**POINTS AND AUTHORITIES IN SUPPORT OF ADMISSIBILITIY OF FORENSIC DNA EVIDENCE and OPPOSITION TO DEFENDANT’S MOTION FOR PERFORMANCE OF DNA TESTING**

##### State of California

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**ARGUMENT**

**I**

**FORENSIC DNA POLYMERASE CHAIN REACTION ANALYSIS MEETS THE GENERAL ACCEPTANCE REQUIREMENT OF *FRYE v. UNITED STATES***

This court should permit admission of forensic DNA typing results derived from typing of the "DQ-Alpha," "Polymarker," and "short tandem repeat" genetic markers. The use and admission of forensic DNA typing results based on the above markers has been previously approved judicially in both California and other jurisdictions in the United States.

A brief examination of relevant standards governing the admission of scientific evidence is instructive. The admissibility of testimony presented by experts in the state of California based upon the use of new or novel scientific techniques is governed by the rules set forth in *Frye v. United States* (D.C.Cir. 1923) 293 F. 1013, and *People v. Kelly* (1976) 17 Cal.3d 24. Specifically, the "*Kelly-Frye*" rule in this state requires the proponent of such evidence to establish, prior to admission, the **reliability** of the scientific method employed. (*People v. Kelly*, *supra*, at p. 30; see also *People v. Leahy* (1994) 8 Cal.4th 587, 604.)

**Reliability** for purposes of compliance with *Frye* has been interpreted by the California Supreme Court to mean the technique used "must be sufficiently established to have gained general acceptance in the particular field in which it belongs." (*People v. Kelly*, *supra*, at p. 30.) The *Kelly* court based its conclusion on the discussion in *Frye* which noted,

". . . while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs." (*Frye v. United States*, *supra*, at p. 1014.)

The *Kelly* court added an additional inquiry in its 1976 decision, requiring the proponent to demonstrate that "correct scientific procedures" were used in the testing conducted in the particular case. (*People v. Kelly*, *supra*, at p. 30; see Argument III, *infra*.)

Contrary to defendant’s assertion, witnesses with an alleged “professional interest” in a technology are frequently the most probative to any court’s decision with regard to the reliability of a scientific technology. In rejecting defendant’s contention that the testimony of bench analysts should be ignore, a California court of appeal concluded in 1987:

“It would be a strange perversion of *Kelly/Frye* to exclude the opinions of analysts, at least well-credentialed ones. Those who work closest to a technique may be uniquely aware of inherent reliability problems. Also, it was particularly important to have actual analysts testify in this case because a major part of defendant’s challenge was to the ability of analysts to differentiate between reliable and unreliable results.” (*People v. Reilly* (1997) 196 Cal.App.3d 1127, 1140.)

DNA testing technologies which have been exploited and applied to forensic investigation include the use of the "polymerase chain reaction" ("PCR") to produce DNA of sufficient quantity for genetic marker typing. PCR, itself simply a molecular biological tool, is employed to rapidly and efficiently prepare evidentiary material of both known and unknown origin for ultimate genetic marker analysis.

First utilized in forensic casework in 1986 in a Pennsylvania homicide prosecution,[[1]](#footnote-1) forensic investigations utilizing PCR-based techniques have increased dramatically in the United States and abroad. Sexual assault and other crimes of violence involving biological evidence are routinely examined in many American and international jurisdictions with PCR-based typing systems.

Developed by a California scientist who received the Nobel Prize in chemistry for his discovery, PCR has proven one of the most significant additions to molecular biology in this century. PCR-based DNA typing systems are currently employed in fields such as human disease diagnosis, endangered species conservation and reproduction, and identification of American war dead remains.

DNA restriction fragment length polymorphism ("RFLP") testing -- not employed in the present case -- necessitates dividing DNA into fragments of various sizes. (*People v. Axell* (1991) 235 Cal.App.3d 836, 846.) Because some of these fragments are relatively large, the RFLP testing process requires that DNA extracted from evidentiary material be well preserved -- in "high molecular weight" form -- for the procedure to be successfully employed.

PCR amplification is utilized to genetically amplify smaller segments of DNA in order to produce sufficient sample for purposes of typing. The HLA Class II genetic marker DQ-Alpha has been typed since 1986. The human population is divided into 28 different DQ-Alpha "genotypes" among which current methods commonly discriminate.

Similar to RFLP typing, forensic use of PCR-based DQ-Alpha typing has increased rapidly both nationally and internationally since 1986. The Federal Bureau of Investigation, as well as numerous local, regional, state, and international laboratories, have added DQ-Alpha and other PCR-based genetic markers to their repertoire of typing programs.[[2]](#footnote-2)

The development in the 1980's of typing systems applied to PCR-amplified evidentiary material has led to the addition of further genetic markers to supplement DQ-Alpha and provide greater discrimination power. One system, the AmpliType® Polymarker PCR amplification and typing kit, is utilized by forensic laboratories to simultaneously type amplified DNA at five genetic markers in addition to DQ-Alpha.[[3]](#footnote-3) Prior to employment in casework analysis, the Polymarker typing system was subjected to extensive and rigorous validation by numerous testing laboratories.[[4]](#footnote-4)

The Polymarker typing kit utilizes the same amplification and typing format as has been employed in the typing of the DQ-Alpha genetic marker since 1990. Polymarker typing increases the discrimination potential of use of the DQ-Alpha marker alone by allowing typing of the additional genetic markers low density lipoprotein receptor ("LDLR"), glycophorin A ("GYPA"), hemoglobin G gamma globin ("HBGG"), D7S8, and group specific component ("GC").[[5]](#footnote-5)

Finally, one further DNA typing approach, applying both the amplification benefit of PCR and the fragment length resolution method of RFLP, is frequently referred to as short tandem repeat ("STR") typing. STR testing techniques are utilized to type evidentiary samples at multiple genetic markers to obtain greater information. STR markers studied and verified as robust, informative and appropriate for forensic identification include the genetic loci D3S1358, vWA, FGA, D8S1179, D21S11, D18S51, D5S818, D13S317, and D7S820.[[6]](#footnote-6)

Forensic DNA PCR-based typing is neither new nor novel within the meaning of the *Kelly-Frye* standard. PCR-based testing, as utilized in the instant case and as was noted, *supra*, has been employed since 1986. Furthermore, even were this court to find that after 11 years PCR-based testing remains new or novel, general acceptance has been previously determined at numerous scientific and legal junctures.

The National Research Council of the National Academy of Sciences, in its report, *DNA Technology in Forensic Science*, endorsed forensic uses of DNA typing technologies, including PCR-based analysis. In particular, the report states:

"Regarding the underlying principles, there is, as we have noted, no longer any question concerning the principle that DNA can be used to obtain identification information; admissibility hearings need no longer address the question. Regarding the particular method for applying the principle, the inquiry will depend on the **new method or technology**. . . In each case, the court can properly limit the inquiry to the **substantially novel aspects** of the technology, focusing on whether the method is accepted for scientific applications and whether it has been validated for forensic identification." (*DNA Technology in Forensic Science*, National Research Council (U.S.), National Academy of Sciences, 1992, at pp. 144-145; emphasis added.)

State supreme and intermediate appellate court opinions addressing the admissibility of PCR-based typing are common. The first decision, rendered by the Virginia Supreme Court in 1990, affirmed the admissibility of PCR DQ-Alpha typing utilizing the reliability standard. (*Spencer v. Commonwealth* (Va. 1990) 393 S.E.2d 609, 621 ("Spencer IV"); see also *Keen v. Commonwealth* (Va.App. 1997) 485 S.E.2d 659.) One year later, a Texas court of appeal similarly concluded that PCR DQ-Alpha testing was sufficiently demonstrated to be reliable and thus admissible before the trier of fact. (*Clarke v. Texas* (Tex.App. 1991) 813 S.W.2d 654, 655 (aff'd Tex.Ct.Crim.App. (1992) 839 S.W.2d 92); see also *Campbell v. State* (Tex. 1995) 910 S.W.2d 475, 479; *Massey v. State* (Tex.App. 1996) 933 S.W.2d 141.)

Since that time numerous additional states, including California, have upheld the admissibility of PCR-based genetic marker typing results. (*Payne v. State* (Ala.App. 1995) 683 So.2d 440, 456; *Seritt v. State* (Ala.App. 1994) 647 So.2d 1, 5; *Brodine v. State* (Alas.App. 1997) 936 P.2d 545; *Harmon v. State* (Alas.App. 1995) 908 P.2d 434, 442; *State v. Tankersley* (Ariz. 1998) 956 P.2d 468; *State v. Adams* (Ariz. 1999) 984 P.2d 16; *Johnson v. State* (Ark. 1996) 934 S.W.2d 179 [finding PCR-based DNA typing population frequency estimates admissible]; *Esty v. State* (Fla. 1994) 642 So.2d 1074, 1079 [but see *Murray v. State* (Fla. 1997) 692 So.2d 157 (finding testimony of single technician insufficient to justify admissibility)]; *Redding v. State* (Ga.App. 1995) 464 S.E.2d 824, 828; *People v. Pope* (Ill.App. 1996) 672 N.E.2d 1321; *State v. Isley* (Kan. 1997) 936 P.2d 275; *State v. Haddock* (Kan. 1995) 897 P.2d 152, 167; *State v. Hill* (Kan. 1995) 895 P.2d 1238, 1247; *State v. Pooler* (La.App. 1997) 696 So.2d 22; *State v. Spencer* (La.App. 1995) 663 So.2d 271, 275; *Commonwealth v. Sok* (Mass. 1997) 683 N.E.2d 671; *Commonwealth v. Rosier* (Mass. 1997) 683 N.E.2d 671; *People v. Lee* (Mich. 1995) 537 N.W.2d 233, 257-258; *State v. Brown* (Mo.App. 1997) 949 S.W.2d 639; *State v. Hoff* (Mo.App. 1995) 904 S.W.2d 56, 59; *State v. Moore* (Mont. 1994) 885 P.2d 457, 475; *State v. Harvey* (N.J. 1997) 699 A.2d 596; *State v. Dishon* (N.J.App. 1997) 687 A.2d 1074; *People v. Morales* (N.Y.App. 1996) 643 N.Y.S.2d 217; *State v. Lyons* (Ore. 1996) 924 P.2d 802, 816; *State v. Moeller* (S.D. 1996) 548 N.W.2d 465, 483; *State v. Begley* (Tenn. 1997) 956 S.W.2d 471; *United States v. Hicks* (9th Cir. 1996) 103 F.3d 837; *United States v. Beasley* (8th Cir. 1996) 102 F.3d 1440.)

In an extended discussion, the Washington Supreme Court specifically approved the admissibility of PCR DQ-Alpha typing using the *Frye* general acceptance standard. (*State v. Russell* (Wash. 1994) 882 P.2d 747.) Following a lengthy pretrial hearing which included the testimony of seven expert witnesses, the trial court concluded that PCR DQ-Alpha testing was generally accepted in the scientific community. (*State v. Russell*, *supra*, at p. 761.)

Russell complained to the Washington Supreme Court, like defendant in the present case, that the National Research Council report demonstrated that general acceptance of PCR-based typing was absent. The court disagreed and noted that the report firmly supported general scientific acceptance of the use of PCR-amplified product for forensic typing. (*Id*., at pp. 763-769.)

The court carefully detailed the routine use of PCR-based testing outside forensic science, including, for example, the fields of disease detection and diagnosis, gene therapy, epidemiology, pedigree analysis, and anthropology. Significantly, the court also noted uses of the technology with other than pristine samples, including to detect microorganisms in water, food, dairy, and soil samples, monitor environmental contamination, and identify the remains of American war dead. (*Id*., at p. 765; see also *State v. Gentry* (Wash. 1995) 888 P.2d 1105, 1117-1118.)

California case law has resolved the admissibility of PCR-based forensic typing. The First District, in an opinion delivered in March 1996, concluded that PCR-based forensic testing meets the *Frye* general acceptance standard. (*People v. Morganti* (Cal.App. 1996) 43 Cal.App.4th 643, 671.) Specifically, the Court of Appeal concluded:

"In ruling that PCR analysis of the DQ alpha gene is generally accepted in the relevant scientific field, the trial court relied on expert testimony of two witnesses and extensive documentary evidence. The court found there is no significant controversy or dispute with respect to the reliability of this method and that the evidence did not indicate any flaw in the method or its use. Our review of the record confirms these findings." (*People v. Morganti*, *supra*, at p. 663.)

The same court of appeal delivered a subsequent opinion in 1998 regarding the continued litigation of admissibility of forensic PCR-based DNA typing results. That court, in *People v. Wright* (1998) 62 Cal.App.4th 31, approved admissibility of both DQ-Alpha and Polymarker genetic marker typing results. (*People v. Wright*, *supra*, at p. 41.)

Importantly, the court of appeal underscored the fact that continued litigation of forensic PCR-based typing admissibility was unnecessary. Specifically, the court stated:

"Our trial courts will no longer need to expend valuable time and resources on repetitive *Kelly*-*Frye* hearings directed to this issue of the admissibility of DNA evidence derived from the PCR method, as the trial court was forced to do in this case, now that the well-reasoned *Morganti* decision has become final. [Fn. omitted.] Issues as to the proper weight to be accorded to such evidence are for the jury, and may not be avoided by attempts to recast such jury issue as *Kelly*-*Frye* issues." (*People v. Wright*, *supra*, at pp. 42.)

Evidence sought to be introduced by the People in the present case, as noted above, will include, in addition to the DQ-Alpha genetic marker, the typing of PCR-amplified evidentiary material at the genetic loci LDLR, GYPA, HBGG, D7S8, and GC (the "Polymarker" system), and the STR markers D3S1358, vWA, FGA, D8S1179, D21S11, D18S51, D5S818, D13S317, and D7S820.

The California Supreme Court has directly addressed the admissibility of results of typing at multiple genetic markers. The defendant in *People v. Cooper* (1991) 53 Cal.3d 771, complained that typing results obtained through use of electrophoresis to type the protein genetic marker transferrin ("Tf") were inadmissible. Specifically, Cooper contended that the addition of transferrin to the stable of genetic markers typed through the use of electrophoresis was too new to have obtained general scientific acceptance.

The Supreme Court rejected Cooper's complaint. Specifically, the Court stated:

"All of the experts . . . who testified on the matter said that testing for transferrin was a valid application of a method such as

electrophoresis that has been accepted as reliable. (See *People v. Smith* (1989) 215 Cal.App.3d 19, 27, fn. 4 [once electrophoresis is admissible, criticism of any specific methodology goes to the weight of the evidence, not its admissibility].)" (*People v. Cooper*, *supra*, at pp. 812-813; see also *People v. Fierro* (1991) 1 Cal.4th 173, 214.)

The report of the National Research Council similarly concludes that relitigation of admissibility of results obtained from typing of different genetic markers is unnecessary. In particular, the report provides, as discussed above:

"Regarding the particular method for applying the principle, the inquiry will depend on the **new method or technology**. . . In each case, the court can properly limit the inquiry to the

**substantially novel aspects** of the technology . . ." (*DNA Technology in Forensic Science*, *supra*, at pp. 144-145; emphasis added.)

The only feature in typing the five Polymarker genetic loci (LDLR, GYPA, HBGG, D7S8, and GC) which differs from the testing of DQ-Alpha alone is the simultaneous amplification ("multiplex amplification") through PCR of those five specific genes.[[7]](#footnote-7) Multiplex amplification has been thoroughly investigated and validated.[[8]](#footnote-8) The 1996 report of the National Research Council, *The Evaluation of Forensic DNA Evidence* (see also argument II, *infra*), concludes that Polymarker typing is robust and scientifically validated. (*Id*., at p. 72 [Exhibit 1, attached].)

The admissibility of Polymarker typing following PCR amplification has already been resolved in several states, including Alaska, California, Kansas, Massachusetts, New Jersey, New York and the Eighth Circuit, under both the general acceptance and *Daubert* standards. (*Brodine v. State* (Alas.App. 1997) 936 P.2d 545; *State v. Isley* (Kan. 1997) 936 P.2d 275; *Commonwealth v. Sok* (Mass. 1997) 683 N.E.2d 671; *Commonwealth v. Rosier* (Mass. 1997) 683 N.E.2d 671; *State v. Harvey* (N.J. 1997) 699 A.2d 596; *People v. Morales* (N.Y.App. 1996) 643 N.Y.S.2d 217; *United States v. Beasley* (8th Cir. 1996) 102 F.3d 1440; see also *Keen v. Commonwealth* (Va.App. 1997) 485 S.E.2d 659.)

Furthermore, examination of STR genetic markers, which utilize the PCR amplification procedure prior to fragment length analysis, has been studied, described, validated, and scientifically employed since at least 1991.[[9]](#footnote-9) The 1996 National Research Council report, *The Evaluation of Forensic DNA Evidence*, *supra*, has also endorsed the use of PCR-based STR typing. (*Id*., at pp. 32, 70-71, 73, 117-119 [Exhibit 1, attached].)

Significantly, both the Supreme Judicial Court of Massachusetts and the Nebraska Supreme Court have fully endorsed the admissibility of short tandem repeat ("STR") PCR-based typing, the former citing the 1996 National Research Council report. (*Commonwealth v. Rosier* (Mass. 1997) 685 N.E.2d 739; *State v. Jackson* (Neb. 1998) 582 N.W.2d 317.)

Most importantly, a 1999 California Court of Appeal opinion concluded general acceptance had been established by the testimony of one witness of STR PCR-based DNA typing. Citing both the 1996 National Research Council report and two out-of-state opinions, the court determined that admissibility was clearly established. (People v. Allen (Cal.App. 1999) 72 Cal.App.4th 1093, 1099-1101.)

Defendant in the instant case complains that continued litigation should be undertaken by this court due to the use of genetic markers not previously litigated and published in appellate court precedent in California. Defendant’s contention, if accepted, would require litigation of PCR-based DNA analysis forever. The scientific method and continued research and investigation of genetic markers necessarily leads to the use of more robust and informative locations of the human genetic code.

Furthermore, existing case law states that such continued litigation is unnecessary and unduly burdensome to the criminal justice system. The California Supreme Court has specifically stated with regard to serological electrophoretic analysis, in the context of a defense *Kelly-Frye* attack based on a novel application of the technology:

“Defendant also asserts that the particular method of testing utilized in this case, the multisystem method, has not achieved general acceptance in the scientific community. As we recently observed, however, once electrophoresis is deemed to be admissible, criticism of any particular methodology goes to the weight of the evidence, not to its admissibility. (*People v. Cooper, supra,* 53 Cal.3d at pp. 812-813.)” (*People v. Fierro* (1991) 1 Cal.4th 173, 214.)

**II**

**POPULATION FREQUENCY DATA DERIVED FROM USE**

**OF THE PRODUCT RULE MEETS THE**

**REQUIREMENTS OF *FRYE v. UNITED STATES***

Defendant also challenges the admissibility of population frequency estimates attached to matching DNA profiles. Curiously, defendant cites *People v. Soto* (1999) 21 Cal.4th 512, which resolved any admissibility questions regarding RFLP-based genetic marker testing.. Frequency estimates in the present case have been calculated by the Serological Research Institute ("SERI") from PCR-based genetic markers, alone, without need to resort to the near-infinite variations within RFLP markers.

Numerous scientific and legal events have demonstrated clear and unequivocal acceptance of the reliability of population frequency data as calculated by testing laboratories since the advent of forensic DNA typing, whether for RFLP or PCR-based genetic markers.

Defendants nationwide have relied substantially on the 1992 report of the National Research Council, *DNA Technology in Forensic Science*. A committee composed of numerous scientists and non-scientific members specifically addressed the area of population frequency data and rendered several opinions. Specifically, the report noted with regard to the potential that statistical estimates of matching DNA profiles may overestimate the rarity of a match, that some population geneticists "believe that the absence of substructure [pockets of human populations that share characteristics more commonly than larger population groups] cannot be assumed, but must be proved empirically." (*Id*., at p. 80.)

Other population geneticists, the report concluded, "while recognizing the possibility or likelihood of population substructure, conclude the evidence to date suggests that the effect on estimates of genotype frequencies are [sic] minimal." (*Ibid*.) Significantly, the committee specifically noted that the empirical data produced to date demonstrated that any substructuring which may exist had no appreciable effect on the calculation of population frequencies. (*Ibid*.)

However, the committee elected to "assume for the sake of discussion" that such substructuring may both exist and sufficiently affect population frequency calculations so as to require remedy. The committee made several recommendations and concluded that until studies the committee suggested were undertaken and completed, an interim mathematical calculation approach should be employed by testing laboratories, denominated the "interim ceiling approach." (*Id*., at pp. 91-93.)

The effect of the "interim ceiling approach" was to artificially reduce the rarity of matching profiles from estimates obtained through use of long-standing statistical practices of testing laboratories. The committee also specifically stated that its recommendations were prospective in nature only; the committee in no manner intended to question the calculation of population frequency data presented in prior cases. (*Id*., at p. 93.)

Appellate court discussion and reaction to the report of the National Research Council varied. The Massachusetts Supreme Judicial Court, in *Commonwealth v. Lanigan & Breadmore* (Mass. 1992) 596 N.E.2d 311 ["*Lanigan* I"], reviewed a trial court order precluding introduction of population frequency data. The Court concluded the trial court did not err in finding the existence of an ongoing scientific dispute and thus the absence of general acceptance of the method by which RFLP frequency data was calculated. The court, however, specifically referred to the report of the National Research Council and invited the use of frequency data compiled through use of the "ceiling" method. (*Commonwealth v. Lanigan & Breadmore*, *supra*, at p. 316; see also *State v. Vandebogart* (N.H. 1992) 616 A.2d 483, 494; *State v. Bible* (Ariz. 1993) 858 P.2d 1152, 1188; *State v. Cauthron* (Wash. 1993) 846 P.2d 502, 516-517; *State v. Sivri* (Conn. 1994) 646 A.2d 169, 192.)

However, the Massachusetts Supreme Judicial Court later reversed its earlier finding of inadmissibility of frequency data, concluding that application of the "ceiling method" rendered statistical results appropriate for admission. (*Commonwealth v. Lanigan* (Mass. 1994) 641 N.E.2d 1342, 1349 ["*Lanigan* II"]; see also *Commonwealth v. Teixeira* (Mass. 1996) 662 N.E.2d 726, 728.)

Finally, the same court in 1997 revoked its earlier reasoning, turned full circle, and endorsed use of the unadorned or "unmodified" product rule as used by laboratories since the advent of forensic RFLP typing. (*Commonwealth v. Fowler* (Mass. 1997) 685 N.E.2d 746; *Commonwealth v. Rosier* (Mass. 1997) 685 N.E.2d 739.)

Significantly, the states of New Hampshire, Arizona and Washington -- which initially rejected use of statistical estimates -- have embraced their usage in later opinions, agreeing with many of the same conclusions accepted by the Massachusetts Supreme Judicial Court in 1997 and rejecting their own earlier findings. (*State v. Vandebogart* (N.H. 1994) 652 A.2d 671, 675; *State v. Johnson* (Ariz. 1996) 922 P.2d 294; *State v. Johnson* (Ariz.App. 1995) 905 P.2d 1002, 1008-1011; *State v. Copeland* (Wash. 1996) 922 P.2d 1304, 1319; *State v. Buckner* (Wash. 1997) 941 P.2d 667, 668.)

The large majority of federal and state supreme and intermediate appellate courts which confronted the admissibility of population frequency data have approved admissibility of estimates derived from use of the long-standing unmodified product rule and rejected the 1992 National Research Council recommendation. (*Lindsey v. People* (Colo. 1995) 892 P.2d 1, 291-292; *Brim v. State* (Fla. 1997) 695 So.2d 268; *Clark v. State* (Fla.App. 1996) 679 So.2d 321, 322; *People v. Miller* (Ill. 1996) 670 N.E.2d 721; *People v. The Almighty Four Hundred* (Ill.App. 1997) 677 N.E.2d 1332; *Jenkins v. State* (Ind. 1993) 627 N.E.2d 789, 794; *State v. Colbert* (Kan. 1995) 896 P.2d 1089, 1097-1098; *State v. Dykes* (Kan. 1993) 847 P.2d 1214, 1218; *State v. Fleming* (Me. 1997) 698 A.2d 503; *Armstead v. State* (Md.App. 1996) 673 A.2d 221, 240-243; *Keirsey v. State* (Md.App. 1995) 665 A.2d 700, 712; *Commonwealth v. Rosier* (Mass. 1997) 685 N.E.2d 739; *Commonwealth v. Fowler* (Mass. 1997) 685 N.E.2d 746; *People v. Leonard* (Mich.App. 1997) 569 N.W.2d 663; *People v. Chandler* (Mich.App. 1995) 536 N.W.2d 799, 803; *People v. Adams* (Mich.App. 1992) 489 N.W.2d 192, 197-198; *State v. Huchting* (Mo.App. 1996) 927 S.W.2d 411, 420; *State v. Kinder* (Mo. 1996) 942 S.W.2d 313; *State v. Freeman* (Neb. 1997) 571 N.W.2d 276; *State v. Marcus* (N.J.App. 1996) 683 A.2d 221; *People v. Wesley* (N.Y. 1994) 633 N.E.2d 451, 457; *State v. Futrell* (N.C.App. 1993) 436 S.E.2d 884, 890-891; *State v. Pierce* (Ohio 1992) 597 N.E.2d 107, 115; *Taylor v. State* (Okla.App. 1995) 889 P.2d 319, 336; *State v. Futch* (Ore.App. 1993) 860 P.2d 264, 272-273 [aff'd, *State v. Futch* (Ore. 1996) 924 P.2d 832]; *State v. Campbell* (R.I. 1997) 691 A.2d 564 [frequency data question of weight, not admissibility]; *State v. Morel* (R.I. 1996) 676 A.2d 1347, 1356; *State v. Copeland* (Wash. 1996) 922 P.2d 1304, 1319, 1333 [noting general acceptance of use of product rule]; *State v. Jones* (Wash. 1996) 922 P.2d 806, 810 [recognizing likely abandonment of earlier recommended ceiling approach to frequency estimates]; see also *State v. Stenson* (Wash. 1997) 940 P.2d 1239, fn. 14; *State v. Buckner* (Wash. 1997) 941 P.2d 667, 668; *United States v. Black Cloud* (8th Cir. 1996) 101 F.3d 1258; *United States v. Bonds, et al.* (6th Cir. 1993) 12 F.3d 540, 564-565.)

Studies compiling frequency data from around the world have been published in scientific journals and other publications since the release of the National Research Council report in 1992. Those studies have clearly demonstrated the conservative nature of frequency calculation methods employed by forensic laboratories, thus validating the approaches originally adopted by those laboratories. (See, e.g., *VNTR Population Data: A Worldwide Study*, Volumes I-IV, Federal Bureau of Investigation, Washington, D.C., 1993; Budowle, B., Monson, K. L., Giusti, A. M., and Brown, B. L., *The Assessment of Frequency Estimates of Hae III-Generated VNTR Profiles in Various Reference Databases*, Journal of Forensic Sciences, JFSCA, Vol. 39, No. 2, March 1994, pp. 319-352; Budowle, B., Monson, K. L., Giusti, A. M., and Brown, B. L., *Evaluation of Hinf I-Generated VNTR Profiles Using Various Ethnic Databases*, Journal of Forensic Sciences, JFSCA, Vol. 39, No. 4, July 1994, pp. 988-1008.)

An editorial in the journal *Science* was published in 1994, sharply critical of court subscription to the voices of a distinct minority of scientists:

"[A]cceptance of the validity of DNA evidence is exactly what most scientists in this area have believed appropriate, and a rebuke to the judicial process that has been so slow to accept DNA evidence by failing to see that a couple of outspoken individuals were less representative of the scientific community than the vast majority of careful scholars. . . Some judges are continuing to make silly rules indicating they still do not understand the science, but most courts now accept DNA data as routine. The courts need better procedures to validate new technologies rather than allowing an individual judge to establish a precedent or a few scientists to represent a division in the community when the vast majority are not divided." (Koshland, D., "The DNA Fingerprint Story (Continued)," *Science*, Vol. 265, August 19, 1994, p. 1015.)

A publication in the British journal *Nature* perhaps placed the controversy surrounding population frequency data admissibility in the proper perspective. Authored by Dr. Bruce Budowle, one of the "principal architects" of the DNA typing program developed by the Federal Bureau of Investigation, and Dr. Eric Lander, an "early and vigorous critic of the lack of scientific standards" in forensic DNA typing and member of the NRC Committee, the publication specifically addresses the question of admissibility:

"We recently discussed the current state of DNA typing, and could identify no remaining problem that should prevent the full use of DNA evidence in any court. What controversy existed seems to have been fully resolved by the NRC report, the TWGDAM ["Technical Working Group on DNA Analysis Methods"] guidelines and the extensive scientific literature. The DNA fingerprinting wars are over." (Lander, E. and Budowle, B., "DNA Fingerprinting War Laid to Rest," *Nature*, Vol. 371, October 27, 1994, pp. 735-738, at p. 735.)

Specifically with regard to frequency calculations, the authors noted ambiguity present in the NRC Report: "A few poorly worded sentences have been seized upon by lawyers trying to undermine the straightforward calculation of ceiling frequencies (although such arguments have not succeeded). Most important, the report failed to state clearly enough that the ceiling principle was intended as an ultra-conservative calculation, **which did not bar experts from providing their own `best estimates' based on the product rule**. This failure was responsible for the major misunderstanding of the report. Ironically, it would have been easy to correct." (*Id*., at p. 737; emphasis added.)

Finally, on May 1, 1996, the National Research Council released its second report on forensic DNA typing, "*The Evaluation of Forensic DNA Evidence*" [Exhibit 1, attached]. That report was issued following a second investigation into the use of forensic DNA typing evidence, specifically focussed on population frequency data.

The committee reaffirmed the findings contained in the 1992 report regarding the use of forensic DNA typing:

"The technology for DNA profiling and the methods for estimating frequencies and related statistics have progressed to the point where the reliability and validity of properly collected and analyzed DNA data should not be in doubt. The new recommendations presented here should pave the way to more effective use of DNA evidence." (*The Evaluation of Forensic DNA Evidence*, National Research Council (U.S.), National Academy of Sciences, 1996, p. 2 [Exhibit 1, attached].)

The 1996 committee offered several recommendations for the calculation and use of population frequency data. The committee recognized the current existence of substantial data from different population groups, allowing the calculation of reliable profile frequencies. (*Id*., at p. 10.) A slight modification to product rule statistical calculation methods already in use by testing laboratories was offered to account for greater population subpopulation homogeneity. (*Id*., at pp. 28-30.)

Significantly, the 1996 committee concluded the ceiling principles recommended in the 1992 report were no longer necessary. (*Id*., at p. 35.) Within one month, the Rhode Island supreme court specifically agreed. (*State v. Morel* (R.I. 1996) 676 A.2d 1347, 1356.) Within three months, a Florida court of appeal not only endorsed use of the unmodified product rule, but also concluded the ceiling approach was not generally accepted. (*Clark v. State* (Fla.App. 1996) 679 So.2d 321, 322; see also *State v. Marshall* (Ariz.App. 1998) 975 P.2d 137; *People v. Hickey* (Ill. 1997) 687 N.E.2d 910; *Crawford v. State* (Miss. 1998) 716 So.2d 1028, fn. 5; *State v. Kinder* (Mo. 1996) 942 S.W.2d 313; *State v. Dishon* (N.J.App. 1997) 687 A.2d 1074; *Brim v. State* (Fla. 1997) 695 So.2d 268 [finding both frequencies calculated using the modified ceiling approach and unmodified product rule can be generally accepted]; *Commonwealth v. Fowler* (Mass. 1997) 685 N.E.2d 746; *Commonwealth v. Rosier* (Mass. 1997) 685 N.E.2d 739.)

Importantly, the committee specifically noted, "The state of the profiling technology and the methods for estimating frequencies of properly collected and analyzed DNA data should not be in doubt." (*Id*., at p. 2.) Population frequency estimates calculated by forensic DNA RFLP typing laboratories are generally accepted in the scientific community. Since the 1996 publication of the second National Research Council report, no scientific publication has demonstrated the absence of such general acceptance.

Several states, including California, have specifically addressed PCR-based DNA typing population frequencies and upheld admissibility, including unmodified use of the product rule with DQ-Alpha, Polymarker and "STR" loci. (*Johnson v. State* (Ark. 1996) 934 S.W.2d 179, 187; *People v. Pope* (Ill.App. 1996) 672 N.E.2d 1321, 1327-1328; *State v. Isley* (Kan. 1997) 936 P.2d 275; *State v. Pooler* (La.App. 1997) 696 So.2d 22; *Commonwealth v. Rosier*, *supra* [Massachusetts]; *State v. Brown* (Mo.App. 1997) 949 S.W.2d 639, 642-643; *State v. Harvey* (N.J. 1997) 699 A.2d 596.)

The California court of appeal in *People v. Wright*, *supra*, citing California Supreme Court authority, specifically noted the admissibility of population frequency data derived from use of the product rule:

"The product rule is simply a general principle of mathematics and statistics which was applied here to genetic data, in which the probability of another individual having the same genetic characteristics is determined by multiplying the probabilities for each characteristic." (*People v. Wright*, *supra*, at p. 43.)

Ironically, the Massachusetts Supreme Judicial Court, which earlier in this decade rejected DNA RFLP typing results, came full circle this year by fully approving Cellmark's use of DQ-Alpha, Polymarker, three STR genetic markers, and accompanying population frequency data based on all nine genetic markers and through use of the same product rule employed by testing laboratories for years. ((*Commonwealth v. Rosier* (Mass. 1997) 683 N.E.2d 671.)

Finally, defendant in the instant case challenges the admissibility of population frequency without modification due to alleged laboratory “error rates.” The 1996 National Research Council report, *The Evaluation of Forensic DNA Evidence,* considered that option and rejected any such incorporation of error rates. Specifically, the committee stated:

“For all those reasons, we believe that a calculation that combines error rates with match probabilities is inappropriate. The risk of error is properly considered case by case, taking into account the record of the laboratory performing the tests, the extent of redundancy, and the overall quality of the results.” (*The Evaluation of Forensic DNA Evidence, supra,* at p. 87.)

**III**

**"CORRECT SCIENTIFIC PROCEDURES"**

**AND THE PROPER SCOPE OF *KELLY*-*FRYE***

The *Kelly* court added an additional inquiry in its 1976 decision, requiring the proponent to demonstrate that "correct scientific procedures" were used in the testing conducted in the part+icular case. (*People v. Kelly*, *supra*, at p. 30.) Some trial and appellate courts have improperly interpreted this provision to mandate that the procedures were employed "correctly" rather than that "correct" procedures were used.

Analysis of the supporting authorities in *Kelly* is enlightening. Other than the reference to a federal trial court decision -- *United States v. Ridling* (E.D.Mich. 1972) 350 F.Supp. 90, 94, discussing the use of controls ". . . to assure good results" -- no other language can be found that supports the *Kelly* court's conclusion that scientific procedures must be used "correctly." In fact, examination of the reference in Comment, 56 Minnesota Law Review 1235, 1244, supports the conclusion that "correct" is the proper interpretation of this portion of the inquiry discussed in *Kelly*.

Defendant in the present case attacks several aspects of PCR-based DNA typing, including contamination, sample degradation, allele misincorporation, and false positives. However, decisions by both the California Supreme Court and appellate courts have settled any question regarding the proper interpretation of "correct scientific procedures." Specifically, in *People v. Farmer* (1989) 47 Cal.3d 888, the Supreme Court was confronted with a defense contention that footprint evidence was improperly seized and preserved, in violation of the requirements of *Kelly*-*Frye*. The court concluded the argument was without merit:

". . . the *Kelly*-*Frye* rule tests the fundamental validity of a new scientific methodology, not the degree of professionalism with which it is applied. (See, e.g., *People v. Coleman* [(1988) 46 Cal.3d 749], at p. 775.) Careless testing affects the weight of the evidence and not its admissibility, and must be attacked on cross-

examination or by other expert testimony." (*People v. Farmer*, *supra*, at p. 913.)

Similarly, in a defense-mounted attack on the use of electrophoresis in protein genetic marker typing, the First District concluded the *Farmer* rationale was determinative. In particular, the court of appeal noted:

"Much of appellant's argument at this level is directed towards a perceived bias on the part of Mr. Keel, as well as alleged careless testing procedures on the part of the Oakland Police Department Laboratory. `Careless testing affects the weight of the evidence and not its admissibility, and must be attacked on cross-examination or by other expert testimony.' (*People v. Farmer* (1989) 47 Cal.3d 888, 913.)" (*People v. Smith* (1989) 215 Cal.App.3d 19, 28.)

More recently, the California Supreme Court has reaffirmed the fact that the manner in which testing is conducted does not bear on admissibility. In a death penalty blood and saliva stain protein analysis case, challenge was made to the admission of evidence based on alleged infirmity in the testing process. The Supreme Court dismissed the contention, concluding that the *Farmer-Smith* rationale was correct. (*People v. Cooper* (1991) 53 Cal.3d 771, 814.)

The conclusion that the manner in which the testing was carried out in a particular case is not subject to *Kelly-Frye* inquiry is supported by reason and logic. The trial court in a hearing conducted pursuant to the *Frye* rule is not to determine whether or not a technique is, in fact, reliable. (*People v. Shirley* (1982) 31 Cal.3d 18, 55; *People v. Reilly* (1987) 196 Cal.App.3d 1127, 1152.) Rather, the trial court is directed to simply determine whether or not that method is "generally accepted" as reliable by the scientific community. (*Ibid*.) Were the rule otherwise, the trial court would be placed in the awkward position of being forbidden from determining whether the scientific method employed was reliable, yet required to find whether the actual results obtained in a specific case were accurate and valid.

The question of the scope of the third prong of *Kelly-Frye* with respect to DNA identification evidence has been addressed in California. The Court of Appeal in *Axell* specifically concluded that the California Supreme Court was in error in stating that the actual procedures utilized in a specific case are not subject to *Kelly-Frye* inquiry. (*People v. Axell, supra,* at p. 462.) Particularly, the Court of Appeal stated with regard to prior Supreme Court case law:

"Since the California Supreme Court was not called upon to decide the admissibility of a new scientific procedure in *Farmer*, we find that case distinguishable on its facts. (See *U.S. v. Jakobetz*, *supra*, 747 F.Supp. 250, 257-258, fn. 16.) Moreover, the court still listed this third requirement as subject of the hearing on admissibility in *People v. Kaurish* (1990) 52 Cal.3d 648, 688, even though it stated that *careless* testing affects the weight of the evidence and not its admissibility in *People v. Cooper* (1991) 53 Cal.3d 771, 814. Accordingly, we adhere to the traditional view that the third prong of the *Kelly* test is also the subject of a pretrial hearing on the question of admissibility." (*People v. Axell*, *supra*, at p. 862; see also *People v. Barney & Howard*, *supra*, at pp. 823-825.)

Three observations are significant. First, the *Axell* court demonstrates the same confusion described, *supra*, with regard to "correct" versus "correctly" in its citation to *Kaurish*. Second, the Supreme Court in *Cooper* clearly rejected the argument that any irregularities in the analyst's testing procedure were subject to *Kelly-Frye* inquiry. (*People v. Cooper*, *supra*, at p. 814.)

Finally, reference to the decision of the United States Court of Appeals, Second Circuit, in *United States v. Jakobetz* (8th Cir. 1992) 955 F.2d 786 is important. The *Axell* court specifically cited the **district court** opinion in *Jakobetz*, *supra*. However, the **Second Circuit** noted:

"Given the findings made by the district court, and after careful consideration and review by this court, it appears that in future cases with a similar evidentiary issue, a court could properly take judicial notice of the general acceptability of the general theory and the use of these specific techniques. See *McCormick*, § 203 at 608. Beyond such judicial notice, the threshold for admissibility should require only a preliminary showing of reliability of the particular data to be offered, *i.e.*, some indication of how the laboratory work was done and what analysis and assumptions underlie the probability calculations. The probability data may well vary among different segments of the population. Affidavits should normally suffice to provide a sufficient basis for admissibility. DNA profiling evidence should be excluded only when the government cannot show this threshold level of reliability in its data. The district court should focus on whether accepted protocol was adequately followed in a specific case, but the court, in exercising its discretion, should be mindful that this issue should go more to the weight than to the admissibility of the evidence. Rarely should such a factual determination be excluded from jury consideration. (*United States v. Jakobetz*, *supra*, at pp. 799-800.)

Clearer guidance has been provided by the Court of Appeal in *People v. Morganti*, *supra*. Responding to a challenge that the People failed to properly establish the use of correct procedures, the court, citing *People v. Barney*, *supra*, noted:

". . .[W]hen general acceptance is established by precedent, the `third-prong hearing' that must be conducted will not approach the `complexity of a full-blown' *Kelly* hearing. ([*People v. Barney*, *supra*, at p. 825].) `All that is necessary in the limited third-prong hearing is a foundational showing that correct scientific procedures were used.' (*Ibid*.) The trial court properly found that the prosecution made the necessary foundational showing. Not only did Harmor testify that he followed established procedure or protocol, his testimony establishes that he followed the exact procedures that were deemed correct in *Yorba* [*People v. Yorba* (1989) 209 Cal.App.3d 1017].)" (*People v. Morganti*, *supra*, at pp. 661-662.)

Significantly, the court later noted, "we focus on the correctness of the procedures that were used as opposed to the quality of the analyst's performance of those procedures." (*Id*., at p. 667.)

More recently, the court of appeal in *People v. Wright*, *supra*, rejected contentions that possible sample contamination or confusion, or lack of "rigorous or controlled" procedures, implicated admissibility concerns. Instead, the court noted, such objections are properly raised before the trier of fact and not prior to evidence admission. (*People v. Wright*, *supra*, at p. 41.)

Finally, on May 11, 1998, the California Supreme Court again addressed the meaning of correct scientific procedures in the context of DNA RFLP typing. (*People v. Venegas* (1998) 18 Cal.4th 47.) The supreme court reaffirmed earlier court of appeal conclusions that the determination of the third prong of *People v. Kelly*, *supra*, requires case-specific examination. (*People v. Venegas*, *supra*, at p. 81.)

The court further concluded that due to the inherent complexity of DNA typing, trial courts must first determine whether correct procedures were utilized by the testing laboratory in the particular case at issue. (*Id*, at pp. 80-81.) The court did note that "shortcomings such as mislabeling, mixing the wrong ingredients, or failing to follow routine precautions against contamination may well be amenable to evaluation by jurors without the assistance of expert testimony," and thus affect weight rather than admissibility. (*Id*, at p. 81.) Finally, the court stated that expert testimony in support of the use of correct procedures can be presented solely by the examining analyst, so long as that analyst sufficiently understands the "technique and its underlying theory." (*Ibid*.)

To add further confusion and reinvigorate the debate regarding the exact showing required, the California Supreme Court later reiterated its comments in *People v. Venegas*, *supra*, and stated, “. . . *Kelly*-*Frye* requires determination 'whether a laboratory has **adopted** correct, scientifically accepted procedures' for conducting the test." (*People v. Roybal* (Cal. 1998) 19 Cal.4th 481; emphasis added.)

The approach mandated by *Farmer*, *Coleman*, *Kaurish*, *Cooper*, and *Morganti* clearly frustrates any contention of defendant this court should conduct an extensive hearing regarding the specific testing performed in the present case.

##### IV

**THIS COURT MAY TAKE JUDICIAL NOTICE OF FINDINGS AND TESTIMONY PRESENTEDAT *FRYE* HEARINGS IN OTHER COURTS**

Evidence to be presented this court in support of the admissibility of DNA typing results will include the testimony of one witness, Dr. MM, from another proceeding conducted before this court. Judicial notice of the testimony of witnesses presented in "*Kelly*-*Frye"* evidentiary hearings is authorized by Evidence Code sections 452 and 453, as well as case law.

The First District, for example, has specifically concluded:

"Contrary to appellant's assertions, we conclude it was appropriate for the trial court to take judicial notice of the earlier proceedings from within the same trial court. Evidence Code section 452, subdivision (d)(1) provides that judicial notice may be taken of the records of any court of this state. In accord with Evidence Code section 453, the prosecutor gave appellant advance notice of its requests for the court to take judicial notice of the other *Kelly*/*Frye* hearings and furnished the court with the transcripts necessary to enable it to take judicial notice as requested. Under these circumstances, the statute prescribes that the trial court *shall* take judicial notice of the matters specified. (Evid. Code, § 453.)" (*People v. Smith* (1989) 215 Cal.App.3d 19, 25; emphasis in original.)

Importantly, the First District specifically concluded that judicial notice may -- or must if proper notice is given -- be taken of both the transcripts of testimony of witnesses, as well as the findings of the trial court before which such testimony was taken. (*Ibid*.)

The court's approval of judicial notice in *Frye* admissibility proceedings is consistent with the nature of the inquiry involved. The court noted California Supreme Court endorsement of consideration of "California precedent, cases from other jurisdictions, and scientific literature" in the determination of general acceptance. (*Ibid*.) Authorization of consideration of writings of scientists yet disallowal of testimony given under oath by the same experts would appear nonsensical.

New or additional information may be presented by either party, thus preserving the right to offer evidence. (*Ibid.*) Defendant in the present case -- as well as any defendant against whom new or novel scientific testing results are offered -- may present such information or other evidence impacting general acceptance of such a technique.

Finally, the use of previous testimony in admissibility litigation conserves precious judicial and financial resources. To require the same or other expert witnesses to repeatedly appear in court and testify to the same facts and opinions is improvident and contrary to reason and logic.

**CONCLUSION**

Accordingly, for the above reasons, it is respectfully requested that defendant's motion to exclude evidence be denied.

Dated:

Respectfully submitted,

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Deputy District Attorney

1. Bugawan, T.L., Saiki, R.K., Levenson, C.H., Watson, R.M., and Erlich, H.A., *The Use of Non-Radioactive Oligonucleotide Probes to Analyze Enzymatically Amplified DNA for Prenatal Diagnosis and Forensic HLA Typing*, Bio/Technology, Vol. 6, 1988, pp. 943-947. [↑](#footnote-ref-1)
2. Proceedings of the *International Symposium on Human Identification 1993*, Scottsdale, Arizona, Promega Corporation, September 27-30, 1993; Proceedings of the *Second International Symposium on the Forensic Aspects of DNA Analysis*, Laboratory Division, Federal Bureau of Investigation, Quantico, Virginia, March 29-April 2, 1993; Proceedings of *The First Forensic Experts Conference - Dubai - U.A.E. 94*, Dubai, United Arab Emirates, January 8-10, 1994. [↑](#footnote-ref-2)
3. 3 Herrin, G., Fildes, N., and Reynolds, R., *Evaluation of the AmpliType® PM DNA Test System on Forensic Case Samples*, Journal of Forensic Sciences, JFSCA, Vol. 39, No. 5, September 1994, pp. 1247-1253; Fildes, N., and Reynolds, R., *Detection and Resolution of Mixtures with the Polymarker DNA Typing System*, Journal of Forensic Sciences (in press). [↑](#footnote-ref-3)
4. See, e.g., Fildes, N. and Reynolds, R., *Consistency and Reproducibility of AmpliType® PM Results between Seven Laboratories: Field Trial Results*, Journal of Forensic Sciences, JFSCA, March 1995 (in press). [↑](#footnote-ref-4)
5. Herrin, G., et al., *Evaluation of the AmpliType® PM DNA Test System*, *supra*, note 3, at p. 1247. [↑](#footnote-ref-5)
6. See, e.g., Hammond, H.A., Jin, L., Zhong, Y., Caskey, C.T., and Chakraborty, R., *Evaluation of 13 Short Tandem Repeat Loci for Use in Personal Identification Applications*, American Journal of Human Genetics, Vol. 55, 1994, pp. 175-189; Alford, R.L., Hammond, H.A., Coto, I., and Caskey, C.T., *Rapid and Efficient Resolution of Parentage by Amplification of Short Tandem Repeats*, American Journal of Human Genetics, Vol. 55, 1994, pp. 190-195; Micka, K.A., et al, *TWGDAM Validation of a Nine-Locus and a Four-Locus Fluorescent STR Multiplex System*, Journal of Forensic Sciences, Vol. 44, No. 6, 1999, pp. 1243-1257; Wallin, J.M., Buoncristiani, M.P.H., Lazaruk, K.D., Fildes, N., Holt, C.L., and Walsh, S., *TWGDAM Validation of the AmpFISTR Blue PCR Amplification Kit for Forensic Casework*, Journal of Forensic Sciences, Vol. 43, No. 4, 1998, pp. 854-870. [↑](#footnote-ref-6)
7. Fildes, N., et al., *Consistency and Reproducibility of AmpliType® PM Results*, *supra*, note 4, at pp. 3-4. [↑](#footnote-ref-7)
8. See, e.g., Patel, P., Lo, Y.M., Bell, J.I., and Wainscoat, J.S., *Rapid HLA Typing by Multiplex Amplification Refractory Mutation System*, Journal of Clinical Pathology, Vol. 46, No. 12, December 1993, pp. 1105-1108; Richards, B., Skoletsky, J., Shuber, A.P., Balfour, R., Stern, R.C., Dorkin, H.L., Parad, R.B., Witt, D., and Klinger, K.W., *Multiplex PCR Amplification from the CFTR Gene Using DNA Prepared from Buccal Brushes/Swabs*, Human Molecular Genetics, Vol. 2, No. 2, February 1993, pp. 159-163; Cuppens, H., Buyse, I., Baens, M., Marynen, P., and Cassiman, J.J., *Simultaneous Screening for 11 Mutations in the Cystic Fibrosis Transmembrane Conductance Regulator Gene by Multiplex Amplification and Reverse Dot-Blot*, Molecular Cell Probes, Vol. 6, No. 1, February 1992, pp. 33-39.) [↑](#footnote-ref-8)
9. See, e.g., Budowle, B., et al, *Validation Studies of the CTT STR Multiplex System*, *supra*, note 6. [↑](#footnote-ref-9)