

BRIEF RESEARCH REPORT

Health Policy

Clarifying the volume of estimated need for public health and prevention services within an emergency department population

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Abstract

Objectives: Emergency departments (EDs) are called to implement public health and prevention initiatives, such as infectious disease screening. The perception that ED resources are insufficient is a primary barrier. Resource needs are generally conceptualized in terms of total number of ED encounters, without formal calculation of the number of encounters for which a service is required. We illustrate potential differences in the estimated volume of service need relative to ED census using the examples of HIV and hepatitis C (HCV) screening.

Methods: This cross-sectional analysis adjusted the proportion of ED encounters in which patients are eligible for HIV and HCV screening according to a cascade of successively more restrictive patient selection criteria, presuming full implementation of each criterion. Parameter estimates for the proportion satisfying each selection criterion were derived from the electronic health records of an urban academic facility and its ED HIV and HCV screening program during 2 time periods. The primary outcome was the estimated reduction in proportion of ED visits eligible for screening after application of the entire cascade.

Results: There were 76,104 ED encounters during the study period. Applying all selection criteria reduced the number of required screens by 97.1% (95% confidence interval, 97.0–97.2) for HIV and 86.1% (95% confidence interval, 85.9–86.3) for HCV.

Conclusions: Using the example of HIV and HCV screening, the application of eligibility metrics reduces the volume of service need to a smaller, more feasible number than estimates from ED census alone. This approach might be useful for clarifying perceived service need and guiding operational planning.

KEYWORDS

emergency department, epidemiology, hepatitis C, HIV/AIDS, public health screening

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1 | INTRODUCTION

Emergency departments (EDs) have been recognized as important venues for health prevention interventions because of their broad access to at-risk populations not otherwise receiving prevention services.^{1,2} In the late 1990s, the Society for Academic Emergency Medicine identified several US Preventive Services Task Force recommendations appropriate for implementation in an ED setting.² A nationwide sample of EDs in 2007 found growing acceptance of these measures, with a majority of EDs having implemented some sort of screening program. However, EDs face significant barriers to implementation of any public health intervention, including operational (ie, insufficient personnel time, competing resource demands, crowding, and increased patient length of stay), system (ie, degree of health department involvement, lack of follow-up), and cognitive factors (ie, knowledge and attitudes).^{1,3,4} After accounting for the cost of initial program set-up and ongoing quality assurance, the primary driver of resource requirements is the volume of service provided. It follows that a detailed understanding of the volume of services required is an essential component of feasibility assessment and program acceptability.

Systems and procedures to assess service requirement volume are underdeveloped and underused. It is intuitive and widely recognized that ED patients are repeatedly encountered and that not all patients are eligible for a given service. Nonetheless, it is easy to simply combine the conventional unit of ED census (annual number of ED encounters) with recommendations for large-scale implementation (ie, universal screening)⁵ to quickly estimate the volume of service need and assume the service is not feasible.

Available literature is limited in its ability to refine this more general estimation of service need. Demonstration projects and research reports identify the number of interventions delivered, but they are fairly inconsistent in reporting the denominator of patients who are eligible, and standards for doing so are either unavailable or variably followed.^{1,3} When such numbers are reported, they are not highly emphasized as primary outcome measures.

It is possible that these factors combine to facilitate a general perception that ED-based public health and prevention interventions are less feasible than is actually the case. The objective of this investigation was to illustrate the potential changes in the proportion of patients requiring public health services when fully considering patient and operational eligibility criteria using the example of ED HIV and hepatitis C (HCV) screening.

2 | METHODS

2.1 | Study design

This cross-sectional analysis adjusted the proportion of ED encounters in which patients are eligible for HIV and HCV screening according to a cascade of successively more restrictive patient selection criteria, presuming full implementation of each criterion. Use of these data

The Bottom Line

Screening for public health conditions in the emergency department such as HIV and hepatitis C can be challenging. This study showed that targeting specific emergency department patients can reduce the respective number of required HIV and hepatitis C tests by 97% and 86%.

for research purposes, with a waiver of consent for participants, was approved by the study site institutional review board.

2.2 | Study setting and population

The study was conducted at an urban academic trauma center with $\approx 76,000$ annual ED encounters. A public health-supported HIV screening program has functioned within this ED since 1998.⁶ Over time, a variety of screening assessments have been integrated into the electronic health record (EHR) involving automated EHR query and EHR prompts to encourage triage nurses to ask patients about HIV and HCV behavioral risk and prior testing history as well as provide an opportunity for the patient to decline testing. We included all ED encounters from May 2017 through April 2018 in the study sample.

2.3 | Data collection and measurement

We used both real and theoretical eligibility estimates to derive the proportion eligible. Real eligibility was calculated directly from the study sample. Theoretical eligibility was calculated from our site's participation in The HIV Testing Using Enhanced Screening Techniques in Emergency Departments Trial (TESTED)(June 24, 2015–December 28, 2015), which contained additional eligibility criteria of interest, and then those proportions were applied to the study sample. This assumes no meaningful changes in the ED population between the 2 time periods, and we have no reason to believe that any differences would be significant enough to change the interpretation of our findings.

We defined each screening criterion as follows: unique patients (excluding repeat visits within the same year), age range (18–64 for HIV and 18–73 for HCV), not previously positive (no EHR diagnosis, previous positive lab result, or self-reported positive status during triage screen), not a “walk-out” (ED discharge disposition was not “left without being seen”), length of stay <30 minutes (assessed by triage nurse), able to participate in screening (assessed by triage nurse), no prior test (no previous test result or positive diagnosis in EHR records or no previous test self-reported to triage nurse), “at risk” (composite from triage nurse application of selected Behavior Risk Screening Tool⁷ and Denver HIV Risk Score⁸ questions [for HIV it was defined as lifetime history of injection drug use, men who have sex with other men, or sex

with an HIV-positive partner; for HCV it was defined as born between 1945 and 1965 or lifetime history of injection drug use), and did not decline testing.

2.4 | Data analysis

Analysis was descriptive and began with calculating proportions for each potential screening eligibility criterion. Specifically, point estimates were calculated using (1) true eligibility available during the 1-year study period (unique patients, age, current HIV/HCV status, not a "walk-out," and whether testing was declined) and (2) theoretical eligibility from our site's participation in the TESTED trial (length of stay <30 minutes, ability to participate, and "at risk" for HIV/HCV). The denominator used to calculate each proportion was the number of patients for whom that criterion was assessed.

As a conceptual model, we then arithmetically applied the proportion calculated for each criterion individually in combination using the number of ED encounters occurring within the chosen study year as the baseline. The primary outcome was the reduction in the proportion of ED visits requiring screening for HIV and HCV applying the entire cascade of selection criteria cumulatively in combination. All outcomes are reported as proportions with 95% confidence intervals. Statistical analyses were performed in R 3.6.2.⁹

3 | RESULTS

During the 1-year study period there were 76,104 ED visits. Using HIV and HCV screening specifically, the estimated proportion eligible by each criterion individually is shown in Table 1. The cascade of reduction in the proportion eligible that occurred as each additional criterion was applied successively in combination is depicted in Figure 1 (HIV) and Figure 2 (HCV). The reduction in the proportion of eligible visits after application of the entire cascade was 97.1% (95% confidence interval, 97.0–97.2) for HIV and 86.1% (95% confidence interval, 85.9–86.3) for HCV.

4 | LIMITATIONS

The fundamental limitation of this work is that the estimates provided are unlikely to be precise or highly generalizable. In addition, patient selection criteria in clinical practice vary widely and may not match those we selected for this illustration. For example, we estimated the proportion at risk, although current public health recommendations encourage single lifetime screening for HIV and HCV without risk assessment. Our calculations of the proportion eligible based on the application of all criteria is a conceptual model and not an actual retrospective analysis of real patient data using a single data set. However, an advantage of this approach is that it allows for the assumption of full implementation and thus service need. A prospective or retrospective study of an actual program would

only assess what was done rather than what was necessary in ideal circumstances.

5 | DISCUSSION

Applying a cascade of point estimates for the number of patients satisfying progressively restrictive selection scenarios in this analysis suggests that the necessary number of HIV and HCV tests may be up to 97% or 86% lower (respectively) than the number of ED encounters. Our objective was to illustrate an approach to estimating ED service needs rather than providing a specific and generalizable estimate of those needs. We recognize that time and effort (ie, resources) would be needed in developing individual estimates; however, the magnitude of effect should emphasize the need for more routine consideration of measures such as these in policy, administrative, and operational planning. At a minimum, ED and hospital administrators should view the goal of screening the ED population for HIV and HCV as far more achievable than would be perceived based only on ED census and current screening recommendations.

The importance of the findings from this analysis depends in part on the assertion that emergency physicians and administrators have inadvertently overestimated the volume of testing required to screen the ED population for HIV and HCV. Support for this assertion is only anecdotal. However, multiple studies demonstrate that concerns over feasibility, specifically time and cost requirements are frequently reported as barriers to implementation.^{1,3,4,10–13} Therefore, any misperceptions about the true magnitude of these barriers should be an important subject of implementation science research and intervention.

The feasibility of adding a service in the ED setting is certain to vary according to many factors, including the activity in question and the approach to its accomplishment. Regardless, the frequency at which the service is provided would be a key and overarching driver of feasibility both in perception and actual practice. In the example of HIV screening, costs for 1 program were estimated to include \$55,000 for staff time, \$7,000 for supplies and equipment, and \$77,000 for tests.¹⁴ Crudely calculated, this equated to ≈\$9 per patient tested and a maximal reduction from \$685,000 to \$20,000 for the numbers used in this article's analysis. One caveat is the degree to which resources are required to implement the narrower patient selection strategy (eg, risk-targeting questions). In our example, many criteria can be assessed by an automated EHR system algorithm or during the usual course of evaluating the presenting complaint. Asking additional questions to target behavioral or environmental risks would take longer, but anecdotally anything more than ≈1 minute per person strains clinical acceptability and is not generally necessary.

The reduction in testing that we have demonstrated is largely attributed to the fact that not every ED encounter represents a unique patient because many patients present for care repeatedly over time.^{5,15,16} However, repeating an intervention may be advisable depending on the goals of a given setting and recommendations

TABLE 1 Proportion of emergency department encounters with patients eligible for HIV or hepatitis C screening

	Separate proportions ^a			Cumulative proportions ^b	
	N of dataset for each criterion ^a	No. meeting each criterion	%	N = 76,104 ^b	%
HIV					
Primary eligibility criteria ^c					
Unique patients	76,104	46,744	61.4	46,744	61.4
Age 18–64	76,104	65,726	86.4	40,335	53.0
Not previously HIV positive	76,104	75,355	99.0	39,955	52.5
Operational criteria ^d					
Not a “walk-out” ^e	76,104	71,820	94.4	37,748	49.6
Length of stay >30 minutes	37,585	33,105	88.1	33,257	43.7
Able to participate	37,585	33,920	90.2	29,985	39.4
Secondary eligibility criteria ^f					
No prior test	76,104	62,042	81.5	24,429	32.1
At risk ^g	12,579	1196	9.5	2359	3.1
Do not decline testing	76,104	71,140	93.5	2207	2.9
Hepatitis C					
Primary eligibility criteria ^c					
Unique patients	76,104	46,744	61.4	46,744	61.4
Age 18–73	76,104	71,080	93.4	43,608	57.3
Not previously hepatitis C positive	76,104	75,489	99.2	43,303	56.9
Operational criteria ^d					
Not a “walk-out” ^e	76,104	71,820	94.4	40,868	53.7
Length of stay > 30 minutes	37,585	33,105	88.1	35,997	47.3
Able to participate	37,585	33,920	90.2	32,496	42.7
Secondary eligibility criteria ^f					
No prior test	76,104	71,106	93.4	30,365	39.9
At risk ^g	12,579	4449	35.4	10,731	14.1
Do not decline testing	76,104	74,697	98.2	10,578	13.9

^aProportion satisfying each criterion calculated separately from other criteria as a proportion of emergency department (ED) encounters. Variation in ED encounter denominator used for each criterion is provided: study sample (N = 76,104), preliminary eligibility assessment by nurse at triage (N = 37,585), and risk assessment questions asked by nurse at triage (N = 12,579).

^bSequential application of each criterion to the proportion of ED encounters satisfying the criterion immediately prior beginning with an N of 76,104. A logical sequence of criteria was chosen, although mathematically the order of computation does not influence the final number of eligible ED encounters after all criteria have been applied. Neither the chosen criteria nor this order of application is intended as a practice recommendation. Bold data represent the estimated proportion of ED encounters in this conceptual illustration after all factors have been applied in combination.

^c“Primary eligibility criteria” are defined here to include highly standard and easily applied factors. The inclusion of unique patients and proportion not previously tested prioritizes a single lifetime screen for the population of individuals receiving care at that ED. A proportion of patients in need of repeat screening was not calculated, but might crudely equate to the proportion of annual encounters at high risk.

^d“Operational criteria” are defined here to include factors inherent to ED operation that would preclude or allow testing. Ability to participate refers to cognitive and circumstantial ability (eg, not gone from the ED for a test, unable to obtain blood) to understand the test is occurring, decline if desired, and provide a biospecimen.

^eED discharge disposition was not “left without being seen.”

^f“Secondary eligibility criteria” are defined here to include criteria that may vary by screening program philosophy or resources.

^gAt risk for HIV was defined here by a composite from selected questions from the Behavior Risk Screening Tool or the Denver HIV Risk Score in our local experience in the targeted arms of the TESTED trial. At risk for HIV was defined as (1) men who have sex with other men, (2) sex with an HIV-positive partner, or (3) lifetime history of injection drug use. At risk for hepatitis C was approximated here to include (1) birth between 1945 and 1965 or (2) a lifetime history of injection drug use.

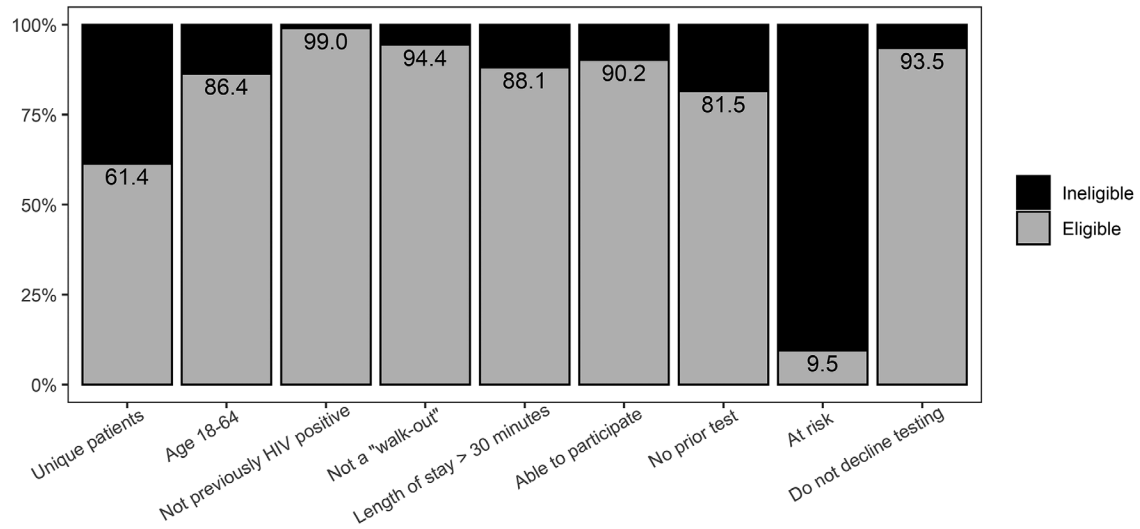
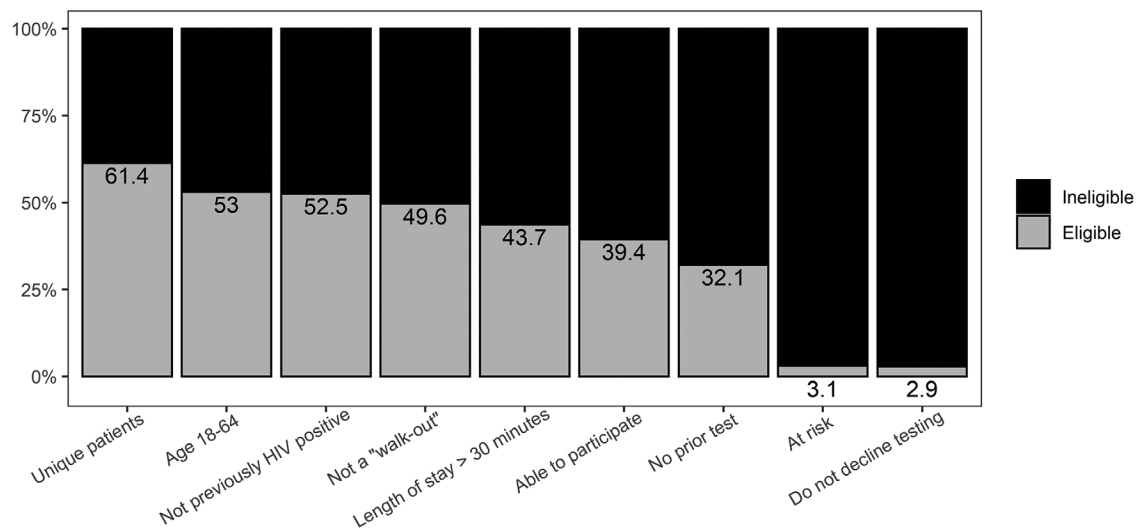
A Eligibility proportion for each criterion: HIV

B Cumulative eligibility proportions sequentially applied: HIV


FIGURE 1 Proportion satisfying each criterion separately as a proportion of emergency department encounters (A) for HIV (N = 76,104). Sequential application of each criterion to the proportion of emergency department encounters satisfying the criterion immediately prior (B) for HIV (N = 76,104). Eligibility criteria were obtained from data associated with encounters in the electronic health record from the 1-year study period (unique patients, age, current HIV status, HIV test history, and whether testing was declined), theoretical proportions from the prior study at this site (length of stay, ability to participate, and "at risk" for HIV), and from the hospital administration ("walk-out")

for a given service.^{5,17,18} In this analysis, our inclusion of only 1 ED encounter for each patient underestimates the need for repeat testing among those with ongoing risk.

An innovation contributed by this work is simply assembling point estimates for various eligibility criterion in a single location. However, even these estimates are obtained from clinical data sets without the rigor of formal research assessments and are unlikely to be generalizable to all settings. The available literature for HIV and HCV screening frequently report elements of study flow, but with varying rigor and completeness. Such parameters are generally viewed as explanatory and contextual measures of secondary rather than primary importance. This report should call attention to the relevance of sample

descriptions and methods for assessing eligibility criterion for future implementation science and practice.

Calculations for our conceptual model assume that each eligibility assessment is implemented with full fidelity. This would not be the case in reality. For example, not every patient would be asked about risk, and not every patient eligible for testing would receive testing. Therefore, our results pertain specifically to the volume of testing needed and overestimate the volume of testing that would actually occur.

In summary, rigorous or even cursory consideration of the full range of eligibility criterion results is a much lower resource burden than would be assumed based on ED census and general understanding of the desired service. This finding is likely relevant to operational

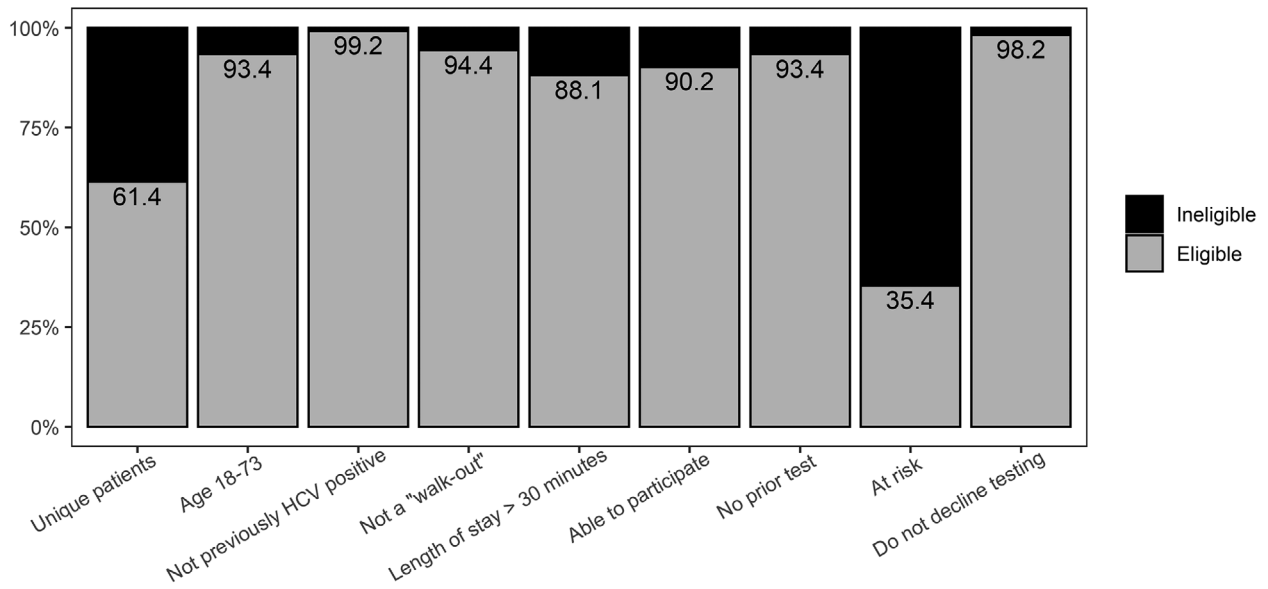
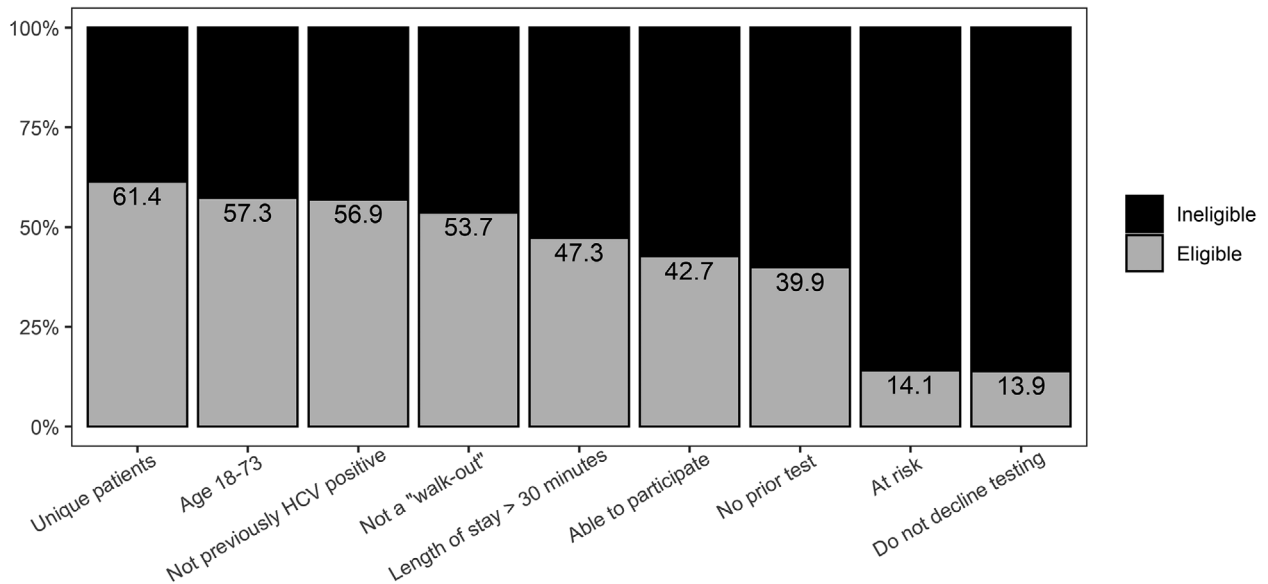
A Eligibility proportion for each criterion: Hepatitis C

B Cumulative eligibility proportions sequentially applied: Hepatitis C


FIGURE 2 Proportion satisfying each criterion separately as a proportion of emergency department encounters (A) for HCV (N = 76,104). Sequential application of each criterion to the proportion of emergency department encounters satisfying the criterion immediately prior (B) for HCV (N = 76,104). Eligibility criteria were obtained from data associated with encounters in the electronic health record from the 1-year study period (unique patients, age, current HCV status, HCV test history, and whether testing was declined), theoretical proportions from the prior study at this site (length of stay, ability to participate, and "at risk" for HCV), and from the hospital administration ("walk-out"). HCV, hepatitis C

planning and future implementation science interventions targeting perceptions and attitudes of clinical staff. Although we have focused on HIV and HCV, this conceptual model and the corresponding strategy applying progressively more restrictive patient selection scenarios should be broadly applicable to any new health service being proposed for ED implementation. The ability to engage in analyses such as these will be enhanced by the availability of reliable and generalizable point estimates for clinical and operational variables relevant to

patient selection for a given service. Research investigating new clinical services should carefully attend to the assessment and reporting of eligibility criterion to promote future implementation.

CONFLICTS OF INTEREST

Michael S. Lyons, Rachel M. Ancona, Andrew H. Ruffner, and Kiran A. Faryar received investigator-initiated support paid to the institution from Gilead Sciences, Inc.

AUTHOR CONTRIBUTIONS

Rachel M. Ancona, David Habib, Andrew H. Ruffner, and Michael S. Lyons developed the conceptual framework for this manuscript. Rachel M. Ancona provided data management and analysis. All authors contributed to manuscript drafting, revision, and approved the final version.

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