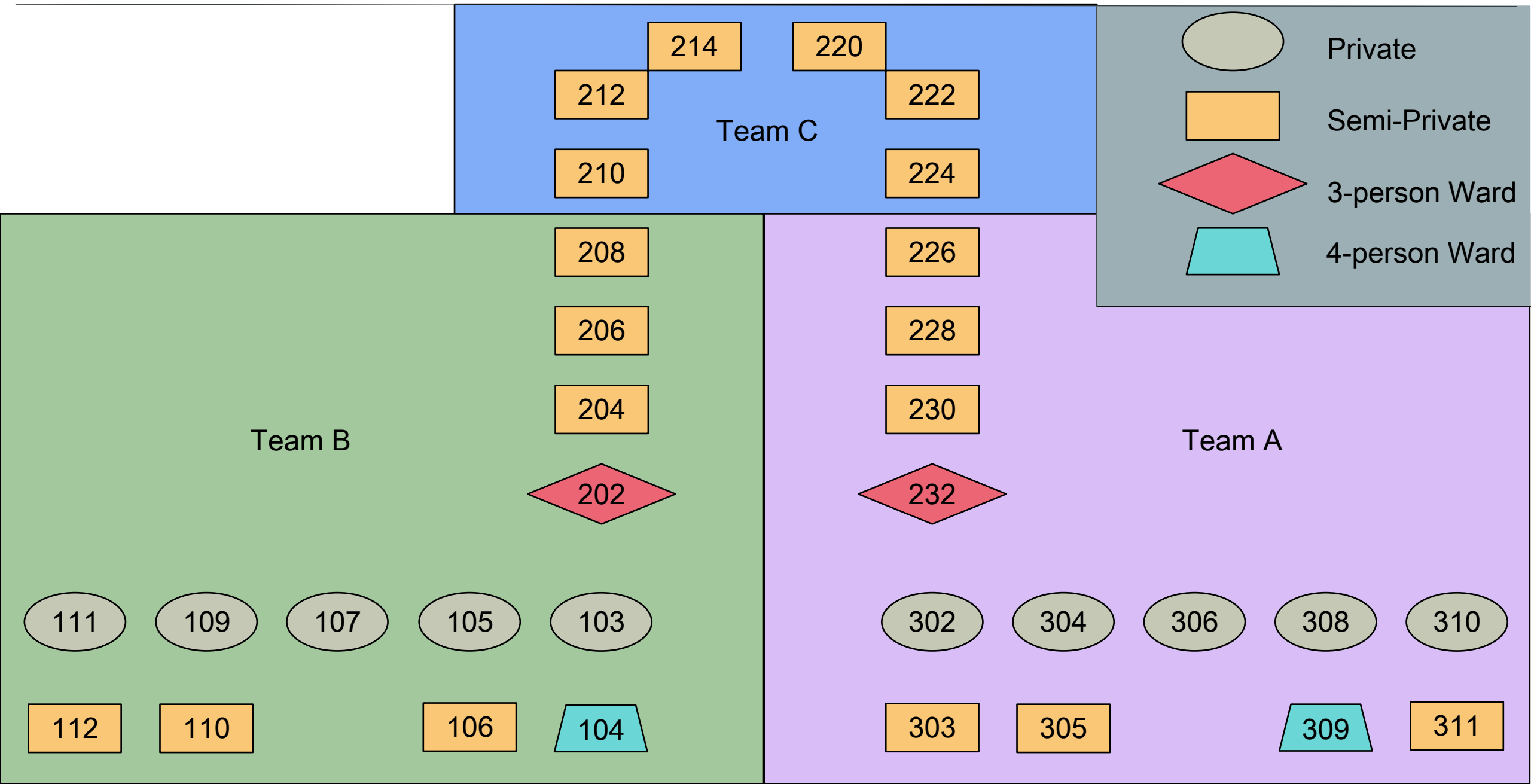
TEAM ASSIGNMENT

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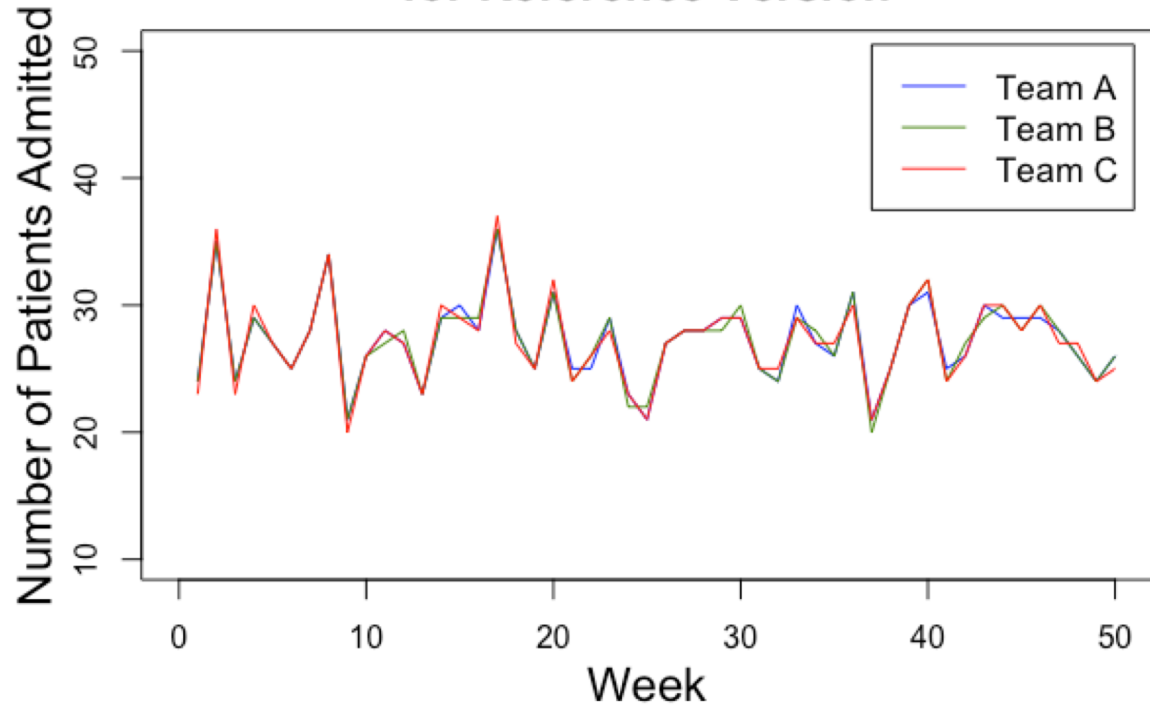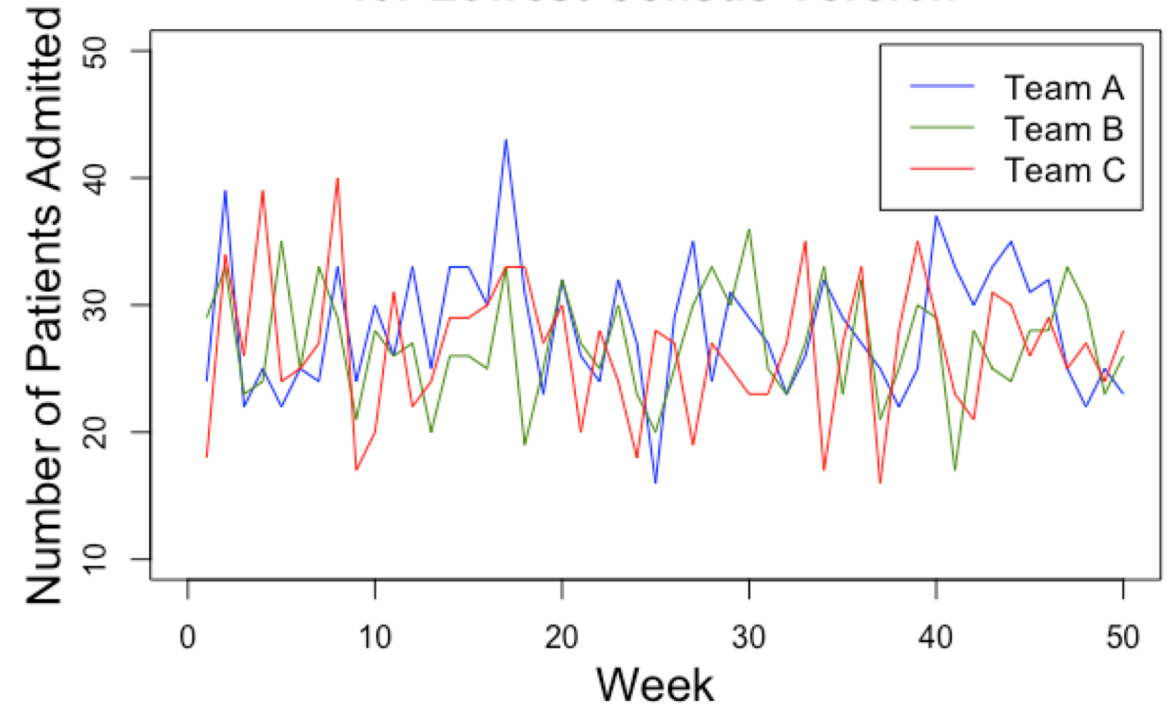
RESULTS

Performance Averages

Metric	Reference Value (Sim.)	GeoFlow 95% CI (Sim.)	
		Low	High
Floor Utilization	94.7%	94.3%	95.1%
Medicine Utilization	82.7%	82.2%	83.1%
Number of Admitted Patients Waiting	3.1	3.0	3.3
Waiting Time	7.1	6.8	7.4

RESULTS

Patients Per Nurse (PPN)

Version	Team	Start Day	End Day	Start Night	End Night
Reference Value (Sim.)		1.50	1.47	1.80	1.85
GeoFlow Value (Sim.)	Team A	3.14	2.97	4.33	4.58
	Team B	3.14	2.98	4.33	4.58
	Team C	3.21	3.05	3.78	3.98

NEW METRICS

Team Census Variance

Metric	Reference Value (Sim.)	GeoFlow 95% CI (Sim.)	
		Low	High
Team Census Variance	6.37	0.40	0.43

SUMMARY

Goal

- Maximize patients per nurse and minimize team census variance.

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Solution

- Assign a team to each bed so that team nurses are geographically co-located.
- Assign patients to the team with the lowest census when possible.