

System Engineering in Healthcare Operations Management

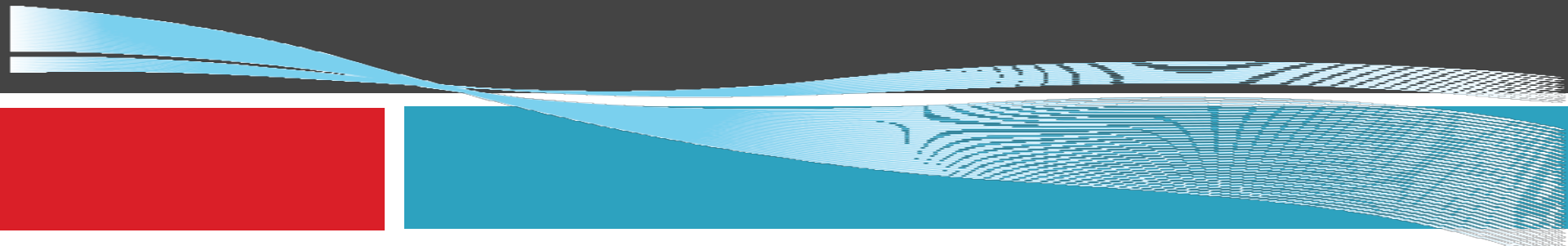
- Reduce Waste of Healthcare Resources

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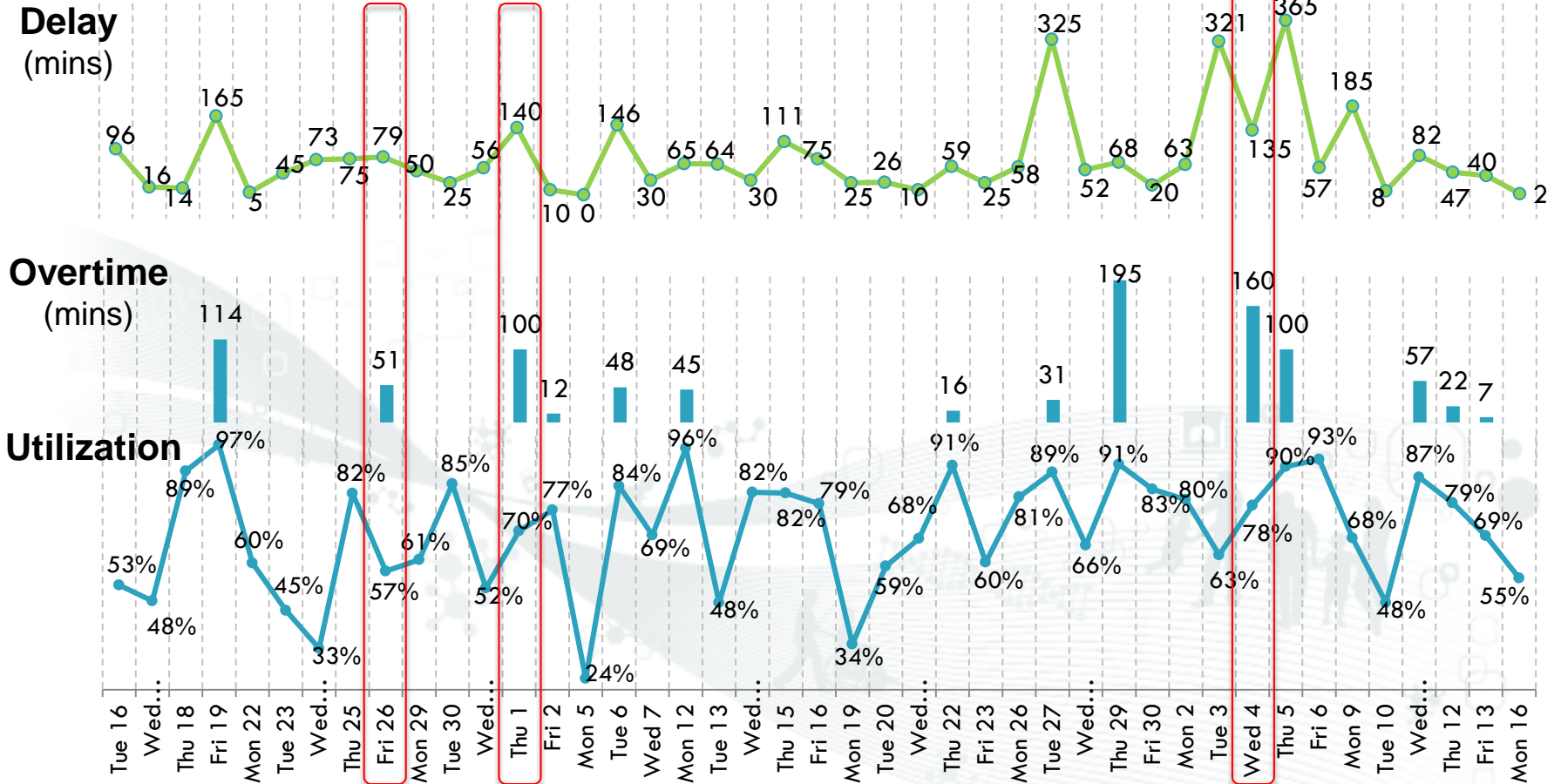
Department of Systems Engineering & Engineering Management

The Chinese University of Hong Kong

May 2017



Operating Room (OR) performance



Working hour: 8:30-16:30

Our field



Operations Research

Systems Engineering

Management Sciences

Industrial Engineering

Operations Management

Business Analytics

Decision Analysis

Decision Sciences



Systems Engineering

- Decision-making and efficiency
 - + Applied math—simulation, optimization, probability
- Past – Manufacturing
- Trend – Service
 - + Pricing, gambling, healthcare





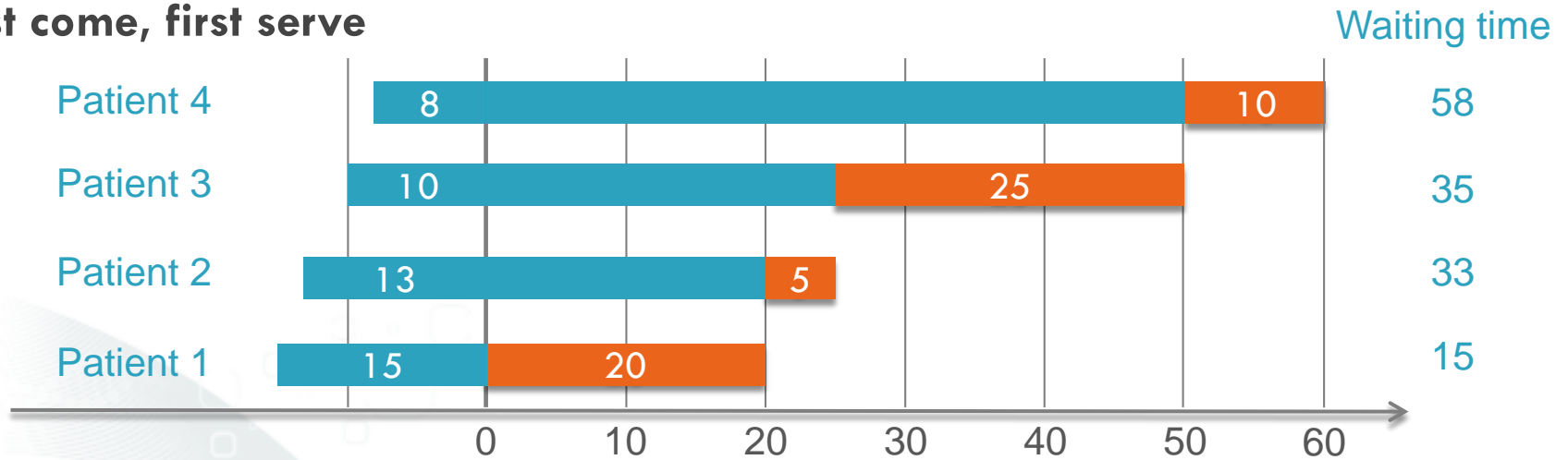


Scheduling patients for treatment

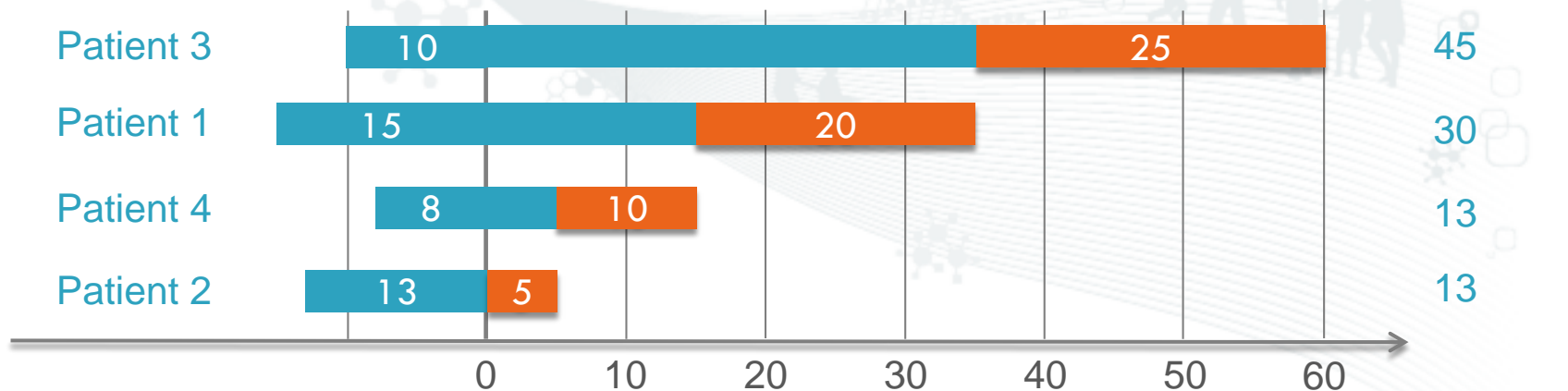
	Current waiting time	Estimated consultation time
Patient 1	15	20
Patient 2	13	5
Patient 3	10	25
Patient 4	8	10

Two appointment rules

First come, first serve



Shortest consultation time first

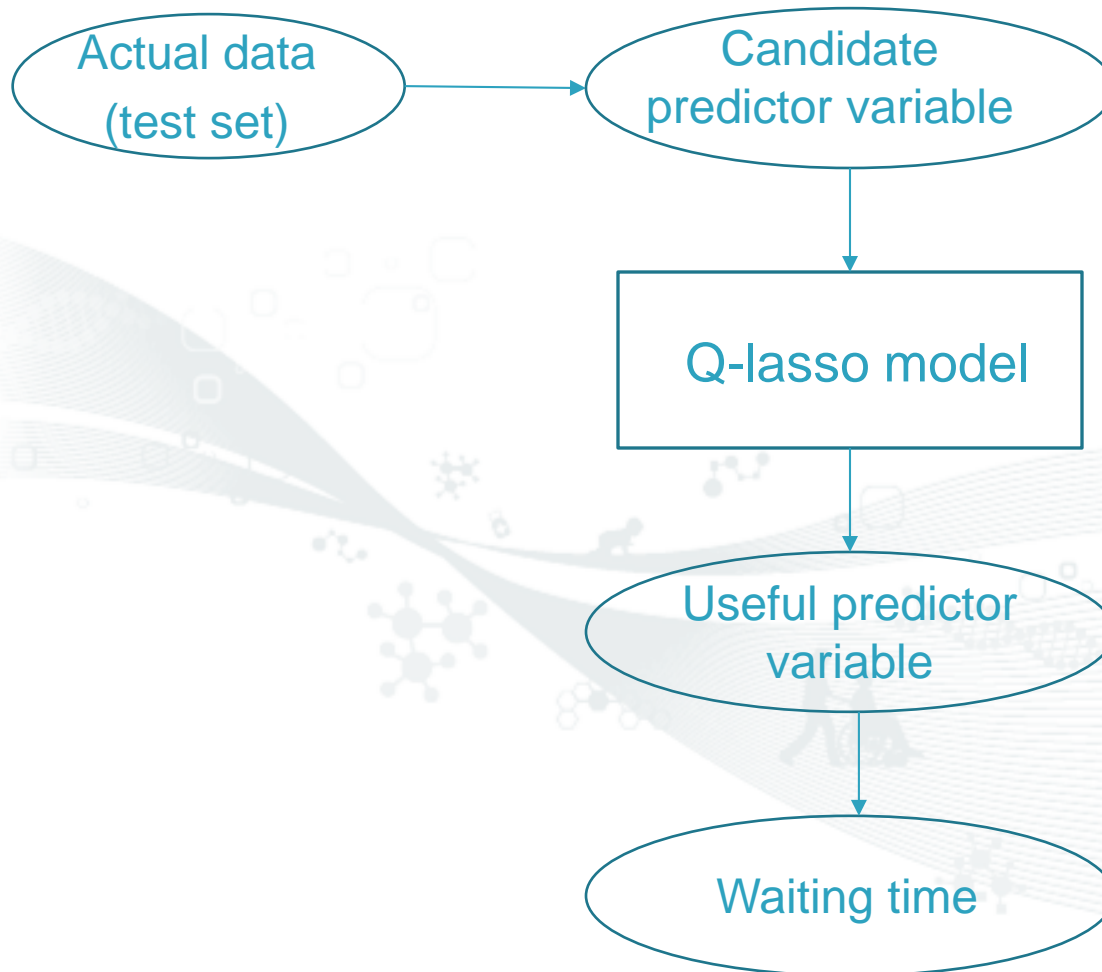


Accurate ED Wait Time Prediction

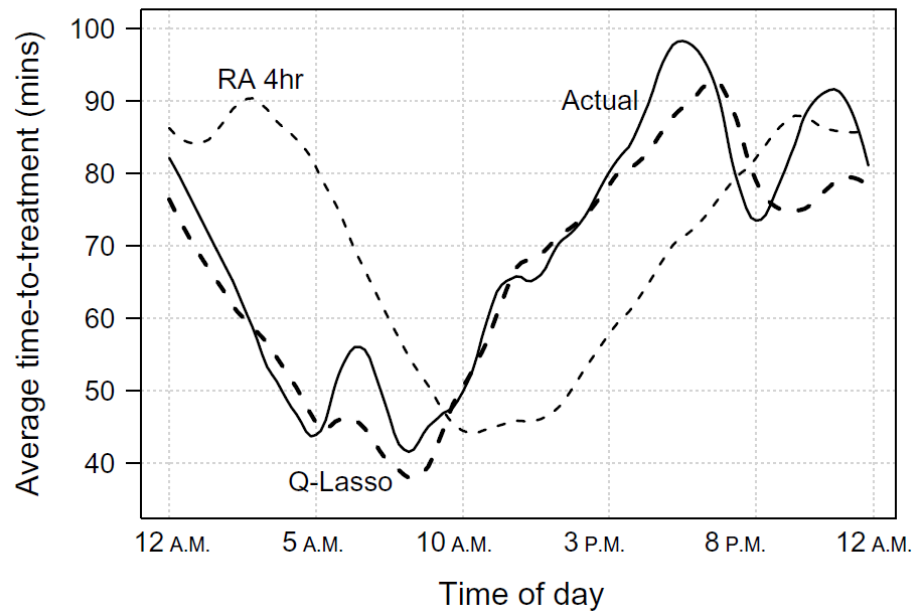
- Many benefits from providing estimation
 - Estimates are misleading to patients and has called for improved accuracy (The American College of Emergency Physicians, 2012)
-
- ❖ **Underestimate**
 - Actual waiting > 6hrs, i.e., 8hrs
 - ❖ **Overestimate**
 - Actual waiting < 6hrs, i.e., 4hrs



Model

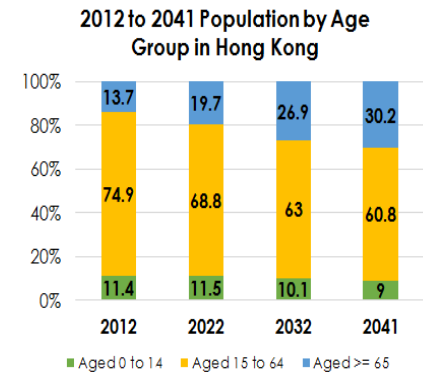


Results



Project on Elderly Care

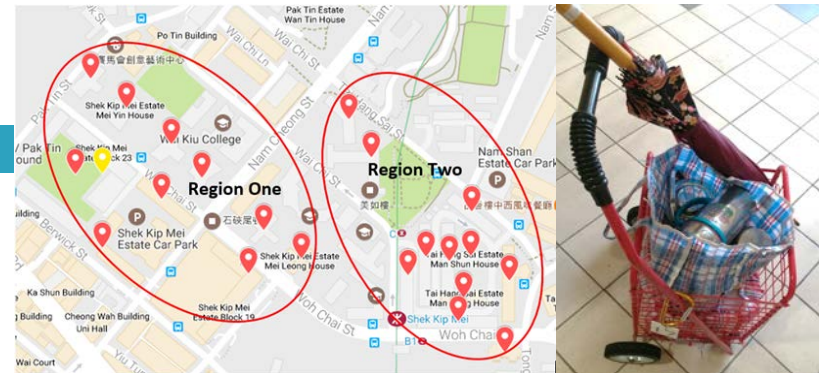
- Hong Kong Christian Service (HKCS)
 - + Established in 1952
 - + Provides elderly support service
- Meal Delivery Service
 - + Lunch and dinner delivery service
 - + Service region: public housing estates



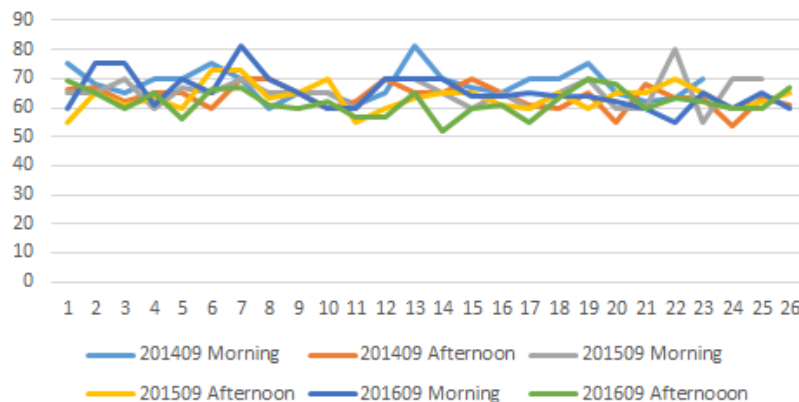
香港基督教服務處
HONG KONG CHRISTIAN SERVICE
全人關心 卓越創新
care for all excel in all

Data Analysis

- Total 12 routes in meal delivery
 - + 6 in Region One by walking
 - + 6 in Region Two by van
- Each staff carry a trolley at a time
- Allowed arrival time
 - + Lunch: 11:00 AM – 12:00 NN
 - + Dinner: 4:30 PM – 5:30 PM



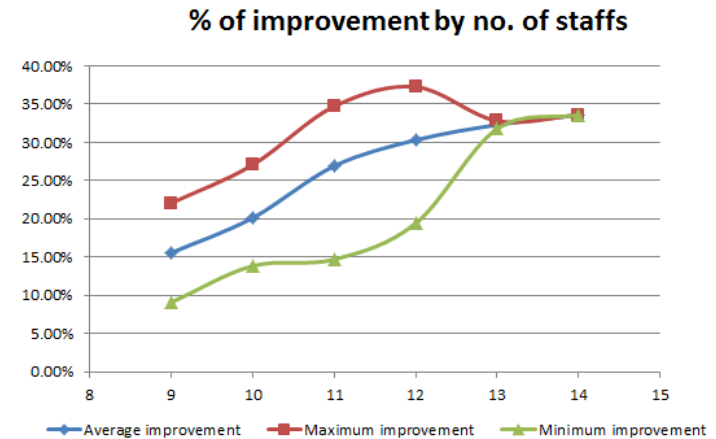
Comparison of max delivery time



- Max delivery time
 - 80 - 81 minutes
- At least one delivery route exceeds the 60-minutes limit in every session

Result & Discussion

Number of staffs	Average improvement	Maximum improvement	Minimum improvement
9	15.56%	22.07%	9.08%
10	20.14%	27.08%	13.85%
11	26.92%	34.73%	14.69%
12	30.31%	37.26%	19.42%
13	32.3%	32.82%	31.78%
14	33.59%	33.59%	33.59%
Average	26.75%	31.33%	20.69%



The average, maximum and minimum improvement for different sizes of problems

Other Applications



- Personalized Diabetes Management
- Combination Chemotherapy
- Bed management
- Emergency Department
- ICU
- Ambulance reallocation
- Inventory of medicines
- ...

Ongoing practice in the world

- MIT --- Mass General Hospital
- Wharton --- Penn Medicine, Children's Hospital of Philadelphia
- Columbia --- New York City hospital
- University of Pittsburgh --- University of Pittsburgh Medical Center
- Tel Aviv University --- Rambam Hospital
- National University of Singapore --- NUH, KTPH
- Shanghai Jiao Tong University --- Rujin Hospital
- ...