The Impact of Boarding Policies on ED: A Discrete-Event Simulation Study

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- 主題: Emergency and Critical Care: Reorganization for More-Efficient Care Delivery (急重症醫療照護: 組織重整追求更有效之醫療服務)
- Professor Wheyming Song:
  Title: The Impact of Inpatient Boarding on ED Efficiency

Overall Goal and Our Objective

- Overall Goal: How could we decrease ED crowding?

  What could be the causes of the ED crowding?

  - triage polity
  - physician or nursing scheduling
  - boarding policy
  - others...

- Our Objective: To investigate the effect of boarding policies on the Emergency Department (ED)

Simulation Model

- Method: Discrete Event Simulation (DES)
- Performance measures:
  - NEDOCS (National Emergency Department Crowding Scale)
  - LWBS ratio: the rate of leave without been seen patients per day
- Decision variable: different boarders released ratio

Demonstrating DES via Flexsim

- Well Known DES softwares: Flexsim, Sigma, Arena, ...
- Q: Why do I prefer using Flexsim?

Demonstrating DES via Flexsim

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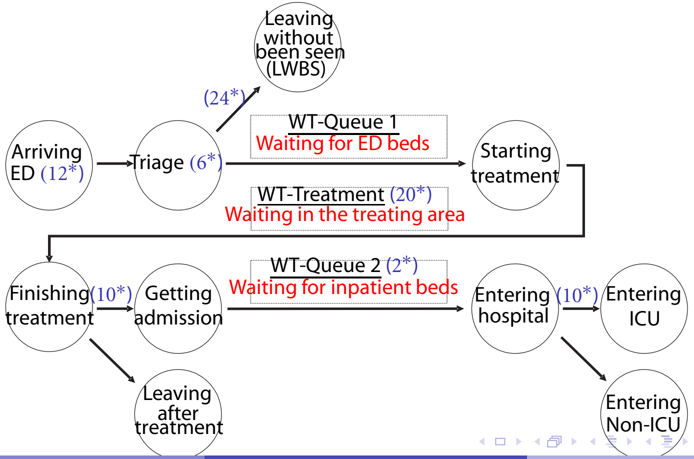
- A: Animation

Simulation Framework

ED: A Level 1 trauma center in California 26,984 patients from January 2008 through May 2008.



NEDOC: by Weiss et al. (2005)

$$\text{NEDOCS}(t) = -20 + \frac{85.8\mathrm{L_{ED}}}{\mathrm{b_{ED}}} + \frac{600\mathrm{L_{admit}}}{\mathrm{b_h}} + 5.64\mathrm{W_{ED}} + 0.93\mathrm{W_{admit}} \quad (1)$$

$\mathrm{L_{ED}}(t)$: Total patients in ED at time t

$\mathrm{b_{ED}}(t)$: Number of ED beds at time t

$\mathrm{L_{admit}}(t)$: Total admitted patients in ED at time t

$\mathrm{b_h}(t)$: Number of hospital beds

$\mathrm{W_{ED}}(t)$: Waiting Time from triage to ED bed placement

$\mathrm{W_{admit}}(t)$: the longest boarding time of patients waiting for admission,

NEDOCS: overcrowded+ and overcrowded-

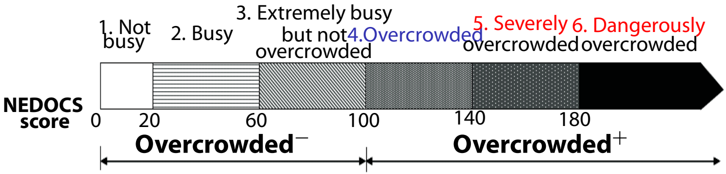


Table : The ED crowding levels in UCDMC

- Q: What does NEDOCS can do for us?

NEDOCS: overcrowded+ and overcrowded-

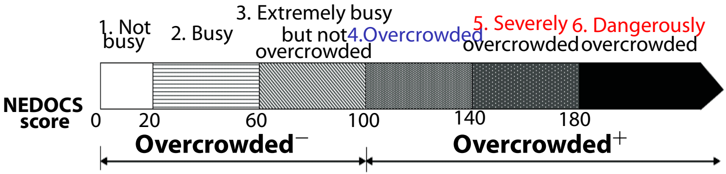


Table : The ED crowding levels in UCDMC

- Q: What does NEDOCS can do for us?
- A: Quantify overcrowd+ and overcrowd- in terms of a real number 100

Input Random Factors

Distributions	Probability Model/Value	# of Ran Stream
Patient inter-arrival time	$c_t \text{Beta}_1(\alpha_t, \beta_t)$	12
Treating time	$c_{m,s,a} \text{Beta}_2(\alpha_{m,s,a}, \beta_{m,s,a})$	20
Boarding time	Adult: 4270$\text{Beta}_3(0.59, 6.53)$	1
	Ped.: 1110$\text{Beta}_3(0.84, 4.32)$	1

- Q: Why do I prefer using beta distribution?

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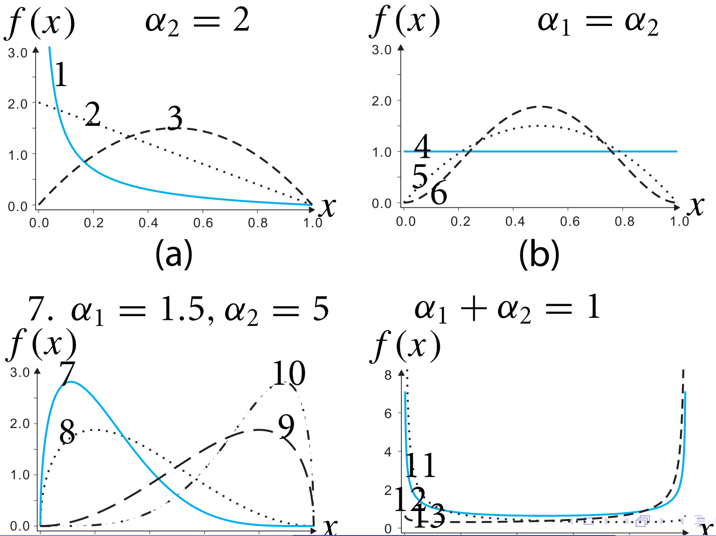
- Q: Why do I prefer using beta distribution?
- A: With upper and lower bounds, see figures next page.

beta (α_1, β_2)



Validation

	Average number of patients per day				Average Wait Time (min.)		
	Adult Arrival	Pediatric Arrival	Adult LWBS	Pediatric LWBS	Queue 1 (ED beds)	Waiting Treating	Queue (Boarde
True	143.9	34.8	19.1	2.4	92.8	293.0	333.2
Fitted	140.6	37.4	17.6	2.2	86.2	326.0	349.9
% error	-2.3%	7.5%	-7.9%	-8.3%	-7.1%	10.3%	5.0%

- The maximum % error is about 10%

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- We conclude that the proposed simulation model is valid

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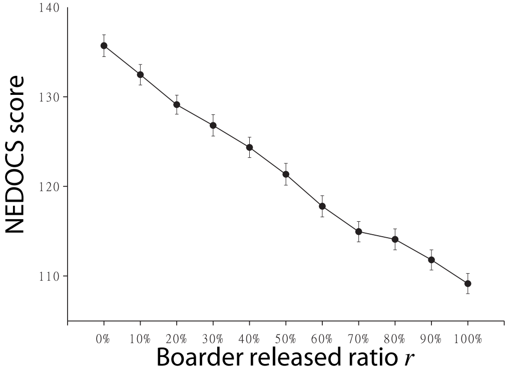
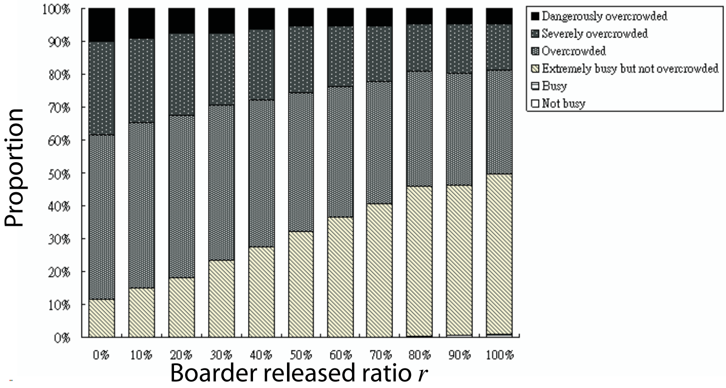
Effects of r on NEDOCS



- NEDOCS: 136; r=0%; NEDOCS: 102; r=10%
- the NEDOCS decrease by 20 % when r increse from 0 to 100

Effects of r on NEDOCS in 6 levels



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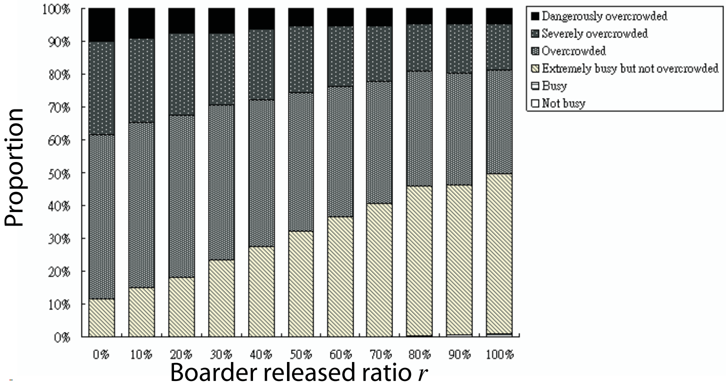
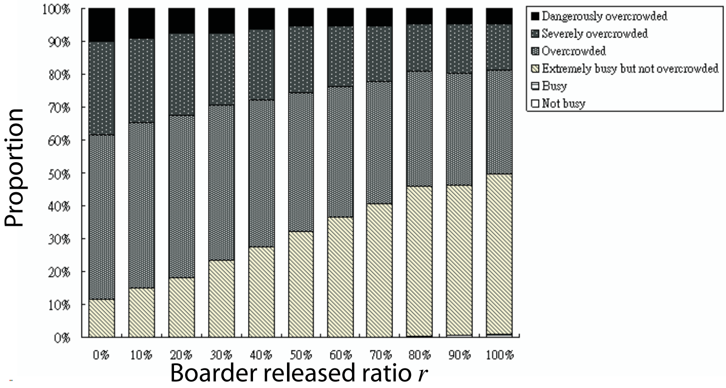


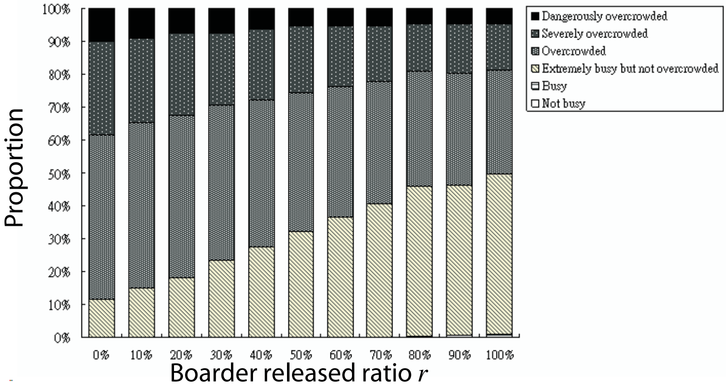
- r =0%; overload+: 90%

Effects of r on NEDOCS in 6 levels



- r =0%; overload+: 90%
- r =100%; overload+: 50%

Effects of r on NEDOCS in 6 levels



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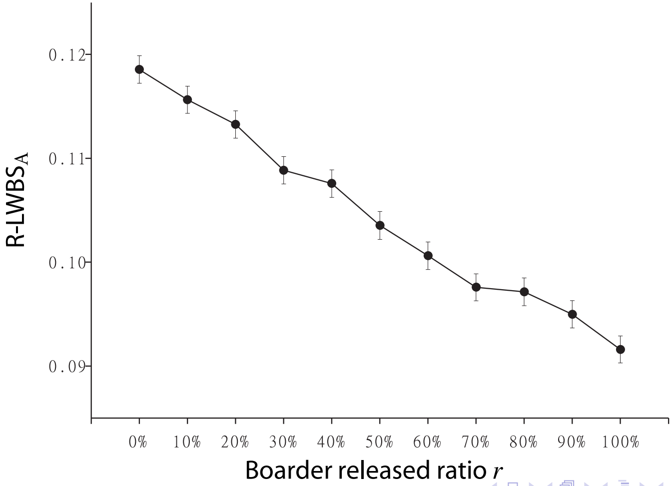
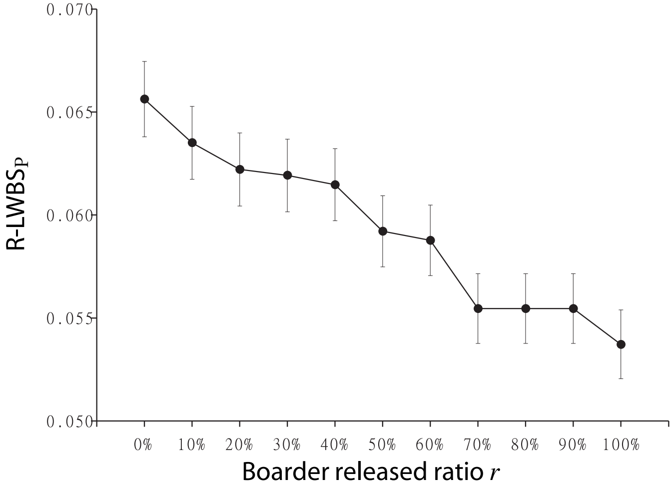
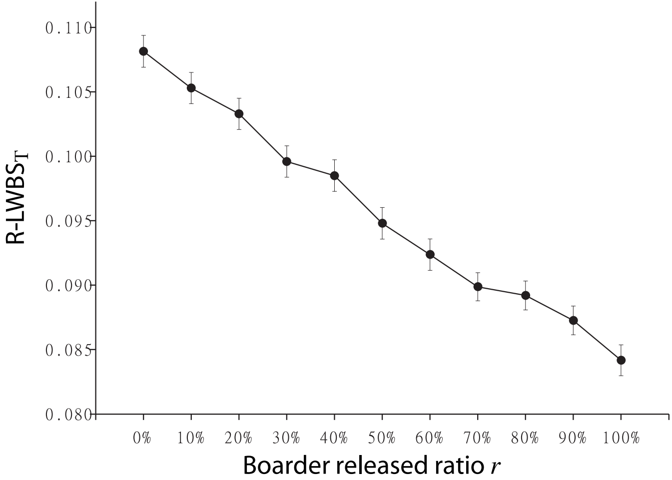
The effect of r on $LWBS_A$



The effect of r on $LWBS_P$



The effect of r on $LWBS_T$



Summary of Simulation Results

- NEDOCS score, R-LWBS$_{\mathrm{A}}$, R-LWBS$_{\mathrm{P}}$, and R-LWBS$_{\mathrm{T}}$ can be decreased for more than 20%, in UCDMC Emergency Department when $r = 100\%$.
- The study provided ED and hospital administrators with investigation to check the boarding policies for improving ED crowding and LWBS phenomenon.