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chapter 4

Estimated cost per HIV infection diagnosed through routine HIV testing offered in acute general medical admission units and general practice settings in England

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ABSTRACT

Objectives

Following national guidelines to expand HIV testing in high-prevalence areas in England, a number of pilot studies were conducted in acute general medical admission units (ACUs) and general practices (GPs) to assess the feasibility and acceptability of testing in these settings. The aim of this study was to estimate the cost per HIV infection diagnosed through routine HIV testing in these settings.

Methods

Resource use data from four 2009/2010 Department of Health pilot studies (two ACUs; two GPs) were analysed. Data from the pilots were validated and supplemented with information from other sources. We constructed possible scenarios to estimate the cost per test carried out through expanded HIV testing in ACUs and GPs, and the cost per diagnosis.

Results

In the pilots, cost per test ranged from £8.55 to £13.50, and offer time and patient uptake were 2 minutes and 90% in ACUs, and 5 minutes and 60% in GPs, respectively. In scenario analyses we fixed offer time, diagnostic test cost and uptake rate at 2 minutes, £6 and 80% for ACUs, and 5 minutes, £9.60 and 40% for GPs, respectively. The cost per new HIV diagnosis at a positivity of 2/1000 tests conducted was £3230 in ACUs and £7930 in GPs for tests performed by a Band 3 staff member, and £5940 in ACUs and £18 800 in GPs for tests performed by either hospital consultants or GPs.

Conclusions

Expanded HIV testing may be more cost-efficient in ACUs than in GPs as a consequence of a shorter offer time, higher patient uptake, higher HIV positivity and lower diagnostic test costs. As cost per new HIV diagnosis reduces at higher HIV positivity, expanded HIV testing should be promoted in high HIV prevalence areas.

INTRODUCTION

Over 100 000 people are living with HIV in the UK, approximately a fifth of whom are unaware of their infection [1]. Overall, 47% of newly diagnosed persons are diagnosed late (with a CD4 count < 350 cells/ μ L), which is associated with high morbidity and mortality, high health care costs and a higher risk of onward HIV transmission [2–4]. Improving HIV diagnosis rates through HIV testing forms the cornerstone of HIV prevention policy, given the benefit of earlier diagnosis both for the individual and for public health [5].

In 2008, the national guidelines for HIV testing recommended an expansion of HIV testing outside the traditional settings of antenatal and sexual health clinics in higher prevalence areas. The guidelines recommended that HIV testing should be considered for all new general practice (GP) registrants and for all hospital acute general medical admissions

in geographical areas with a diagnosed HIV prevalence of 2 per 1000 population (henceforth referred to as expanded HIV testing in this paper) [6]. This recommendation was endorsed by guidelines from the National Institute for Health and Care Excellence (NICE) published in 2011, and the more recent Public Health England evidence summary on HIV testing [7–9]. Notwithstanding this, these guidelines have been poorly implemented and recent studies show a low offer rate in these non-traditional settings for HIV testing [10–16].

There are currently limited data on the feasibility and cost of expanded HIV testing in the UK [10,17–19]. In the USA, evidence suggests that HIV testing is cost-effective in areas with an undiagnosed prevalence of 1 per 1000 [20,21]. Cost-effectiveness analyses in France and Portugal suggest that one-time routine HIV screening in the general population and more regular screening in specific high-risk populations, including men who have sex with men (MSM), can be cost-effective [22,23].

In 2009, the Department of Health (DH) funded a number of pilot studies to support the development of the national HIV testing guidelines to assess the feasibility and acceptability of HIV testing in general medical service settings. We aimed to identify in which of the different general medical settings it is most cost-efficient, as assessed by cost per new HIV diagnosis, to introduce expanded HIV testing in order to assist in commissioning local HIV screening and testing services. Firstly, we present cost data collected from four of the DH pilot sites [two in acute general medical admission units (ACUs) and two in GPs]. Secondly, using scenario analyses, we standardized the cost per test conducted by setting and applied these values to estimate cost per new diagnosis in the two different medical settings.

METHODS

Pilot settings

A brief description of the four pilot projects and their main outcomes is given in Table 1, and further details have been presented elsewhere [11,24,25]. Resource use data from the four pilot sites included in this analysis were obtained from two acute general medical admission units (one site in Brighton and Hove, and one site in Leicester) and from GPs in two areas: Brighton and Hove (nine practices) and Lewisham, London (18 practices). At the time of the pilots (2009), all sites were located in areas with a diagnosed local HIV prevalence above 2 per 1000 [27].

HIV testing was routinely offered to patients aged 16–79 years (Brighton and Hove ACU); 16–60 years (Leicester ACU); 16–59 years (Brighton and Hove GPs); and 18–59 years (Lewisham GPs). In GPs, testing was offered to new registrants using point-of-care HIV tests (POCTs). Blood samples were collected in the two ACUs with serology carried out on blood drawn from patients at the time of admission.

Data on resources used in each site were collected during site visits by a researcher (A. C. Thornton). The information collected included: (1) an estimated time spent offering a test; (2) staff level/pay band of individuals offering the test; (3) type and cost of diagnostic test used. Information from two other published sources (a poster on the pilot conducted at

Table 1. Resources (diagnostic test, staff pay level and staff time) used, test uptake rate, and positivity rate at the four pilot sites [1,24,25]

	Acute general medical admissions (ACUs)		General practice settings (GPs)	
Pilot sites	Brighton & Sussex University Hospital Acute Admissions; Brighton & Hove City PCT	University Hospital Leicester Acute Medical Admissions Unit; Leicester City PCT	Brighton & Hove GP Surgeries; nine GPs; Brighton & Hove City PCT	Lewisham; 18 GP surgeries; Lewisham PCT
Test type/sample used	HIV serology officer to medical/surgical consultant	HIV serology Band 5 HCA	INSTI rapid POCT Band 4 to band 5 HCA	INSTI rapid POCT Band 5 HCA/nurse
Staff level*	2	2	5	5
Time to offer a test (min)	1553	Not reported	2478	4376
Number of tests offered	1413	938	1473	2713
Number actually tested	0.91	Not reported	0.59	0.62
Test uptake rate	1.42	10.66	1.36	7.00
Positivity rate (per 1000 tests)	£1.43	£0.57	£0.56	£0.63
Average staff cost per min† [£(2013/14)]	£3.14	£1.25	£4.75	£5.04
Average staff time cost	£5.41	£8.65	£5.41	£8.44
HIV diagnostic test cost	£8.55	£9.90	£10.15	£13.48
Total cost per HIV test conducted				

*Nonmedical staff bands based on NHS Agenda-for-Change pay bands.

†Unit staff cost taken from Personal Social Services Research Unit's unit costs of health & social care [26]. HCA, health care assistant; PCT, primary care trust; POCT, point-of-care HIV test.

Brighton and Hove ACU [24] and a published short report from Leicester ACU [11]) was used to identify whether there were gaps in the primary data collected.

At the end of each pilot, positivity rates per 1000 tests conducted for each site were calculated as the number of reactive HIV test results over the number of HIV tests performed. Cost per HIV test conducted was separated into two components: (1) the staff time cost and (2) the cost of the HIV diagnostic test (laboratory testing costs or price of POCT) used. Staff time cost was calculated as:

$$(\text{time taken to offer in minutes}) \times (\text{staff cost per minute test}) / (\text{test uptake rate}).$$

Where a site used staff of different pay levels, the average value was taken for that site, as we do not have detailed information on the actual number of tests offered by staff according to their pay levels. Test uptake rate was not available for one of the ACU pilots (Leicester) and the value from the other ACU (Brighton and Hove) was taken as a proxy.

This report takes the economic perspective of health care providers in high HIV prevalence areas in England carrying out expanded HIV testing in ACUs and GPs. Unit staff costs were obtained from a publication by the Personal Social Services Research Unit [26]. Nonmedical staff levels were based on the National Health Service (NHS) Agenda-for-Change pay bands, while medical staff levels were based on NHS medical awards. All costs were adjusted to 2013/14 British pounds.

Scenario analyses 1 – estimating cost per test conducted by setting

We standardized the cost per test conducted in the two different medical settings and applied these values to estimate cost per new diagnosis. We drew from external literature sources to support key estimates in the cost calculations. This was a pragmatic choice because of the lack of detailed micro-costing and with only point estimates available for each site.

The four key components used to estimate the cost per HIV test conducted were the cost of the actual test, the patient uptake rate, the staff level of the individual offering the test, and the time needed to offer the test, collect samples and carry out the test if it was a POCT. However, there are uncertainties about these parameter values obtained from the pilot studies. The first uncertainty highlighted by the pilot was the cost of the actual HIV test. The type of test differed by setting, with ACUs using laboratory serology tests and GPs using POCTs. These costs were updated in our analysis, referencing the average cost of a test across six Department of Health pilot sites as reported in the Time to Test for HIV final report 2011 (Four in London; one Brighton; one Leicester) [25] for tests conducted on drawn blood for ACUs; for GPs, we took the average POCT prices published in NHS Supply Chain.

The second uncertainty relates to patient uptake of HIV tests offered to them. Only one of the two ACUs provided data that enabled an uptake rate calculation. Therefore, we generated output of cost per HIV test conducted that encompasses uptake rate ranging from 10% to 100%, using a fixed HIV laboratory/rapid test cost.

The third layer of uncertainty was the pay level of staff involved in offering an HIV test in a testing service. Data from the pilot studies indicated that staff levels varied, and thus we have presented the cost analysis covering a range of potential staff levels involved from Band 3 to hospital consultant/GP.

Another point of potential uncertainty was the time needed to offer an HIV test. To the best of our understanding, the time needed to offer a test and test an individual in ACUs will only include the offer time, as HIV tests will be included in the list of tests to be conducted on routine blood samples collected at admission, and thus no additional time is thought to be needed. The situation is likely to be quite different in GP settings because routine blood tests are not conducted during patient registration appointments and any HIV tests conducted will consume additional staff time for test sample collection. Therefore, we used a testing time of 2 min in ACUs and 5 min in GPs (both based on our pilot data).

Scenario analyses 2 – estimating cost per new HIV diagnosis

In the final analysis, we calculated the cost per new HIV diagnosis, depending on the HIV positivity rate of the testing site. We fixed the test uptake rate by setting. The uptake rate was estimated with reference to the literature identified in the appendix of a recently published paper by Elmahdi *et al.* [16]. We included seven papers that had complete data on the number of HIV tests offered and conducted in ACU settings in England (three in London and one each in Brighton and Hove, Manchester, Bournemouth, and Newcastle) [13,19,24,28–31] and five more papers reporting on tests offered and conducted in GP or primary care settings in England (all based in London) [29,32–34]. Their weighted test uptake rates were 77.83% (ACU) and 43.49% (GP). These were rounded to 80% in ACUs and 40% in GPs. We also fixed the time needed to offer a test to 2 min in ACUs and 5 min in GPs.

RESULTS

HIV testing at the four pilot sites

The test uptake rate was 91% in the ACU in which these data were available, and 59% and 62% in the two GP settings (Table 1). Positivity rates per 1000 tests in the ACUs were 1.42 (Brighton and Hove ACU) and 10.66 (Leicester ACU); and in the GPs they were 1.36 (Brighton and Hove GP) and 7.00 (Lewisham GP).

The time taken to offer a test was 2 min in the ACUs and 5 min in the GPs. Staff offering the tests varied across the four sites, from Band 4 staff through to medical/surgical consultants. Staff time costs per test offered were calculated as £3.14 and £1.25 in the two ACUs, while the costs were £4.75 and £5.04 in the GPs. HIV laboratory diagnostic test costs were £5.41 (Brighton and Hove ACU) and £8.65 (Leicester ACU) in the ACUs, while the costs of HIV POCTs were £5.41 (Brighton and Hove GP) and £8.44 (Lewisham GP). These figures lead to a total cost per test ranging from £8.55 to £9.00 in the ACUs and £10.15 to £13.48 in GP surgeries.

Scenario analyses 1 – estimating cost per test conducted by setting

The average cost of an HIV antigen/antibody serology test reported in six Department of Health pilot sites was around £6 (March 2014 information), while the average prices of HIV POCTs sold on NHS Supply Chain was £9.60 (January 2015 information).

The HIV diagnostic test cost was fixed at £6 for laboratory tests in ACUs and £9.60 for POCTs in GPs (as estimated from the above data), the time needed to offer a test was fixed at 2 min in ACUs and 5 min in GPs (as estimated from the pilot studies). Cost per HIV test was calculated for different rates of test uptake, stratified by different staff types conducting the test, as the pilots have shown that tests can be offered by a range of staff (Fig. 1a and 1b). Given the difference in diagnostic test cost and offer time needed, the cost per test is more than 50% cheaper in ACUs compared with GPs, as the time needed to offer a test is less and the laboratory diagnostic test cost is lower.

For both medical settings, we observed a less rapid reduction in cost per test conducted at test uptake rates > 40%. In a scenario of lower uptake, the difference in cost per HIV test provided by the lowest and the highest pay-level staff (Band 3 staff and hospital consultants/GPs, respectively) is much greater than in scenarios of higher uptake. For example, at an uptake rate of 40%, an offer time of 5 min and a POCT cost of £9.60, the cost per test conducted in a GP setting by a Band 3 staff member was £16, and it was £38 if conducted by a GP. At a 100% uptake rate, the cost per test conducted reduced to £12 and £21 for tests offered by a Band 3 staff member and a GP, respectively, and similarly the cost difference between staff members offering the test become smaller.

Scenario analyses 2 – estimating cost per new HIV diagnosis

When test uptake was fixed at 40% for GP surgeries and 80% for ACUs, we also saw large reductions in cost per new HIV diagnosis as HIV positivity rate per 1000 tests increased from 1/1000 to 10/1000, reflecting the rates reported in the four pilot sites (Table 1). Differences in cost by setting reduced at higher HIV positivity rates. For example, this difference was £17 200 for Band 3 staff at 0.5/1000 positivity, and reduced to £861 at 10/1000 positivity, with shorter time needed and higher uptake rate in ACUs (Fig. 2).

DISCUSSION

Main finding of this study

We have used published data and data from pilot projects to estimate the cost per test and cost per new diagnosis when routine offer of an HIV test is introduced in two different general medical settings. To our knowledge, this is the first study to include real-life data on the time taken to offer a test and the levels of staff who can feasibly offer tests in these settings. Expanded HIV testing may be more cost-efficient, as determined by cost per new HIV diagnosis, in ACUs than in GPs as a consequence of the shorter offer time, higher patient uptake, higher HIV positivity and lower diagnostic test costs.

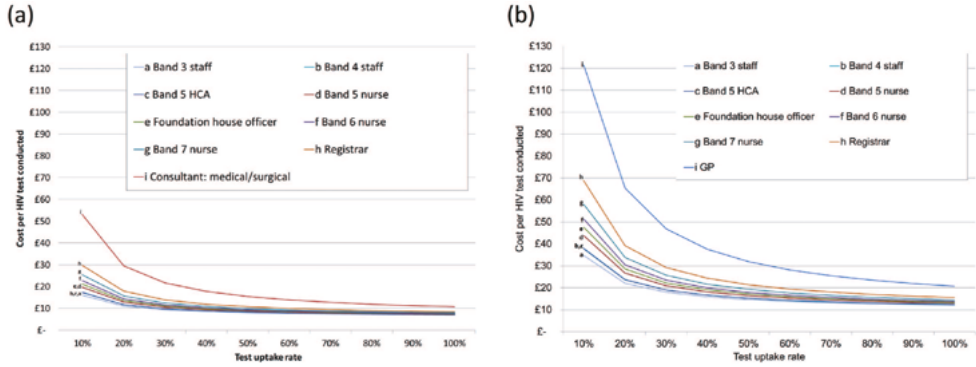


Figure 1. The cost per HIV test conducted. (a) The cost per test conducted in acute general medical admission units (ACUs), at varying test uptake rates and varying cost per test shown by staff pay bands; the cost of an HIV test is fixed at £6 (the average HIV diagnostic test cost from six Department of Health pilot sites; non medical staff levels were based on the NHS Agenda-for-Change pay bands), and the time to offer a test is fixed at 2 min. (b) The cost per test conducted in general practices (GPs), at varying test uptake rates and varying cost per test shown by staff pay bands; the cost of an HIV test is fixed at £9.60 [the average HIV diagnostic test cost from point-of-care HIV test (POCT) prices published in NHS Supply Chain; nonmedical staff levels were based on the NHS Agenda-for-Change pay bands], and the time to offer a test is fixed at 5 min. HCA, health care assistant.

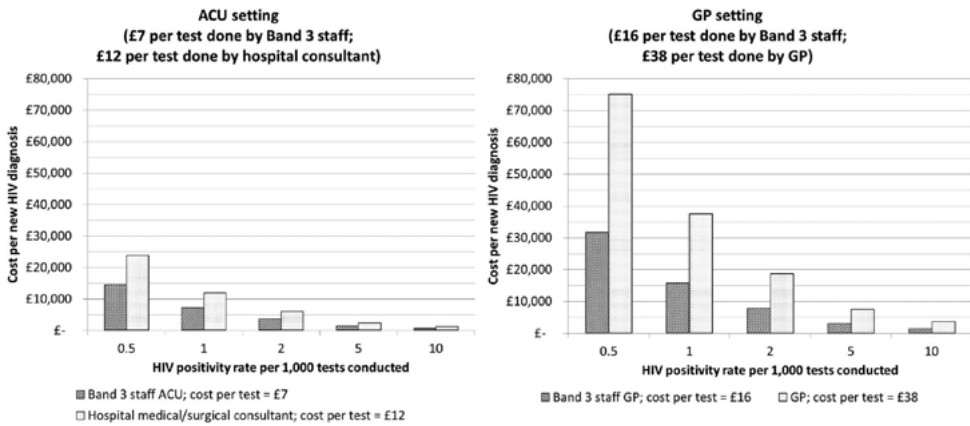


Figure 2. Cost per new HIV diagnosis for 80% uptake, 2 min offer time and £6 laboratory serology diagnostic test cost [reflecting the acute general medical admission unit (ACU) setting] versus 40% uptake, 5 min offer time and £9.60 point-of-care HIV test (POCT) cost [reflecting the general practice (GP) setting]. Nonmedical staff levels were based on the NHS Agenda-for-Change pay bands. The cost is shown for the lowest and highest staff pay bands in each setting.

Results from this cost analysis exercise suggest that the return on investment of expanded HIV testing activities improves with increased patient uptake rate and in areas of high HIV positivity. Both uptake rate and HIV positivity rate will determine how efficiently staff time

is spent. With a fixed diagnostic test cost of £6 in ACUs and £9.60 in GPs (Fig. 1a and 1b), we observed much larger reductions in staff time cost with increase in uptake when rates were <40%, compared to similar increases when uptake rates were higher. Nonetheless, test uptake was much greater than 40% in all pilots reported in this paper and averaged 78% (ACUs) and 43% (GPs) based on the synthesis of results of 14 other studies reported in Elmahdi *et al.* [16], reflecting high patient acceptability of HIV testing in these general medical settings [35,36].

Similarly, the cost per new HIV diagnosis reduced substantially as the positivity rate per 1000 tests conducted increased. However, to date, few studies have been conducted that were powered to provide HIV positivity estimates in general medical settings. Therefore, testing uptake rate and HIV positivity should be regularly monitored when implementing expanded HIV testing in a locality or service. National HIV testing guidelines recommend expanded HIV testing in areas with a diagnosed prevalence of more than 2 per 1000 [6,9], which could be used as an indicator of the likely cost effectiveness of any expanded HIV testing programme in a locality.

It is intuitive that HIV testing cost will be lower if the unit staff cost involved in offering the test is lower, at a constant uptake rate. Data from the Brighton and Hove ACU pilot showed that uptake rate did not appear to depend on staff seniority [24]. However, the offer rate was significantly lower for more senior staff. In contrast, Phillips *et al.* [10] reported in their study that nurses had more enthusiasm in implementing a routine opt-out HIV screening policy in ACUs (mixed pay levels here, as some nurses may have higher pay than some junior doctors). As a lower pay grade did not appear to adversely affect the offer or uptake of HIV testing and the ultimate aim is to increase overall HIV testing coverage, it is more important that health care workers offer an HIV test at every suitable opportunity.

Similarly intuitive is that less time needed to offer a test lowers the cost per HIV test conducted, again keeping uptake rate constant. Perhaps more important is the feasibility of optimizing testing time. The pilot data suggest that testing offer time will be lower in ACUs because HIV tests are added to routine blood tests, with minimal specific additional resources needed, a point similarly argued by Phillips *et al.* [10]. It is quite different in GP settings, however, where testing for HIV is a stand-alone initiative and involves sample collection and waiting time for results.

What this study adds

From a policy implementation perspective, within a jurisdiction it may be more feasible and easier to establish a programme of routine HIV testing at a single ACU than in a large number of different GPs. Moreover, the current analysis suggests that conducting HIV tests may be more cost efficient in ACUs, as testing in this setting involves less time to offer a test and has a higher patient uptake rate, and the actual cost of the diagnostic test is lower, compared with testing in GP settings. In addition, evidence suggests that rapid POCTs used in GP settings have lower sensitivity and specificity compared with HIV antigen/antibody

serology tests, resulting in a higher risk of false positives as well as false negatives using POCTs [37,38].

Nevertheless, expanded HIV testing in GP settings should not be ruled out, as GPs may be more accessible to patients (given that 90% of all NHS contacts are with GPs [39]). The results of the pilot projects reported here showed that HIV testing in GP settings is both feasible and acceptable. In the study by Pillay *et al.* [36], it was found that, when suitable training was given to staff working in a GP in a high prevalence area, testing rates and positivity rates increased.

4

Study limitations and caveats

We have compared the efficiency of introducing routine HIV testing in two different general medical services using cost per HIV diagnosis, rather than quality-adjusted life years (QALYs), as an outcome measure. This was appropriate as QALYs are a way of equably distributing limited resources while, for the purpose of this analysis, cost per diagnosis provides insight into the most efficient use of already allocated resources.

We have presented a study of cost per HIV diagnosis as a measure of the efficiency of routine HIV testing in two different general medical services. We estimated the cost per HIV test conducted in a scenario where HIV testing is normalized into routine health care practice. Therefore, start-up costs, promotional material costs and additional clinician incentives have not been included. Also, the costs of confirmatory tests for an initial reactive result were not included as these were thought to be minimal, and depend on the local positivity rate.

Furthermore, we acknowledge that the waiting time for results of POCTs may differ depending on the test kit used. The POCTs used in the two pilot GPs were INSTI (bioLytical™ Laboratories Inc., Richmond, British Columbia, Canada), which returns results in 1 min [40]. Other POCTs may take longer to return results, which in turn will involve more staff time.

We have considered only uptake rate in our analysis and not the offer rate by health care professionals. The latter will impact on the overall coverage of HIV testing in the attending population. However, from a resource use perspective, if health care providers are not offering tests in the first instance, no cost will have been incurred. This will make expanded HIV testing promotional activities less cost-efficient but will not impact on the actual running cost.

CONCLUSIONS

This paper provides an analysis of the cost per HIV test conducted in four HIV testing pilot study sites and has estimated the cost variations based on different staff pay levels, test uptake rates and rates of HIV positivity. The findings suggest that HIV testing should be prioritized in ACU settings as it may be more cost-efficient than testing in GP settings, given the higher rate of patient uptake, the lower staff time cost involved, the higher positivity rates per 1000 tests conducted and the lower diagnostic test costs. However, HIV testing in GP settings is still an important component of expanded HIV testing because of its higher

population coverage and the fact that it becomes increasingly cost-efficient in higher HIV prevalence areas and hence should be promoted.

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part 2

Human Papillomavirus [HPV]

