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Center for Statistics and
Applications in Forensic Evidence

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Analysis of Forensic Testimony and Reports

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Project Rationale & Goals

- CSAFE " . . . works to build a statistically sound and scientifically solid foundation for the analysis and interpretation of forensic evidence . . ."

- To what extent do we have "statistically sound . . . interpretation of forensic evidence" now?

- Can explore the advantages and disadvantages of various "types" of probabilistic testimony (e.g., verbal, quantitative)

- Can provide a baseline for CSAFE's efforts

Key Questions

1. whether reports are consistent with published disciplinary standards

2. whether reports are probabilistic in nature and, if so, how probability is expressed

Standards

of uncertainty in reported results and associated estimated probabilities where possible.

Recommendation 2:

The National Institute of Forensic Science (NIFS), after reviewing established standards such as ISO 17025, and in consultation with its advisory board, should establish standard terminology to be used in reporting on and testifying about the results of forensic science investigations. Similarly, it should establish model laboratory reports for different forensic science disciplines and specify the minimum information that should be included. As part of the accreditation and certification processes, laboratories and forensic scientists should be required to utilize model laboratory reports when summarizing the results of their analyses.

What is meant by reporting "standards"?

Do we actually mean to prescribe the words the experts in particular disciplines would use in particular situations?

Yes

- Without standardized language, experts will not be able to convey the weight of the evidence in a calibrated fashion . . . Which is difficult enough to do in the first place

No

- If experts' language is rigidly bound by standards, then are they really functioning as scientists?
- Can they truly convey the weight of evidence as they perceive it if they are bound by standards

Testimony reviews

- Simon A. Cole, *Where the Rubber Meets the Road: Thinking About Expert Evidence as Expert Testimony,* 52 Villanova Law Review 803 (2007).

- FBI/NACDL Hair Comparison Review (2015)
  - 269 transcripts
  - Erroneous testimony in 258 (96%)
    1. Donor pool is specific individual, rather than group
    2. Baseless probability given
    3. Computes statistic based on casework

Testimony review

The Washington Post
Democracy Dies in Darkness

Public Safety

Justice Department frames expanded review of FBI forensic testimony

Deputy Attorney General Sally Yates is expected to propose expanding the Justice Department's review of forensic testimony by the FBI Laboratory beyond hair matching to widely used techniques such as fingerprint examinations. (Evelyn Hockstein/For The Washington Post)

By Spencer S. Hsu March 21, 2016

The Justice Department on Monday proposed expanding its review of forensic testimony by the FBI Laboratory beyond hair matching to widely used techniques such as fingerprint examinations and bullet-tracing.

Officials also said that if the initial review finds systemic problems in a forensic discipline, expert testimony could be reviewed from laboratories beyond the FBI that do analysis for DOJ.

"The authority afforded to scientific experts is second to none, and we must make sure that our statements are clearly supported by sound science," Deputy Attorney General Sally Yates said.

Data Issues

What we want

- Record of each laboratory report and trial transcript for each discipline in each case

- Or, laboratory Protocol or Standard Operating Procedure (SOP) for each laboratory or identification unit

What we have

- Trial transcripts are not systematically archived, indexed, or made publicly available
  - May in some cases be possessed by litigants
  - Usually not possessed by expert or laboratory
- Laboratory reports are even less well archived, indexed, or made publicly available
  - May in some cases be possessed by litigants
  - Usually possessed by expert or laboratory, but no mandate to archive, index or make publicly available
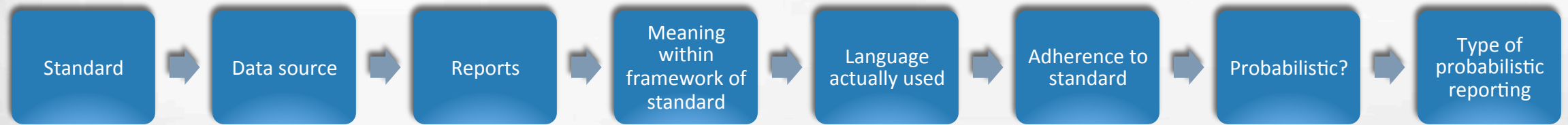
Data Sources

Discipline	Report sample size	From Westlaw	From consultants	From CTS	Median year
Latent Prints	91	41	50	0	2009
Firearm and Tool Marks	48	25	23	0	2003
Questioned Document	52	52	0	0	2006
Shoe prints	48	0	0	48	2017
Blood pattern	0				

- Sample is opportunistic, non-random
- Sample is probably skewed toward higher quality expert evidence

Presumptions

- All evidence is probabilistic in nature

- All evidence should therefore be reported in probabilistic fashion, meaning some probability no matter how small, should be assigned to each hypothesis

- "Categorical" reporting is at least suboptimal, if not worse

- Data > no data

- Absent data, the use of subjective probabilities might be preferable to the alternative

Process

Standard → Data source → Reports → Meaning within framework of standard → Language actually used → Adherence to standard → Probabilistic? → Type of probabilistic reporting

Types of Probabilistic Reporting

- **Explanation:** After examining the evidence, the analyst offers insight into areas of potential investigation, sometimes called "investigative leads" [Add an example]. The analyst articulates that their conclusions are not exhaustive, and no evaluation is conducted on their plausibility.
- **Evidence -**
- **Likelihood Ratio:** The ratio of the probability of the evidence on the assumption that the accused is guilty to the probability that of the evidence on the assumption that the accused is not guilty.
- Example: these hair characteristics are more likely to be observed if the hair come from Mr. X than if the hair come from somebody else.
- **Random Match Probability:** the probability that an item selected at random from some population will "match" (in some defined sense of "matching") another preselected item. For example, a hair is collected at a crime scene. The random match probability is the probability that the hair of a person chosen at random from the general population will match the characteristics of the hair from the crime scene.
- **Probability Inclusion:** The quantified measure of uncertainty that a suspect is included in a pool of possible offenders.
- **Compound Probability of Exclusion:** The proportion of a particular population that a specified characteristic would exclude. For example, if one out of five people in Kansas City has blue eyes, the probability that a person chosen at random from this population has blue eyes is 1/5. The probability of exclusion for the characteristic 'blue eyes' is 4/5.
- **Consistent with; Match:** describes an association of features, statements of similarity and does not offer a measure of the rarity or significance of the association.
- Example: "The characteristics of this hair are consistent with the hair from the defendant."
- "The hair found at the crime scene matches the hair of the defendant."
- **Subjective Posterior Probability, Verbal Statement:** A verbal statement offered regarding the probability, determined *after* consideration of specified evidence. Posterior probability is a measure of a person's beliefs in the accused's guilt or in the veracity of a witnesses account.
- Example: "It is highly likely that the hair found on the garment of the victim are from Mr. X."
- **Subjective Posterior Probability, Numerical Statement:** A numerical statement offered regarding the probability, determined *after* consideration of specified evidence. Posterior probability is a measure of a person's beliefs in the accused's guilt or in the veracity of a witnesses account.
- Example: "There is 95% chance that the hair found at the crime scene were left by Mr. X."
- **Objective Posterior Probability, Verbal Statement:** A verbal statement offered regarding probability that conforms to a logical statement that is taken to be true, with a measureable outcome.
- Example: "Using [some data/database/study], there is a high probability that the hair found under the nails of the victim belongs to Mr. X."
- **Objective Posterior Probability, Numerical Statement:** A numerical statement offered regarding the probability that conforms to a logical statement that is taken to be true, with a measureable outcome.
- Example: "Using some data/database/study, there is an 80% chance that the hair found under the nails of the victim came from Mr. X."
- **Categorical Conclusion:** All uncertainty is eliminated from the conclusion, there is no doubt expressed.
- Example: "I have excluded Mr. X as the source of the hair found at the crime scene."
- "I have identified the source of the hair found at the crime scene as being from Mr. X."
- "I am certain that Mr. X. left this hair."
- Definitions are based on information from The Royal Statistical Society in their Guide *Communicating and Interpreting Statistical Evidence in the Administration of Criminal Justice: 1. Fundamentals of Probability and Statistical Evidence in Criminal Proceedings*

Standards

Discipline	Standard	Date
Latent Prints	SWGFAST #10	2011
Firearm and Tool Marks	AFTE Range of Conclusions	2011
Questioned Document	SWGDOC Standard Terminology for Expressing Conclusions . . .	2013
Shoe print	SWGTREAD Range of Conclusions	2013

Shoe prints (n=48)

Report type according to standard	n	Actual language used	n	Adherence to standard	Probabilistic	Statistical Report Type		
						Consistent/match	Subjective verbal probability	Categorical
Lacks sufficient detail	0		0	0	0	0	0	0
Exclusion	2	No relation/not same	2	0	0	0	0	2
Indications of non-association	2	Indications of non-association	2	2	2	2	0	0
Limited association	6	Limited association	1	1	1	1	0	0
		Similar	4	0	4	2	2	0
		Consistent/correspondence	1	0	1	1	0	0
Association	4	May have	2	0	2	0	2	0
		Similar	2	0	2	1	1	0
High degree of association	34	High degree of association	17	17	17	15	2	0
		Extremely/very strong support	6	0	6	0	6	0
		Consistent/Correspondence	6	0	6	6	0	0
		(Very) likely/probably	4	0	4	0	4	0
		Similar	1	0	1	1	0	0
Identification	0		0	0	0	0	0	0
Total	**48**	**48**	**48**	**20 (42%)**	**46 (96%)**	**29 (60%)**	**17 (35%)**	**2 (4%)**

Shoeprints: Observations

- No use of "identification"
- Testimony is almost always probabilistic
  - But no objective or quantitative probabilities
- Clustering of "associations" in "high"
- Same term in report used to indicate different conclusions according to standard
  - E.g., "similar" for "limited association," "association," and "high association"
  - "consistent/correspondence" for "limited" and "high association" [!]
- Low adherence to standard
- Ambiguity as to whether purpose of reporting is to describe consistencies or posterior probabilities
- Vocal minority of Bayesian responses
  - Contrary to (US) standard
  - But only for "high association" [?]

Fingerprints (n=91)

Report type according to standard	n	Actual language used	n	Adherence to standard	Probabilistic	Statistical Report Type	
						Consistent/match	Categorical
Exclusion	4	Exclusion	4	4	0	2	2
Inconclusive	1	Inconclusive	1	1	1	1	0
Individualization	86	Individualized	8	8	0	0	8
		Identified	34	34	0	0	34
		Same source/person	27	27	0	0	27
		Match	8	0	0	7	1
		Possession	9	0	0	0	9
Total	**91**		**91**	**74 (81%)**	**1 (1%)**	**10 (11%)**	**81 (89%)**

Fingerprints: Observations

- High adherence to standard
  - But standard allows at least 3 formulations for "individualization/ identification"
- Variety of formulations used for "individualization/ identification" in actual testimony
- Almost all testimony categorical
  - virtually all if "match" is considered categorical
- Almost no testimony probabilistic
  - Probability mentioned only in its denial

Firearm/toolmark (n=48)

Report type according to standard	n	Actual language used	n	Adherence to standard	Probabilistic	Statistical Report Type			
						Consistent/ match	Subjective posterior verbal	Subjective posterior numerical	Categorical
Exclusion	6	Exclusion	6	6	0	0	0	0	6
Inconclusive	14	Inconclusive	14	14	14	5	8	1	0
Individualization	28	Identified	12	12	2	0	2	0	10
		Same source/ person	16	16	0	0	0	0	16
Total	**48**		**48**	**48 (100%)**	**16 (33%)**	**4 (8%)**	**10 (21%)**	**1 (2%)**	**32 (67%)**

Firearm/toolmark: Observations

- Complete adherence to standard
- Narrower use of language than fingerprints
- 2/3 all reports categorical
- Almost no probabilistic reports (except for inconclusives)
- Verbal probabilistic reports for identification
  - "The probability is very very low. . . . Anything is possible, anything. But the probability, due to all the variables that I mentioned before, is close to zero."
- One numerical probabilistic report for inconclusive
  - "I was not able to assign it a hundred percent certainty, but a, what we call an 'entirely consistent,' 95 percent certainty."
- Probability discussed in its denial

Questioned documents (n=47)

Report type according to standard	n	Actual language used	n	Adherence to standard	Probabilistic	Statistical Report Type		
						Consistent/match	Subjective posterior verbal	Categorical
Elimination	10	Elimination	1	1	0			1
		Not same	9	9	0			9
Strong probability did not	1	May have	1	0	1		1	
Probably did not	2	Probably not	2	2	2		2	
Indications did not	2	Indications did not	2	2	2		2	
No conclusion	5	No conclusion	3	3	3		3	
		Could not determine	2	2	2		2	
Indications	1	May have	1	0	1	1		
Probable	7	Probably	7	7	7		7	
Strong probability	7	Strong/highly probably/likely	7	7	7		7	
Individualization	17	Identified	6	6	0			6
		Same source/person	11	11	1		1	10
Total	**52**		**52**	**50 (96%)**	**26 (50%)**	**1 (2%)**	**25 (48%)**	**26 (50%)**

Summary

Discipline	n	Adherence to standard	Probabilistic	Statistical report type			
				Consistent/ match	Subjective verbal	Subjective numerical	Categorical
Shoe prints	48	42%	96%	60%	35%		4%
Friction Ridge	91	74%	1%	11%			89%
Firearm/toolmark	48	100%	33%	8%	21%	2%	67%
Questioned documents	52	50%	50%	2%	48%		50%

Summary: Observations

- Adherence to standards higher in disciplines with fewer categories

- But probabilistic testimony is lower

- High usage of categorical testimony and consistent/match

- Probabilistic testimony overwhelmingly tends to be verbal

- Almost no numerical probabilities

  - Source of the little there are is not clear

Survey distributed by ASCLD

Membership Survey Requests

You are being asked to participate in a research study on forensic reporting practices. The purpose is to understand how forensic results are being reported in crime laboratories right now. The survey is being administered by The Center for Statistics and Applications in Forensic Evidence (CSAFE) .

Link Or copy and paste
https://ucisoe.qualtrics.com/jfe/form/SV_emPjzxm8gZj0Pyd
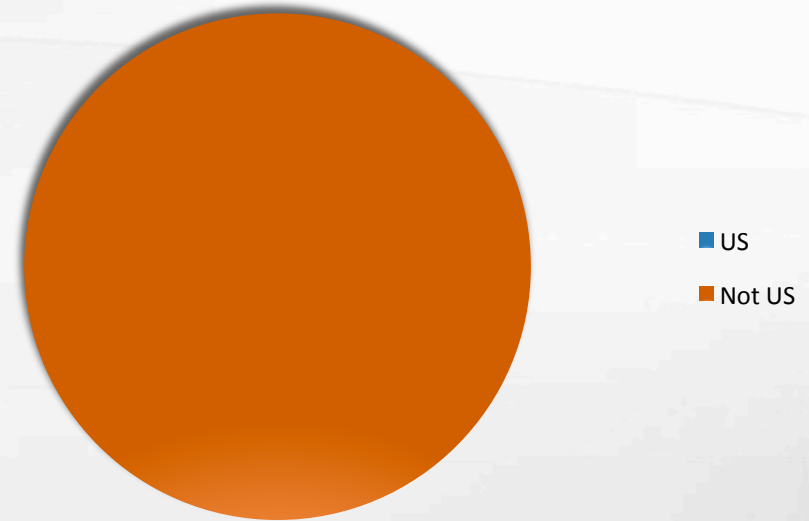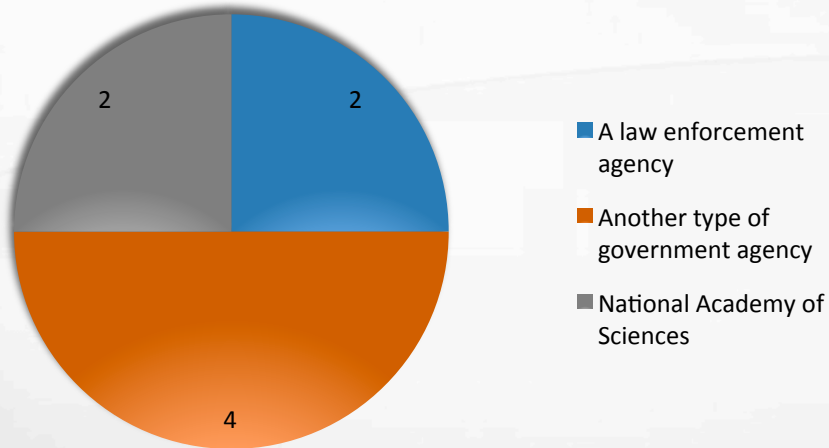
DNA Analysis Methods

Cedar Crest College's accredited forensic science program is conducting a survey to determine current methods of presumptive and confirmation testing in laboratories to guide our research efforts and curriculum.

https://www.surveymonkey.com/r/DNAanalysismethods

We greatly appreciate your assistance; please let me know if you have any questions.

Survey responses: descriptive (n=8)

Pie chart legend:
- A law enforcement agency (2)
- Another type of government agency (4)
- National Academy of Sciences (2)

Pie chart legend:
- US
- Not US

- Appeared in ASCLD newsletter 9 times
- Distributed twice by ENFSI Secretariat
- 71 opened surveys
- 28 responded eligible and willing to participate
- 8 answered questions about reporting practices in specific disciplines
- 14 answered opinion questions

- Laboratory size
 - Mean = 110
  - Range = 30-500

Survey results: reporting

Discipline	Practice	Consider reporting probabilistic	Verbal report	Verbal categories range	Verbal categories mean	Quantitative basis for verbal report	Numerical report
Handwriting	8	4	7	3-7	5.9	1	1
F/T	6	2	5	5-7+	5.6	1	1
Fingerprint	5	1	5	3-5	4	0	0
Footwear	4	2	4	5-7+	7.3	1	0
Tire	4	2	4	5-7+	5.5	1	0
Blood	3	1	3	5-7+	5.7	1	0

Survey: Observations

- Some European laboratories believe they are testifying probabilistically, but not all

- Probabilities are overwhelmingly verbal

- Almost no numerical probabilities

  - And basis for those there are is not clear

- One laboratory claims to have numerical basis for verbal probabilities

Opinion survey respondents: descriptive (n=14)
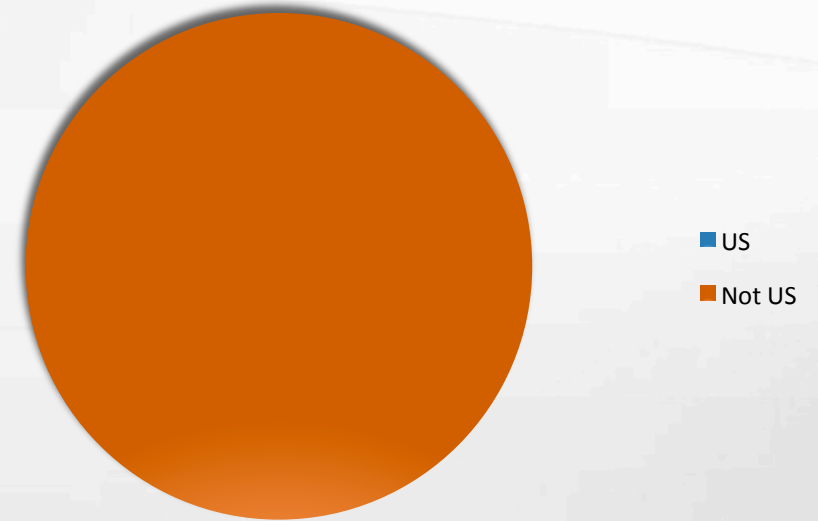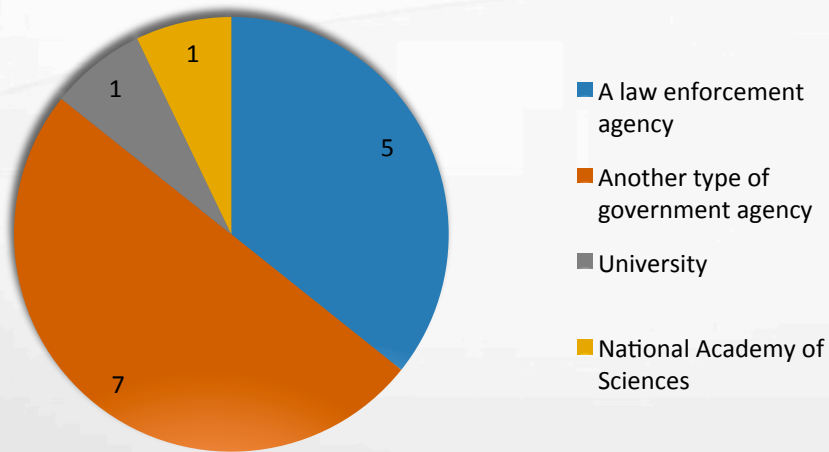
- Laboratory Size
  - Mean = 125
  - Range = 2-500

Survey: opinions (n=15)

Do you think probabilistic reporting of forensic results is necessary?				
Definitely yes	Probably yes	Might or might not	Probably not	Definitely not
6	6	3	0	0

How important do you think probabilistic reporting of forensic results is?				
Extremely important	Very important	Moderately important	Slightly important	Not important at all
3	7	5	0	0

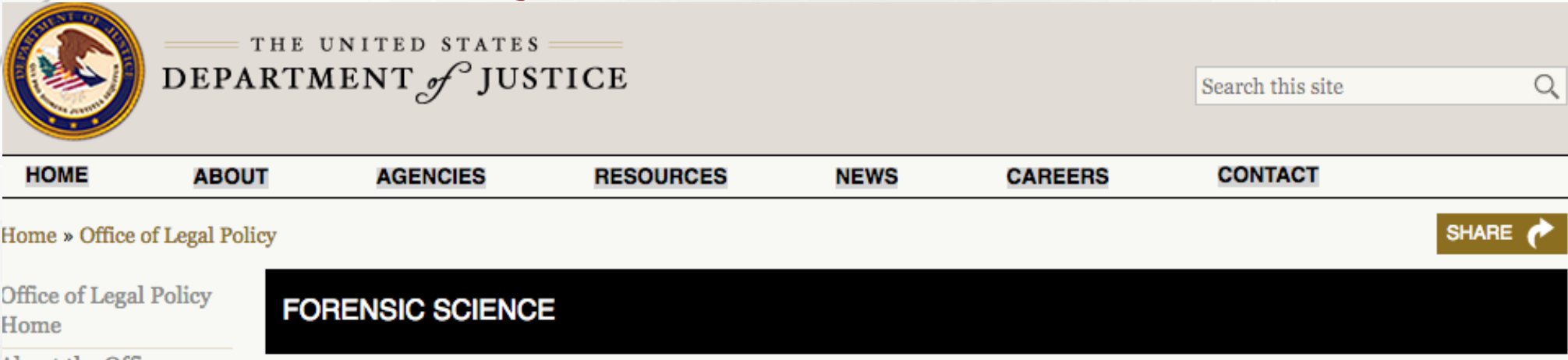| How would you characterize the steps you feel your laboratory has taken toward the probabilistic reporting of forensic results?				
A great deal	A lot	A moderate amount	A little	None at all
3	4	5	3	0

Survey: opinions (n=13)

- What percentage of all forensic reports would you estimate use the probabilistic reporting of forensic results?
  - Mean = 62%
  - Range = 10%-100%

- What percentage of all forensic reports would you estimate use the probabilistic reporting of forensic results?
  - Mean = 44%
  - Range = 5%-100%

Publicly available SOPs

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FORENSIC SCIENCE

QUALITY MANAGEMENT SYSTEM DOCUMENTS

The Department posts quality management system documents online to promote the scientific value of transparency and enhance knowledge of Department forensic policies and practices by the stakeholders. These documents include quality assurance measures, laboratory policies, and standard operating procedures for testing and analysis, and summaries of internal validation studies for forensic methods and techniques that are currently used by Department labs.

FBI Quality Management System Documents ⌐

DEA Quality Management System Documents

ATF Quality Management System Documents

Summary: survey

- Probabilistic reporting is viewed as important
- Progress is viewed as modest

Conclusions

- Data is difficult to obtain

- Most SOPs are still not publicly available

- Little American interest in completing surveys on reporting

- Little probabilistic reporting, especially in disciplines with "identification/individualization" commonly used and 3-category schemes (e.g., latent prints, F/T)

- What probabilities there are overwhelmingly subjective and verbal

  - Little or no quantitative basis for verbal probabilities

Verbal scales

3 category

- High adherence to standards
- High use non-probabilistic reports

5+ category

- Lower adherence to standards
- More probabilistic testimony
  - But neither objective nor quantitative
- Will require greater regulation of actual language used

Thanks

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