WHITEPAPER - CASE STUDY

# Quantifying the added value of Abbott Architect instrumentation and process optimisations in the Kostanay Blood Bank Infectious Diseases Screening Lab

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## Introduction

### Background

The continuing push for qualitative, cost-efficient solutions drives hospital and blood bank labs towards automated systems in an attempt to do more with fewer resources and less overhead while at the same time improving overall quality. The present study aims to quantify, in monetary value, the added value of process improvements and cost reductions realized as a result of implementing Abbott Architect instrumentation and associated process optimizations by investigating potential cost and efficiency gains in a series of representative case studies.

### The Kostanay Blood Bank Infectious Diseases Screening Lab

The Kostanay Blood centre is a regional blood centre. Next to the main facility it comprises a blood collection office in Rudniy city. Currently, the Kostanay blood centre serves 35 hospitals across the Kostanay region, producing over 11,000 litres of blood per year over 22,000 donations. Its main objectives are to ensure the safety of blood products in all hospitals in the Kostanay region and to develop altruistic blood donations.

### Scope & approach

The scope of the analysis was limited to the quantification of costs and efficiency gains due to implementation of Abbott Architect instrumentation and associated process improvements. Specifically, we analysed the analytical phase of lab processes related to HCV, HBsAg, HIV and syphilis testing performed by automated MTP instrumentation in the 2011 *as is* and by Abbott Architect instrumentation in the 2013 *to be* situation. The added value of the *to be* versus the *as is* situation is expressed by calculation of the total direct cost per donation the 2011 *as is* situation as compared to the total direct cost per donation in the 2013 *to be* situation.

*"Implementing ARCHITECT i2000sr allowed us to obtain accurate and timely results. The testing process has become even more secure, we are confident in the infectious safety of blood components."*

— Elena S. Iosipenko —

Director of Municipal State Organization "Regional Blood Bank" of Department of Health akimat of Kostanay region

## Key findings

As a result of switching from MTP to Abbott Architect instrumentation, the Kostanay Blood Bank Infectious Diseases Screening Lab has:

(1) Increased testing efficiency (+5.8% to +9.8%)

(2) Increased staff productivity (+9.02%)

(3) Decreased device investment costs (-62.66%)

(4) Decreased cost per donation (-14.84%)



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## Cost types

### Direct and indirect costs

A **direct cost** is a cost that is specifically linked to the execution of testing. As a rule of thumb, if the omission of the cost means the test cannot be performed, this cost is most likely a direct cost. Examples are operator staff cost, reagent costs, device costs, etc.

An **indirect cost** is a cost which is not specifically linked to the execution of testing - they are 'overhead' costs. In contrast to direct costs, omitting these costs usually does not immediately imply testing cannot be performed. Example costs are administrative staff cost, overhead expenses such as phone bills or travel costs, etc.

### Fixed and variable costs

A **fixed cost** is a cost that does not change as a function of the lab's activity over a reference time period, i.e. this cost is fixed over the time period regardless of the number of tests performed. Examples are device costs, staff costs, etc. It should be noted that the nature of fixed costs usually implies some limitation on the number of &tests that can physically be performed, e.g. the maximum number of tests that can be performed with a given number of staff or a given set of devices. If more tests should be performed, the fixed cost will also need to increase to accommodate this increase.

A **variable** cost on the other hand, is directly linked to the volume of tests performed by the lab. Each unit increase in number of tests performed will result in a unit increase of the variable cost. A typical example is reagent costs.

# Methods

The costing approach used for comparing the 2013 *to be* cost per donation to the 2011 *as is* cost per donation is based on an absorption costing approach taking into account only direct costs. Costs were calculated using a break-even calculation methodology after adjustment of the 2011 unit costs to 2013 unit cost price points.

## Scope, costs assignment and distribution and cost comparability

The goal of the present analysis is to analyse the impact of the switch to Abbott Architect instrumentation on the cost per donation in the Kostanay Blood Bank Infectious Diseases Screening Department. To simplify the analysis and avoid obfuscation of the impact of the instrumentation switch, indirect (overhead) costs were not taken into account in the cost analysis. This approach was chosen at it provides a clear focus on the impact of Abbott Architect instrumentation and associated process improvements on costs directly associated with the purchase, operation and maintenance of the lab instrumentation.

To capture all relevant fixed and variable direct costs, an absorption costing approach was used. Costs which are shared and thus cannot directly be linked to a specific test were proportionally allocated to - or absorbed by - individual tests. Practically, this means costs which are not available on the individual test level were distributed using a distribution key, which was chosen to reflect the relative importance of the test in generating the total cost to be distributed. Costs were then proportionally distributed up to the individual test level based on this distribution key (Figure 1).

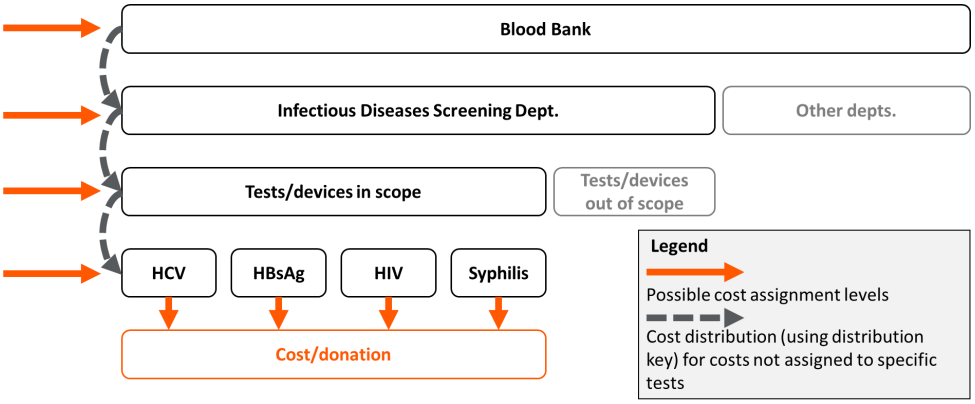


**Figure 1:** Costs assignment level and costs distribution

In comparing 2011 and 2013 costs, it is important to adjust for cost inflation. Average consumer price inflation from 2011 to 2013 was about 14%. In order for the cost analysis to be based on comparable costs, 2011 unit costs ware adjusted to the 2013 price point using one of two approaches:

- For cost items for which the 2013 price was available, the total cost for 2011 was calculated by multiplying 2011 resource use by 2013 unit costs.
- For cost items for which the 2013 price was not available, the total 2011 cost was inflated to 2013 costs based on the inflation figures shown in table 1.

| Year | Inflation |
|---|---|
| 2011 | 8.3% |
| 2012 | 5.1% |

**Table 1:** Yearly inflation[3]

## Cost calculations

The 2011 *as is* costs per donation are compared to the 2013 *to be* costs per donation based on the break-even calculation principle. Briefly, the break-even calculation principle is based on the premise of calculating the total cost per donation at which all fixed and variable costs are covered.

In what follows, results will be presented as a total (comparable) cost per donation, and split up into component costs (cost per test type and per cost category).



[3]Source: http://data.worldbank.org

# Data collection and analysis

Data were collected over the course of two site visits performed in May 2012 and July 2013. Data collected included number of registered donations, financial information, staff cost and occupation data, testing efficiency registrations and device investment and maintenance costs. Data collection, processing and analyses were performed by **hict** as an independent project partner. All data inputs, processing and results were validated by lab management.

## Number of donations & efficiency registrations

The total number of donations tested in 2011 and 2013 was obtained from the Kostanay Blood Bank Infectious Diseases Screening lab. Each donation is tested with 4 types of tests: HBsAg, HCV, HIV and syphilis. Test samples with initially test positive (primary positive samples) are retested up to three times to confirm. According to local Health Ministry guidelines, one of the retests for primary positive samples must be performed using a different manufacturer of reagent. For the 2013 *to be* situation, for primary positive samples, one retest is performed using manual MTP. Figure 2 illustrates the testing workflow in scope in the 2011 *as is* and 2013 *to be* situations.

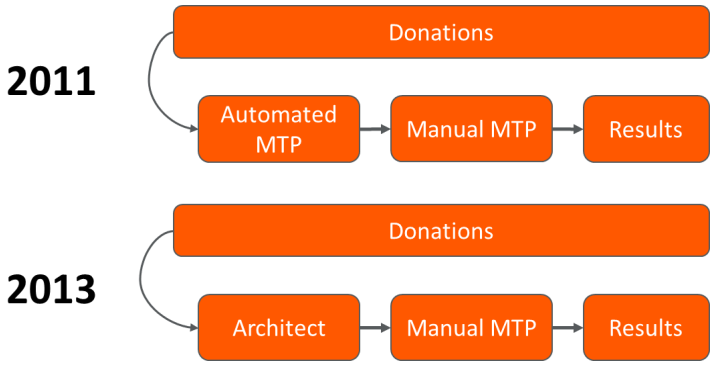


**Figure 2:** 2011 and 2013 testing workflows

Next to sample tests, each test type requires a set number of calibration and control tests. For MTP testing, which is batch processed on microplates, additionally some wells may remain empty. This means that any given donation may result in multiple tests per test type (sample test, retests for primary positive samples) and a proportion of calibration, control and possibly empty tests. Figure 3 illustrates the link between tests and donations.

While the number of retests required over a given time frame is only dependent on the number of primary positive samples, and thus is technology-independent, the number of calibration, control and empty tests are technology and process specific. To quantify the efficiency of testing in the 2011 *as is* and 2013 situations, i.e. the proportion of the total number of wells available actually used for sample testing, the total number of sample, calibration, control and empty tests were collected over the course of two representative time frames for the *as is* (April-May 2012) and *to be* (April-May 2013) situations.

In the *as is* situation, MTP tests are performed in batches using MTP microplates. For each type of test and each plate, a specific reagent insert is required containing calibration and control wells. The remaining wells on the plate are available for sample testing (tests and retests). As tests are performed batch-wise, for each plate some of the remaining wells available for samples may remain empty if not enough samples are available to fill all wells at the time the plate is processed.

For the 2011 *as is* situation, MTP plate usage was registered over the course of a two month period (April - May 2012). For each test type, for the total number of wells available over the reference time frame, the total number of wells used for samples, calibration, control and the total number of empty wells was registered.

Likewise, for the 2013 *to be* situation, a certain number of calibration and control testing is required. The total number of calibrator, control and sample tests performed on Abbott Architect were registered over a two month period (April - May 2013). As Abbott Architect testing is a continuous process, no 'empty' tests are performed.

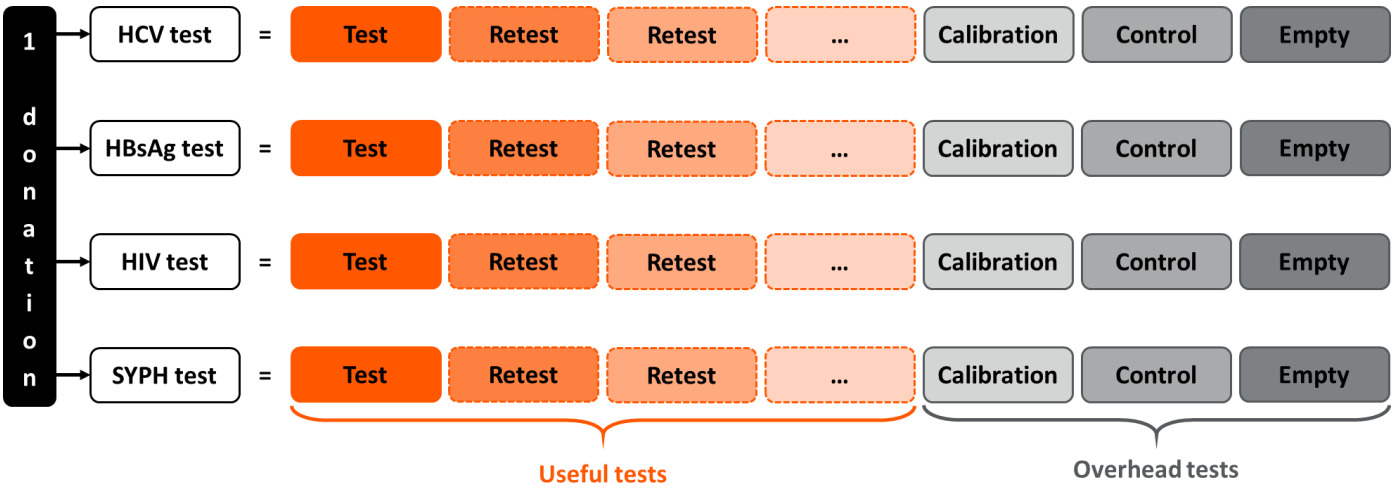


**Figure 3:** Testing performed per donation

## Consumables cost

For the 2011 *as is* situation, the total cost for consumables registered in 2011 was obtained from the Kostanay Blood Bank Finance Department. Consumables not linked to MTP testing were not taken into account for the cost analysis. The consumables cost was inflated to 2013 cost levels (Table 1) for cost comparison.

For the 2013 *to be* situation, the total cost for Architect consumables registered over a two month time period was extrapolated to obtain an estimated total yearly cost for consumables. Additionally, for each test type, the number of MTP retests (for primary positive Architect results) was obtained. An additional cost for consumables linked to these tests was calculated and added to the total consumables cost per test type.

## Reagents

Reagent kit costs for MTP and Abbott Architect HCV, HIV, HBsAg and syphilis testing were obtained from the Kostanay Blood Bank Finance Department. The reagent kit costs for 2013 were used for the 2011 cost calculations in order to compare comparable costs. The total reagent cost was calculated from the number of tests performed in the 2011 *as is* and 2013 *to be* situations and the unit cost per test as obtained from the total test kit cost and the number of tests than can be performed with each test kit. Both for MTP (*as is*) and Architect (*to be*) testing, the number of tests performed for each test type was calculated based on the registered number of donations and aforementioned testing efficiencies. For the 2013 *to be* situation, additional reagent cost for MTP retesting was taken into account.

## Calibrators and controls

For the 2011 *as is* situation, no specific additional costs were registered for calibrators and controls. Costs for calibrators and controls were implicitly included in the testing efficiency calculations.

For the 2013 *to be* situation, additional costs for calibrators and controls were included in the cost calculations. For calibrator usage, the total cost for calibrators was extrapolated from the two month registration period (April - May 2013) based on the number of donations tested in the two month registration period and the total number of donations registered in 2013. For controls, which are performed once daily, costs were expressed as costs per device per working day. Average daily cost for controls was calculated based on the controls usage during the two month registration period (April - May 2013) and the number of working days during this time frame and extrapolated to a yearly cost based on the average number of working days per year in the Kostanay Blood Bank Infectious Diseases Screening Lab.

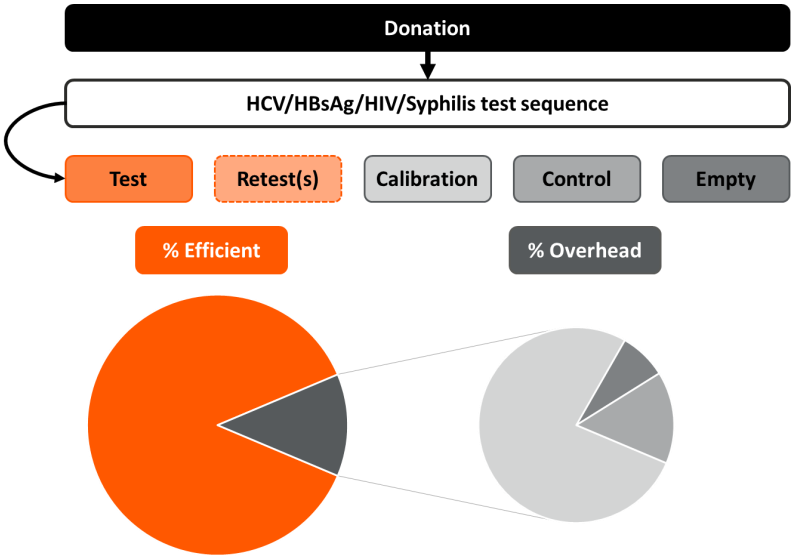


**Figure 4:** Testing efficiency and overhead

## Staff costs and productivity

The number of hours registered by lab staff over 2011 was obtained from the Kostanay Blood Bank Finance Department. For 2013, the total number of hours was extrapolated based on the number of hours registered during the first six months of 2013. In order to calculate comparable staff costs, staff costs were calculated using the 2013 cost per hour for each staff member.

To quantify staff productivity, the total cost for staff for the 2011 *as is* and 2013 *to be* situations were divided by the total number of tests performed in 2011 and 2013 to obtain an average staff cost per test. This surrogate efficiency measure provides a weighted average estimate of the total staff effort (weighted for cost per hour).

## Device investment costs

The total investment cost for all devices in scope was obtained from the Kostanay Blood Bank Financial Department, both for the 2011 *as is* and 2013 *to be* situations. For each device, the total investment cost was depreciated over a set time period, as per local accounting guidelines, to calculate a total yearly investment cost.

### Direct costs in the Kostanay Blood Bank Infectious Diseases Screening Lab

| Cost category | (Fixed/ variable) | Assignment level | Distribution key |
|---|---|---|---|
| Consumables | Variable | Device | # tests |
| Reagents | Variable | Test | - |
| Calibrators | Variable | Test | - |
| Controls | Variable | Test | - |
| Staff (Lab) | Fixed | Lab | # tests |
| Investments | Fixed | Device | Fixed assignments and # tests |

# Results

## Increased testing efficiencies - Reduced overhead testing

As a result of switching to Abbott Architect instrumentation and associated process optimizations, the number of overhead (calibration, control, empty tests) was significantly reduced from the 2011 *as is* to the 2013 *to be* situation. Figure 5 shows the percentage useful (initial sample and sample retests) and percentage overhead (calibration, control, empty) in the 2011 *as is* and 2013 *to be* situation. The number of overhead tests per type avoided as a result of this increased efficiency are detailed in the insert on the following page.

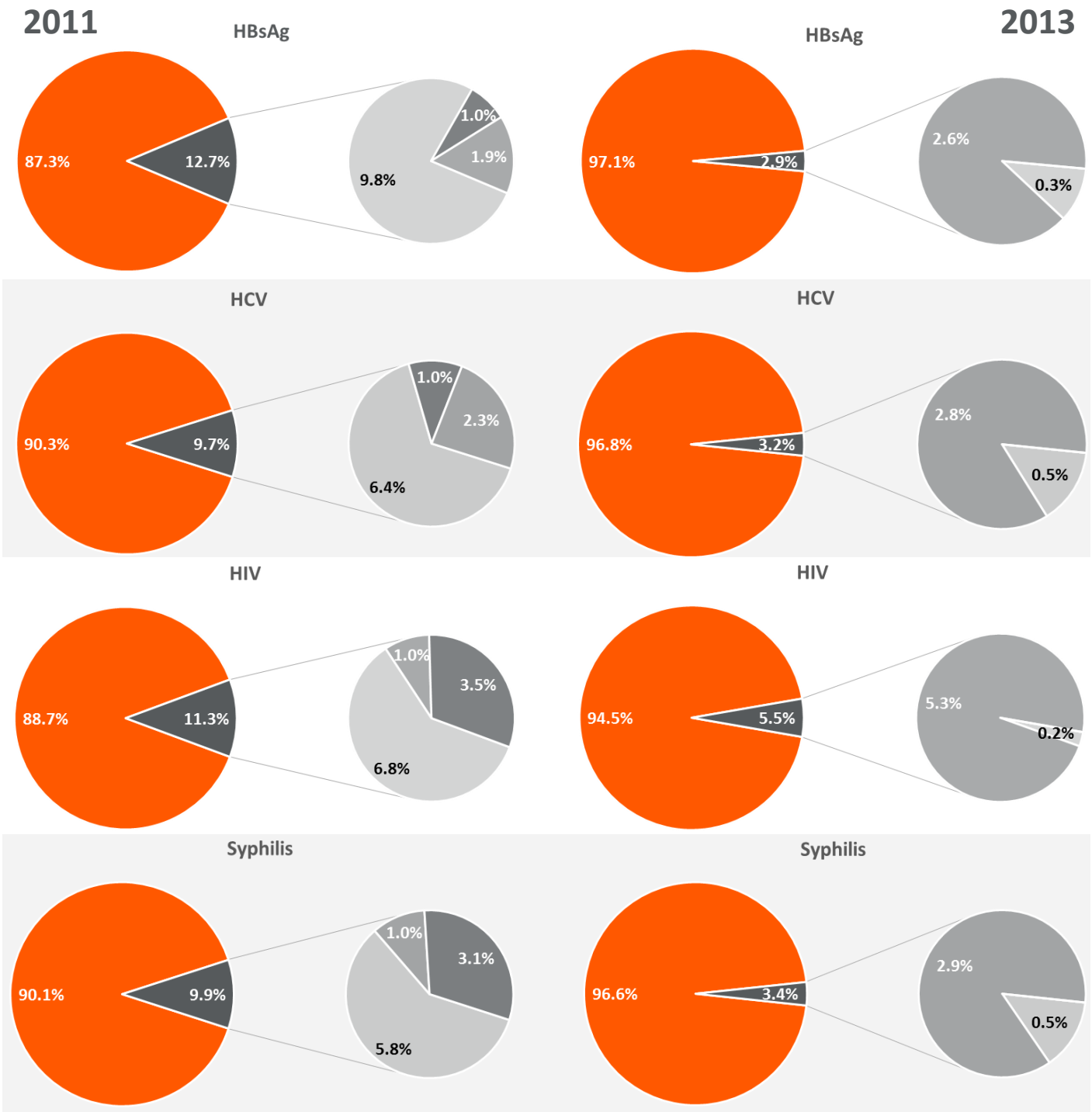


**Figure 5:** Testing efficiency and overhead per test type for the 2011 *as is* (left) and 2013 *to be* (right) situation

| | Δ Calibration | Δ Control | Δ Empty | Δ Total [#] | Δ Total [%] |
|---|---|---|---|---|---|
| **HBsAg** | -1,964 | 337 | -402 | -2,029 | -9.7% |
| **HCV** | -1,211 | 358 | -476 | -1,329 | -6.4% |
| **HIV** | -1,416 | 923 | -749 | -1,242 | -5.8% |
| **Syphilis** | -1,113 | 389 | -638 | -1,362 | -6.5% |
| ***Total*** | | | | *-5,963* | *-7.1%* |

## Overhead tests avoided

Due to the increased efficiency of Abbott Architect instrumentation, a significant number of overhead tests were avoided: 5,963 tests on a total of 83,851 IA tests performed (7.1%)

## Increased staff productivity

As a result of switching to Abbott Architect instrumentation and associated process optimizations, lab staff productivity was increased by 9.02%, as evidenced from a decrease in lab staff cost per test from ₸121 in 2011 to ₸110 in 2013 (Table 2).

| | Total cost | # tests | Cost/test |
|---|---|---|---|
| **2011** | ₸ 10,460,651 | 86,815 | ₸ 120.49 |
| **2013** | ₸ 11,706,188 | 106,481 | ₸ 109.94 |

**Table 2:** Staff cost and productivity

Should staff productivity not have increased (i.e. should the staff cost per test not have changed from 2011 to 2013), based on the number of tests performed in scope in 2013, total staff cost would have been ₸ 13,122,300. In other words, the 9.02% productivity increase results in a total estimated savings of ₸ 1,416,112.

| | Yearly |
|---|---|
| **2011** | ₸ 10,7118,035 |
| **2013** | ₸ 4,001,685 |

**Table 3:** Device investment costs

## Decreased device investment cost

2013 yearly depreciation cost to cover device investments was reduced by 62.66% (₸ 6,716,350) from 2011 yearly depreciation cost (Table 3).

The 2013 reduction in device investment achieved without negatively impacting total consumables, reagents, calibrators and controls cost per donation, which was reduced by 3.65% (₸ 129) (Table 4)

| | HBsAg | HCV | HIV | Syphilis | *Total* |
|---|---|---|---|---|---|
| **2011 cost per donation** | ₸ 577 | ₸ 2,032 | ₸ 534 | ₸ 392 | *₸ 3,534* |
| **2013 cost per donation** | ₸ 375 | ₸ 1,625 | ₸ 645 | ₸ 760 | *₸ 3,405* |

**Table 4:** Total cost per donation for consumables, reagents, calibrators and controls in 2011 and 2013

## Decreased total cost per donation

Total cost per donation was decreased by 14.84% (₸ 719) from the 2011 *as is* to the 2013 *to be* situation (Table 5). Tables 6 and 7 on the following page show the total cost per donation per test type and category. Figure 6 on the following page illustrates the total cost per donation difference between 2011 and 2013 with their component costs by category.

| | HBsAg | HCV | HIV | Syphilis | *Total* |
|---|---|---|---|---|---|
| **2011 cost per donation** | ₸ 915 | ₸ 2,384 | ₸ 846 | ₸ 700 | *₸ 4,847* |
| **2013 cost per donation** | ₸ 555 | ₸ 1,803 | ₸ 829 | ₸ 940 | *₸ 4,128* |
| **Δ 2013 - 2011 [₸ ]** | -₸ 359 | -₸ 584 | -₸ 16 | ₸ 241 | *-₸ 719* |
| **Δ 2013 - 2011 [%]** | -39.28 % | -24.48 % | -1.94 % | +34.43 % | *-14.84 %* |

**Table 5:** Total cost per donation for the 2011 *as is* and 2013 *to be* situations

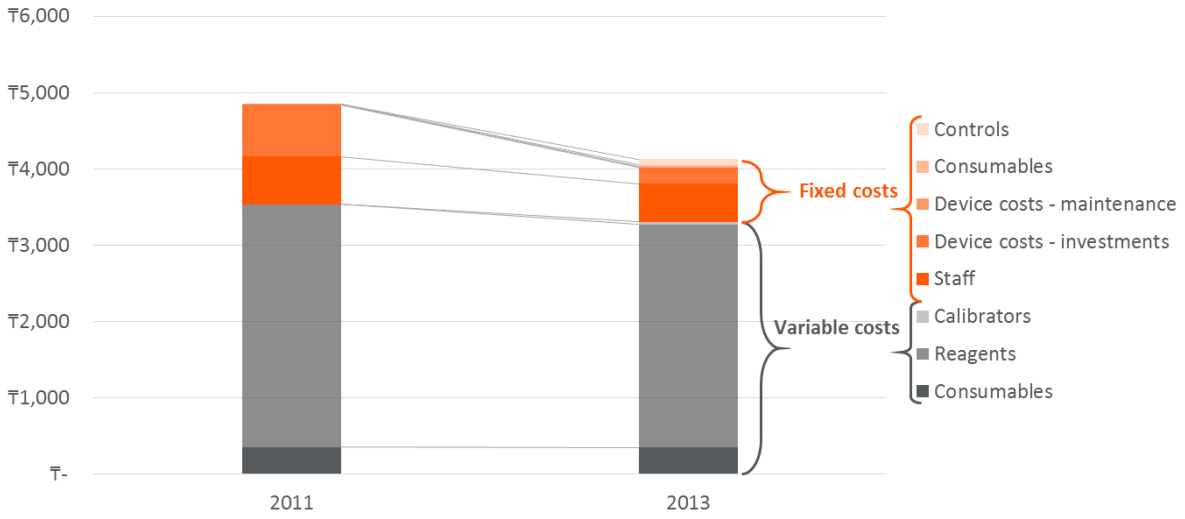


**Figure 6:** Costs per donation per category - 2011 *as is* vs 2013 *to be* situation

| | HBsAg | HCV | HIV | Syphilis | *Total* |
|---|---|---|---|---|---|
| **Variable costs** | | | | | |
| **Consumables** | ₸ 92 | ₸ 96 | ₸ 85 | ₸ 83 | ***₸ 356*** |
| **Reagents** | ₸ 485 | ₸ 1,935 | ₸ 449 | ₸ 308 | ***₸ 3,178*** |
| **Calibrators** | ₸ - | ₸ - | ₸ - | ₸ - | ***₸ -*** |
| ***Subtotal*** | ***₸ 577*** | ***₸ 2,032*** | ***₸ 534*** | ***₸ 392*** | ***₸ 3,534*** |
| **Fixed costs** | | | | | |
| **Staff** | ₸ 162 | ₸ 170 | ₸ 150 | ₸ 148 | ***₸ 630*** |
| **Device cost - investments** | ₸ 173 | ₸ 182 | ₸ 160 | ₸ 158 | ***₸ 673*** |
| **Device cost - maintenance** | ₸ 3 | ₸ 3 | ₸ 2 | ₸ 2 | ***₸ 10*** |
| **Consumables** | ₸ - | ₸ - | ₸ - | ₸ - | ***₸ -*** |
| **Controls** | ₸ - | ₸ - | ₸ - | ₸ - | ***₸ -*** |
| **Subtotal** | *₸ 338* | *₸ 355* | *₸ 312* | *₸ 308* | ***₸ 1,313*** |
| **Total** | ***₸ 915*** | ***₸ 2,387*** | ***₸ 846*** | ***₸ 700*** | ***₸ 4,847*** |

**Table 6:** Total cost per donation per category for the 2011 *as is* situation (for comparable costs)

| | HBsAg | HCV | HIV | Syphilis | *Total* |
|---|---|---|---|---|---|
| **Variable costs** | | | | | |
| **Consumables** | ₸ 88 | ₸ 87 | ₸ 89 | ₸ 89 | ***₸ 353*** |
| **Reagents** | ₸ 260 | ₸ 1,502 | ₸ 525 | ₸ 632 | ***₸ 2,918*** |
| **Calibrators** | ₸ 5 | ₸ 13 | ₸ 4 | ₸ 14 | ***₸ 35*** |
| ***Subtotal*** | ***₸ 352*** | ***₸ 1,601*** | ***₸ 618*** | ***₸ 735*** | ***₸ 3,306*** |
| **Fixed costs** | | | | | |
| **Stafff** | ₸ 124 | ₸ 122 | ₸ 127 | ₸ 125 | ***₸ 498*** |
| **Device cost - investments** | ₸ 54 | ₸ 53 | ₸ 55 | ₸ 54 | ***₸ 216*** |
| **Device cost - maintenance** | ₸ 2 | ₸ 2 | ₸ 2 | ₸ 2 | ***₸ 9*** |
| **Consumables** | ₸ 6 | ₸ 6 | ₸ 6 | ₸ 6 | ***₸ 23*** |
| **Controls** | ₸ 17 | ₸ 18 | ₸ 22 | ₸ 19 | ***₸ 76*** |
| **Subtotal** | ***₸ 203*** | ***₸ 201*** | ***₸ 212*** | ***₸ 206*** | ***₸ 822*** |
| **Total** | ***₸ 555*** | ***₸ 1,803*** | ***₸ 829*** | ***₸ 940*** | ***₸ 4,128*** |

**Table 7:** Total cost per donation per category for the 2013 *to be* situation

# Discussion

Prior to switching to Abbott Architect instrumentation, the Kostanay Blood Bank Infectious Diseases Screening Lab was faced with the important challenge of managing an ever increasing testing workload while maintaining good testing standards of quality with fixed resources. The key points of importance in switching to Abbott Architect instrumentation were therefore to increase testing capacity with a focus on improving cost-efficiency, to reduce staff working pressure and increase testing standards of quality through process automation and optimization.

The main findings of the present analysis clearly demonstrate these goals has been met. Fixed staff and device investment costs have been significantly reduced, with a considerable increase in staff productivity expressed as staff cost per donation, while positively impacting staff workload and working pressure. The reduced fixed costs coupled to the increased testing efficiencies, with reduced costs for overhead calibration and control tests and the avoidance of 'empty' tests associated with the switch from batch-processed MTP microplate testing to continuous testing using Abbott Architect instrumentation, mean that the increase in reagent cost associated with the automated Architect instrumentation was offset to result in a considerable total cost saving per donation.

The present installation offers room for accommodating further increases in numbers of donations. The reduction of the relative importance of fixed costs in the total cost in the 2013 *to be* situation also makes costs per donation estimations easier to manage and plan for, which represents a major advantage for daily lab management faced with fluctuating and increasing numbers of donations.

## A telling case study

The present case study clearly demonstrates the added value of the implementation of automated Abbott Architect instrumentation and associated process optimizations in the context of infectious diseases screening in blood banks in Kazachstan and elsewhere. By reducing total staff cost through increasing staff productivity, avoiding investment costs, improving testing efficiencies and reducing 'overhead' tests, total cost per donation can be decreased even when reagent cost per test is increased.

In theory, break-even cost calculations could be used for extrapolating an estimated cost per donation for increasing or decreasing numbers of donations. However, it should be pointed out that any extrapolation should be handled with care. For one thing, extrapolation based on break-even calculations assumes fixed costs remain fixed, which certainly in the case of the 2011 *as is* situation is highly unlikely, as according to lab management, the lab was working at near or even over maximal capacity in the 2011 *as is* configuration. Any increase in numbers of donations would likely have resulted in increased fixed costs for staff or device investments. Likewise, for variable costs, often economies of scale start playing a role for larger test volumes, especially for reagent cost, which is the most important cost driver in the cost analysis. Creating any model for cost extrapolation should minimally take into account these effects, but was out of scope for the present analysis.

The present analysis takes into account direct costs only. This approach was chosen so the results of the analysis clearly reflect those cost items which can reasonably be expected to be influenced by the installation of new instrumentation and associated lab process improvements. The study did not aim to calculate a total cost of ownership, including indirect costs, which may also be affected through the increase in number of donations through factors other than instrumentation and associated lab processes.

# Conclusions

By switching to Abbott Architect instrumentation and associated process optimizations, the Infectious Diseases Screening Lab of the Kostanay Blood bank has realised considerable efficiency (reduction in the number of overhead tests performed) and productivity (more tests performed per staff member) gains.

The Architect instrumentation financing model employed results in a significant decrease of fixed device investment costs (-62.66%) while still reducing variable consumables, reagents, calibrators and controls costs per donation (-3.65%).

These efficiency and productivity gains, coupled with the significant fixed and variable cost reductions, especially for staff and device investments, yield a cost per donation decrease of 14.84% from the 2011 *as is* to the 2013 *to be* situation.

**Disclaimer**
Data collection, processing and manuscript preparation were independently performed by **hict**. Project funding was provided by Abbott. All inputs, analyses and results were validated by the Kostanay Blood Bank.

## About hict

**hict** is an independent consultancy company for the healthcare sector. We believe in future oriented healthcare systems delivering higher quality outcomes at affordable costs through more efficient processes or more effective use of resources. We provide quality services through in-depth analysis, independent advice and professional realisation of projects using proven and customised methodologies coupled to our expertise in the healthcare sector.

*For more info on **hict**, including our references, visit our website: www.hict.com*