Discrete Event Simulation Analysis for Optimization of Outpatient Flow

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Introduction

- "Long waiting-time" was the most important and critical issue for ambulatory care. (*Annual consumer satisfaction survey at Okayama Central Clinic*)
- To identify the bottleneck of the outpatient flow and plan the countermeasures against them is the possible way to solve the systematic problem.
- Discrete Event Simulation is one of the simulation techniques, that has been used to analyze ambulatory care. Improvement plan for ambulatory care can be inspected by the simulation.

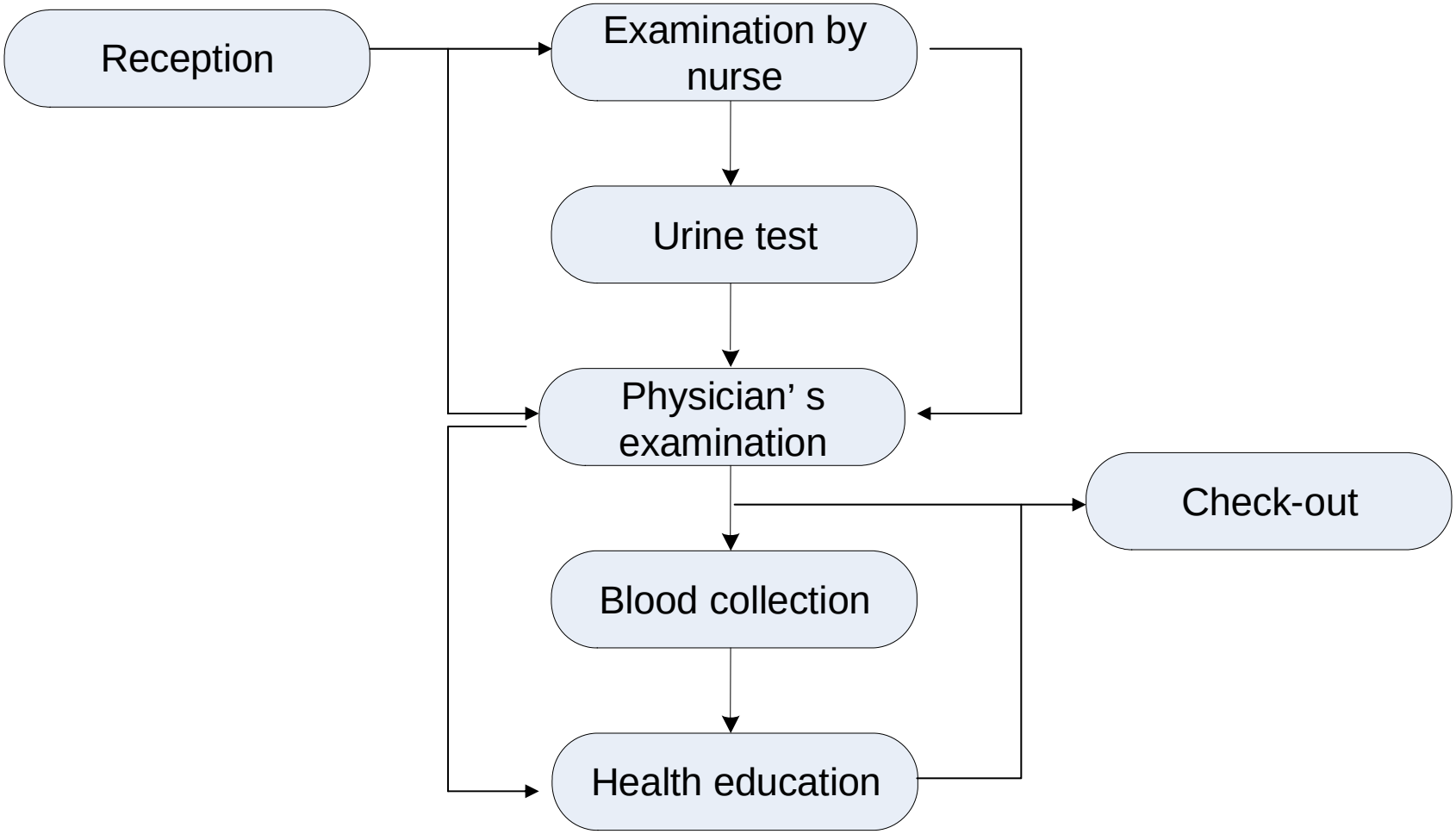
Purpose

Simulate the outpatients flow in a primary care clinic to develop a quality improvement plan

Methods

- Identify the process main activities from start to end – Used SIMUL8 software to model the process
- Apply time data derived from the time study undertaken at the Okayama Central Clinic
- Analyze and identify potential problems and suggest improvements
- Implement the changes and analyze the impact on the overall process

Simplified Work Flow at the Clinic



Prerequisites

- Data of time spent in each work station

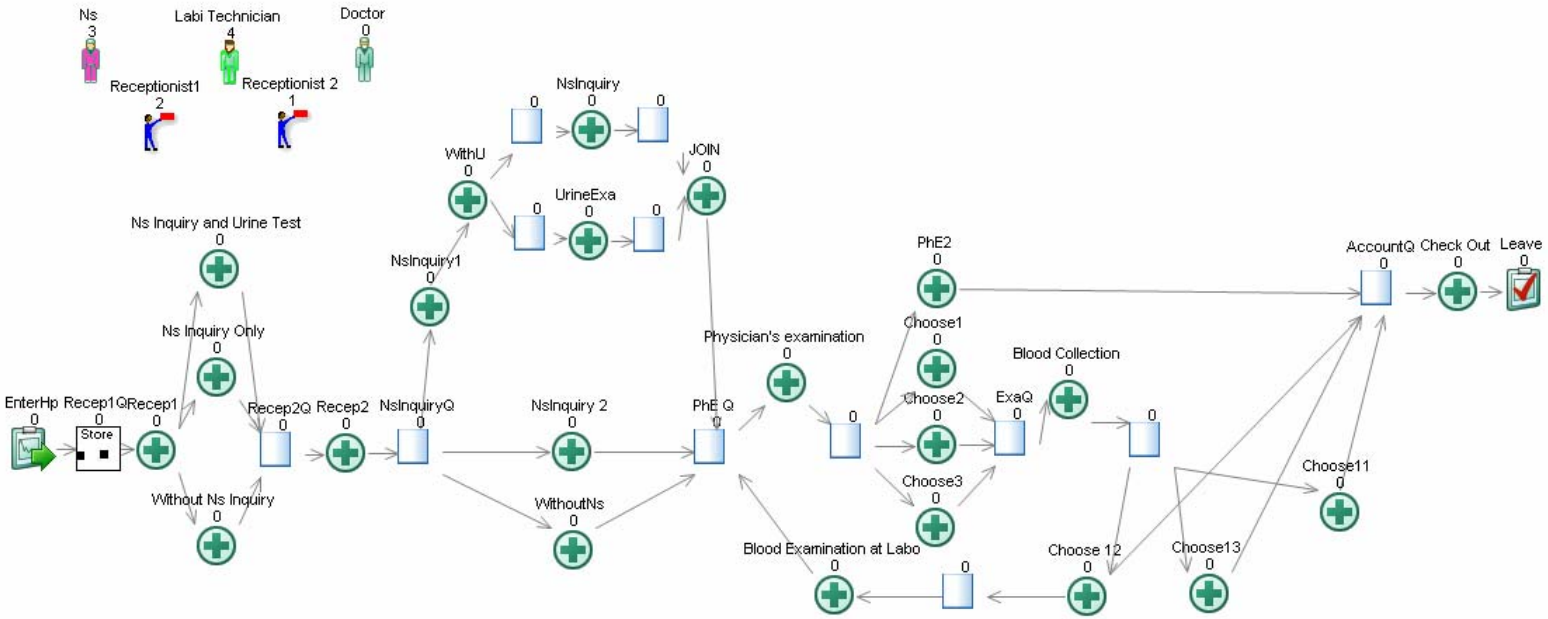
Name of Work Station	Patient's Time spent (Minutes)
Reception 1	8
Reception 2	5
Nurse's Inquiry (Patients with urine test)	10
Nurse's Inquiry (Patients without urine test)	15
Urine examination	20
Physician's examination	10
Blood collection	5
Blood examination at Laboratory	30
Check out	10

Prerequisites

- Item (patient)
  - Label 1 (70%); Who has nurse's inquiry with urine test
  - Label 2 (20%); Who has nurse's inquiry without urine test
  - Label 3 (10%); Who passes nurse's inquiry and urine test
- Resources

  Doctor; 1 Nurse; 3 Receptionist; 4 Lab Technician; 4
- Operation Time
  - The opening time of the clinic is 9:00A.M.
  - Acceptance of the patient; until 12:00

The model on Simul8



Base line data

The number of Patients completed 23

Average time spent in the model 99.9 min

Work Station	Average Time Waiting (minutes)	patients waiting less than 10 minutes (%)
Reception 1	0.2	100.0
Reception 2	0.1	98.1
Nurse Inquiry	0.8	98.1
Physician's examination	35.3	1.6
Check Out	9.0	60.3

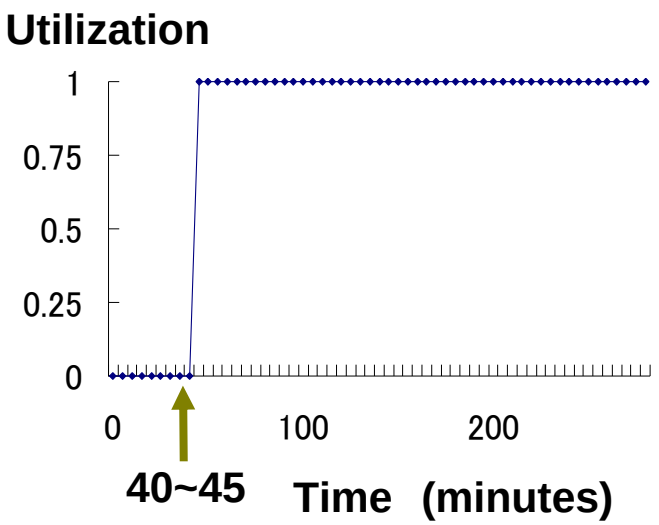


Fig. Time trend of utilization of the physician

Implementation of improvements

- Suggested Improvement area

  The bottleneck in the model; physician′s examination

- Results of the simulation

Simulation Requirements	Average Patients' Time Spent (minuts)	Number of Patients	Availability of doctors (%)
Open at 9AM (similar to real clinic)	99.9	23	98.8
Open at 9AM with 1 hour warm-up	85.5	24	95.8
Physician start work at 8:45AM	81.5	24	95.8

Conclusion

- This analysis demonstrates that we could identify the bottleneck of the system using Discrete Event Simulation.
- The simulation proved that the improvement plan increase efficiency without increase bottle-neck capacity, physician workload.
- Further analysis is needed to identify the optimal resource utilization to improve availability of the physician and throughput of the system.

References

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