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4th Generation HIV Screening in the Emergency Department: Net Profit or Loss for Hospitals?

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Abstract

Universal opt-out 4th generation HIV screening in emergency departments (EDs) can reach populations less likely to receive risk-based HIV screening. Despite the CDC's recommendations for routine universal HIV screening, widespread implementation of universal opt-out HIV testing in EDs has not been embraced and institutional costs may represent a major deterrent. The objective of this study was to determine hospital costs and revenue of universal opt-out HIV ED screening.

An electronic medical record (EMR)-directed, automated ED screening program was instituted at an academic medical center in San Diego, California. A base model calculated net income in US dollars for the hospital by comparing annual testing costs with reimbursements using payor mixes and cost variables. To account for differences in payor mixes, testing costs, and reimbursement rates across hospitals in the US, we performed a probabilistic sensitivity analysis.

The base model included a total of 12,513 annual 4th generation HIV tests with the following payor mix: 18% Medicare, 9% MediCal, 28% commercial and 8% self-payers, with the remainder being capitated contracts. The base model resulted in a net profit for the hospital. In the probabilistic sensitivity analysis, universal 4th generation HIV screening resulted in a net profit for the hospital in 81.9% of simulations.

Universal 4th generation opt-out HIV screening in EDs resulted in a net profit to an academic hospital. Sensitivity analysis indicated that ED HIV screening results in a net-profit for the

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majority of simulations, with higher proportions of self-payers being the major predictor of a net loss.

Keywords

HIV; insurance; testing; Emergency Department; cost analysis

Introduction

Although targeted testing of those engaged in transmission risk behaviors results in a higher yield of HIV diagnoses(Chaillon et al., 2020; Martin Hoenigl et al., 2015; M. Hoenigl, Graff-Zivin, & Little, 2016; M. Hoenigl, Little, et al., 2019; Martin et al., 2020; Osorio et al., 2017), universal opt-out 4th generation (i.e., p24 Ag/Ab) HIV screening in emergency departments (EDs) can reach populations, including marginalized populations and non-traditional risk groups who are less likely to receive risk-based HIV screening elsewhere(Dijkstra, Lin, de Bree, Hoenigl, & Schim van der Loeff, 2020; Haukoos & Hopkins, 2013; Jain et al., 2008). As a consequence, the Centers for Disease Control and Prevention (CDC) recommends routine, universal opt-out 4th generation HIV screening for all persons 13–64 years of age(Branson et al., 2006); however, widespread implementation of this testing strategy in EDs has not yet been embraced. The reasons for poor uptake are likely multifactorial, but institutional costs may be a major deterrent(Schackman et al., 2016). While several studies have explored the potential benefits and barriers of universal opt-out HIV testing from a community perspective (e.g., cost deterrents, need for venipuncture, concerns about turnaround time, laboratory capacity), studies from a hospital perspective are lacking(Farnham, Sansom, & Hutchinson, 2012; M. Hoenigl, Chaillon, et al., 2016). The objective of this study was to determine hospital costs and revenue of universal 4th generation opt-out HIV ED screening.

Material and Methods

A universal opt-out 4th generation HIV screening program was established and integrated into the electronic medical record (EMR) system(M. Hoenigl, Mathur, et al., 2019; Lara-Paez, Zuazo, Blumenthal, Coyne, & Hoenigl, 2021; Mathur et al., 2020). The EMR-directed, automated screening algorithm provided opt-out HIV testing to adults in two EDs with a combined annual census of approximately 80,000 visits between 2017–2019 (30 months) at the University of California San Diego (UCSD) Health System. All the project methods were carried out in accordance with relevant guidelines and regulations. The study was approved by the UCSD institutional review board which exempted informed consent of participants.

Base Model

The base model calculated net income in 2018 US dollars (USD) for the hospital by comparing costs (i.e. annual costs for an established HIV screening program; data not shown) with reimbursements by commercial insurance, Medicare, Medicaid and self-payers using payor mixes and cost variables from the ED screening program. Testing cost data

(Architect, Abbott, United States), were obtained from the UCSD Health System. Costs were calculated from our established HIV screening programs perspective, which screens only patients who get a routine blood draw ordered in the ED (therefore the model did not include costs for nursing time and phlebotomy) once every 12 months. The model did therefore not include costs for establishing the HIV screening program (e.g., EMR programming, staff education). An average of 12,513 ED 4th generation HIV screening tests were conducted each year between 2017–2019, and our model did not include costs and reimbursement for either subsequent HIV confirmatory tests for the proportion of participants with positive 4th generation test results (0.4% in our setting), or patient disclosure and linkage to care in case of positive results. Reimbursement variables were established as commercial insurance, Medicare, Medi-Cal/Medicaid (a social program in California/the US that provides health insurance to low-income populations), and self-payers (i.e., utilizing actual cost recovery rate in our setting). In addition, there was a significant proportion of capitated contracts (i.e., fixed reimbursement per patient per year independent of hospital services), for which we conservatively set the reimbursement value to zero. Payor mix and reimbursement data for 2018 were obtained from the UCSD Health System.

Probabilistic Sensitivity Analysis

We assessed the variability of direct costs, reimbursement payments, and payor mixes by employing a probabilistic sensitivity analysis (PSA) to examine uncertainty in each variable. For the PSA we assigned uniformly distributed 95% confidence intervals (CI) to the direct cost, each reimbursement payment amount, and payor mixes. In order to account for differences in lab costs, 95% CI were determined for the direct cost of each HIV test. Payor mixes and generalized reimbursement rates across the US were established by literature review (Bush, Gerber, Stepanova, Escheik, & Younossi, 2018; McConville, Danielson, & Hsia, 2019; Pines et al., 2016; Stocks, 2017; Sun R (AHRQ), 2018). To account for capitated contracts, the commercial reimbursement 95% CI was skewed towards zero. To determine the frequency at which 4th generation HIV screening resulted in a net profit for the hospital we conducted Monte Carlo simulations to obtain 1000 samples from all distributions (i.e., randomly assigning different payor percentages that always resulted in a total of 100%).

Determination of Net Profit or Loss

We determined 4th generation HIV screening to result in a net profit if total hospital revenue was greater than the total costs of testing. Definitions and equations are displayed in Table 1.

Statistical analysis

The model and sensitivity analyses were performed using Excel 365 (Microsoft, Seattle, WA, USA) and SPSS 21 (SPSS Inc, Chicago, IL, UCA).

Results

Base Model

The base model used UCSD Health System data comprising of the direct cost and reimbursement rates. Data on the direct costs of a 4th generation HIV tests were calculated using UCSD Health System internal data. To avoid having these data impact patient costs

or hospital reimbursement rates, data are not shown. Payor mixes seen at the UCSD Health System were broken down as 28% commercial payors, 18% Medicare, 9% Medi-Cal, and 8% self-payers, with the remainder being capitated contracts (Table 1). Reimbursement rates were either a percentage of the gross charge to insurance companies or flat rates (Table 1). Using the net benefit calculation, we determined that ED 4th generation HIV testing in UCSD Health System EDs resulted in a significant net-profit (data not shown).

Probabilistic Sensitivity Analysis

Payor mix data and 95% CI used for the PSA to vary the payor mixes and reimbursements to the extremes that reflect the entire US EDs are depicted in Table 2. Of note, the commercial reimbursement lower 95% CI was skewed towards 0 to account for capitated contracts. Results of the PSA determined that universal 4th generation HIV screening resulted in a net profit in 81.9% of simulations (maximum profit of 310,703 USD), and a net loss in 18.1% of simulations (maximum loss of 102,966 USD). Simulations with higher proportions of self-payers, and/or low commercial reimbursement rates and/or high test costs were associated with a net-loss.

Discussion

We found that HIV ED screening resulted in a net profit for the hospital not only in the base model, but also in the majority of simulated ED settings across the US.

UCSD Health System EDs implemented EMR directed automated opt-out 4th generation HIV testing in 2017 and on average conduct over 12,500 HIV tests per year (M. Hoenigl, Mathur, et al., 2019). Our study showed that the implemented program resulted in a net profit for the hospital with reimbursement for testing surpassing actual testing costs. Importantly our cost evaluation did stop at the time of testing and did not consider costs and reimbursements for patient notification and linkage to care of those who are HIV positive, which will be highly variable across ED settings in the US.

Cost and accessibility of HIV screening are important in increasing HIV diagnoses and reducing HIV transmission across the US. Our probabilistic sensitivity analysis indicated that ED HIV screening may also result in a net profit in the majority (81.9%) of other ED settings across the US, while it resulted in a net loss in the remaining 18.1% of simulations. The biggest factors driving a net loss were high rates of self-payers with low cost recovery rate, high testing costs and low commercial reimbursement payments. Other factors that drive a net loss include high costs per HIV test that may occur particularly in smaller ED settings where testing numbers are smaller, and settings where commercial reimbursement is nearly exclusively happening through capitated contracts (i.e. no additional revenue for performing medical services). UCSD Health System EDs had a self-payer percentage of 8% which is a substantially lower rate compared to the nationwide ED sample between 2006 and 2014 where the rate of self-payers was 18.9% (Stocks, 2017). In fact, the lower UCSD self-payer percentage is in line with the observed change of US ED payor mixes since the establishment of the Affordable Care Act, which resulted in a significant decrease in self-payers (and an increase of Medicaid) (Pines et al., 2016). Overall for EDs, full Medicaid expansion has been shown to result in increased payments for emergency physicians'

professional services compared with reimbursement in non-expansion states (Pines et al., 2019). Higher reimbursement was driven primarily by lower proportions of uninsured patients and increased reimbursement per visit for both commercially insured and self-pay patients in states with full Medicaid expansion (Pines et al., 2019). Importantly, cost recovery rate in self-payers is low. Patients with no insurance can therefore make EDs particularly vulnerable to financial pressures (Wilson & Cutler, 2014). In line, it is likely that opt-out ED HIV screening programs are more likely to result in a net-profit in states with full Medicaid expansion, than in non-expansion states.

Our study has several limitations, including: 1) limited literature on the costs of 4th generation HIV screening, and 2) limited information about ED payor reimbursement rates across the nation. Also, the differences in Medicaid coverage and reimbursements across the US limit the generalizability of our analysis to certain settings in the US with Medicaid coverage or reimbursements on the extremes (Altman & Beatrice, 1990).

In conclusion, universal 4th generation opt-out HIV screening in EDs resulted in a net profit not only for an academic tertiary hospital in San Diego, but probably also in most hospital ED settings across the US, with higher proportions of self-payers being the major predictor of a net loss.

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Conflicts of Interest

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Table 1:

Definitions and equations for parameters used in the models as well as 2018 Payor mixes and reimbursement for 4th generation HIV testing at University of California San Diego (UCSD) Emergency Departments in patients 13–64 years of age

Equations to determine cost benefit in UCSD Health System (base model)		
Total Cost	Total Cost = $d \times 12,513$	
	Considering:	
	d = Direct Cost per test	
	Annual ED HIV screening tests conducted = 12,513	
Reimbursement per payor	Reimbursement per payor = $R_j = r_j \times m_j \times 12,513$	
	Considering:	
	r = reimbursement in USD per payor per test	
	m = respective payor mix %/100	
j = Payor (commercial, Medicare, Medi-Cal, and self-payor; capitated contracts set too 0)		
Total Reimbursement	Total Reimbursement = Sum (R_j) = $R_{\text{Commercial}} + R_{\text{Medicare}} + R_{\text{Medi-Cal}} + R_{\text{Self}}$	
Net Benefit	Net Benefit = Total Reimbursement – Total Cost	
Reimbursement Payer	UCSD Payer Mix %	UCSD Reimbursement
Commercial (PPO/HMO)	28%	52% (of gross charge)
Medicare	18%	\$29.73
Medi-Cal/Medicaid	9%	\$20.26
Self-Payer	8%	2% (of gross charge)
Commercial Capitated Contracts (PPO/HMO)	37%	\$0

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Table 2:

Payor mix and reimbursement variables in the probabilistic sensitivity analysis (testing costs not shown). Data derived from base model and literature (Bush et al., 2018; McConville et al., 2019; Pines et al., 2016; Stocks, 2017; Sun R (AHRQ), 2018).

Payor Mix (Proportion)	Average	Lower 95% CI	Upper95%CI
Commercial (includes capitated contracts) *	0.39	0.18	0.59
Medicare	0.20	0.14	0.26
Self-payer	0.13	0.07	0.19
Medicaid	0.28	0.10	0.46
Reimbursement (USD)	Average	Lower 95% CI	Upper 95% CI
Commercial (includes capitated contracts)	35	15	55
Medicare	29.73	29.73	29.73
Self-payer	2.6	0.6	4.6
Medicaid *	20.26	15.26	25.26

* Commercial payor mix proportion was calculated by the remaining proportion in order to fill 100%