

# The use of a self-check-in kiosk for early patient identification and queuing in the emergency department

Natalie Coyle, MSc, BScPA\*; Andrew Kennedy, MSc, BScN\*; Michael J. Schull, MD, MSc\*†‡; Alex Kiss, PhD†‡; Darren Hefferon\*; Paul Sinclair\*; Zuhair Alsharafi, MD\*

## CLINICIAN'S CAPSULE

### What is known about the topic?

Emergency department (ED) wait-times before triage are not well captured and can represent a significant period of time.

### What did this study ask?

Can a self-check-in kiosk be used by ambulatory patients to check into triage and decrease identification time?

### What did this study find?

Self-check-in kiosks can be implemented effectively in the ED to improve patient identification time and queue patients for triage.

### Why does this study matter to clinicians?

Local implementation of similar self-check-in kiosks could improve staff and patient satisfaction while improving departmental flow and patient experience.

*time-to-first-identification*, defined as the interval between ED arrival and identification in the hospital system.

**Results:** Median (interquartile range) time-to-first-identification was 1.4 minutes (1.0–2.08) for intervention patients and 9 minutes (5–18) for control patients. Regression analysis revealed that the adjusted time-to-first-identification was 13.6 minutes (95% confidence interval 12.8–14.5) faster for the intervention group.

**Conclusion:** A self-check-in kiosk significantly reduced the time-to-first-identification for ambulatory patients arriving in the ED.

## RÉSUMÉ

**Objectif:** Les délais d'attente inhérents au processus de triage des malades au service des urgences (SU) peuvent mettre en péril leur sécurité. L'étude visait donc à valider le principe selon lequel l'utilisation d'un guichet d'auto-inscription diminuerait le temps nécessaire pour signaler l'arrivée des malades ambulatoires au SU. A été comparé le processus d'utilisation d'un guichet d'auto-inscription d'un nouveau type pour signaler l'arrivée des malades au SU avec le processus habituel d'inscription des malades par le personnel infirmier.

**Méthode:** L'étude consistait en un essai prospectif, à répartition aléatoire et hebdomadaire, d'inscription, réalisé selon le processus expérimental ou le processus témoin, sur une période de 10 semaines. Durant les semaines d'expérimentation, les malades se dirigeaient vers le guichet d'auto-inscription à leur arrivée; un signal électronique informait le personnel infirmier affecté au triage de l'heure d'arrivée des malades et des motifs de consultation avant le triage lui-même. Durant les semaines témoins, les guichets étaient fermés et les malades étaient inscrits selon le processus habituel de triage effectué par le personnel infirmier. Le principal critère d'évaluation était le temps écoulé avant le signal d'arrivée, défini comme

## ABSTRACT

**Objective:** Delays in triage processes in the emergency department (ED) can compromise patient safety. The aim of this study was to provide proof-of-concept that a self-check-in kiosk could decrease the time needed to identify ambulatory patients arriving in the ED. We compared the use of a novel automated self-check-in kiosk to identify patients on ED arrival to routine nurse-initiated patient identification.

**Methods:** We performed a prospective trial with random weekly allocation to intervention or control processes during a 10-week study period. During intervention weeks, patients used a self-check-in kiosk to self-identify on arrival. This electronically alerted triage nurses to patient arrival times and primary complaint before triage. During control weeks, kiosks were unavailable and patients were identified using routine nurse-initiated triage. The primary outcome was

From the \*Department of Emergency Medicine, Sunnybrook Health Sciences Centre, Toronto, ON; †Sunnybrook Research Institute, Toronto, ON; and the ‡ICES, Toronto, Canada.

**Correspondence to:** Dr. Zuhair Alsharafi, Department of Emergency Services, Sunnybrook Health Sciences Centre, 2075 Bayview Avenue, C753, Toronto, ON M4N 3M5; Email: [Zuhair.Alsharafi@sunnybrook.ca](mailto:Zuhair.Alsharafi@sunnybrook.ca)

l'intervalle entre l'arrivée des malades au SU et leur inscription dans le système de l'hôpital.

**Résultats:** Le temps médian (écart interquartile) écoulé avant le signal d'arrivée était de 1,4 minute (1,0–2,08) durant les semaines d'expérimentation contre 9 minutes (5–18) durant les semaines témoins. D'après les résultats de l'analyse de régression, le temps rajusté écoulé avant le signal d'arrivée

était de 13,6 minutes (IC à 95% : 12,8–14,5) plus court dans le groupe d'expérimentation que dans le groupe témoin.

**Conclusion:** L'utilisation d'un guichet d'auto-inscription a permis de réduire considérablement le temps écoulé avant le signal d'arrivée des malades ambulatoires au SU.

**Keywords:** Self-check-in, triage, wait-time

## INTRODUCTION

Prolonged wait-times in the emergency department (ED) increase mortality and hospital admission,<sup>1</sup> decrease productivity,<sup>2</sup> and increase patient complaints.<sup>3</sup> Although the triage process is largely standardized,<sup>4</sup> the method in which patients are identified on arrival and queued for triage is variable and ED arrival time is often captured.<sup>5</sup> The typical first-come-first-serve triage approach does not account for patient acuity when determining triage order. Interestingly, delays to triage are rarely reported or included in wait-times and often exceed the Canadian Triage and Acuity Scale (CTAS) recommended time to physician initial assessment.<sup>4</sup>

We identified three concerns with our triage identification system. Firstly, it does not capture the number of patients waiting for triage, placing patients at risk of being unidentified for prolonged periods. Secondly, not queuing patients based on acuity may create delays in the management of time-sensitive conditions. Finally, it may cause confusion and anxiety for patients and result in unnecessary interruptions for triage staff.

Self-service kiosks are one strategy to improve ED operations<sup>6</sup> and have been used effectively to distribute discharge instructions,<sup>7</sup> screen patients,<sup>8</sup> and enter basic medical history.<sup>9</sup> We believe that introducing kiosks in ED waiting rooms can provide a solution to the triage identification gap. The goal of this study was to provide proof-of-concept that ED patients can use a self-check-in kiosk upon arrival and to compare time-to-first-identification with our current triage system.

## METHODS

### *Study design, setting, and population*

The prospective randomized trial took place at the ED of a tertiary care academic hospital in Toronto, Canada,

that treats an average of 63,000 patients yearly. Ethics approval was obtained from the hospital. The kiosk was available on weekdays during random weeks with intervening control periods where triage nurses identified arriving patients. Data were collected during a 10-week period.

Patients arriving during study hours (1030 to 1830) were eligible for enrolment. Research assistants approached random patients on arrival, obtained consent to access their health records, and documented their arrival times on a tablet. Research assistants did not direct patients following consent. Patients who arrived via ambulance, directed to an admitting service, or were a CTAS Level 1<sup>10</sup> were excluded prior to analysis.

### *Intervention*

During intervention weeks, patients were directed by signs, floor maps, and security staff, to one of two kiosks. Kiosks were custom designed by an inter-professional group of ED staff. At the kiosk, patients swiped their Ontario Health Insurance Plan card or typed their demographic information before selecting their chief complaint from a pre-populated list or entered a free-text response. Patients then received an instruction sheet about their ED visit with an alphanumeric identifier. The information entered and arrival time were immediately available to triage nurses on screens at triage. Nurses selected patients for triage based on arrival time or complaint, and called them using their alphanumeric identifier.

During control weeks, patients were identified by triage nurses using standard processes or pre-triage processes. Pre-triage occurred when multiple patients were queuing at triage and required a nurse to create a pre-triage list limited to name, chief complaint, and time, which was then used to prioritize triage order. During peak hours, there were three triage nurses who share these duties.

## Outcomes

### Time-to-first-identification

In the intervention group, time-to-first-identification was the interval from ED arrival to kiosk completion. In the control group, time-to-first-identification was the interval from ED arrival to pre-triage or triage, as captured in the Emergency Database Information System (EDIS). This measure is an estimate of time required for new arrivals to be identified by the system rather than the time to direct contact with a healthcare provider.

### Time-to-triage

*Time-to-triage* is defined as the interval from ED arrival to the completion of triage.

### Time-to-MD

*Time-to-MD* is defined as the interval from ED arrival to physician assessment as captured in EDIS.

### Kiosk usability

*Kiosk usability* is defined as the percentage of ambulatory patients that used the kiosk during the intervention periods.

### Data collection

Pre-triage time, triage time, demographics, and CTAS scores were collected from EDIS.

### Analysis

A statistical analysis was performed with SAS Version 9.4 (SAS Institute, Cary, NC, USA). Descriptive statistics were calculated for all variables of interest. Comparisons between groups were run using two-sample, two-sided t-tests for continuous variables and chi-square tests for categorical variables. Only patients who used the kiosk were labeled as the intervention group.

Multiple linear regressions were performed to examine differences in our outcome measures, controlling for age, CTAS, patient disposition, and triage burden. To adjust for the effect of variable inflow during the intervention and control periods, we created a volume burden on triage measure. Patients were assigned a triage burden value, defined as the number of patients triaged during the period from their arrival to their triage, with higher values reflecting a higher inflow demand.

## RESULTS

Of 3,561 eligible arriving patients, research assistants enrolled 2,181 (61.2%). After data matching and exclusion, a final sample of 1,732 patients was analysed. Kiosk usability was found to be 97%. Baseline characteristics were similar for control and intervention groups, except for the triage burden (Table 1), which was significantly higher in the intervention group.

The analysis showed that the median (interquartile range) time-to-first-identification was 4 (1.0–2.08) for intervention patients and 9 (5–18) for control patients. The regression analysis revealed that the time-to-first-identification was 13.6 minutes (95% confidence interval [CI]: 12.8–14.5) faster in the intervention group (Table 2). The median time-to-triage was 27.5 (14–51) and 22 (11–44) in the intervention and control groups, whereas the median time-to-MD was 145 (98–207) and 144 (86–210) in the intervention and control groups. The regression analysis found no statistically significant difference for both variables after correcting for triage burden.

## DISCUSSION

In this study, we examined whether a self-check-in kiosk could be used to identify patients arriving in our ED, and its effectiveness. We found that 97% of patients arriving in our ED during peak hours were able to use the kiosk and that the kiosk significantly improved the time required to identify new arrivals. Two limitations of

**Table 1. Comparison of baseline characteristics across groups**

Characteristics	Control	Intervention	<i>p</i> -value
Number of patients	834	898	
Age, y, mean (SD)	52.6 (21.4)	53.0 (21.0)	<i>p</i> = 0.71
Male sex, No. (%)	339 (40.7)	404 (45.0)	<i>p</i> = 0.07
CTAS 2, No. (%)	218 (26.1)	254 (28.3)	<i>p</i> = 0.41
CTAS 3, No. (%)	514 (61.3)	551 (61.4)	
CTAS 4, No. (%)	99 (11.9)	92 (10.2)	
CTAS 5, No. (%)	3 (0.4)	1 (0.1)	
Patients admitted, No. (%)	114 (13.4)	129 (14.4)	<i>p</i> = 0.91
Patients discharged, No. (%)	687 (82.4)	733 (81.6)	
Triage burden, mean (SD)	7.3 (6.0)	8.6 (7.1)	<i>p</i> < 0.0001
Time-to-first-identification, min, mean (SD)	13.4 (12.9)	1.7 (1.7)	<i>p</i> < 0.0001

CTAS = Canadian Triage and Acuity Scale; SD = standard deviation.

**Table 2. Results of linear regression analysis on time-to-first-identification (n = 1663)**

Parameter		Estimate	95% Confidence interval limits	p-value
Intercept		-0.33	(-1.93, 1.26)	0.68
Disposition	Admitted	-0.02	(-1.32, 1.28)	0.97
	Discharged (r.c.)			
Kiosk	Control, n r.o kiosk	13.63	(12.76, 14.51)	< 0.0001
	Intervention, kiosk (r.c.)			
Age		0.01	(-0.01, 0.03)	0.31
Triage burden		0.23	(0.17, 0.30)	< 0.0001

r.c. = reference category.

our study were that we tested the kiosk only during peak hours, and we had only one research assistant for data collection. We believe that testing during peak times meant that ED stressors would be felt most during these times, and the kiosk's success or failure would be highlighted. Our limited research assistant coverage and challenges matching names to our administrative database resulted in some missing data; however, we believe that this was random and did not skew the data in one particular direction.

Although we found no improvement in time-to-triage or time-to-MD, we are confident that this study provided an important first step in evaluating and improving ED triage processes. The kiosk provides an objective measure of the pre-triage interval, which traditionally is not included in wait-time data or collected. The automated measurement of the pre-triage interval is an important gain because it allows for measuring and improving time-to-triage. Before this study, we were unaware of the time before triage, which is significant at over 30 minutes during peak hours. The ability to track triage delays in real time provides a mechanism to activate triage surge strategies and allocate resources in an efficient manner. It is also thought that chief complaint information allows nurses to prioritize triage based on perceived acuity, and this could be an area of future study.

## CONCLUSION

This study shows that a self-check-in kiosk can be used by patients arriving in the ED to self-identify and capture the arrival times of patients. We believe that these results provide a strong proof-of-concept for the use of kiosks in EDs.

**Competing interests:** None declared.

## REFERENCES

- Guttman A, Schull MJ, Vermeulen MJ, Stukel TA. Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. *BMJ* 2011;342:d2983.
- Rondeau KV, Francescutti LH, Zanardelli JJ. Emergency department overcrowding: the impact of resource scarcity on physician job satisfaction/practitioner application. *J Healthc Manag* 2005;50(5):327-42.
- Derlet RW, Richards JR. Overcrowding in the nation's emergency departments: complex causes and disturbing effects. *Ann Emerg Med* 2000;35:63-8.
- Iverson KV, Moskop JC. Triage in medicine, part I: concept, history and types. *Ann Emerg Med* 2007;49(3):275-81.
- Betz M, Stempien J, Trivedi S, Bryce R. A determination of emergency department pre-triage times in patient not arriving by ambulance compared to widely used guideline recommendations. *CJEM* 2017;19(4):265-70.
- Wiler JL, Gentle C, Halfpenny JM, et al. Optimizing emergency department front-end operations. *Ann Emerg Med* 2010;55(2):142-60.
- Porter SC, Cai Z, Gribbons W, et al. The asthma kiosk: a patient-centered technology for collaborative decision support in the emergency department. *J Am Med Inform Assoc* 2004;11(6):458-67.
- Houry D, Kaslow NJ, Kembal RS, et al. Does screening in the emergency department hurt or help victims of intimate partner violence? *Ann Emerg Med* 2008;51(4):433-42.e7.
- Sinha M, Khor KN, Amresh A, Drachman D. The use of a kiosk-model bilingual self-triage system in the pediatric emergency department. *Pediatr Emerg Care* 2014;30(1):63-8.
- The Canadian Triage and Acuity Scale. Combined adult/paediatric educational program. Triage training resources. Version 2.5b; 2013. Available at: [http://caep.ca/sites/caep.ca/files/caep/participant\\_manual\\_v2.5b\\_november\\_2013\\_0.pdf](http://caep.ca/sites/caep.ca/files/caep/participant_manual_v2.5b_november_2013_0.pdf) (accessed August 2, 2016).