



Combination of easily measurable real time variables to predict ED crowding

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Introduction:

Almost every domain of quality is reduced in crowded emergency departments (ED), with significant challenges around the definition, measurement and interventions for ED crowding. The most widely known tool to measure crowding is NEDOCS; this is a validated score. In Saint John, there is a local tool based on NEDOCS, known locally as the ED Saturation Calculator. We wished to determine if a combination of 3 easily measurable variables could perform as well as these standard tools (NEDOCS score and a NEDOCS-derived LOCAL tool) in predicting ED crowding in the Saint John Regional Hospital, a tertiary hospital with 57,000 visits per year.



Methods:

Over a 2 week period, we recorded ED crowding predictor variables and calculated NEDOCS and LOCAL scores. These were compared every 2 hours to a reference standard Physician Visual Analog Scale (range 0 to 10) impression of crowding to determine if any combination of variables outperformed NEDOCS and LOCAL (crowded =5 or greater). Five numeric variables performed well under univariate analysis: i) Total ED Patients; ii) Patients in ED beds + Waiting Room; iii) Boarded Patients; iv) Waiting Room Patients; v) Patients in beds To Be Seen. These underwent multivariate, log regression with stratification and bootstrapping to account for incomplete data and seasonal and daily effect.

Results:

143 out of a possible 168 observations were made. Two different combinations of 3 variables outperformed NEDOCS and LOCAL. The most powerful combination was: Boarded Patients; plus Waiting Room Patients; plus Patients in beds To Be Seen, with Sensitivity 81% and Specificity 76% ($r=0.844$, $\beta=0.712$, $p<0.0001$, strong positive correlation). This compared favourably with NEDOCS and LOCAL, each with Sensitivity 71% and Specificity 64%[PA1] ($r=0.545$ and $r=0.640$ respectively). For the binary crowding VAS, Cohen's kappa for 2 raters showed a $k=0.424$, or moderate agreement.

Conclusion:

Emergency department crowding has multiple adverse effects in the ED, the hospital and in the community. A combination of 3 easily measurable ED variables (Boarded Patients; plus Waiting Room Patients; plus Patients in beds To Be Seen) performed better than the validated NEDOCS tool and a NEDOCS-derived LOCAL Score at predicting ED crowding, when compared against our clinicians' own sense of crowding and safety within the department. Work is on going to design a simple tool that can predict crowding in real time and facilitate early interventions. Correlation with ED system and clinical outcomes should be studied in different ED environments.

Table 1: Comparison of ED Crowding Tools

	NEDOCS	Saint John ED Saturation	# patients in the ED	# patients in ED beds + waiting room	# patients TBS	# waiting room patients	# boarders
Variable	Scores	Single variables					
# patients in ED* ¶	✓	✓	✓				
# boarders **	✓	✓					✓
# critical care (1:1) patients	✓	✓					
ED admit time for boarders	✓	✓					
Last door to bed time ***	✓	✓					
# pts in ED beds		✓		✓			
# patients in waiting room		✓				✓	
# ambulances expected		✓					
Ambulance offload time		✓					
# Triage Level 1's		✓					
# Triage Level 2's		✓					
# Triage Level 3's		✓					
# Triage Level 4's		✓					
# Triage Level 5's		✓					
# nurses short		✓					
# MD's short		✓					
# pts waiting To Be Seen					✓		

* NEDOCS uses a "Patindex" = # patients in ED / # ED beds
 ¶ Includes # patients in waiting room + # waiting to triage + # in ED Beds (includes ED patients + admitted patients in ED), instead of this, the local ED Saturation Records use # patients in waiting room and # patients in ED beds
 ** NEDOCS uses "Admit index" = # boarders / # beds in the hospital
 ¶¶ The ED saturation records break down Med/Surg Admits and ICU/CCU admit
 *** For NEDOCS and Saint John, this # includes Level 3/4/5 patients