How Many Doctors Does it Take to Clear the Waiting Room?

Queueing Theory Applications for Emergency Medicine Operations

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queues
lines
waiting
math
relationship
complex
most important
no math
simple tools
misconceptions
donuts
coffee
flights
discrete
complex combination of steps
Little
separate
distinct
NOBODY ELSE WANTS THAT HALF OF A DONUT YOU LEFT

GO AHEAD AND TAKE THE LAST ONE
triage
discrete
1. Find out who the patient is
2. Find out why they are here
3. Briefly examine and take vital signs
4. Assess their priority
six minutes
exceptions
example
ten patients per hour
IT WAS MY UNDERSTANDING
THERE WOULD BE NO MATH
not averages
just ten patients per hour
How many nurses do you need to avoid a wait?
60 minutes/hour
10 patients/hour
6 minutes/patient
1 nurse
problems
Capacity is being wasted

Wait times are growing

9 min

13 min

2 min

2 min

4 min
averages out?
no.
You can’t stockpile capacity.
poisson
interarrival times
exponential
Likelihood vs. Time since last arrival
evenly spaced arrivals are very rare
How long does it take to be seen?
Erlang
Utilization

service time vs. average arrival time
magic number
more variability, more problems
Increase the number of nurses
what conclusions can we draw?
“no wait ED”
does not exist
The graph illustrates the relationship between waiting time and utilization. As utilization increases, the waiting time increases significantly, indicating a non-linear relationship.
Utilization vs. Waiting Time
level of service guarantee
can be calculated
Results may not be fun to contemplate
simplify
simulations
simplify
Physician Management
History and physical → Diagnostics and therapeutics → Disposition
multitasking
task-switching
History and physical  ➔ Diagnostics and therapeutics  ➔ Disposition
History and physical → Diagnostics and therapeutics → Disposition
History and physical

Diagnostics and therapeutics

Disposition

Work is being done
History and physical → Diagnostics and therapeutics → Disposition
History and physical → Diagnostics and therapeutics → Disposition
Modelling attending physician productivity in the emergency department: a multicentre study

Joshua W Joseph,1,2 Samuel Davis,3 Elissa H Wilker,2,4,5 Matthew L Wong,1,2 Ori Litvak,3 Stephen J Traub,6 Larry A Nathanson,1,2 Leon D Sanchez1,2

ABSTRACT
Objectives Emergency physician productivity, often defined as new patients evaluated per hour, is essential to planning clinical operations. Prior research in this area considered this a static quantity; however, our group’s study of resident physicians demonstrated significant variation within attending physicians.

Key messages
What is already known on this subject
- The productivity of individual emergency physicians is reported in terms of an average...
current paradigm
Patients Per Hour By Year of Training

- 1st Year
- 2nd Year
- 3rd Year
robots
Active Patients
queue is full
steady-state
Results Are Coming Back

Active Patients
Results Are Coming Back

Active Patients

Second Team Arrives

New Patients This Hour

Shift Hour
Results Are Coming Back
Second Team Arrives
Relief Is In Sight

Active Patients

Box plots showing the distribution of new patients this hour over different shift hours.
Wait times
before noon
late evening
Wait times in the early afternoon
Can’t change the total number of physicians
Can’t blow up the schedule
“Beat the peak!”
Capacity gets wasted.
Smallest possible intervention
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Mean Time in WR
55min -> 46min

Median Time in WR
25min -> 19min
www.edqueue.org
Number of Providers

3

Patient Arrivals per Hour

3

Time per Workup in Minutes

43

Mean server utilization: 0.717

Mean number of patients in the department: 3.458

Mean number of patients waiting: 1.308

Mean time in the department (minutes): 69.155

Mean wait time to be seen (minutes): 26.155

Model Selection

M/M/c

Run Model
Take-Home Points
Waits are going to happen
80% Capacity
If you can’t add more service, match it to demand.
Questions?