

An Evaluation of the Clinical and Financial Value of Work Station Single Sign-on in 19 Hospitals

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Abstract

Background: A large health system implemented computer workstation single sign-on (SSO) in 19 community hospitals. In SSO technology, manual keyboard login is replaced with an identification badge reader that clinicians swipe for expedited access to the electronic health record (EHR) and clinical applications while roaming the hospital.

Objective: To assess the clinical workflow and financial value of SSO implementation in reducing clinician time logging in to the EHR and clinical applications.

Methods: Mean login time duration before and following SSO implementation was measured over 128 logins during two seven-day periods across eight hospitals selected randomly from 19 facilities where the technology was live. Mean first-of-shift login duration and mean reconnect login duration during the rest of shift were compared prior to and post-SSO implementation. Dollar values of keyboard time saved were calculated for physicians, nurses, and ancillary clinicians. Total facility-wide and enterprise-wide clinician time liberated from keyboard use are reported in hours and in dollar value per week and per year.

Results: Following SSO implementation, first-of-shift login was reduced by 5.3 seconds (15.3 percent), and reconnect login duration in the remainder of the shift was reduced by 20.4 seconds (69.9 percent). The total weekly time savings realized by SSO was 943.4 hours (the equivalent of 78.6 12-hour shifts) across 19 hospitals, a mean of 49.7 hours (4.1 shifts) per facility. Annually, 49,056.8 hours (4,088.1 shifts) of mixed clinician time were liberated from keyboard use for the enterprise, a mean of 2,584.4 hours (215.4 shifts) per facility per year. The annual dollar value of clinician time liberated from keyboard use to care for patients was \$3,201,001 for 19 facilities, or \$168,474 per hospital. Future savings due to desktop virtualization and use of a thin client device, in lieu of replacing more costly desktop computers, increases the annual financial value conveyed by SSO to \$3,330,601.

Conclusions: In the 19 hospitals evaluated, SSO improved clinician efficiency and delivered substantial financial value. The use of SSO is an effective method for liberating clinician time from keyboard use to focus on providing patient care, and can facilitate EHR use.

Keywords: computer workstation login; single sign-on; clinical workstation security; electronic health record secure access

Introduction

Physician dissatisfaction with electronic health records (EHRs) and perceived EHR inefficiencies remain persistent concerns for hospitals in an era of increasing fiscal discipline.¹⁻³ For many clinicians, EHRs have low usability and are regarded as a time-consuming interruption to an already busy workflow and disruptive to patient relationships.⁴⁻⁶ In addition, efforts must be made to maintain the security of protected health information. Password protection of EHR access, with the need to continually update complex passwords, impedes the clinical workflow.

At CHRISTUS Health, clinicians—and physicians in particular—need to recall and update up to an estimated 20 passwords for clinical applications. Other hospitals have reported that clinicians typically login to eight or more applications.⁷ Entering, updating, and resetting passwords uses time that would be better spent on patient care. We regarded single sign-on (SSO) technology as a method to ease and expedite EHR use for over 20,000 clinicians. This technology enables a clinician to login by keyboard at the start of a shift and then use a streamlined method to reconnect on subsequent logins for the rest of the shift. The use of SSO limits keyboard login to once per shift and accelerates access, eliminating the need to create and remember complex passwords. Many clinicians roam across the hospital, often facing significant time pressures, and SSO provides roaming clinicians with rapid access to information systems at the point of care. Purkayastha et al. found that SSO users reported increased ease of EHR use with a streamlined workflow, and they recommended its implementation to improve EHR usability and navigation.⁸

Our objective in implementing SSO technology was to provide clinicians with expedited access to their clinical applications and to eliminate time expended in managing passwords. Once logged in at the start of a shift, clinicians swipe a proximity identity badge on card readers at computer workstations. The badge logs clinicians in and out as they roam the hospital, bringing them back to where they left off in the EHR or an application. When the clinician moves to another workstation, the badge reader accesses the current state of the last computer used. The SSO technology reduces repetitive manual logins and expedites authenticated access to the EHR and clinical software applications for the balance of a 12-hour shift, after which keyboard login in the usual fashion must be repeated to enable another shift of proximity card logins.

Varied applications, including terminal, client-server, and cloud-based applications, can be accessed with SSO. New applications can be profiled and deployed rapidly, and coding is not required. Automated application password change processes ease the burden of password administration for clinicians, who can focus on patient care rather than refreshing passwords. By automatically launching and opening applications for providers, SSO technology liberates clinicians' time from the keyboard for patient care. The proximity badge technology automatically locks the workstation when clinicians leave. The need to manually lock sessions or employ unreliable inactivity timers is thereby eliminated, as is the risk of losing work in the EHR when clinicians are distracted or diverted. In this way, SSO minimizes preventable disruptions to clinical workflows.

We determined that it was operationally necessary in SSO implementation to migrate from workstation personal computers (PCs) to a thin client, where processing occurs in the cloud. A virtual desktop infrastructure replaced physical PCs to enable clinician roaming. Forty-five clinical software applications were profiled and SSO enabled.

The health system first began SSO implementation in 2016, and we completed an early evaluation of the clinical impact and value in the first six hospitals.⁹ We did so in part to validate that further investment was justified, and to demonstrate to both clinician users and executive leaders the value of investment in SSO. At the time, however, we had not yet made efforts to adjust and improve other components of our information technology (IT) infrastructure to optimize SSO and reduce login times. Nonetheless, our findings from that earliest phase of SSO implementation were highly favorable

with respect to clinician time liberated from keyboard use and net financial return on investment.¹⁰ In the ensuing two years, we completed implementation of SSO technology at an additional 13 facilities, and we also improved components of our IT infrastructure. These IT improvements may have had a beneficial impact in reducing SSO login times. This report completes a new analysis of the impact and value of SSO implementation across all 19 hospitals after two years of continuous improvement to our systems.

Our last evaluation shared anecdotal reports of improved clinician user satisfaction resulting from SSO implementation, parallel to the findings of an evaluation of perceptions of SSO satisfaction in emergency departments.¹¹ Proximity card authentication significantly expedited perceived speed of login among clinicians, and diminished shared-login errors.¹² This report builds on past efforts to assess the value of SSO by complementing self-reported data and qualitative research methods with direct sampling and quantification of actual login times before and after implementation of SSO in 19 hospitals. We quantify annualized clinician time liberated from keyboard use by clinician type, and estimate its financial value at the enterprise and facility levels by using national reports of the mean hourly wages of these different clinical end users. The objective of the present study was to assess the impact and value of SSO implementation in reducing the amount of time clinicians spend logging in, after the system was optimized to enhance SSO performance. Also examined are cost savings rendered by migrating to a thin client and virtual desktop infrastructure that enabled replacement of desktop PC workstations. Both are compared with the findings of our prior evaluation of the first six facilities where SSO technology was implemented.

Methods

Study Setting

CHRISTUS Health is an independent delivery network operating in six US states and three foreign markets, with 49 hospitals, 350 other services, and more than 15,000 physicians. Its Health Information Management and Health Informatics departments began implementation of SSO across the enterprise in late 2015 and completed it in 2018. Implementation focused on enabling SSO among physicians, midlevel providers, nurses, and ancillary clinical service providers, including respiratory therapists, dietitians, and physical therapists, who roam across departments and service lines within 19 community or general hospitals. These hospitals have the usual multidisciplinary range of clinical service lines and vary in licensed bed capacity from approximately 80 to 170 beds. About 5,800 physicians work at the facilities, including all major specialties and subspecialists. The EHR system in these facilities is MEDITECH Client/Server version 5.66, and the SSO product implemented was Imprivata OneSign version 5.1.

Study Design

We collected data on clinician time liberated from keyboard use by the implementation of SSO, and then translated the time saved into estimates of the total dollar value of this time by clinician type, using the mean of national estimates of hourly wages. Hours and 12-hour shift equivalents of time were converted into total dollar value produced when clinicians' time is liberated to care for patients rather than manage secure access to the EHR. We calculated weekly and annual time savings and associated dollar value at the enterprise and average facility levels. In addition, we calculated annual recurrent financial savings from eliminating the need to replace desktop PCs as a result of the migration to a virtual desktop system to facilitate SSO.

The SSO software enabled precise quantification of the number of logins/reconnects by various clinicians. Our SSO product, Imprivata OneSign version 5.1, and our Citrix virtualization software provided data on real-time and retrospective SSO logins, including the number and type of clinical users and the frequency of access by application and per unit of time. Caregiver satisfaction was not systematically surveyed, but we report communication of increased clinician satisfaction from

approximately 80 physicians and nurses whom we encountered while rounding in the facilities and attending clinical leadership meetings in the weeks following implementation.

Sampling Techniques

The SSO access involved two logins: the first login of the shift to the desktop and then to the EHR system, and subsequent reconnections or re-logins to the EHR system using the card reader. We sampled two seven-day observation periods of SSO usage in April 2018. Eight general/community hospitals were selected randomly in Texas and Louisiana for sampling. At least one hospital was sampled from each of the eight markets or operational clusters in the enterprise. The facilities selected for sampling do not differ meaningfully from the rest of the 19 facilities for SSO performance, and the login and reconnect times within any region or cluster of hospitals were historically very similar. Measurements of actual login and re-login/reconnect durations to representative workstations were completed before and after SSO implementation during the two observation periods. A total of 128 login time samples, including time to login, were measured during day shifts, when EHR use and system demand are greatest. After measuring and validating actual first-of-shift login and reconnect times over the course of the seven-day sampling periods, we derived mean first-of-shift and reconnect/re-login times across the enterprise for each period before and following SSO implementation. Workstations were sampled on different floors and service lines of each facility. We had no a priori reason to suspect any substantial systematic variation or changes in system performance between samplings, or between facilities, and none was evident during repeated sampling.

Sample Size

An average of 184,606 logins to the enterprise EHR by clinicians occurred across 19 facilities over each of two seven-day periods sampled in April 2018, before and after SSO implementation. The total number of potential SSO end users across the enterprise equaled 27,667, of whom 16,840 were enrolled for SSO use (60.9 percent). Of these, 12,903 clinicians (76.6 percent) were active on SSO in the 19 hospitals.

Data Collection Tools

Citrix Studio was the virtualization analytics tool utilized, and manual reports were generated from the Imprivata OneSign appliance. Hands-on evaluation of sample login times were completed manually at each of the eight hospitals on end-point user devices (PCs pre-SSO implementation and subsequently thin clients).

Data Analysis and Management

Mean login duration was multiplied by number of total first-of-shift and subsequent reconnects/re-logins. We report the total time required for clinicians to login before and after SSO implementation, and we quantify the financial benefit resulting from decreased clinician login times (time liberated from keyboard use). The dollar savings or value of the time liberated from the keyboard for clinicians by SSO does not represent cash returned to the hospital budget or decreased hospital spending on clinician salaries per se, but this information is nonetheless valuable because time liberated from keyboard use enables clinicians to focus on patient care delivery instead of spending time on the keyboard to login to the EHR system throughout their shift.

Multiple national estimates of median/mean hourly wage rates were used to translate hourly and shift equivalent time savings into dollar value/cost savings for physicians, nurses, and ancillary clinicians (respiratory therapists, dieticians, and physical therapists). For future PC purchase savings, we calculated

the total enterprise cost difference resulting from replacing desktop PC workstations with a thin client (Wyse) device utilizing cloud processing to facilitate rapid login and computing functions.

We calculated the value of deploying SSO by clinician type in dollar cost savings or gain of time liberated from keyboard use, which could instead be focused on patient care delivery. Time thus saved in the login process can potentially increase patient throughput/volume and thereby enhance revenue indirectly. Greater focus and time spent on patient care can possibly also improve care quality, as well as patient and provider satisfaction. The breakdown of clinical users in these 19 facilities was 30 percent physicians, 57 percent nurses, and 13 percent ancillary clinicians. The hourly wages of each clinical group were estimated conservatively as follows. For nurses, we used the national average wage of \$34.50.¹³ Physical therapists, dieticians, and respiratory therapists were collapsed into a single ancillary category of users with an average hourly wage of \$32.20.¹⁴

Substantial variation in incomes between physician specialties made estimation of physician hourly wages more complex. We divided physicians into four general groups according to frequency of EHR use within the enterprise. In descending frequency, the physician groups issuing the greatest total volume of clinical care orders in the computerized provider order entry (CPOE) module were hospitalists, emergency medicine physicians, general surgeons, and all other physician specialties. From our CPOE order issuance data by specialty, we estimated that each of these groups accounted for approximately 25 percent of total physician EHR use.

For the other physician specialties category, we averaged physician hourly wage rates from the US Department of Labor occupational statistical database (\$95 per hour) with that released by Becker's Hospital Review (\$165 per hour), for a rate of \$130 per hour.^{15, 16} For hospitalists, emergency medicine physicians, and general surgeons, we averaged three hourly rates reported by specialty from the Medscape Physician Compensation Report 2016, Salary.com, and Becker's Hospital Review data as follows: \$108 per hour for hospitalists, \$144 per hour for emergency medicine physicians and \$170 per hour for general surgeons.¹⁷⁻¹⁹ The mean wage of all four physician categories yielded an overall mean hourly physician wage of \$138. These estimates err toward the conservative in many US markets, and thus so do our estimates of the financial value and impact of SSO.

Future replacement desktop computer purchases for workstations were eliminated in our SSO implementation by migration to a thin client. The cost of a Wyse thin client device, at \$200 per unit, supplants the current desktop PC replacement cost of \$900 per unit. Knowing the number of Wyse thin client devices deployed, we report prospective multiyear savings from averted costs of PC workstation replacement.

Inclusion and Exclusion Criteria

Mobile workstations were part of this SSO implementation. However, there is a high degree of variation in their setup/deployment across facilities that our value analysis could not adequately reflect, such as whether a thin client was deployed, or differences in reliability of mobile wireless access. Therefore, we excluded from our analysis all mobile workstations, which account for approximately 18 percent of all workstations in the 19 hospitals evaluated.

Results

First-of-shift SSO login to the EHR system is a two-step process. Before SSO implementation, accessing the Windows desktop required a mean of 30.1 seconds, followed by 4.5 seconds to access the EHR, for a total duration of 34.6 seconds for first-of-shift login. The duration of pre-SSO manual keyboard reconnections or re-logins during the remainder of the shift after the first login was measured as requiring a mean of 29.3 seconds. After the implementation of SSO, the duration of first-of-shift login was reduced by 5.3 seconds (15.3 percent) to a mean of 29.3 seconds (see Table 1). During the remaining

12-hour shift, when clinicians reconnected to the EHR after first-of-shift login, the mean time required per login was 8.9 seconds, a reduction of 20.4 seconds (69.6 percent) from the time required before SSO implementation (Table 1).

There were 184,606 mean total logins to the enterprise EHR over each of two seven-day periods sampled across the 19 hospitals during April 2018 (see Table 2). A mean of 24,472 logins were first-of-shift and 160,134 were reconnects. Unsuccessful logins, and inadvertent logins to a prior user's account, were infrequent and negligible for the purpose of this analysis. The duration of first-of-shift logins was reduced from 235.2 hours over 7 days pre-SSO implementation to 199.2 hours after SSO implementation, a gain or liberation from keyboard of 36.0 hours (see Table 2). The duration of reconnects/re-logins was reduced from 1303.3 hours to 395.9 hours, a gain or liberation from keyboard of 907.4 hours (or 75.6 shifts of 12 hours). Adding first-of-shift login savings of 36.0 hours per week to the latter yields a total weekly time savings across the 19 hospital implementation of 943.4 hours (78.6 shifts), or 49.7 hours (4.1 shift equivalents) per facility. On an annual basis, 2,584.4 hours or 215.4 shifts of mixed physician, nurse, and ancillary clinician time were liberated from keyboard use per facility. Across 19 hospitals, 49,056.8 hours of clinician time are liberated from keyboard use, or 4,088.1 shift equivalents of 12 hours (see Table 2).

The reduction in all clinicians' login time per facility per year of 2,584.4 hours translates into individual facility financial value and savings, through the liberation of clinician keyboard time to focus on patient care instead of EHR logins, equaling \$168,474 per year per facility (see Table 3). Financial value and savings per year for 19 facilities equals \$3.2 million.

The total enterprise cost of SSO implementation, including Wyse thin client device virtualization, was approximately \$1.23 million (excluding other system components already in place at the time of implementation or which serve other functions). The annual maintenance cost for SSO is \$296,000. Savings will also result from not having to regularly purchase replacement desktop computers, a need largely eliminated by changing to thin client devices. These savings are estimated from having 2,432 Wyse thin client devices deployed across the enterprise over the implementation of SSO, with a unit cost of \$200, versus an estimated replacement cost of \$900 every four years for full desktop computers. At a unit savings of \$700 each, this change produces \$3,404,800 in total device savings over the next eight fiscal years (\$425,600 per fiscal year) (see Table 4).

With clinician time liberated from keyboard use valued at \$3,201,001 per year, the additional savings from averted new PC purchases brings the annual total recurrent savings and financial value of single sign-on to \$3,626,601 across 19 hospitals. When SSO annual maintenance cost is deducted, the net total annual value delivered currently in these 19 facilities is \$3,330,601 (see Table 4). When SSO is implemented in all 49 hospitals of the enterprise, the net financial value rendered may be as high as \$8,589,445 per year.

Although we collected no systematic survey or interview data from clinical end users, anecdotal reports gathered by members of the Health Informatics department during rounds in the hospitals from more than 80 physicians and nurses conveyed a high degree of satisfaction with SSO after implementation. With health informaticists and information management personnel on-site in most of the facilities daily, specifically to surveil for and resolve clinical end-user problems with the EHR, we are highly confident we would have learned of any significant dissatisfaction with SSO if it existed. End users experienced some workflow disruption when logging in using SSO in the early implementation period, but with the usual implementation adjustments, the incidence approached zero by four weeks after initial implementation.

Discussion

Our findings of 49.7 hours of clinician time saved per week and 2,584.4 hours saved annually per facility are comparable to estimates conveyed in other reports.²⁰⁻²² However, our reported time savings are not estimates or self-reported, but actual observed and quantified login time reductions from data reported by our software application. In these 19 hospitals, SSO has had a very positive impact on clinician workflow ease and efficiency. Our financial gain of \$258 per clinician per year is considerably lower than that reported from a survey of IT professionals, where cost savings were \$2,675 per clinician per year.²³ We suspect that actual system performance data on login time reduction and resulting quantified cost savings differ from perception or self-reported survey data, tending toward the conservative side.

Our first evaluation of the clinical and financial value of SSO was completed after SSO was implemented in the first six facilities in the enterprise.²⁴ During this early implementation period, we had not yet had the opportunity to try to reduce SSO login durations in a stable technology environment. In the present report, we see the impact of substantial compression of reconnect/re-login duration. It is difficult to determine and accurately attribute which improvements made to the system and technology environment since our last report enabled such significant improvement in SSO performance. Several updates and patches to our Citrix environment have been completed, as well as hot fixes to our Windows 7 image. We also worked with our vendor, Imprivata, to implement numerous optimizations over the course of the two years since the evaluation of the first six facilities was reported.²⁵ Because these improvements have been gradual, we are unable to discern any single one that contributed disproportionately to the much improved reconnect performance observed in this analysis.

The annual value of liberated clinician time observed in the present analysis, at \$3.2 million, is almost double that projected from our earlier analyses. We attribute this difference to the substantial compression of reconnect time we have achieved since that report, plus a slight shift in the distribution of SSO clinical end users to costlier physician and nurse users, versus relatively lower cost ancillary personnel. While the dollar savings or value of the time liberated from keyboard by SSO for the clinicians does not return to the facility budget or enable less hospital spending on clinician salaries per se, it is nonetheless valuable because clinicians can focus their efforts and limited time on patient care delivery instead of keyboard typing to login to the EHR. While this clinician time liberated from the keyboard may somewhat improve patient throughput, thus contributing indirectly to increased facility revenue potential, we have no evidence in this regard, as it was not assessed as an outcome of this study. The use of SSO does reduce budgetary expenditures for workstation PC replacement purchases when the transition to a virtual desktop system is part of the implementation.

The most significant challenge we faced during SSO implementation was the need to update/upgrade other components of IT infrastructure to optimize SSO performance. The SSO technology required improvement in the processing capacity of desktop PC workstations. Without a substantial upgrade, we had poor SSO performance and clinician dissatisfaction when it was piloted. Once legacy PC workstations were replaced with thin client devices and processing shifted from the local device to the health system's private cloud, we observed dramatically improved SSO performance (at a fraction of the cost of upgrading computer processors).

Conclusions

This quantitative evaluation demonstrates that SSO is delivering substantial clinical value, recurrent annual return on investment, and net equipment cost savings to 19 hospitals within the CHRISTUS Health system. The use of SSO has demonstrably liberated clinicians' time from the keyboard by eliminating the need for repetitive, time-consuming logins to the EHR and frequently used clinical software applications. We also found that the introduction of SSO technology facilitated adoption of key component functionalities and applications within our EHR, including electronic clinical

documentation. This finding parallels other reports.²⁶⁻³⁰ In our experience, SSO performed best when it was combined with migration to a virtual desktop infrastructure and thin client device. This has the added benefit of reducing the need for costly desktop PC replacement and upgrades, conveying further savings. Other qualitative value delivered by implementation of SSO included increased clinician satisfaction with our clinical IT support services. The SSO implementation has also bolstered authentication and increases the security of personal health information. Finally, IT help desk or service calls to reset passwords have been reduced, so this resource can deliver other needed service support.

Clinicians desire a significant evolution of EHR usability and reduced time spent using the EHR, and SSO can ease the burden of EHR use. Anecdotal reports from physician and nurse end users following our implementation suggest that SSO was a very strong “clinician satisfier,” and our experience aligns with that reported by other hospitals.³¹⁻³⁴ The use of SSO does not completely ameliorate physicians’ concerns about the time they expend on the EHR, but it offers incremental and meaningful liberation of clinicians’ time from the keyboard by enabling a more efficient clinical workflow. In hospitals where clinician EHR and clinical applications use rates are high, and where clinicians roam extensively, SSO can save time and money, improve security, and potentially increase clinician productivity and satisfaction.

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Notes

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Table 1

Reduction in Clinician Login Times after Single Sign--On (SSO) Implementation

Implementation Phase	First-of-Shift Mean Login Time	Mean Re-Login Time 12-hour Shift	Time Reduction Per Login (% Improvement)
Before SSO implementation	34.6 seconds	29.3 seconds	—
After SSO implementation	29.3 seconds	8.9 seconds	First login: 5.3 seconds (15.3%) Re-login: 20.4 seconds (69.6%)

Table 2

Reduction in Clinician Login Times in 19 Hospitals after Single Sign-On (SSO) Implementation

Login Performance Parameter	Frequency or Time	Keyboard Time Reduction Enabled by SSO
Total number logins to EHR over 7 days	184,606	–
Number of first-of-shift logins	24,472	
Number of reconnects/re-logins	160,134	
Active clinical users of SSO	12,903	–
Duration of first-of-shift logins (7 days)		
Before SSO implementation	235.2 hours (19.6 shifts ^a)	–
After SSO implementation	199.2 hours (16.6 shifts)	36.0 hours (3.0 shifts ^a)
Duration of reconnects (7 days)		
Before SSO implementation	1,303.3 hours (108.6 shifts)	–
After SSO implementation	395.9 hours (33.0 shifts)	907.4 hours (75.6 shifts)
Total weekly time savings with SSO	19 hospitals	943.4 hours (78.6 shifts)
Total weekly time savings per facility	1 facility	49.7 hours (4.1 shifts)
Total annual time savings with SSO	19 hospitals	49,056.8 hours (4,088.1 shifts)
Total annual time savings per facility	1 facility	2,584.4 hours (215.4 shifts)

^a Shifts are defined as the equivalent of 12 hours.

Table 3

Value of Clinical Time Liberated by Professional Category

Professional Category	Annual Hours Liberated in 19 Facilities	Estimated Hourly Pay Rate	Annual Value of Liberated Time per Facility	Annual Value of Liberated Time in 19 Facilities
Physicians (hospitalists, emergency medicine physicians, surgeons, and all others)	14,717.0 hours (30%)	\$138.00	\$106,892	\$2,030,946
Nurses	27,962.4 hours (57%)	\$34.50	\$50,774	\$964,703
Ancillary (physical therapists, dieticians, and respiratory therapists)	6,377.4 hours (13%)	\$32.20	\$10,808	\$205,352
All professional categories	49,056.8 hours (100%)	–	\$168,474	\$3,201,001

Table 4

Summary of Net Financial Costs and Value of Single Sign-on (SSO)

Expenditure or Savings	Financial Costs	Financial Value/Return
Implementation cost of SSO	\$1,230,000	–
Annual maintenance cost of SSO	\$296,000	–
Averted annual purchase of replacement desktop PCs	–	\$425,600
Clinician time and shift equivalents liberated from the keyboard per year	–	\$3,201,001
Total net annual savings or value rendered by SSO implementation across 19 facilities	–	\$3,330,601 ^a

^a Averted PC purchases + value of liberated clinician time - annual SSO maintenance cost.