Available online at www.sciencedirect.com
ScienceDirect
Forensic Science International: Genetics 2 (2008) 184–189
FSI GENETICS
www.elsevier.com/locate/fsig

A fast analysis system for forensic DNA reference samples

Johannes Hedman [a,b,*], Linda Albinsson [a], Carina Ansell [a], Helene Tapper [a], Oskar Hansson [a], Stig Holgersson [a], Ricky Ansell [a]

[a] *Swedish National Laboratory of Forensic Science (SKL), SE-581 94, Linköping, Sweden*
[b] *Department of Applied Microbiology, Lund University, Box 124, SE-221 00, Lund, Sweden*

Received 19 October 2007; received in revised form 27 November 2007; accepted 17 December 2007

Abstract

On January 1st, 2006, the Swedish legislation on obtaining DNA reference samples from suspects and the recording of DNA profiles in databases was changed. As a result the number of samples analysed at the Swedish National Laboratory of Forensic Science (SKL) increased from about 4500 in 2005 to more than 25,000 in 2006. To meet this challenge, SKL launched a new analysis system to create an unbroken chain, from sampling to incorporation of a profile in the national DNA database and subsequent automatic generation of digitally signed hit reports. The system integrates logistics, digital data transfer, new functions in LIMS (ForumDNA Version 4, Ida Infront AB) and laboratory automation. Buccal swab samples are secured on a FTA® card attached to an identity form, which is barcoded with a unique sample ID. After sampling, the police officer sends a digital request to SKL. The sample is automatically registered in LIMS and processed on delivery. The resulting DNA profiles are automatically classified according to quality using a custom-made expert system. Building the evaluation around mathematical rules makes it reproducible, standardised and minimises manual work and clerk errors. All samples are run in duplicate and the two profiles are compared within LIMS before incorporation in the database. In the first year of operation, the median time for completion of an analysis was 3 days, measured from delivery of the sample to incorporation of the profile in the national DNA database. In spite of the dramatic increase in the number of reference samples there was no backlog.

Keywords: Forensic DNA analysis; Reference sample; DNA database; Automation; LIMS

1. Introduction

In the last decade, national DNA databases have been developed and continuously expanded throughout Europe [1]. The legislations differ greatly between countries, resulting in considerable differences in the number of database entries. United Kingdom introduced a national DNA database in 1995 [2]. In March 2006 it held over 3.7 million profiles from suspects and convicted felons, making it by far the largest in Europe [3]. In order to handle the large numbers of analyses, the Forensic Science Service developed an automated analysis process for buccal swabs [4]. Following legislative changes, laboratories in other countries have developed their own automated systems, either based on cotton buccal swabs [5] or FTA® cards [6]. Some laboratories have also made efforts to combine the automated analysis with improved laboratory information management systems (LIMS) and other solutions for digital data transfer [4,7]. The combination of automation and digitalised data handling has proved to be a powerful tool to speed up analysis, keep down the cost and avoid backlogs.

In Sweden, the first legislation on DNA databases was passed on April 1st, 1999 [8,9]. At that time, the entering of profiles to the national DNA database was restricted to crimes with possible sentences above 2 years imprisonment. Up to 4500 reference samples were analysed annually at the Swedish National Laboratory of Forensic Science (SKL). The samples were predominately blood, analysed as single reactions and extracted using a manual, Chelex® based method [10]. On January 1st, 2006, a new Swedish legislation on the acquisition of DNA reference samples from suspects and the recording of DNA profiles in databases was passed. Samples can now be taken routinely from suspects, and the profile will be kept in the DNA database if convicted to other sentences than fines [11,12].

To prepare for the expected sample increase following the new legislation, SKL developed a new analysis system.

* Corresponding author at: Department of Applied Microbiology, Lund University, Box 124, SE-221 00, Lund, Sweden. Tel.: +46 46 22 28 329; fax: +46 46 22 24 203.
E-mail address: johannes.hedman@tmb.lth.se (J. Hedman).

1872-4973/$ – see front matter
doi:10.1016/j.fsigen.2007.12.011

Automated laboratory procedures are vital parts of this system, but the greatest task was to establish ways of handling information digitally with high security and a minimum amount of manual paper work. Now all information is handled digitally throughout the analysis, from the web based request sent in by the police, via sample information management at the laboratory to sending profiles to the national DNA database and digitally signed hit reports back to the police. The system is supported by new logistics solutions, an expert system for profile evaluation and new functions in LIMS (ForumDNA, Version 4, IDA Infront) (Fig. 1).

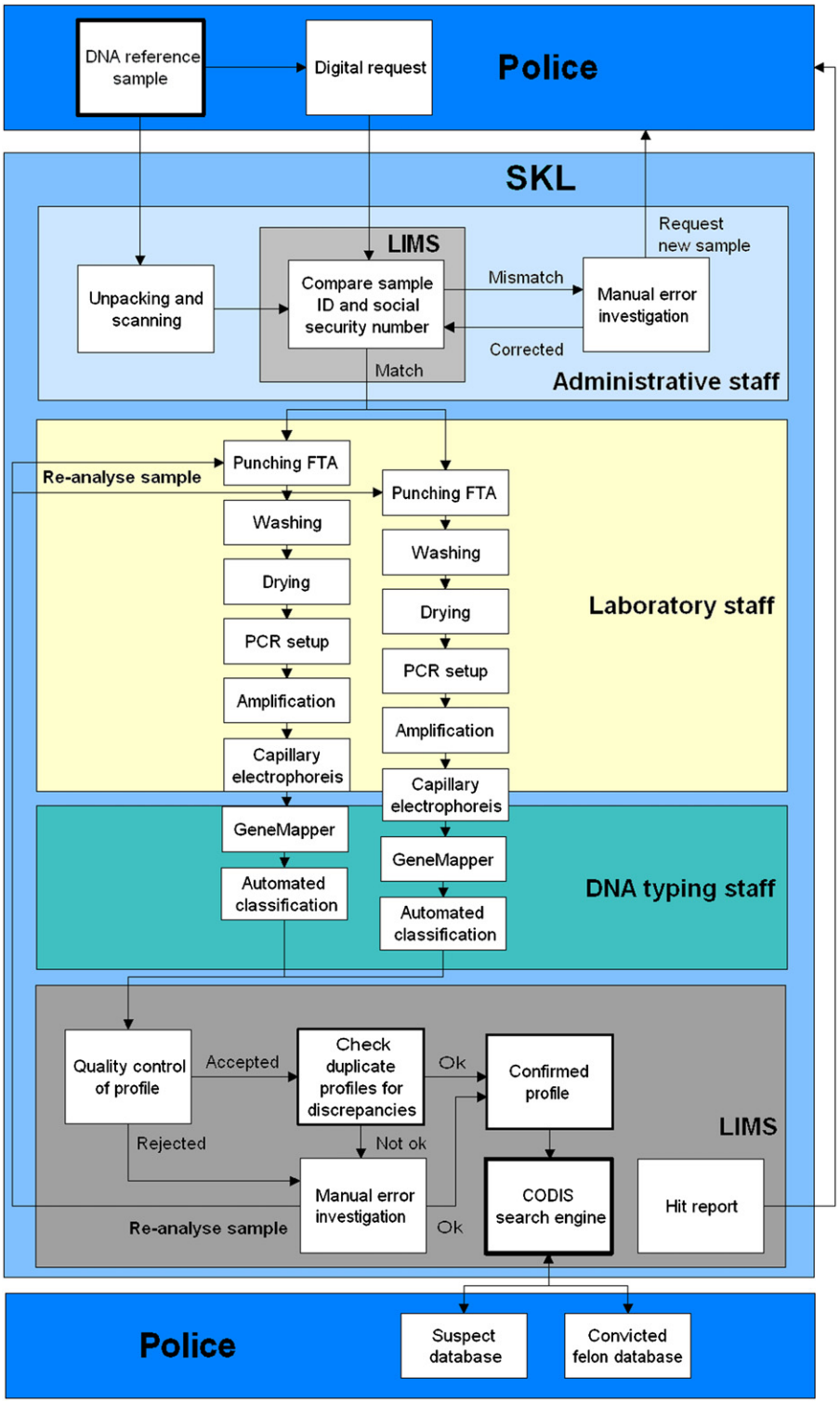

Fig. 1. Overview of the flow of samples and digitalised information in the DNA reference sample analysis system. The police officer orders the analysis via a web based digital request, monitors the analysis process via the web page and gets digital hit reports via e-mail. The samples are analysed and the profiles entered to the national DNA database within a few days.