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Novel Emergency Department Registration Kiosk for HIV Screening Is Cost-Effective

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Abstract

High operating costs challenge sustainability of successful U.S. Emergency Department (ED) HIV screening programs. Free-standing registration kiosks could potentially reduce the marginal costs of ED HIV screening. We investigated incremental cost-effectiveness ratio (CER) per new HIV diagnosis for a kiosk-based approach for offering screening at ED registration, versus a testing staff-based approach to offer testing at the bedside. A rapid oral-fluid HIV screening program, instituted in a U.S. ED since 2005, had a rate of new HIV diagnosis 0.16% in 2012. A two-phase quasi experimental design, including a testing staff-based approach to offer testing at the bedside (Phase I, August and September 2011) and a kiosk-based approach to offer testing at ED registration (Phase II, December 2011 and January 2012), was performed. CER per new HIV diagnosis was defined as total cost of the screening program divided by number of newly diagnosed cases. Costs included screening program personnel (study coordinator, testing staff, and kiosk helpers), diagnostic assays (rapid and confirmatory tests), and kiosks (2 kiosks, software, and IT consulting fees). Sensitivity analyses were performed. Data from our dedicated testing staff program (Phase I) resulted in an estimated 5,434 patients tested in one year and 9 newly diagnosed HIV-infected patients (95% CI: 3, 18). Data from the kiosk program (Phase II), resulted in a projected 4,571 ED patients tested in one year and 21 newly diagnosed HIV-infected patients (95% CI: 4, 70). The overall cost was \$ 201,433 for the dedicated testing staff program, versus \$292,008 for the kiosk program. Incremental CER per new HIV diagnosis for kiosk-based approach was \$7,523 (range: \$1,780 to \$90,025 by sensitivity analysis). Our pilot data demonstrated that the use of kiosks for HIV screening was potentially more cost-effective than a testing staff-based bedside approach.

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Keywords

Emergency Department; HIV; Screening; Kiosk; Cost-Effective

Computerized interactive kiosks have begun to be used in various healthcare settings, including emergency departments (EDs) (Haukoos et al., 2012), as a novel approach to improve efficiency. We implemented a kiosk-facilitated screening program at registration to engage and offer patients HIV testing, following the success of our prototype system as a means of offering HIV testing to ED patients (Orlando et al., 2014; Rothman et al., 2014). Our results demonstrated that a kiosk-driven program increased numbers of engagement of higher-risk patients for testing (Hsieh et al., 2014).

An interactive computerized registration kiosk which offers HIV testing could potentially reduce the marginal costs of screening and provide a potential pathway to sustainable HIV screening for EDs. Practically speaking, were this type of kiosk fully integrated into the registration/triage process, it could improve efficiency, and ideally increase the proportion of the ED population to engage in HIV screening. To our knowledge, no studies have evaluated the cost-effectiveness of kiosks as a mode for facilitating ED HIV screening. Our aim was to determine the cost-effectiveness (as cost per new HIV diagnosis) of a kiosk-based approach versus a dedicated testing staff (DTS) approach for offering HIV screening.

Methods

The study was conducted at an urban adult ED with 60,000 annual census. The study was approved by the XXX University School of Medicine Institutional Review Board.

The cost-effectiveness analysis compared data from the Reference Phase (Phase I) to the Full Kiosk Implementation Phase (Phase II) (Hsieh et al., 2014). In Phase I, DTS offered the test bedside and manually gathered patient demographic and risk information (August – early September 2011). The time spent on collecting demographic and risk factor information on average was approximately 3 to 5 minutes. In Phase II (early December 2011 – January 2012), a stand-alone, enhanced front-end kiosk with automated log-in functionality was used to offer the HIV test. The front-end kiosk, placed immediately adjacent to registration and first ED triage, contained questions on kiosks for general medical and public health information sharing and the patient's interest in HIV testing. Patients who expressed interest in testing were self-referred to a private booth with a back-end stand-alone kiosk, where consent was obtained and HIV testing was performed by testing staff, and patient demographic and risk information was gathered via kiosk. On average, up to a minute was needed for a patient to complete the front-end kiosk and 4 minutes to complete the back-end kiosk. When a patient was tested as reactive at either phase, a confirmatory test was ordered and his/her treating physician provided the post-test counseling including information for HIV care and treatment. Both phases included 24 weekdays with 16 hours of testing operation. In Phase I, 538 patients were tested and none were HIV-positive; in Phase II, 430 patients were tested and 2 (0.5%; 95% CI: 0.08%, 1.53%) were newly diagnosed with HIV (Hsieh et al., 2014).

Key cost information collected included salary and fringe benefits associated with screening program personnel (study coordinator, testing staff, and kiosk helpers), diagnostic assay costs (rapid and confirmatory tests), and kiosk costs [one front-end and one back-end kiosks, software, setup hardware, and information technology (IT) consulting fees]. Costs of the first-year model for each phase were calculated based on the extrapolated yearly number of patients tested and newly diagnosed HIV cases from each phase. Since no new cases identified in Phase I, we applied an observed newly diagnosed HIV prevalence of 0.16% (95% CI: 0.06%, 0.33%) from July to December 2012, as a proxy comparator.

The cost-effectiveness ratio (CER) per new HIV diagnosis was defined as total cost of the screening program divided by the estimated number of newly diagnosed cases. Projected first-year CER was estimated using the observed new HIV diagnosis prevalence during Phase II, and the prevalence in the second half of 2012 for Phase I. We calculated the incremental CER per new HIV diagnosis to demonstrate extra costs per extra unit of effectiveness as the difference in costs between Phase I and Phase II divided by the difference in the number of new HIV cases. Sensitivity analyses were performed for projected first-year CER and incremental CER per new HIV diagnosis based on 95% CIs of new HIV prevalence (0.08%, 1.53%) from Phase II.

Results

Data from Phase I resulted in an estimated 5,434 patients tested patients in one year and 9 newly diagnosed HIV-infected patients (95% CI: 3, 18). Data from Phase II, resulted in a projected 4,571 patients tested in one year and 21 newly diagnosed HIV-infected patients (95% CI: 4, 70). Table 1 displays the itemized first-year costs of each program in personnel, diagnostic assay, and kiosk-related cost as well as the overall cost.

Sensitivity analyses demonstrated that for Phase I, the projected first-year CER per new HIV diagnosis was \$22,381 for the scenario in which 9 positives were identified, \$67,044 for a lower bound (i.e. 3 positives), and \$11,216 for a upper bound (18 positives). For Phase II, the projected first-year CER per new HIV diagnosis was \$13,950 for the scenario in which 21 positives were identified, \$72,790 for a lower bound (4 positives), and \$4,207 for a upper bound (70 positives).

The incremental CER per new HIV diagnosis for kiosk program was \$7,523. The sensitivity analysis demonstrated that the incremental CER ranged from \$1,780 to \$90,025.

Discussion

Our data suggest that using kiosks for HIV screening in the ED is cost-effective. One of the main reasons may be that kiosk-facilitated testing is more private and engages more high-risk patients for acceptance of a test as compared to a traditional DTS, yielding a relative increased prevalence of undiagnosed infection detected. We found that those tested via kiosk were more likely to report high-risk behaviors (Hsieh et al., 2014). These patients might feel that kiosks (which offer HIV test to every single patient) help to de-stigmatize fears and apprehension regarding accepting a test. In addition, patients may perceive that kiosks provide a higher level of privacy (versus by testing staff), making them more likely to accept

a test. Further studies are needed to investigate how kiosks can be improved upon in order to engage those who are not technology-skilled or who prefer human face-to-face interactions.

We estimated that the first-year incremental CER per new HIV diagnosis for kiosk-based approach was \$7,523 relative to the DTS model. The incremental CER for the following years is expected to be even more cost-effective since the fixed cost, \$41,544 for setting up two kiosks, will be not be part of the cost after the first year. For an ED which is not required by the funding agency to collect risk information from patients, the kiosk model will be much more cost-effective since the cost of a back-end kiosk will be excluded. Furthermore, some EDs have begun to use touchscreen computerized kiosks for intake of patients (Wiler et al., 2010). If this type of self-service check-in kiosk becomes a standard model of ED registration in the near future, an HIV test offer is an easy add-on without added much of cost. Further studies are warranted if different type of EDs (size, operational patient flow) might have impacts on the cost-effectiveness of kiosk model.

A recent research report suggests that routine screening in EDs is one of the most cost-effective testing venues (Infectious Disease and Environmental Health Administration Maryland Department of Health and Mental Hygiene, 2011). Within the ED settings, studies comparing non-targeted testing versus diagnostic testing only demonstrate non-targeted testing to be more cost-effective (Dowdy, Rodriguez, Bradley Hare, & Kaplan, 2011; Walensky et al., 2011). Our findings support the kiosk as a potentially cost-effective approach for integrating HIV screening into EDs.

There are limitations in this study. First, our projected first-year incremental CER per new HIV diagnosis was based on data from a short study period of time. Second, estimates were based on small sample size of new HIV cases, and accordingly have quite wide confidence intervals. Therefore, the estimate might have a higher level of uncertainty. Despite the fact that the range of incremental CER estimated was wide, the upper limit still remained within the range of which is generally considered cost-effective (Hsu & Walensky, 2011). Finally, it is possible that some indirect costs associated with our HIV screening program with or without kiosks were not realized. Accordingly, we could have over- or under-estimated the incremental CER.

In conclusion, use of kiosks for offering HIV screening to patients was found to be more cost-effective than a model in which DTS approach patient at the bedside per new diagnosis identified. We believe that registration kiosks are in sync in general with future ED process and patient flows which aim to shorten the length of stay. With the increased utilization of patient-centered computerized kiosks in patient intake area in the ED, we believe that kiosks will ultimately become widely used, and more cost-effective, and can help further destigmatize HIV testing in high-volume settings such as busy EDs. The novel kiosk-facilitated HIV screening program might become a sustainable model to identify many undiagnosed infections in the ED setting.

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Base costs and estimated first-year costs of a kiosk-facilitated HIV test offer model and a testing staff-facilitated model in an emergency department-based HIV screening program

Table 1

Categories / Items	Base Unit Cost* (USD in 2011)			
	Testing Staff	Kiosk	Testing Staff	Kiosk
<i>A. Personnel</i>				
Study Coordinator (per year with fringe)	\$47,425	\$47,425	\$47,425	\$47,425
HIV Testing Facilitator (per year with fringe)	\$44,175	\$44,175	\$88,350	\$88,350
Kiosk Helper (per hour with fringe)	NA	\$15.12	NA	\$58,787
Sub-Total	NA	NA	\$135,775	\$194,562
<i>B. Diagnostic Assay</i>				
OraQuick HIV Assay (per test)	\$12	\$12	\$65,208	\$54,852
Western Blot Test (per test)	\$50	\$50	\$450	\$1,050
Sub-Total	NA	NA	\$65,658	\$55,902
<i>C. Kiosk Related Expense</i>				
Kiosk with Wristband Scanner – VECNA	NA	\$27,493	NA	\$27,493
Kiosk – Creoso	NA	\$6,001	NA	\$6,001
IT Software Consulting Fee	NA	\$7,000	NA	\$7,000
Installation of LAN Outlets	NA	\$1,000	NA	\$1,000
LAN Cables	NA	\$50	NA	\$50
Sub-Total	NA	\$41,544	NA	\$41,544
Total	NA	NA	201,433	292,008

Projected first-year cost for diagnostic assays was based on the estimates that we tested 4,571 ED patients in a year and identified 21 newly diagnosed HIV-infected patients for kiosk-based offering approach in our ED HIV screening program. We also estimated that 5,434 patients were tested in a year and 9 newly diagnosed patients were identified for the testing staff-based offering approach.

* Base unit cost referred the cost of personnel per year (salary with fringe), cost of an HIV test, or cost of a computerized kiosk or an item; First-year cost referred the total cost of specific personnel, diagnostic assay, or kiosk/IT category during the first year.