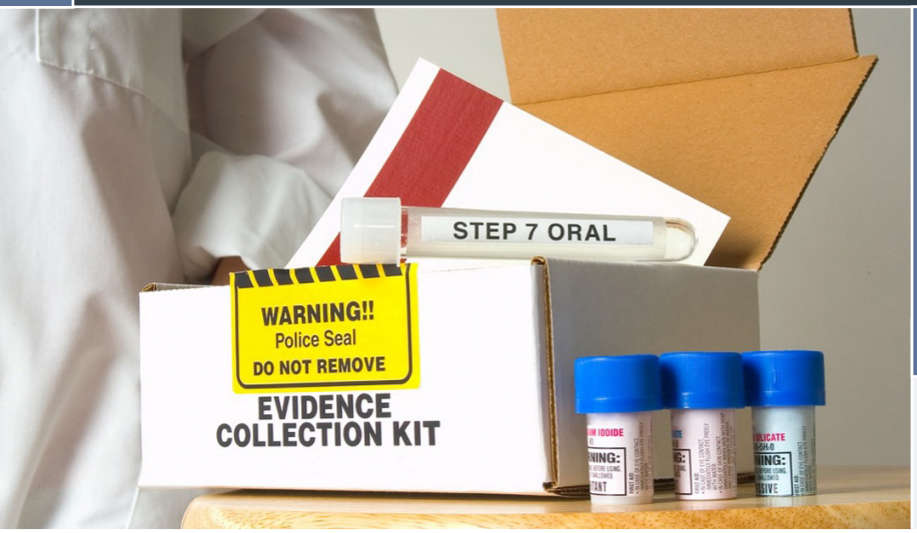
User Guide

Forensic Technology CENTER OF EXCELLENCE

A program of the National Institute of Justice

# Cost-Benefit Analysis Tool for Labor Expenditure Associated With Sexual Assault Kit Processing Workflows




**Technical Contacts**

Shannon Krauss, PhD
RTI International
skrauss@rti.org

Mikalaa Martin, BS
RTI International
mmmartin@rti.org

This user guide was updated in February 2025 to reflect the transition of the Excel-based cost-benefit analysis tool piloted since August 2022 to a prototype web-based platform via RTI International's Unified Platform for Modeling (UPmod®) to enable improved ease of use.

## Impact Statement

Following a sexual assault, survivors may undergo a sexual assault medical forensic examination during which a sexual assault kit (SAK) is collected and submitted to a forensic science service provider (FSSP) for DNA testing and analysis. Ultimately, the DNA analysis results can play a role in the identification and prosecution of a perpetrator. FSSPs can use various SAK processing workflows, each of which has important impacts on FSSP resources (e.g., the number of labor hours required to complete necessary tasks) or societal outcomes (e.g., entering probative DNA profiles into the Combined DNA Index System [CODIS] that may help identify perpetrators). A Direct-to-DNA workflow may increase FSSP efficiency and improve sensitivity while reducing labor expenditure, turnaround time, and overall financial burden. A study that assesses the costs and benefits associated with this approach can provide a critical resource for FSSPs when evaluating differences between SAK processing workflows.

To date, limited research has assessed the costs associated with different SAK processing workflows and the potential benefits or limitations of each. Thus, FSSPs have little evidence-based data for guiding workflow decisions and evaluating the benefits of one workflow over another regarding cost and efficiencies. Research efforts can inform FSSPs on how to best use their resources and the advantages of changing to an alternative SAK processing workflow.

With funding from the National Institute of Justice (NIJ) under the Forensic Technology Center of Excellence (FTCOE), RTI International developed a no-cost SAK processing workflow cost-benefit analysis (CBA) tool to help FSSPs understand the cost of alternative SAK processing workflows and their impacts on FSSP resources and potential benefits to overall public safety.

To access the Cost-Benefit Analysis Tool for Labor Expenditure Associated With Sexual Assault Kit Process Workflows, click here.

**For this document, the FTCOE has defined the following terms:**

- **Direct-to-DNA Workflow:** A workflow that begins with DNA quantitation and is followed by DNA amplification. During DNA quantitation, the amount of male DNA among female DNA (known as Direct-to-DNA) is determined and informs which samples move forward to DNA amplification. For this workflow, serology testing is removed as the initial screening step of a SAK sample; instead, DNA quantitation is used to eliminate—or screen—samples for downstream processing.
- **Continuous Sampling:** A DNA testing process in which SAK sample testing continues sequentially until a CODIS-eligible profile is obtained or until all SAK samples are tested.

## Goals and Methodology

The goal of this study was to evaluate the costs and benefits of a Direct-to-DNA SAK processing workflow coupled with continuous sampling compared with alternative workflows. Therefore, RTI developed a CBA tool that can be used to compare four typical SAK processing workflows:

- **Serology Screening.** A workflow that begins with serology testing before DNA quantitation and DNA amplification. Here, both the initial serology and subsequent DNA quantitation can be used to eliminate samples from further processing (i.e., sample screening).
- **Serology screening with continuous sampling.** A workflow that mirrors serology screening coupled with a procedure to continue testing samples within a SAK request until a CODIS-eligible profile is obtained (i.e., continuous sampling).
- **Direct-to-DNA.** A workflow that begins with DNA extraction and DNA quantitation followed by DNA amplification. During DNA quantitation, the amount of male DNA among female DNA (known as Direct-to-DNA)[a] is determined and informs which samples move forward to DNA amplification. For this workflow, serology testing is removed as the initial screening step of a SAK sample and DNA quantitation is instead used to eliminate—or screen—samples for downstream processing.
- **Direct-to-DNA with continuous sampling.** This workflow mirrors Direct-to-DNA but is coupled with a continuous sampling procedure.

This CBA tool is the product of the following:

1. Conducting secondary research on the four defined SAK processing workflows.
2. Developing and administering questionnaires to collect information about specific costs and CODIS outcomes associated with each of the four workflows.
3. Developing and piloting an initial Excel-based CBA tool based on information gathered.
4. Evaluating the piloted Excel-based CBA tool and adapting it for improved ease of use within a prototype web-based platform.

The workflow-specific questionnaires were designed to create a list of potential costs and performance metrics needed to assess each workflow based on data collected from a sample of publicly funded U.S. FSSPs and to ultimately improve the efficacy of the CBA tool. **To produce this CBA tool, costs that are relatively consistent across all SAK processing workflows, including those related to training and purchasing chemical reagents and SAK materials, were excluded from the workflow-specific questionnaires and are not included within the tool.** Preliminary drafts of the workflow-specific questionnaires were sent to external subject matter experts for review and resulted in important insights that were used to refine the questions and response options.

[a] Determining the amount of male DNA among female DNA using DNA quantitation as a screening step in this workflow is not synonymous with a Y-screening approach, where DNA quantitation is used to screen for the amount of male DNA among the total amount of DNA contained within a sample.

The workflow-specific questionnaires included 43 questions organized into five core sections:

- **Part I:** ***Respondent and FSSP Background Information***, which included questions such as how many testing requests for SAKs the FSSP received and completed in the previous year.
- **Part II:** ***Completed SAK Testing Requests and Case Workflow***, which included questions such as the percentage of testing requests for SAKs that stopped at serology because of negative serology results (if applicable) versus the percentage that stopped after DNA quantitation because of low or no DNA quantity or poor DNA quality.
- **Part III:** ***FSSP Workflow Procedures***, which included questions such as the number of samples within a SAK typically moved forward for DNA extraction following serology (if applicable).
- **Part IV:** ***Labor***, which included questions such as the number of hours of hands-on time spent by various FSSP personnel for different procedures such as serology (if applicable) or DNA extraction.
- **Part V:** ***FSSP Personnel Information***, which included questions such as the salary ranges most representative of different FSSP roles.

Before disseminating the workflow-specific questionnaires, FTCOE developed and administered an initial screening questionnaire to the forensic science community. The American Society of Crime Laboratory Directors (ASCLD) aided in survey distribution to identify publicly funded U.S. FSSPs using each of the four defined SAK processing workflows that would be interested in participating. Based on the FSSPs that completed the screening questionnaire and the timeframe of this pilot study, nine FSSPs were invited to complete the workflow-specific questionnaire. All nine FSSPs followed either the serology screening, Direct-to-DNA, or Direct-to-DNA with continuous sampling SAK processing workflow. Eight FSSPs completed the workflow-specific questionnaires (i.e., three representing the serology screening workflow, one representing the Direct-to-DNA workflow, and four representing the Direct-to-DNA with continuous sampling workflow). Workflow-specific questionnaire responses were valuable to inform additional adjustments to the default inputs of the CBA tool. Although no data were collected from an FSSP representing the serology screening with continuous sampling workflow, information necessary to develop default inputs for this workflow were derived from responses provided for the other three workflows.

## Additional Definitions Used in the CBA Tool

Several terms used in this CBA tool are defined below. These terms and accompanying definitions were used to develop the default inputs in this tool. Although there may be more than one meaning or interpretation for some of these terms, the definitions provided below should be followed when using this tool.

- **Sexual Assault Kit (SAK)**. A kit used by medical professionals to collect and preserve forensic evidence from a survivor following a sexual assault. For this tool, a SAK only includes evidence samples mentioned in the SAK instructions (i.e., evidence not explicitly stated on the SAK instructions such as a survivor's clothing or bedding would not be considered a part of a SAK) and does not include reference samples.
- **Batching.** Samples that are grouped together during one or more steps within an FSSP's workflow. Batching practices may vary between FSSPs depending on at which step in the workflow samples are grouped, or not grouped, together (e.g., DNA quantitation, DNA amplification). For this tool, consider batching of SAK evidence samples only, and do not consider batching evidence samples with reference samples together.

The following terms, as defined in the 2020 Federal Bureau of Investigation's *Quality Assurance Standards for Forensic DNA Testing Laboratories*, guide the interpretation of FSSP roles provided as options within this tool.

- **Technical Leader.** "An employee who is accountable for the technical operations of the laboratory and who is authorized to initiate, suspend, and resume laboratory operations."
- **Casework CODIS Administrator.** "An employee of the laboratory responsible for administration and security of the laboratory's CODIS at a laboratory performing DNA analysis on forensic and casework reference samples. An alternate casework CODIS administrator must be designated by the laboratory as required by the [National DNA Index System] operational procedures."

- **[DNA] Analyst.** "An employee or contract employee, that has successfully completed the laboratory's training requirements for casework sample analysis, passed a competency test, and has entered into a proficiency testing program according to these standards. This individual can conduct and/or direct the analysis of forensic samples, interpret data, reach conclusions, and generate reports."
- **Technician.** "An employee or contract employee who performs analytical procedures on forensic samples or casework reference samples under the direction of a qualified analyst. Technicians do not interpret data to reach conclusions or typing results or prepare final reports."

## Introduction to the CBA Tool for SAK Processing Workflows

FTCOE developed and piloted an Excel-based prototype CBA tool in August 2022. FTCOE then adapted and translated the piloted tool into a web-based platform, RTI's Unified Platform for Modeling (UPmod®), for improved usability. UPmod is a customizable solution for efficiently managing and deploying data models. This updated prototype tool can be accessed here and consists of four main pages. First, the tool will open to an informational page, titled **Getting Started**, which includes an overview of the tool, a link to this user guide, FTCOE organizational information, and a contact email address for submitting questions or feedback. After clicking Next at the bottom of the page, the tool advances to the second page, titled **FSSP Information**. This page contains various form fields (i.e., text boxes) to collect data on the characteristics of the user's FSSP. Each form field contains a description of the needed user input data to the left, a blue information icon (ⓘ) that provides additional details to assist the user while filling in data representing their FSSP, and a form field with a prefilled default value[b] to the right. The user inputs are organized into the following sections:

- SAK requests and CODIS outcomes
- Current workflow type
- Percentage of requests passing each stage of your FSSP's workflow
- Batch sizes for steps with batching

After clicking Next at the bottom of the page, the tool advances to the third page, titled **Salary and Labor**. This page contains form fields to collect data on each FSSP role. Drop-down form field sections are separated based on FSSP role (e.g., "Technician or equivalent," "Serology Analyst or equivalent"). Once the drop-down section is selected for each possible role used within a user's FSSP (using ⌄ and ^ icons), each section has descriptions of the needed user input data to the left and form fields with prefilled defaults values to the right. The user inputs within each section are organized into the following topics:

- Staff salary ranges for labor cost calculations
- Labor hours spent on each workflow task

Finally, clicking Next at the bottom of the page advances the tool to the fourth page, titled **Results**. This page is organized into the following three tabs below the page instructions:

1. Cost and CODIS results by workflow
2. Workflow change analysis (incremental cost and CODIS uploads when changing workflows)
3. Average cost-effectiveness by workflow

For example, an FSSP that uses serology screening without continuous sampling can review a summary of costs and CODIS uploads for their current workflow and for the other workflows (within the "Cost and CODIS results by workflow" tab), thereby showing the hypothetical differences in costs or number of CODIS uploads for implementing a Direct-to-DNA workflow or continuous sampling testing process. Additionally, the **Results** page presents additional workflow analyses, which include the cost per 100 CODIS uploads by workflow and the incremental cost per 100 CODIS uploads when adding continuous sampling (within the "Average cost-effectiveness by workflow" tab). These calculations can help FSSPs understand how much more or less an alternative workflow is likely to cost per CODIS upload.

[b] Default values are based on data provided by the eight publicly funded U.S. FSSPs that completed the workflow-specific questionnaires.

## Preparing Data for the CBA Tool's User Input Pages – FSSP Information and Salary and Labor Pages

Users will open the CBA tool to the **Getting Started** page and select Next to begin inputting information into the **FSSP Information** page. Instructions on this page direct the user to enter their data into form fields. These form fields are prefilled with default values, which are meant to demonstrate a plausible set of inputs; however, the user is encouraged to review and change the default values to best reflect the parameters and workflow of their FSSP. Alternatively, for FSSPs that do not conduct serology screening, it is suggested that users leave the prefilled default values for serology-specific form fields to calculate hypothetical serology workflow scenarios to compare the four differing workflows on the subsequent **Results** page. For ease of use, certain predefined inputs will lock on this and the subsequent **Salary and Labor** page based on dependent selections (e.g., if users select "Yes," a Direct-to-DNA approach is used, then default values for inputs related to serology will lock). To expedite the data input process, users are encouraged to collect the following data values from internal documents before using this tool:

- SAK requests and CODIS outcomes
  - Total SAK requests in a typical year
  - Completed SAK requests in a typical year
  - Completed SAK requests in a typical year that yielded a CODIS-eligible profile and were uploaded to CODIS
    - Subgroup 1: CODIS forensic hit(s)
    - Subgroup 2: Offender hit(s)
- Current SAK processing workflow type
  - Does your FSSP use a Direct-to-DNA casework approach?
  - Does your FSSP use continuous sampling within the same SAK request when no DNA profile is obtained from the initial sample(s)?
    - If yes, approximately how many additional evidence samples per SAK are processed?
    - If yes, approximately what percentage of all CODIS-eligible profiles were obtained from continuous sampling within a SAK?
- Percentage of requests passing each stage of the FSSP workflow *(the following four stages should sum to 100%)*
  - Stage 1: Percentage of SAK requests that were stopped at serology *(if serology is conducted as part of standard workflow)*
  - Stage 2: Percentage of SAK requests that passed serology *(if conducted)* and DNA extraction but stopped after DNA quantitation
  - Stage 3: Percentage of SAK requests that did not yield a CODIS-eligible profile after analysis
  - Stage 4: Percentage of SAK requests that yielded a CODIS-eligible profile that was uploaded to CODIS
- Batch sizes for workflow steps *(if batching is used)*
  - Batch size for DNA extraction
  - Batch size for DNA quantitation
  - Batch size when conducting PCR for STR amplification
- Staff member salary ranges for labor cost calculations *(by FSSP role)*

Users only need to fill in salary ranges for the staff who participate in the workflow steps listed on the **Salary and Labor** page (see next section regarding labor hours spent on each task). The following staff member positions were provided as defaults (see FSSP roles defined in the **Additional Definitions Used in the CBA Tool** section of this guide). The roles and salary ranges can be customized for a user's FSSP and will automatically populate a median value accordingly.

- Technician or equivalent
- Serology Analyst or equivalent
- DNA Analyst or equivalent
- Casework CODIS Administrator or equivalent
- Technical Leader or equivalent
- Section Supervisor or equivalent
- Laboratory Manager or equivalent
- Other

- Labor hours spent on each task
  - Input labor hours by staff position for each of the following workflow steps (users can enter partial hours for staff or leave the input as 0.0 for staff not involved in a workflow step):
    1. Hours for serology per SAK request
    2. Hours for serology report per SAK request
    3. Hours for DNA extraction per SAK request or batch
    4. Hours for DNA quantitation per SAK request or batch
    5. Hours for PCR per SAK request or batch
    6. Hours for STR preparation and run per SAK request
    7. Hours for STR data analysis per SAK request
    8. Hours for DNA report per SAK request
    9. Hours for administrative or technical review
    10. Hours for CODIS data entry
    11. Hours to verify/review CODIS hit reports

## Interpreting the CBA Tool Outputs

The **Results** page automatically updates based on the user's input data from the **FSSP Information** and **Salary and Labor** pages. The resultant outputs presented on the **Results** page are conditionally formatted to display green for lower costs or more effective outcomes and yellow for higher costs or less effective outcomes. The conditional formatting for costs and CODIS outcomes depends on the relative costs or CODIS outcomes within a set of workflow results (i.e., within each table column).

See **Exhibit 1** for exemplary outputs from tab 1 of the **Results** page, titled **Cost and CODIS results by workflow**, of the CBA tool containing the workflow-related costs and CODIS outcomes by workflow type. Tab 1 presents results per 100 completed SAK requests (**Exhibit 1**, left) and per year (**Exhibit 1**, right), based on the user input value for the number of SAK requests completed in a typical year. Currently, cost results only include workflow-related labor costs, and the hourly labor rates include fringe benefits (assuming an additional 30% labor cost for fringe benefits and calculating an hourly wage based on 2,080 working hours per year). Materials costs and general overhead costs were not included in this CBA tool because of relative similarities across workflows.

**Exhibit 1:** Results page: Tab 1, Cost and CODIS results by workflow.

**Cost Results**

Results are shown per 100 SAKs (left) and per year based on your FSSP's annual SAKs completed (right). Costs only include workflow-related labor costs. Hourly labor rates include fringe benefits. Materials costs and general overhead costs are not included.

| Workflow | Median cost per 100 SAKs | Median SAK costs per year |
|---|---|---|
| Serology screening | $59,550 | $9,000,000 |
| Serology screening with continuous sampling | $68,226 | $11,000,000 |
| Direct-to-DNA | $29,188 | $5,000,000 |
| Direct-to-DNA with continuous sampling | $30,669 | $5,000,000 |

**CODIS Upload Results**

Results are shown per 100 SAKs (left) and per year based on your FSSP's annual SAKs completed (right). CODIS results are influenced by your FSSP's input values including the percentage of SAKs passing each workflow stage, continuous sampling inputs, and the number of CODIS uploads relative to requests completed.

| Workflow | Median CODIS uploads per 100 SAKs | Median CODIS uploads per year |
|---|---|---|
| Serology screening | 49.9 | 67.4 |
| Serology screening with continuous sampling | 44.4 | 69.6 |
| Direct-to-DNA | 47.7 | 74.9 |
| Direct-to-DNA with continuous sampling | 49.0 | 76.9 |

**CODIS Forensic and Offender Hit Results**

Results are shown per 100 SAKs (left) and per year based on your FSSP's annual SAKs completed (right). CODIS/offender hits are influenced by your FSSP's input values, including the percentage of SAKs passing each workflow stage, continuous sampling inputs, and the number of CODIS forensic and offender hits relative to requests completed.

| Workflow | Median CODIS forensic and offender hits per 100 SAKs | Median CODIS forensic and offender hits per year |
|---|---|---|
| Serology screening | 15.4 | 24.1 |
| Serology screening with continuous sampling | 15.9 | 24.9 |
| Direct-to-DNA | 17.1 | 26.8 |
| Direct-to-DNA with continuous sampling | 17.6 | 27.6 |

CODIS results presented on the **Results** page, including "CODIS Upload Results" and "CODIS Forensic and Offender Hit Results," are influenced by the user's data inputs such as the percentage of SAKs passing each stage of the FSSP's workflow (i.e., stopped at serology, stopped after DNA quantitation, did not yield a CODIS-eligible profile, yielded a CODIS-eligible profile that was uploaded to CODIS), information related to continuous sampling, and the number of CODIS forensic and offender hits relative to requests completed. These are key inputs, and if the user is unsure or has a range of possible values, they should adjust them in the **FSSP Information** and **Salary and Labor** pages to understand the impact on their results.

See **Exhibits 2–4** for output examples from tab 2, titled **Workflow change analysis**, on the **Results** page of this tool, which presents six potential workflow changes and the associated differences in costs and CODIS uploads. This second tab is designed for FSSPs to evaluate differences between SAK processing workflows. Workflow changes such as switching from Direct-to-DNA approaches to serology screening procedures are not included because of the benefits of Direct-to-DNA approaches, including increased FSSP efficiency and reduced labor consumption.[1] The six workflow changes are as follows:

1. Serology screening to serology screening with continuous sampling
2. Serology screening to Direct-to-DNA
3. Serology screening to Direct-to-DNA with continuous sampling
4. Serology screening with continuous sampling to Direct-to-DNA
5. Serology screening with continuous sampling to Direct-to-DNA with continuous sampling
6. Direct-to-DNA to Direct-to-DNA with continuous sampling

**Exhibit 2** displays the incremental cost per 100 SAKs for each workflow change as the cost of the newly adapted workflow minus the cost of the current workflow per 100 SAKs (costs by workflow are shown in tab 1 tables in the **Results** page shown in **Exhibit 1**). Based on the data provided by publicly funded U.S. FSSPs, these results demonstrated cost savings associated with changing from a serology workflow to a Direct-to-DNA workflow. However, this result can change based on the user's input values. Users are encouraged to conduct their own sensitivity analyses by returning to the **FSSP Information** and **Salary and Labor** pages to change one or two inputs and then view the newly populated results displayed on the **Results** page. For example, if a user wanted to hypothesize the impact of increasing the number of hours allocated for a step in their SAK processing workflow (e.g., DNA report writing), they can observe the magnitude of the cost changes associated with the number of hours needed for a DNA analyst or equivalent to expend on DNA report writing per SAK request from 0.5 hour to 2 hours by changing the input in the **Salary and Labor** page and noting the corresponding change in cost within the **Results** page.

Exhibit 2: Results page: Tab 2, Incremental cost.

**Incremental cost per 100 SAKs: Changing to Direct-to-DNA or adding continuous sampling**

These results show the incremental cost per 100 SAKs for each workflow change as the cost of the newly adapted workflow minus the cost of the current workflow per 100 SAKs (see tab 1 for costs by workflow). Based on data provided by publicly funded U.S. FSSPs, these results demonstrated cost-savings associated with changing from a serology workflow to a Direct-to-DNA workflow. However, this result can change based on your FSSP's input values.

| Workflow | Median |
|---|---|
| Serology screening → Serology screening with continuous sampling | $8,676 |
| Serology screening → Direct-to-DNA | -$30,362 |
| Serology screening → Direct-to-DNA with continuous sampling | -$28,881 |
| Serology screening with continuous sampling → Direct-to-DNA | -$39,039 |
| Serology screening with continuous sampling → Direct-to-DNA with continuous sampling | -$37,557 |
| Direct-to-DNA → Direct-to-DNA with continuous sampling | $1,482 |

**Exhibit 3** displays the incremental CODIS uploads per 100 SAKs for each workflow change as the CODIS uploads of the newly adapted workflow minus the CODIS uploads of the current workflow per 100 SAKs (CODIS uploads by workflow are shown in tab 1 tables; in the **Results** page shown in **Exhibit 1**). Based on the data provided by publicly funded U.S. FSSPs, these results demonstrated that the largest increase in CODIS uploads occurred when changing from a serology workflow to a Direct-to-DNA workflow. Adding continuous sampling resulted in additional CODIS uploads, but the incremental difference was not large given the low input values for the percentage of CODIS-eligible profiles obtained from continuous sampling.

Exhibit 3: Results page: Tab 2, Incremental CODIS uploads.

**Incremental CODIS uploads per 100 SAKs: Changing to Direct-to-DNA or adding continuous sampling**

These results show the incremental cost per 100 SAKs for each workflow change as the cost of the newly adapted workflow minus the cost of the current workflow per 100 SAKs (see tab 1 for costs by workflow). Based on data provided by publicly funded U.S. FSSPs, these results demonstrated cost-savings associated with changing from a serology workflow to a Direct-to-DNA workflow. However, this result can change based on your FSSP's input values.

| Workflow | Median |
|---|---|
| Serology screening → Serology screening with continuous sampling | 1.4 |
| Serology screening → Direct-to-DNA | 4.8 |
| Serology screening → Direct-to-DNA with continuous sampling | 6.1 |
| Serology screening with continuous sampling → Direct-to-DNA | 3.3 |
| Serology screening with continuous sampling → Direct-to-DNA with continuous sampling | 4.7 |
| Direct-to-DNA → Direct-to-DNA with continuous sampling | 1.3 |

**Exhibit 4** displays the incremental cost per additional CODIS upload for each workflow change as the cost of the newly adapted workflow minus the cost of the current workflow, divided by the number of CODIS uploads of the newly adapted workflow minus the number of CODIS uploads of the current workflow (CODIS uploads by workflow are shown in tab 1 tables in the **Results** page shown in **Exhibit 1**). Based on the data provided by publicly funded U.S. FSSPs, adding continuous sampling to corresponding workflows (e.g., Direct-to-DNA to Direct-to-DNA with continuous sampling, serology screening to serology screening with continuous sampling) increased workflow costs and CODIS uploads resulting in an additional cost to gain additional CODIS upload(s) (as shown in **Exhibit 3**). In some cases (e.g., changing to Direct-to-DNA from serology), costs decreased whereas CODIS uploads increased. In these cases, the tool calculates the average cost savings per additional CODIS upload (see **Exhibit 4**). The largest cost savings per additional CODIS upload was observed for a serology workflow changing to a Direct-to-DNA workflow.

Exhibit 4: Results page: Tab 2, Incremental cost per additional CODIS upload.

**Incremental cost per additional CODIS upload: Changing to Direct-to-DNA or adding continuous sampling**

These results show the incremental cost per additional CODIS upload for each workflow change as the cost of the newly adapted workflow minus the cost of the current workflow, divided by the CODIS uploads of the newly adapted workflow minus the CODIS uploads of the current workflow (see tab 1). Based on data provided by publicly funded U.S. FSSPs, adding continuous sampling to corresponding workflows (e.g., Direct-to-DNA to Direct-to-DNA with continuous sampling, serology screening to serology screening with continuous sampling) increased workflow costs and CODIS uploads resulting in an additional cost to gain additional CODIS upload(s). In some cases (e.g., changing to Direct-to-DNA from serology), costs decreased whereas CODIS uploads increased. In these cases, this tool calculates the average cost savings per additional CODIS upload. The largest cost savings per additional CODIS upload was observed for a serology workflow changing to a Direct-to-DNA workflow.

| Workflow | Median |
|---|---|
| Serology screening → Serology screening with continuous sampling | $6,081 |
| Serology screening → Direct-to-DNA | $6,365 |
| Serology screening → Direct-to-DNA with continuous sampling | $4,752 |
| Serology screening with continuous sampling → Direct-to-DNA | $11,677 |
| Serology screening with continuous sampling → Direct-to-DNA with continuous sampling | $8,075 |
| Direct-to-DNA → Direct-to-DNA with continuous sampling | $1,133 |

**Exhibit 5** displays the average cost per 100 CODIS uploads by workflow (not by workflow change as in tab 2, shown in **Exhibits 2–4**). The average cost per 100 CODIS uploads is equal to the expected cost divided by the expected CODIS uploads, multiplied by 100 (to express these results per 100 CODIS uploads). Based on the data provided by publicly funded U.S. FSSPs, these results demonstrated a lower cost per CODIS upload associated with Direct-to-DNA workflows and a higher cost per CODIS upload associated with serology screening and continuous sampling. For example, in a hypothetical FSSP where serology screening excludes the same samples that would be stopped after DNA quantitation, this average cost comparison would favor a change to Direct-to-DNA by $10,000–$30,000 less per 100 CODIS uploads (depending on the workflow).

**Exhibit 5:** Results page: Tab 3, Average cost-effectiveness.

**Average cost-effectiveness by workflow**

These results show the average cost per 100 CODIS uploads by workflow (not by workflow change as is presented in tab 2). The average cost per 100 CODIS uploads is equal to the expected cost divided by the expected CODIS uploads, multiplied by 100 (to express these results per 100 CODIS uploads). Based on data provided by publicly funded U.S. FSSPs, these results demonstrated a lower cost per CODIS upload associated with Direct-to-DNA and a higher cost per CODIS upload associated with serology screening and continuous sampling. However, in a hypothetical FSSP where serology screening excludes the same samples that would be stopped after DNA quantification, this average cost comparison would favor a change to Direct-to-DNA by $10,000—$30,000 less per 100 CODIS uploads (depending on the workflow).

| Workflow | Median |
|---|---|
| Serology screening | $139,000 |
| Serology screening with continuous screening | $154,000 |
| Direct-to-DNA | $61,190 |
| Direct-to-DNA with continuous sampling | $62,581 |

## Future Directions

FSSP data collected for this study were used to pilot an Excel-based version and then a prototype web-based platform version of this CBA tool for FSSPs to use as a resource for evaluating the potential costs and benefits of alternative SAK processing workflows. Data from additional FSSPs could be collected (including voluntary feedback on the usability of this tool) to further adapt this tool, and corresponding trends in user input values and result outputs may be monitored to refine this tool. If deemed useful by FSSPs, this tool could also be expanded to include nominal costs (e.g., training costs) or modified to assess the costs and benefits of hybrid approaches to SAK processing (e.g., a mixed approach when certain evidence types, case types, case circumstances, or investigator-driven requests result in the inclusion of a serology screening workflow in an otherwise Direct-to-DNA SAK processing FSSP).

Currently, the outputs in this tool are strictly related to FSSP workflows and depend on the labor hours associated with each step within the defined workflows. Calculated benefits are limited to the number of CODIS uploads and resulting CODIS hits. In the future, this tool could be expanded to include additional costs and benefits. For instance, CODIS hits are associated with a potential reduction in crime, which can be quantified in terms of economic and quality-of-life impacts for community members (e.g., sexual assault survivor compensation, cost per individual incarcerated for sexual assault, financial and quality-of-life costs averted by preventing sexual assaults through incarcerating potential repeat offenders). Incorporating additional research on related costs and benefits will offer FSSPs a more robust view of the potential long-term impacts that may stem from changes to their SAK processing workflow procedures.

## References

1 SAFER Working Group. (n.d.). Improving laboratory efficiency: A Direct-to-DNA approach for testing sexual assault kits. Sexual Assault Kit Initiative, RTI International. https://www.sakitta.org/toolkit/docs/Improving-Laboratory-Efficiency-A-Direct-to-DNA-Approach-for-Testing-Sexual-Assault-Kits.pdf.

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**FTCOE Contact**
Jeri Ropero-Miller, PhD, F-ABFT
Director, FTCOE
RTI International
jerimiller@rti.org

**NIJ Contact**
Francis Scott, PhD
Program Manager/Physical Scientist
Office of Investigative and Forensic Sciences
frances.scott@usdoj.gov

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