

Pulmonary Clinic Flow Simulation Model Review

Denise White

Craig Froehle

Amy Chima

Robin Hamilton

Division of Health Policy & Clinical Effectiveness

Updated: 05/27/10

Purpose & Background

- In order to improve patient flow through clinic, we need to understand the impact of the scheduling template as well as the interrelationships of all of the process steps, variability of patient needs, and the availability of appropriate staff at each step in the process.
- “Simulation is the process of designing and creating a computerized mathematical model of a real or proposed system for the purpose of conducting numerical experiments to give us a better understanding of the behavior of that system for a given set of conditions.”
- Because of the difficulty to test different options on the system itself, a simulation model is a perfect tool for providing insight into what changes need to be made, and we can test changes to see the impact to clinic flow in a computer “laboratory” setting.

Simulation Model Design

This model simulates the clinic flow of the Pulmonary Department (located at the base) from patient arrival to service completion that may include pulmonary testing procedures and the services of multiple providers in order to find improvements in flow that results favorable service level measures for the patients while maintaining or improving clinical efficiency.

AIM

- To examine and test the effect of operational changes on clinical measures.

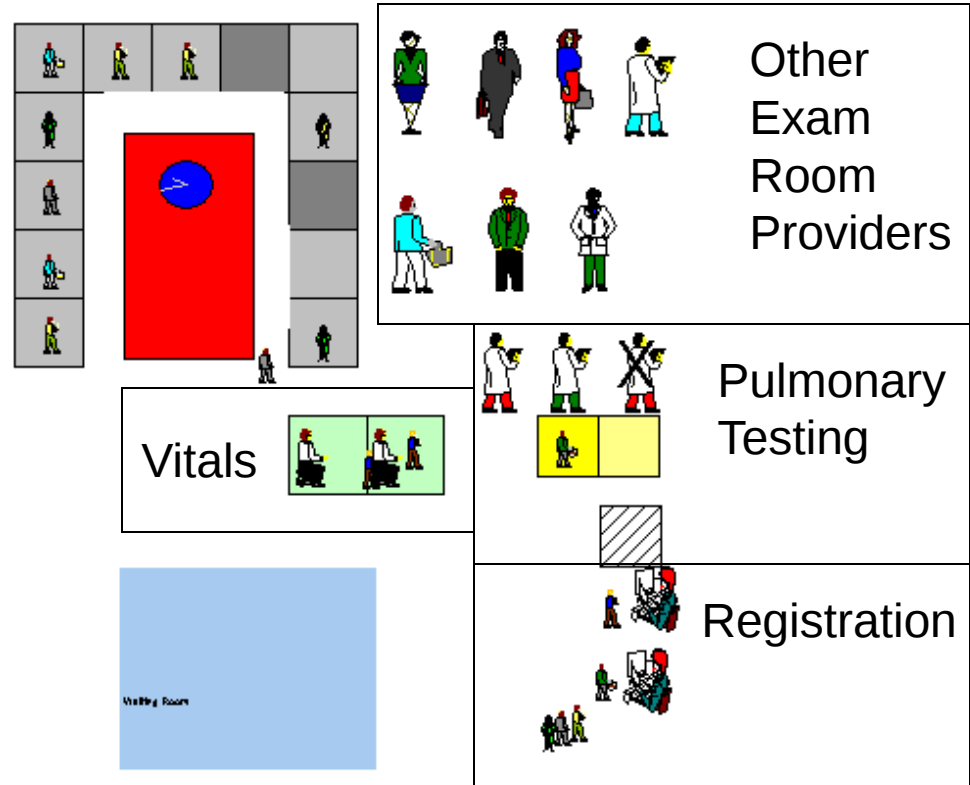
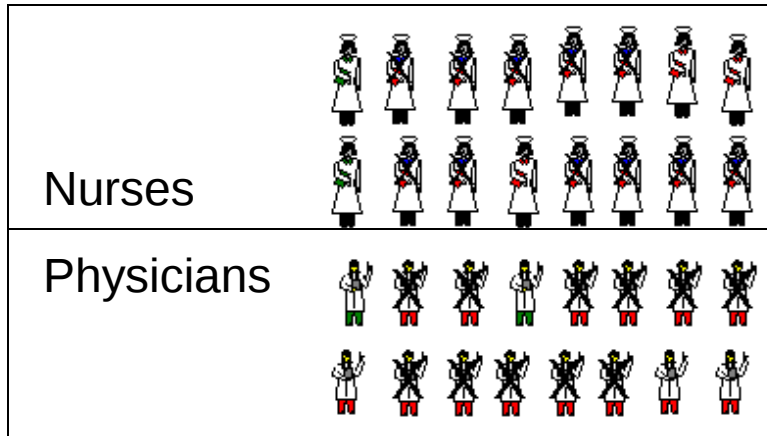
Potential What-If Scenarios/Recommendations

- How should exam rooms be allocated to doctors in a clinic setting?
- Are the resource allocations sufficient?
- Can scheduling or flow modifications be made to improve clinic measures?
- Can variance reduction improve performance?

Outcome Performance Measures

- Patient Touch Time/ Wait Time Measures
- Resource Utilization
- Clinic Duration

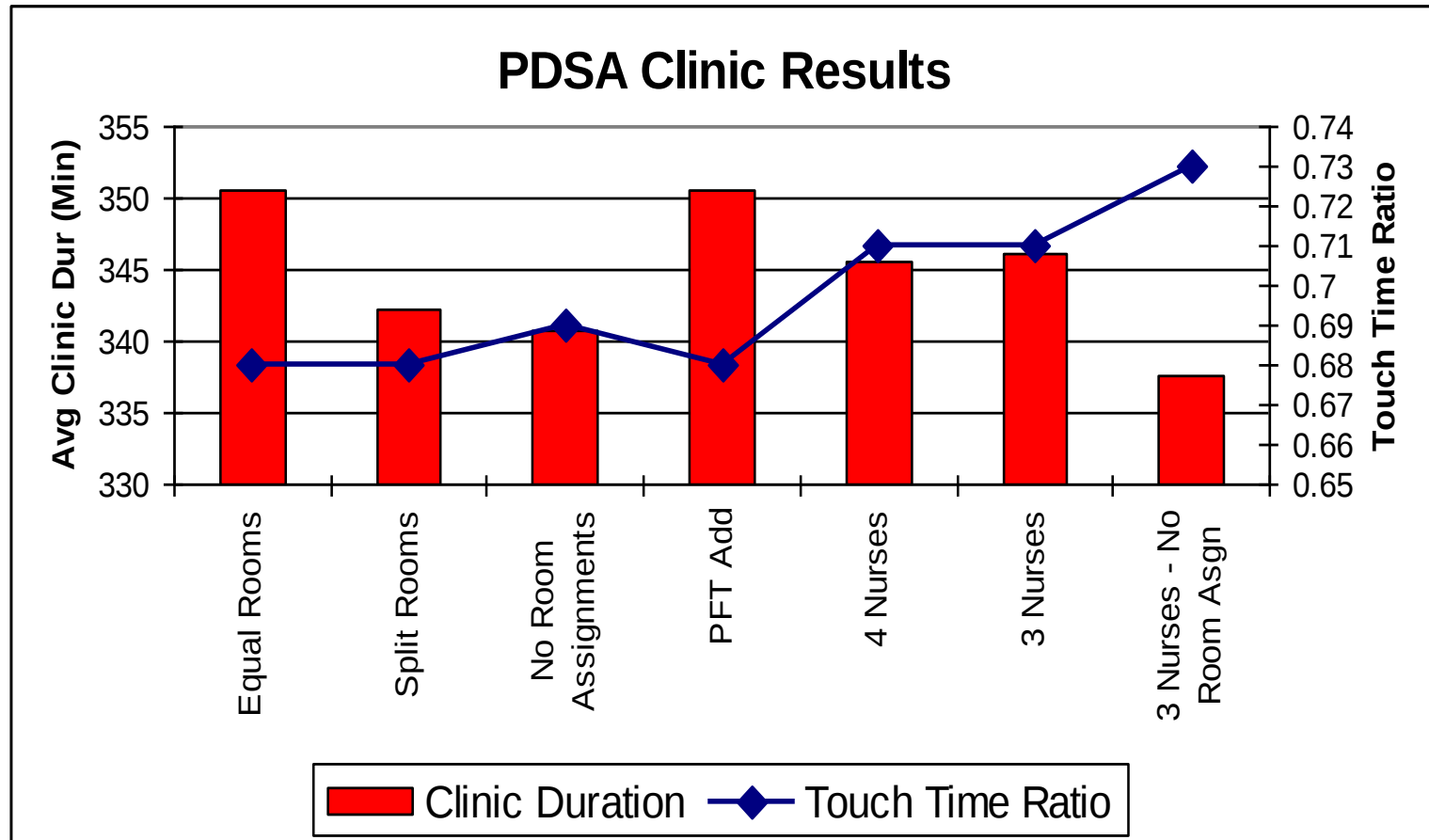
Model Snapshot



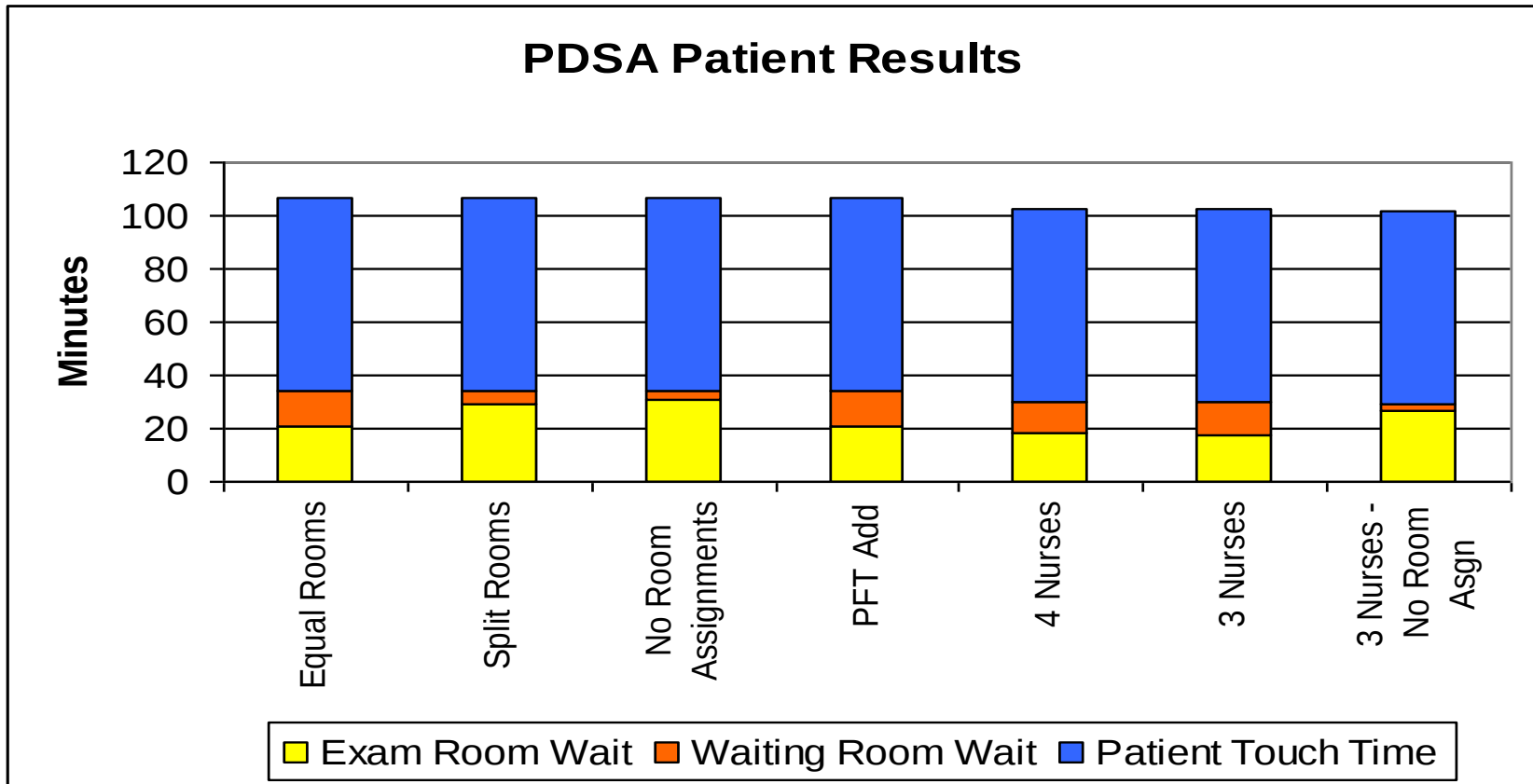
Patients arrive based on scheduling templates of physicians with appointment type determined by template.

Flow scenarios (by appt type) assigned based on historical data.

Operations Results



Patient Results



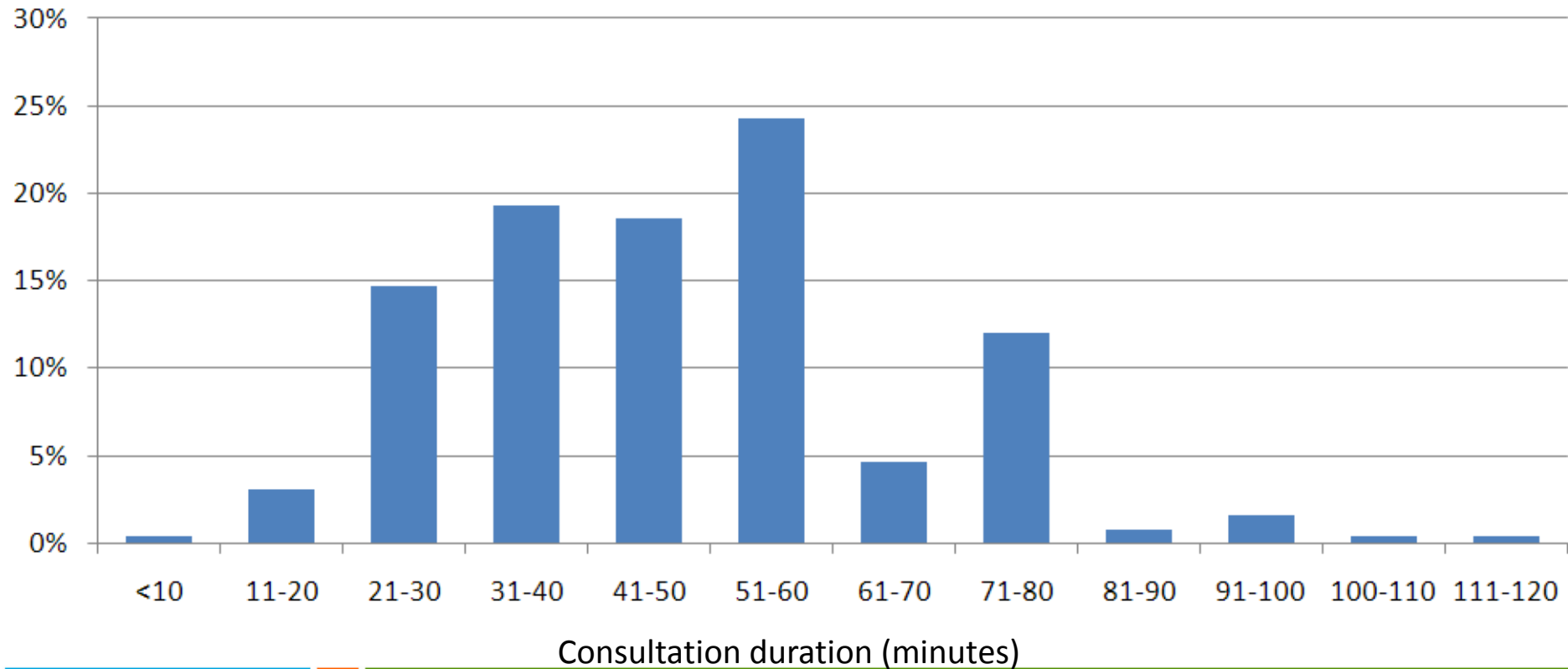
Understanding Patient Flow

Some principles of patient flow:

- Time is a finite and costly resource
- Variability is only bad when it's unanticipated
- System-level performance depends on each individual's actions; everything's connected
- Waiting is minimized when schedule matches actual work

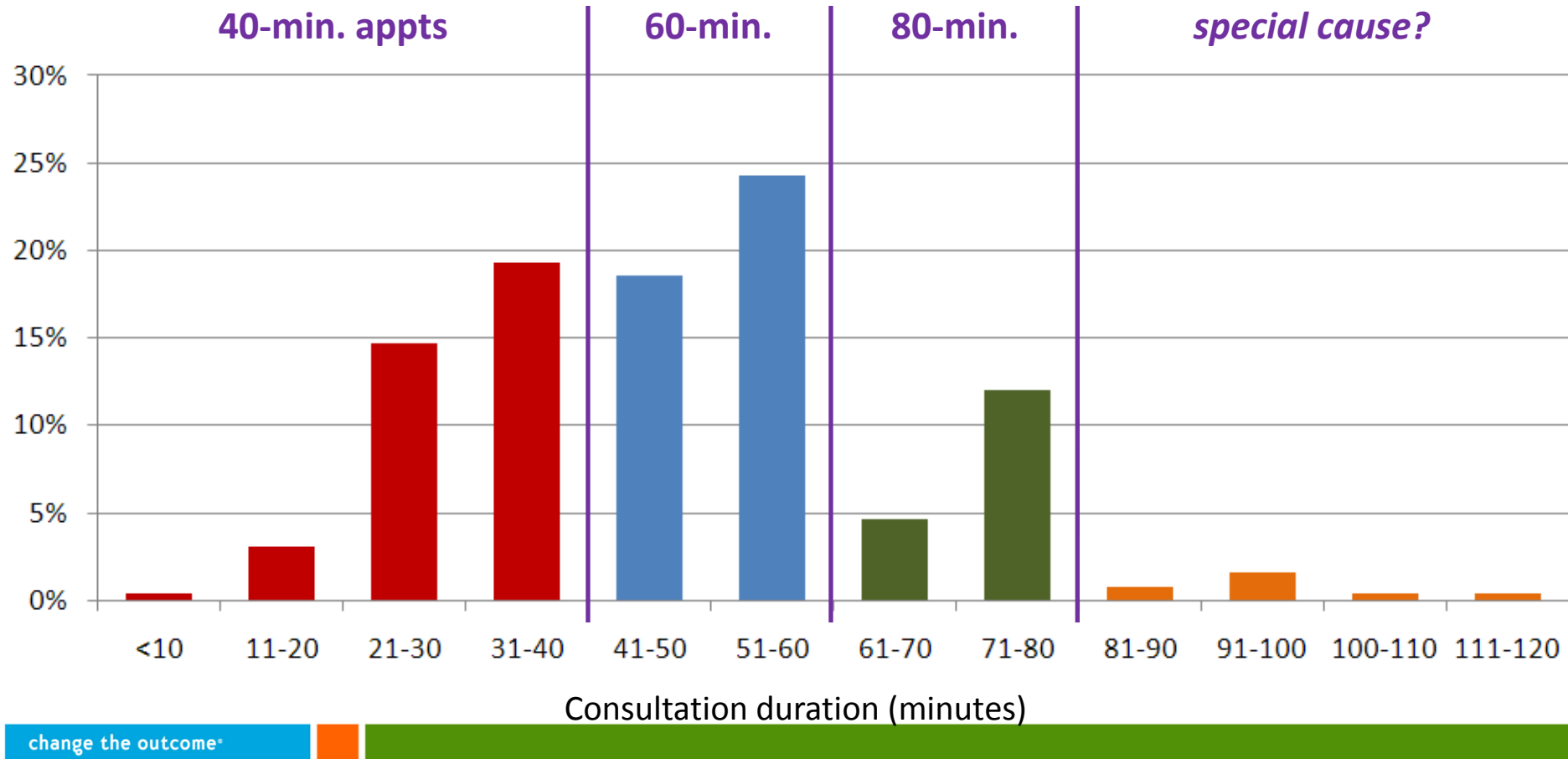
Variability in Consultation Durations

60-minute appointments



change the outcome*

Variability in Consultation Durations



PDSA: Reduce Activity Duration Uncertainty

Hold physician consultation times to scheduled durations

- If scheduled for 30 minutes, then the physician's meeting with patient ends at 30 minutes (if not before)
- Depends on physician and patient/appointment type

Hold non-physician activity times to 150% of historical averages

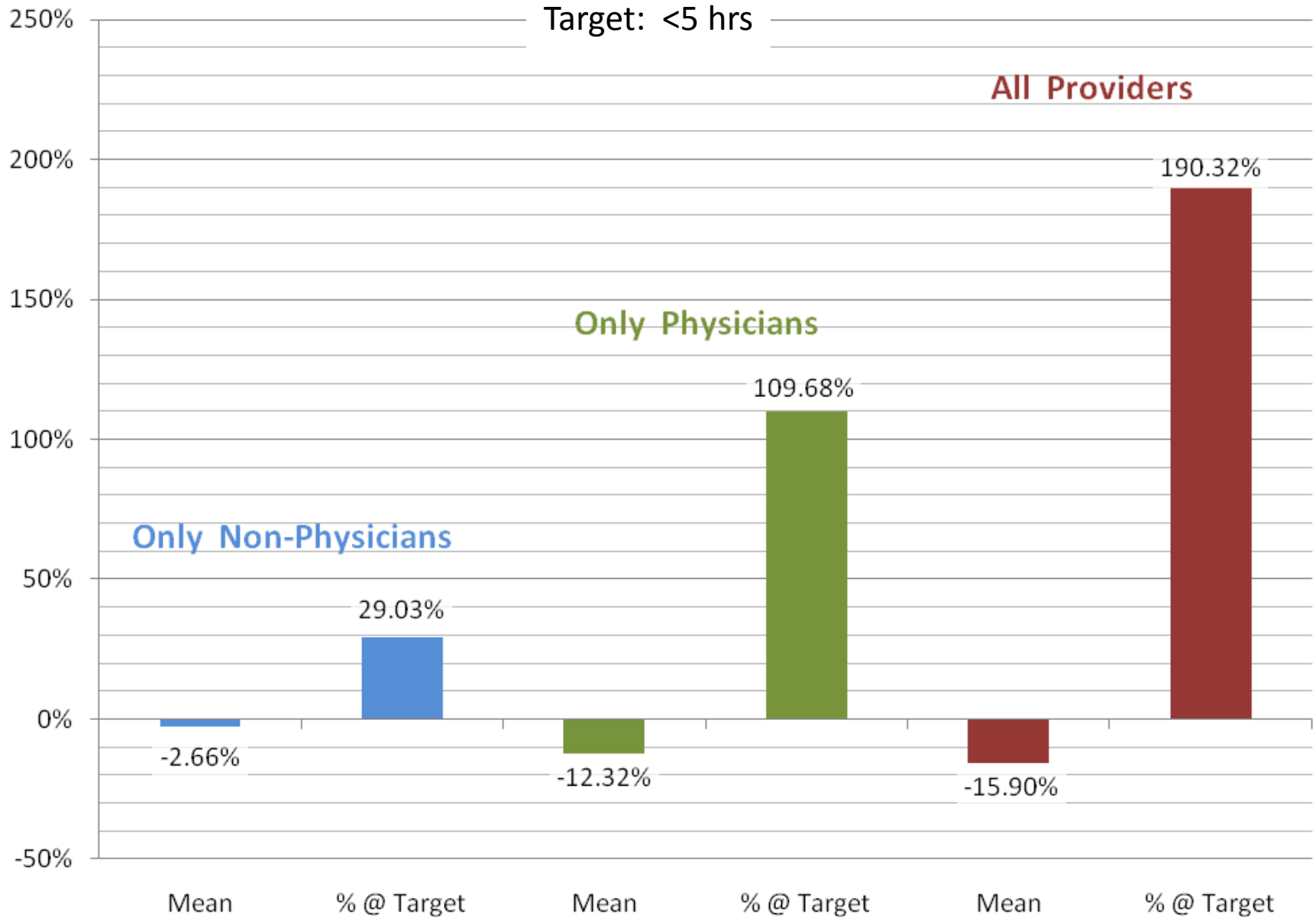


Methods

- Data collection
 - Manual timestamp entry into EPIC
 - 1 clinic met data integrity threshold
 - Extracted empirical time distributions
- Simulation
 - Built simulation model of that specific clinic
 - 150 replications of a clinic session per scenario
 - Used same patient set each time (var. reduction)

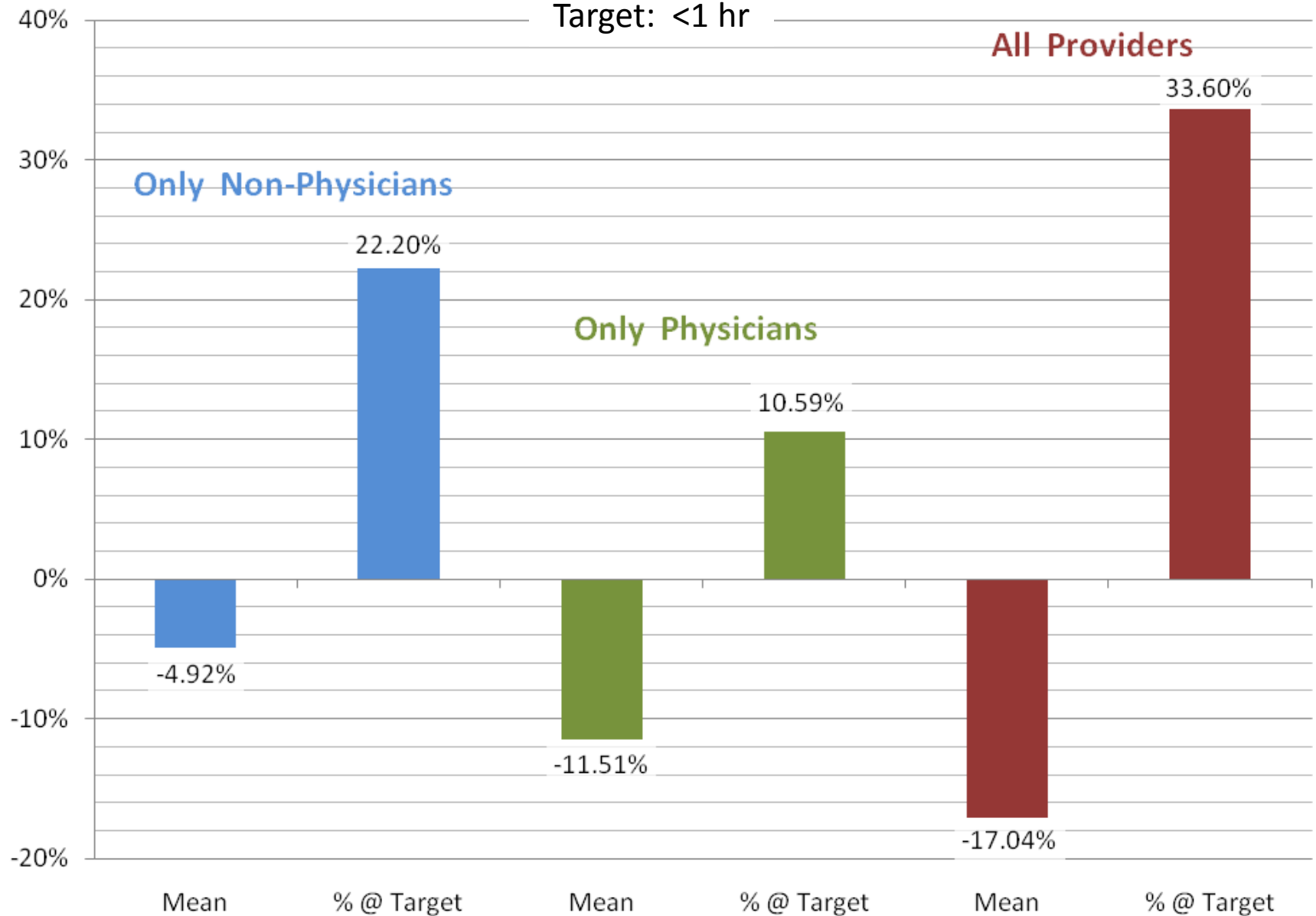
Improvement in Clinic Duration

Target: <5 hrs



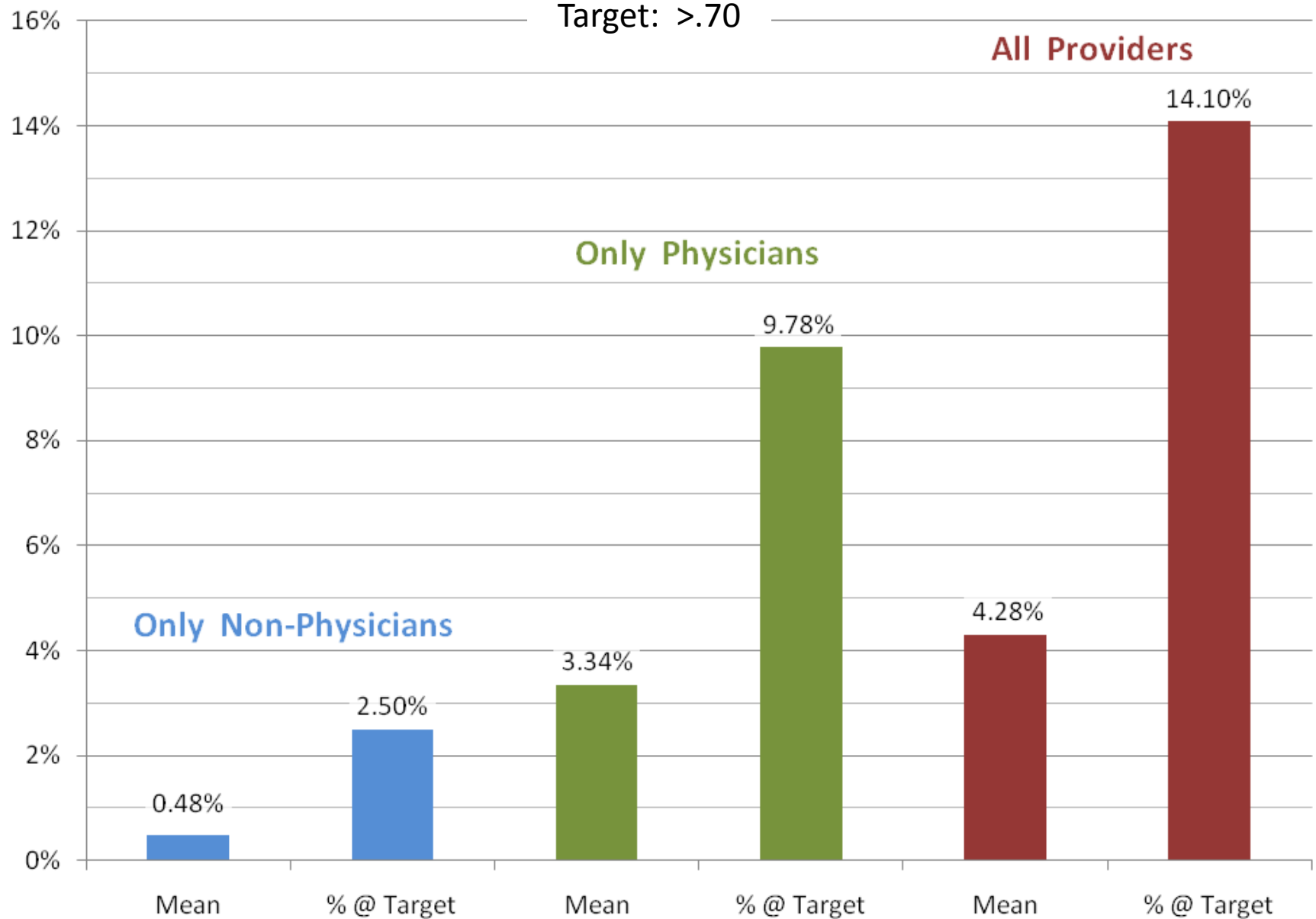
Improvement in Patient Visit Duration

Target: <1 hr



Improvement in Touch Time Ratio

Target: >.70



Raw Numerical Results

		Baseline		Only Non-Physicians		Only Physicians		All Providers	
	Target	Mean	% Meeting Target	Mean	% Meeting Target	Mean	% Meeting Target	Mean	% Meeting Target
Clinic Duration	< 5 hours	350.61	20.00%	341.29	25.81%	307.41	41.94%	294.86	58.06%
	% Change			-2.66%	29.03%	-12.32%	109.68%	-15.90%	190.32%
Patient Cycle Time	< 1 hour	112.03	14.48%	106.53	17.69%	99.14	16.01%	92.94	19.35%
	% Change			-4.92%	22.20%	-11.51%	10.59%	-17.04%	33.60%
Patient Touch Time	< 1 hour	72.26	43.70%	68.69	47.57%	67.35	46.39%	63.74	50.04%
	% Change			-4.93%	8.84%	-6.80%	6.14%	-11.78%	14.51%
Patient Wait Time	< 30 minutes	34.89	60.66%	32.94	62.84%	26.90	67.56%	24.32	71.25%
	% Change			-5.57%	3.60%	-22.91%	11.38%	-30.30%	17.45%
Exam Room Wait	< 30 minutes	20.91	78.53%	20.51	79.65%	17.07	84.90%	16.18	86.67%
	% Change			-1.91%	1.43%	-18.38%	8.11%	-22.63%	10.36%
Waiting Room Wait	< 30 minutes	13.52	83.22%	11.99	84.75%	9.39	87.88%	7.69	90.09%
	% Change			-11.37%	1.84%	-30.60%	5.60%	-43.13%	8.26%
Touch Time Ratio	> .70	0.68	51.87%	0.68	53.17%	0.70	56.94%	0.71	59.19%
	% Change			0.48%	2.50%	3.34%	9.78%	4.28%	14.10%

Full-Factorial Experiment

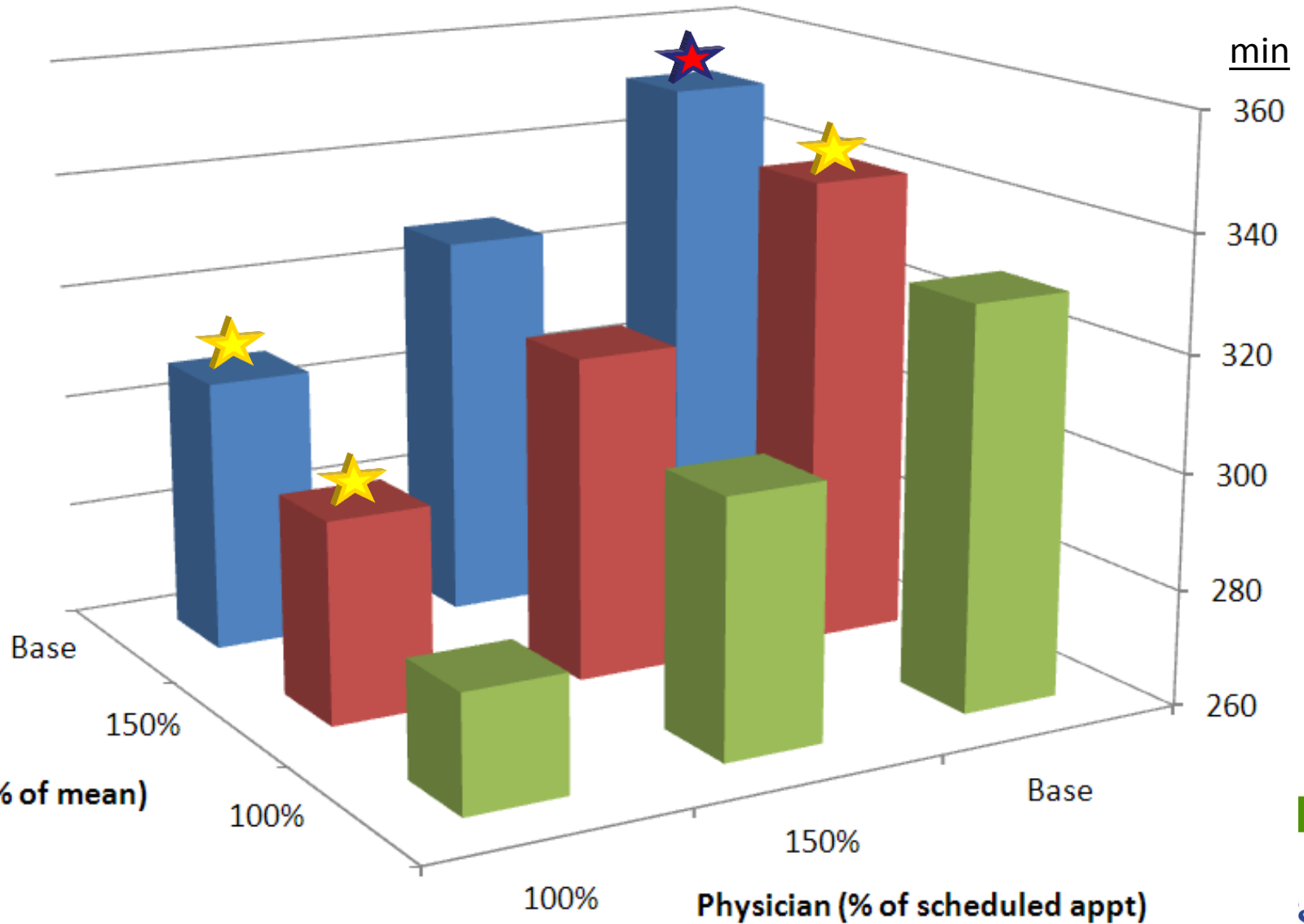
Three levels for physicians:

- Baseline (empirical data)
- 150% of scheduled duration
- 100% of scheduled duration

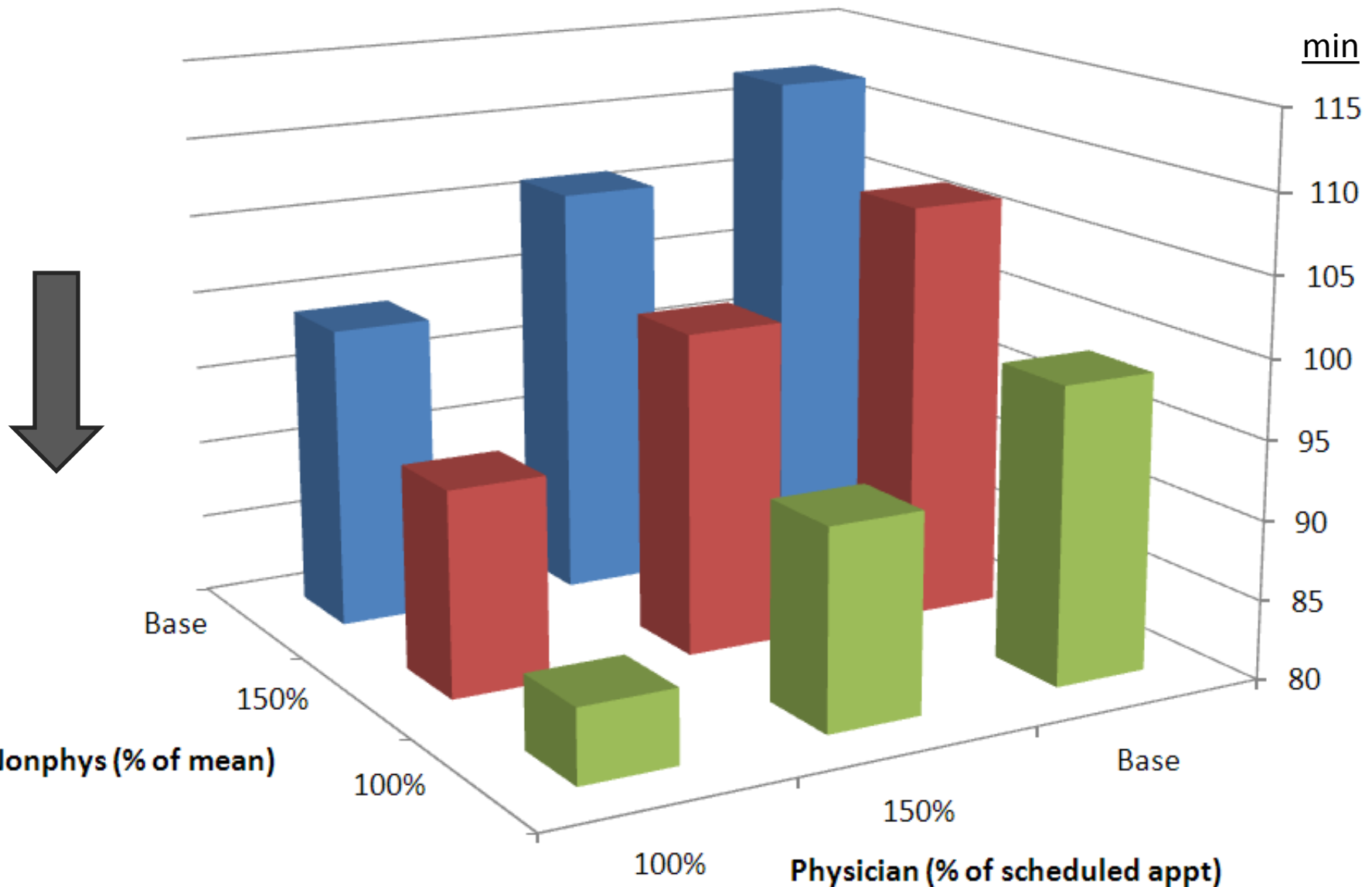
Three levels for non-physicians:

- Baseline (empirical data)
- 150% of mean
- 100% of mean

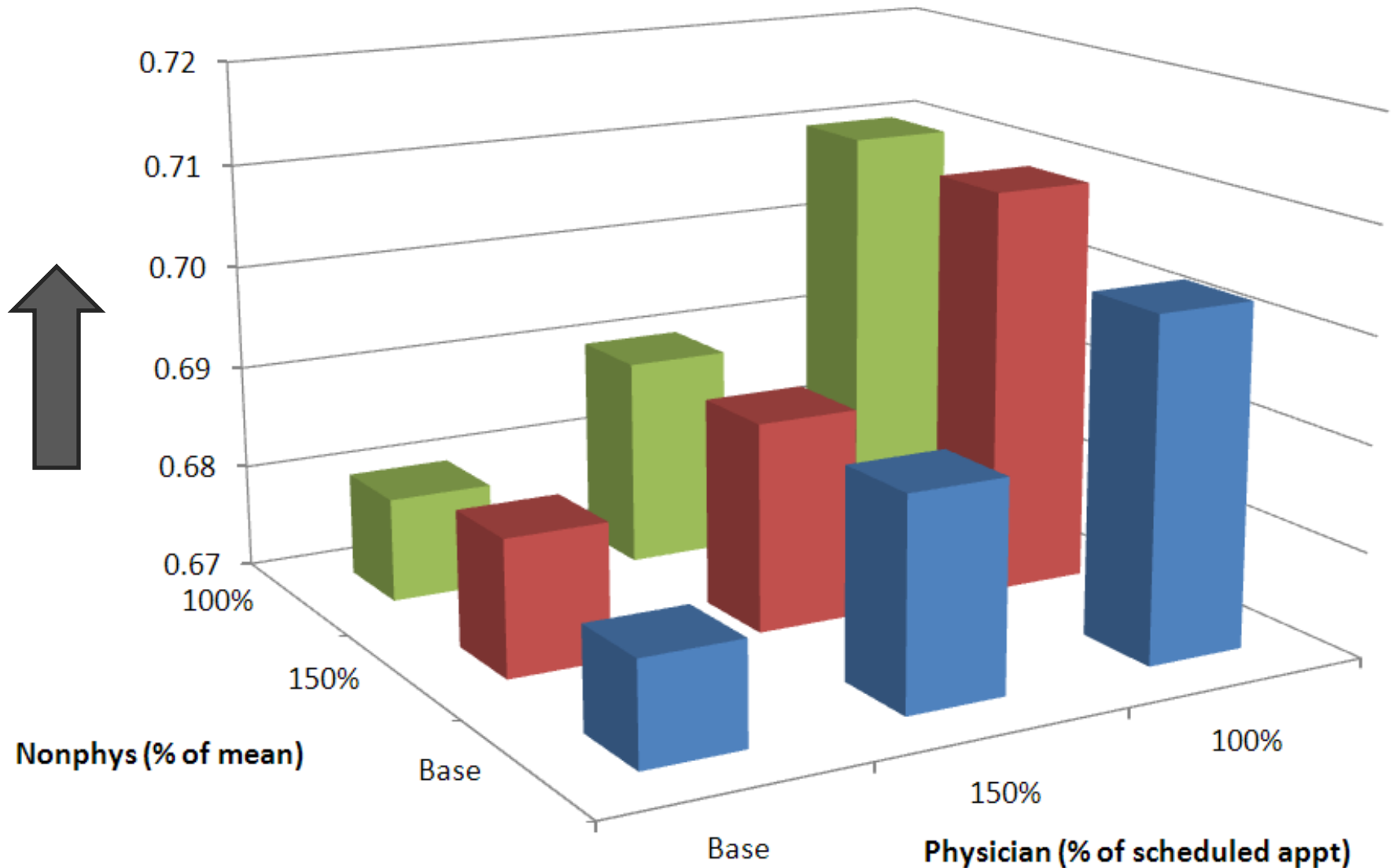
Clinic Duration



Patient Visit Duration

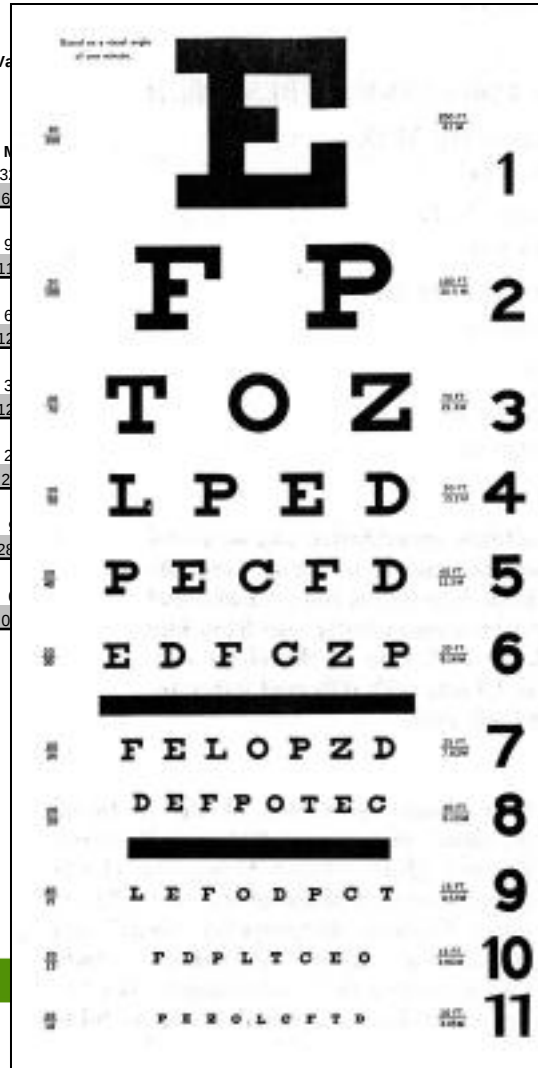


Patient Touch Time Ratio



Raw Numerical Results

	Target	Baseline		Cap Nonphys. at 150% of Mean		Value
		Mean	% Meeting Target	Mean	% Meeting Target	
Clinic Duration	< 5 hours	350.61	20.00%	341.29	25.81%	3
	% Change			2.66%	29.03%	6
Patient Cycle Time	< 1 hour	112.03	14.48%	106.53	17.69%	9
	% Change			4.92%	22.20%	11
Patient Touch Time	< 1 hour	72.26	43.70%	68.69	47.57%	6
	% Change			4.93%	8.84%	12
Patient Wait Time	< 30 minutes	34.89	60.66%	32.94	62.84%	3
	% Change			5.57%	3.60%	12
Exam Room Wait	< 30 minutes	20.91	78.53%	20.51	79.65%	2
	% Change			1.91%	1.43%	2
Waiting Room Wait	< 30 minutes	13.52	83.22%	11.99	84.75%	1
	% Change			11.37%	1.84%	28
Touch Time Ratio	> .70	0.68	51.87%	0.68	53.17%	1
	% Change			0.48%	2.50%	0



Both II (150% Phys, 100% Nonphys)		Cap Physician at Sched. Duration		Both III (100% Phys, 150% Nonphys)		Both I (100% Phys, 100% NonPhys)	
Mean	% Meeting Target	Mean	% Meeting Target	Mean	% Meeting Target	Mean	% Meeting Target
04.00	58.06%	307.41	41.94%	294.86	58.06%	280.10	58.06%
3.29%	190.32%	12.32%	109.68%	15.90%	190.32%	20.11%	190.32%
02.56	19.35%	99.14	16.01%	92.94	19.35%	84.66	19.35%
7.38%	33.60%	11.51%	10.59%	17.04%	33.60%	24.43%	33.60%
61.57	50.04%	67.35	46.39%	63.74	50.04%	58.50	50.04%
4.79%	14.51%	6.80%	6.14%	11.78%	14.51%	19.04%	14.51%
26.11	71.25%	26.90	67.56%	24.32	71.25%	21.28	71.25%
5.16%	17.45%	22.91%	11.38%	30.30%	17.45%	39.00%	17.45%
18.19	86.67%	17.07	84.90%	16.18	86.67%	15.33	86.67%
8.01%	10.36%	18.38%	8.11%	22.63%	10.36%	26.69%	10.36%
7.47	90.09%	9.39	87.88%	7.69	90.09%	5.49	90.09%
4.77%	8.26%	30.60%	5.60%	43.13%	8.26%	59.41%	8.26%
0.69	59.19%	0.70	56.94%	0.71	59.19%	0.71	59.19%
5.00%	14.10%	3.34%	9.78%	4.28%	14.10%	4.44%	14.10%

change the outcome*

Conclusions

Methodological

- Simulation allows for rapid prototyping of potentially disruptive changes and improvement activity
- Validity of results depends on input data

Operational

- Accurate scheduling + conscientious behavior can lead to large improvement on key metrics
- Managerial decisions influence flow with the potential for synergy
- Improvements rely on actions of all providers