Netherlands Forensic Institute
Ministry of Security and Justice

Forensic Science Quality Management: Errors and Incidents

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NFI

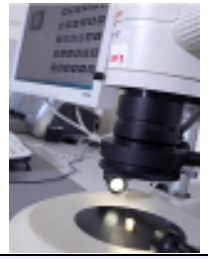
Main Characteristics NFI

Molecular Biology

Forensic Medicine

Organic Analysis

Digital Technology



Micro Traces

Crime Scene & Incident Teams

Biometrics

2014:

Caseload: 80,000

Staff: 550

Budget: 70 mEur

Accredited: ISO 17025

Commodities

Tailor-Made

The power of forensics

From a supporting role forensic science has now become a playmaker in investigations resulting in a growth of cases over the past 15 years.

This growth has been driven by three main factors:

1. The introduction of new technological capabilities
2. The increase in general awareness among customers regarding the value and efficiency of forensic science
3. The appearance of new types of customers from outside the scope of traditional forensics.

As Dr. Jo Handelsman (Associate Director of Science at the White House Office of Science and Technology) said last Tuesday:

"Forensic Science is the future of this country"

Challenges

activity/source

trace

- To get more out of less
- To do it faster
- To do it more efficient
- To deliver quality

Do customers trust forensic evidence?

"Trust arrives on foot and leaves on horseback"

Voice of the customer

- Don’t sit in my chair
- Answer my questions
- Give me advise
- Deliver quality

Quality: Voice of the Customer

1. Methods based on science

science

integrity

2. Integrity of evidence

6. Understandable reports

reports

quality

process

3. On time process

5. Proven quality

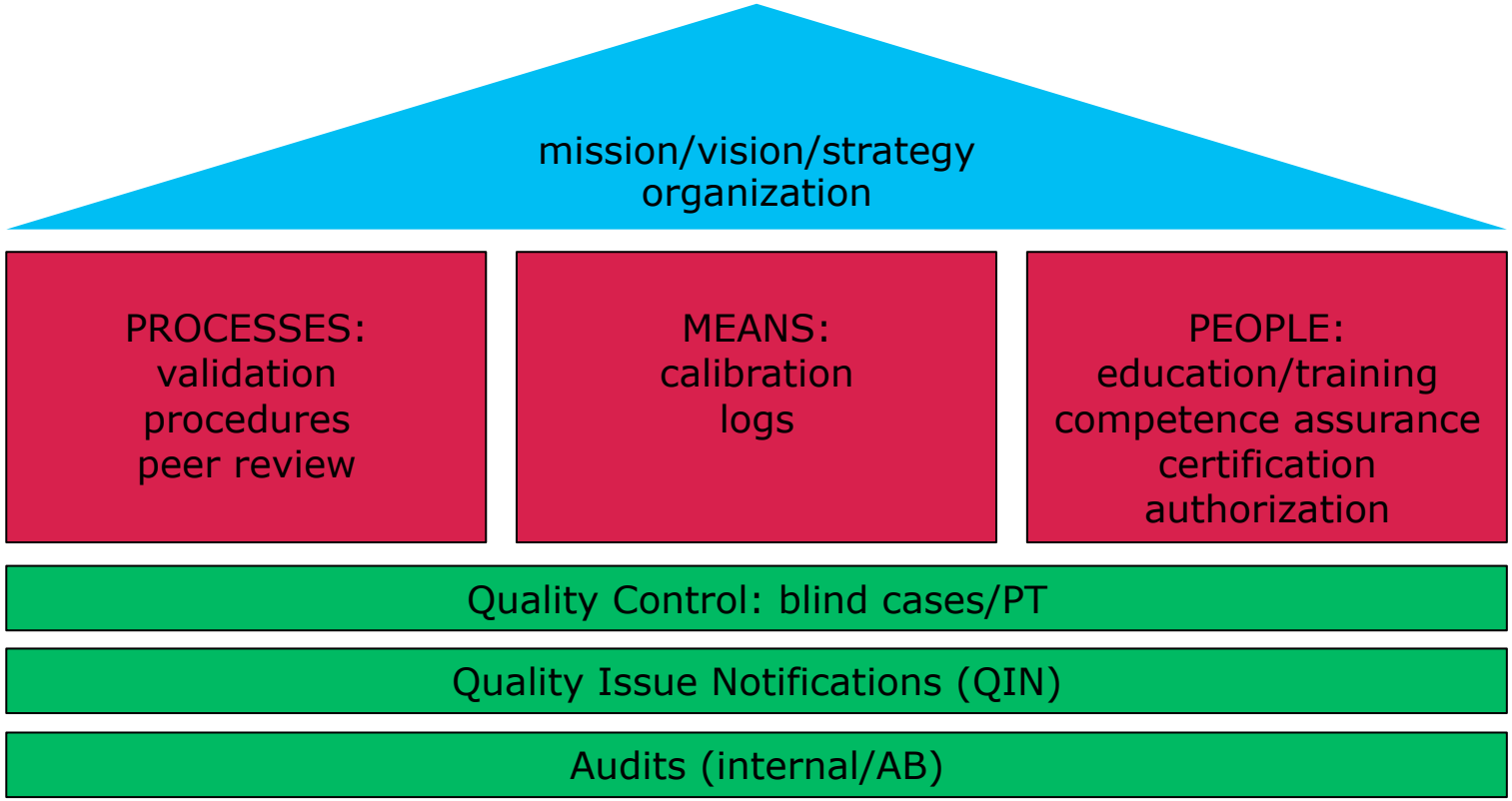
qms

unbiased

4. Unbiased/Objective opinions

POSTER

QMS house according to ISO 17025



Quality Issue Notifications (QIN's)

- ISO 17025 does not directly refer to incidents or errors, but talks about non-conforming testing, improvement, corrective actions and cause analysis (paragraphs 4.9 – 4.11).

- Incident and error management including a root cause analysis will highly contribute to your understanding of your errors and incidents.

- Absence of thorough incident management is a dissatisfier for customers. They will loose trust in your services.

Webbased QIN registration system

The NFI Quality On Line (QOL) system (which is available on all workstations in the laboratory) contains an automated, web-based system designed to make notifications.

The QOL notification holds the following headings:

Description of the quality issue “CSAO”

1. Cause
2. Scale (number of samples effected)
3. Action and measures taken to correct the failure and prevent future incidents
4. Operational nature of the improvement

Freedom of Information Act: NFI errors in the press and parliament

"Hundreds of errors in forensic DNA analysis at the NFI"

By Jolande van der Graaf

AMSTERDAM – When performing DNA profiling in heavy cases the NFI has made hundreds, sometimes irreversible mistakes. This was concluded from a internal incident analysis document which was requested by De Telegraaf on the basis of the Freedom of Information Act, enforced upon

De Telegraaf

Research:

- **95%** of the journalists would be more suspicious of a company if they found that it had **withheld** critical information, or **tried** to cover it up, than if the company had **released** the information **proactively**

- Nine out of ten said, knowing that the company had **deliberately withheld information** would **cause** them to dig **deeper and harder** for additional **incriminating** information

- **98%** of journalists say the fact that the company had tried to withhold information would prompt additional coverage

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The way forward…

NFI publishes every year on their external website:

- All QIN data
  - DNA since 1997
  - Other since 2008
- All external audit reports of the accreditation body (RvA) since 1999
- All internal audit reports since 2008
- Accreditation scope

http://www.forensischinstituut.nl/over_het_nfi/organisatie/kwaliteit/kwaliteitsrapportages.aspx

Error rates in DNA analysis: A deep dive*

* From Error rates in forensic DNA analysis: Definition, numbers, impact and communication
Ate Kloosterman, Marjan Sjerps, Astrid Quak (Netherlands Forensic Institute); Published in Forensic Science International 12 (2014)

Quality failures in Laboratory Medicine

Review of the literature

Laboratory	Medical laboratory[1]	Medical laboratory[2]	Molecular genetic testing center[3]	Medical laboratory[4]
Year of Publication	1997	1998	1999	2007
Data collection period	3 months	3 years	1 year	3 months
No. of tests	40 490	676 564	88 394	51 746
No. of errors	189	4135	293	160
Frequency (% of test results)	0.47%	0.61%	0.33%	0.31%

1. Plebani M, Carraro P. Clin Chem 1997;43:1348–51
2. Stahl M, Lund ED, Brandslund I. Clin Chem 1998;44:2195–7.
3. Hofgartner WT, Tait JF. Am J Clin Pathol 1999;112:14–21.
4. Carraro P, Plebani M. Clin Chem 2007; 53:1338-1342

Forensic Biology and DNA analysis at the NFI: number of quality issue notifications 2008-2012

	2008	2009	2010	2011	2012
No. of DNA-analyses	66.391	82.896	89.977	100.407	132.456
No. of notifications	328	329	435	526	572
Frequency (%)	0,5%	0,4%	0,5%	0,5%	0,4%

Laboratory	Medical laboratory[1]	Medical laboratory[2]	Molecular genetic testing center[3]	Medical laboratory[4]
Frequency (% of test results)	0.47%	0.61%	0.33%	0.31%

Different categories of notifications

	2008	2009	2010	2011	2012
a. External origin	23	10	23	54	100
b. External contamination	3	0	5	24	22
c. Opportunity for improvement	11	6	3	(2)	(10)
d. Positive response	19	9	11	6	17
e. Clerical (no adverse outcome)	29	25	92	77	82
f. Not related to case work	13	9	20	10	5
g. Other (NFI related)	230	270	281	355	346
Total	328	329	435	526	572

Categories of quality issues of type g (NFI related) by cause

	2008	2009	2010	2011	2012
g. Other (NFI related)	230	270	281	355	346
Contamination	49	56	57	130	135
Human Error	105	124	135	139	114
Technical Problem	17	28	37	21	19
Deviation quality Document	0	0	3	5	2
Capacity / Planning	1	1	0	1	0
Deviation from Competence Matrix	0	1	0	0	0
Sample Mix Up	24	32	25	30	34
Other	34	28	24	29	40
Ongoing	0	0	0	0	2

Who contaminated?

	2008	2009	2010	2011	2012
Total contaminations	53	58	72	158	160
Contamination with DNA from a staff member	21	18	17	26	53
Contamination with DNA from another sample and “other”	29	40	50	108	84
External DNA contamination	3	0	5	24	23

What was contaminated?

	2008	2009	2010	2011	2012
Total contaminations	53	58	72	158	160
Contamination in control (blank, negative and positive control)	23	28	39	102	46
Contamination in a reference sample	9	5	6	8	40
Contamination in a crime sample	20	23	18	46	72
Contamination in wipe sample (bench monitoring)	1	2	9	2	2

Intensity of the DNA contamination in the control samples

	2008	2009	2010	2011	2012
Contamination in control (blank, positive control)	23	28	39	102	46
Sporadic contamination	9	8	17	74	18
Gross contamination (source identified)	13	12	18	24	21
Gross contamination (source not identified)	1	8	4	4	7

Potential and actual impact on conclusions report

Potential impact: What could have happened?

- Important for improvement

Actual impact: What has happened?

- Important for evaluating errors

Potential impact* of registered Quality Issue Notifications (NFI related)

	2008	2009	2010	2011	2012
0. No adverse outcome	39	22	78	158	125
1. Potentially negative outcome; repairable	144	197	138	155	137
2. Potentially negative outcome; irreversible	47	51	65	42	81
Under Investigation	0	0	0	0	3
Total	230	270	281	355	346

*Impact on the conclusions of the NFI report

The actual impact of Quality Issue notifications (NFI related)

	2008	2009	2010	2011	2012
Negative outcome; potentially irreversible	47	51	65	42	81
0. Failure without adverse outcome	22	16	36	20	17
1. Failure with adverse outcome; failure corrected; revised forensic report	0	0	3	0	1
2. Failure with adverse outcome; irreversible; stated in the forensic report	21	32	23	22	60
3. Failure with adverse outcome; irreversible; revised forensic report	4	3	3	0	0
4. Actual impact unknown	0	0	0	0	3

Why are there increasing numbers?

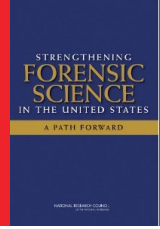
- Yearly increase in samples for analysis (2012 > 2x 2008)
- Introduction of Next Generation Multiplex (NGM) method (more sensitive) in 2011
- Errors are registered in year of recovery, but could result out of (ever more) old and cold cases
- Growing elimination database (NFI-staff and police)
- Change in criteria for registration of QIN (2010)
- Introduction of automated DNA techniques (like automated extraction for reference samples)

Error rate in forensic science

The error rate includes both type 1 (false positive) errors and type 2 (false negative) errors.

- A type 1 error in forensic DNA analysis is the event where the DNA profile of the reference sample from a suspect is incorrectly concluded to match with the crime sample

- A type 2 error is the event of wrongly reporting a non DNA match between two samples when in truth there is one.



Error rate in forensic science

- To prevent false convictions facts on the rate of type I errors is of particular relevance to the criminal justice system.

- Lack of knowledge of the true rate of error creates an important element of uncertainty about the value of DNA evidence[1].

1. William C. Thompson, Franco Taroni and Colin G. G. Aitken (2003); How the Probability of a False Positive Affects the Value of DNA Evidence *J Forensic Sci* ***48*** *1-8*

Type 1 and type 2 errors at the NFI 2008-2012

Definition:

- Wrongful DNA match (or no match) reported to the authorities (public prosecutor)
- Misidentification notified by internal control or external notification by police or prosecution service
- Characteristic: all defenses have failed

	2008	2009	2010	2011	2012
Type 1 error	2	1	0	0	0
Type 2 error	4	3	1	2	4
Type 1 and type 2 error	0	2	0	0	2
Total (2008-12 = 21)	6	6	1	2	6

Type 1 and Type 2 errors: breakdown by cause

Conclusion: The source of most of the misidentification errors are in the post-analytical phase.

Type 1 and Type 2 errors: breakdown by cause

Errors 2008-2012 **(total= 21)**	
Pre-analytical	2
Analytical	6
Post-analytical	13

In conclusion 2008-2012

Number of DNA analyses	472,127
Number of quality issue notifications	2190
NFI related	1483
Potentially negative outcome for the CJS; irreversible	286
False inclusion; Wrong exclusion	21

What can we learn from this exercise?

Relevant questions

- Should error rates be reported?
- Should error rates be incorporated in overall evidence?

Insight in Quality management issues

- How many errors and incidents do we have?
- Of what kind?
- How do they progress over time?
- What were the consequences?
- What could the consequences have been?
- Where should we implement improvements?
- Are current budget allocations the right ones to make?

Conclusions

- Forensic institutes like the NFI should be accountable for their actions and therefore also errors and incidents.
- Disclosure on error rates is essential to obtain confidence of the criminal justice system and brings errors in perspective with the total number of cases handled.
- It can only work in a blame-free culture. Management play a key role in this.
- The Quality Issue Notification (QIN)-system generates important information on the performance of the laboratory and provides objective information to prioritize corrective actions.

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- Astrid Quak (NFI)

Thanks for your great work!

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End of presentation

Thank you for your attention!