

LOU/LOH/LOT Tool

3	Flow Calculation	Split Flow
4	LOU/LOH/LOT	Inpatient Transitional Care
5	Capacity Planning	Time Stamps
6	Staffing Profile	Target Utilization
		Integer Effect

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Analysis Goals

- With this tool, the user will be able to answer the question: “How are my emergency department’s patient stay hours consumed?”
- This analysis is based on the patients Length of Use (LOU), Length of Hold (LOH) for Admitted Patients, and Length of Test Turnaround/ Treatment (LOT).

Why A Tool for Patient Stay Times?

“A one-hour increase of average daily ED length of stay was found to increase the odds of LWBS (left without being seen) events by 41%, while an additional patient arrival per day resulted in a 2.4% increase odds of LWBS events.”^[1]

“We conclude that (1) reducing LOS is associated with a decrease in the number of ED patients who leave without seeing a physician and (2) many patients who leave without being seen are classified as urgent at presentation.”^[2]

“A long length of stay in the emergency department can contribute to the hospital being on bypass status or critical-care divert status... Management’s goal was to reduce the amount of time patients stay in the emergency department, which would have a direct impact on the hospital’s status and its ability to meet community medical needs.”^[3]

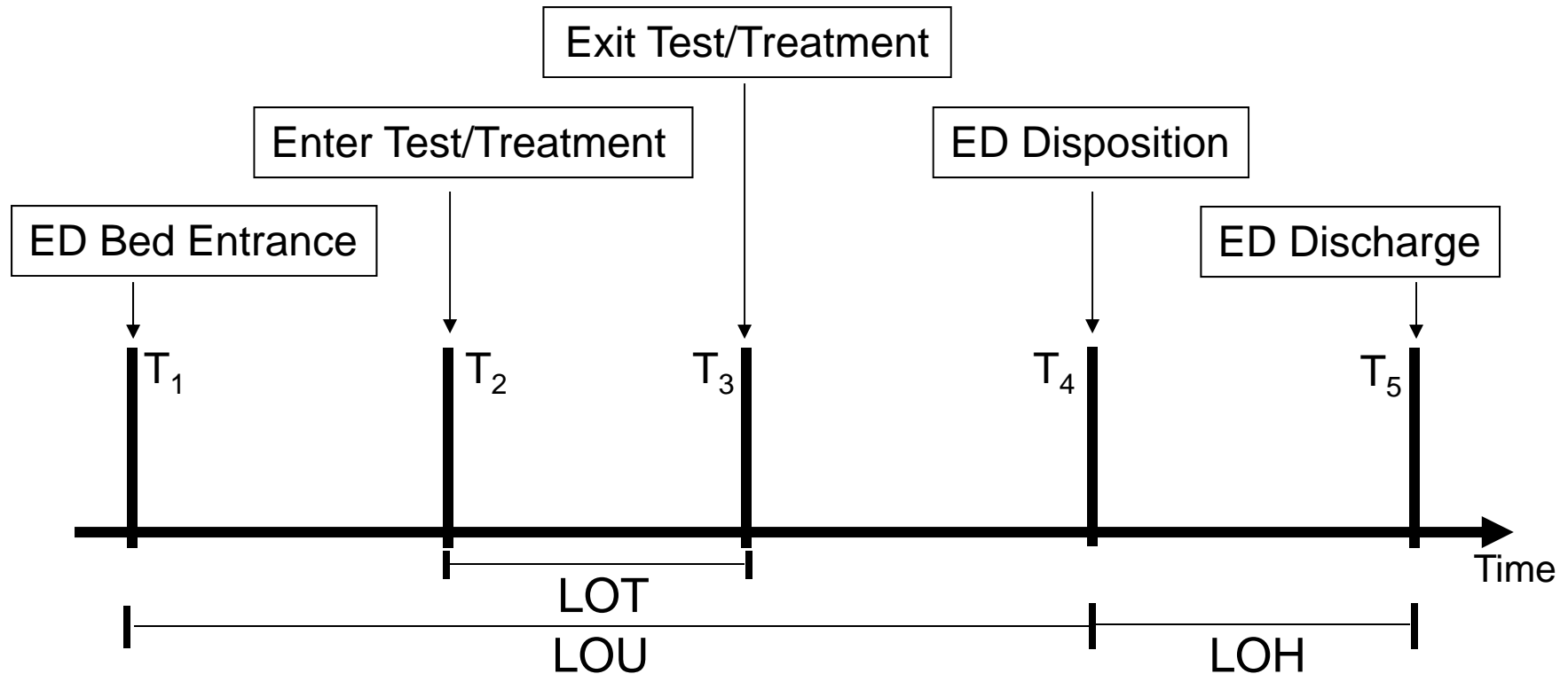
“Our results clearly implicate admitted patients and delays in the admission process as important contributors to ambulance diversion in our ED. During our study period, up to 16 patients were admitted in a single interval; this alone would account for a 39% increase in duration of ambulance diversion over the median for those intervals...admitted patients represent a minority of patients seen in the ED but contribute disproportionately to ambulance diversion.”^[4]

Tool 4 Time Stamps and Time Durations

LOU = Length of Use = Time from IP_{ED} Bed Seize to Bed Disposition = $T_4 - T_1$.

LOH = Length of Hold = Time from IP_{ED} Dispo to Bed Clear (Admitted Patients Only) = $T_5 - T_4$.

LOT = Length of Test/Treatment = Time in Results Waiting (incl. patient hydration) = $T_3 - T_2$.



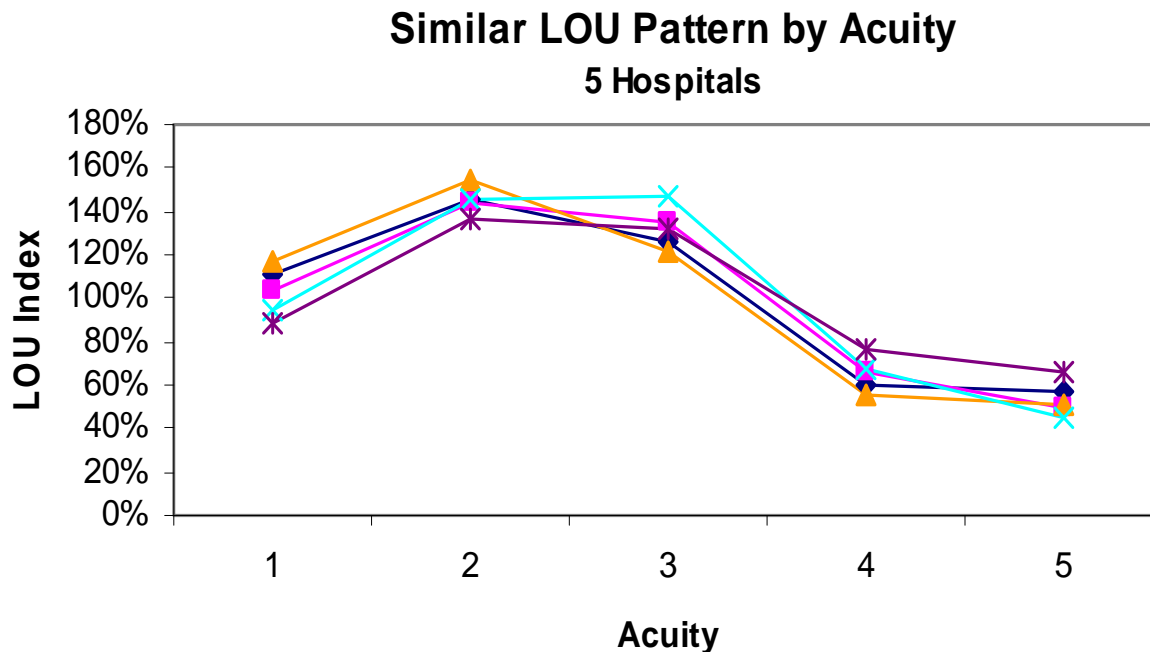
Tool 4 Input Data

	Average Time (min.)	Standard Deviation (min.)
Quick Look	7.5 ←	Average Length of Use
Intake	15.0 ←	Average Length of Holding (Admitted Patients Only)
OP _{ED} Discharge	7.5 ←	Average Length of Test Results or Treatment
LOT	120.0	120.0
LOH (Admit)	131.0	209.0
Overall LOU	173.4	170.0
		3
Reenter the following information from Flow Calculation		
Acuity	Fraction	Fraction of Patients from OP _{ED} to IP _{ED} (r _{OI}).*
1	0.03%	20.0%
2	8.28%	
3	68.73%	
		* 20% is Default Based on ED Expert Experience

Notes: Overall LOU includes all patients at all ESI urgency levels. The LOT value shown is typical of D2D post-implementation but varies based on ED test turnaround times and relative “watched” patient times.

Adjusting Overall LOU to LOU by Acuity

- We find that relative LOU by acuity level has a similar pattern across facilities - a result we use in Tool 4.
- Multiplicative indices^[5] are found by dividing the LOU for each patient acuity by overall average LOU.



Multiplicative Indices
103%
146%
132%
65%
54%

Weighting IP_{ED} LOU by Patient Acuity Mix

- **4** Output:

Area	Average Time (min.)	Coefficient of Variation
Quick Look	7.5	0.19
Intake/Discharge	11.3	0.37
LOT - Results Waiting	120.0	1.00
LOU - IP_{ED}	238.0	0.88
LOH (Admit) - Inpatient Transitional Care	131.0	1.60

$$Avg. LOU IP_{ED} = \frac{f_1 * L_1 + f_2 * L_2 + f_3 * f_{RE} * L_3}{f_1 + f_2 + f_3 * f_{RE}}$$

f_i = The patient fraction of Acuity i

f_{RE} = The patient probability of Intake/Discharge to IP_{ED}

L_i = The LOU of Acuity i

- Coefficient of Variation = Standard Deviation/Average
- Average Intake/Discharge Time = Average of Intake and Discharge Times.
- Average Admit Hold LOH and Test Results LOT are Not modified by Tool 4; they remain your inputs.

LOH = Holding = Boarding

- Length of hold is one of the major problems for EDs.^[6]
- We include waiting for inter- facility transfer in the definition, since ED bed time is consumed.

Sample Size = 8598

Admitted Patients			
		LOU	LOH
Acuity	Sample Size	Avg. (min)	Avg. (min)
1	199	158.5	149.9
2	2453	227.0	195.6
3	5730	255.4	200.2
4	214	221.5	190.4
5	2	393.5	48.5

% Usable Patient Records = 92.6%

Case Study Example (at left):

LOH here is calculated =
 $(199 \times 149.9 + 2453 \times 195.6 + 5730 \times 200.2 + 214 \times 190.4 + 2 \times 48.5) / (199 + 2453 + 5730 + 214 + 2) = 197.4 \text{ min.}$

Sample Size = 27537

NonAdmit			
		LOU	LOH
Acuity	Sample Size	Avg. (min)	Avg. (min)*
1	157	170.3	88.3
2	2585	230.4	72.7
3	17991	182.5	44.8
4	6684	82.9	32.5
5	120	87.9	20.2

% Usable Patient Records = 93.6%

EDs are surprised at their amount of non-admit patient holding time*.

*Non-admitted LOH is not used in any toolkit calculations, but reducing it can improve ED performance.

The EXCEL[®] Tool 4

Purpose: Estimate, by acuity mixing, patient length of time in each split flow area.

INPUT:						
		Average Time (min.)	Standard Deviation (min.)	LOU by Acuity		
	Quick Look	7.5		Acuity	Indices	Avg. LOS
	Intake	15.0		1	103%	178.4
	OP _{ED} Discharge	7.5		2	146%	252.6
	LOT	120.0	120.0	3	132%	229.3
	LOH (Admit)	131.0	209.0	4	65%	113.3
	Overall LOU	173.4	170.0	5	54%	93.4
	Reenter the following information from Flow Calculation					
	Acuity	Fraction	Fraction of Patients from OP _{ED} to IP _{ED} (r _{OI})*			
	1	0.03%	20.0%			
	2	8.28%				
	3	68.73%				
			* 20% is Default Based on ED Expert Experience			
OUTPUT:						
	Enter below into Capacity Planning					
	Area	Average Time (min.)	Coefficient of Variation			
	Quick Look	7.5	0.19			
	Intake/Discharge	11.3	0.37			
	LOT - Results Waiting	120.0	1.00			
	LOU - IP _{ED}	238.0	0.71			
	LOH (Admit) - Inpatient Transitional Care	131.0	1.60			

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- 3 Flow Calculation
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- 5 Capacity Planning
- 6 Staffing Profile

Split Flow
 Inpatient Transitional Care
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Using Tool 4 Output

- Comparing the lengths of time (LOU, LOH, LOT) spent as portions of a typical patient stay in your ED can reveal opportunities for improvement. They can also be compared on a relative basis. In our example,
 - %LOT = Results Waiting / IP_{ED} = $120/238 = 50.4\%$
 - %LOH = Inpatient Transitional Care / IP_{ED} = $131/238 = 55.0\%$.
- In Tool 5, LOU, LOH, and LOT will be used to estimate how much space you need in each area of your Split ED to provide safe patient care.

Next Step to

3	Flow Calculation
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6	Staffing Profile

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- Reenter, don't copy and paste, the LOU (Acute), LOH, and LOT output into Capacity Planning **5**
- For example:

Area	Average Time (min.)
Quick Look	7.5
Intake/Discharge	11.3
LOT - Results Waiting	120.0
LOU - IP _{ED}	238.0
LOH (Admit) - Inpatient Transitional Care	131.0

Reenter

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References

- [1] Green LV, Soares J, Giglio JF, Green RA. Using queuing theory to increase the effectiveness of emergency department provider staffing. *Academic Emergency Medicine* Jan 2006; 13(1):61-68.
- [2] Fernandes CMB, Price A, Christensen JM. Does reduced length of stay decrease the number of emergency department patients who leave without seeing a physician? *The Journal of Emergency Medicine* 1997; 15(3):397-399.
- [3] Samaha S, Armel WS, Starks DW. The use of simulation to reduce the length of stay in an emergency department. *Proceedings of the 2003 Winter Simulation Conference*. Chick S, Sanchez PJ, Ferrin D, Morrice DJ, eds., 2003; 1907-1911.
- [4] Schull MJ, Lazier K, Vermeulen M, Mawhinney S, Morrison LJ. Emergency department contributors to ambulance diversion: A quantitative analysis. *Annals of Emergency Medicine* Apr 2003; 41(4):467-476.
- [5] Ozcan YA. *Quantitative Methods in Health Care Management*. San Francisco, CA: Jossey-Bass. Chapter 2: Forecasting, *Employing Seasonal Indices in Forecasting*. pp. 37; 2005.
- [6] United States General Accounting Office, *Hospital Emergency Departments: Crowded Conditions Vary among Hospitals and Communities* 2003.