

GUEST EDITORIAL

Evaluating the Work of Forensic Scientists by Citation Analysis

"The Hottest in Forensics: Citations Tell Whodunnit" was the catchy rubric used to introduce the lead article in the January 1995 number of *Science Watch*, a newsletter published by the Philadelphia based Institute for Scientific Information (ISI). ISI is perhaps better known for producing the Science Citation Index (SCI) and Current Contents, two widely used tools for literature retrieval and bibliometric evaluation of science and scientists. The *Science Watch* newsletter team identifies trends and performances in basic and applied research by means of citation counts and thus helps to spot hot-topics and emerging research fronts. *Science Watch* also publishes interviews with scientific superstars and authors of highly cited papers.

Science Watch's survey of the forensic sciences was done by searching ISI's Science Indicators Database for all articles published between 1981–93 in nine leading international journals specializing in forensic science, analytical toxicology, and legal medicine. These journals were; *American Journal of Forensic Medicine and Pathology*, *Crime Laboratory Digest*, *Forensic Science International*, *International Journal of Legal Medicine*, *Journal of Analytical Toxicology*, *Journal of the Forensic Science Society*, *Journal of Forensic Sciences*, *Medicine, Science, and the Law*, and *Zeitschrift für Rechtsmedizin*. By counting the number of citations received by articles published in these core journals between 1981–93, the *Science Watch* team documented several important items. The most cited papers, the institutions where the work originated as well as the most highly cited authors in forensic sciences were compared and ranked accordingly.

The following three charts were produced:

1. The top-10 institutions publishing in forensic science journals were ranked according to the total number of papers they produced and the average number of cites/paper.
2. The top-15 most highly cited papers appearing in the core forensic science journals, the names of the authors, the titles of the works, and the actual journals where the work was published.
3. The top-10 authors of relatively highly cited articles over the period 1981–93 were identified. The names of the authors, the total number of papers they published and the average number of cites/paper were documented.

The University of Mississippi was number one among the top-ten most highly cited institutions, receiving 9.25 cites per paper for a total of 20 papers. Next in line was the University of Miami with 6.92 cites/paper and 26 papers in total. Only one non-US institution made the top-ten list and this was the State University of Groningen in the Netherlands (ranked 7) scoring an impressive

6.30 cites per paper for a total output of 30 papers. Looking at the 15 most highly cited papers published in the forensic journals over this period, one finds that all of them appeared in just two journals, namely *Journal of Forensic Sciences* with 9 papers and the rest were published in *Journal of Analytical Toxicology*.

The most highly cited paper was penned by a solo author, M.E. Jolley (Abbott Laboratories, Chicago) and his contribution was cited 98 times between 1981–93. The work was entitled "Fluorescence polarization immunoassay for the determination of therapeutic drug levels in human plasma" and was published in *Journal of Analytical Toxicology* Vol. 5(5) 236–40, 1981. Jolley described a new method for analysis of drugs in body fluids which has subsequently become widely used in forensic and clinical laboratories worldwide. Indeed, several of the top-15 highly cited papers described methods for quantitative and/or qualitative analysis of drugs and their metabolites in body fluids and tissue. Methods papers often become highly cited and, indeed, the most highly cited paper of all time by O.H. Lowry was published in *Journal of Biological Chemistry* and described a micro-method for the analysis of proteins. This work was cited 187,652 times between 1951 and 1988 and by now has probably passed the 200,000 citation mark.

The top-15 most highly cited papers also included work dealing with forensic applications of the polymerase chain reaction (PCR); an article by Kasai et al. from the National Institute of Police Sciences, Tokyo, received 63 cites since it appeared in the *Journal of Forensic Sciences* 35(5): 1196–200, 1990. Papers dealing with the analysis of DNA in blood stains and sperm were also highly cited. Out of curiosity, I checked the AAFS section affiliation of the 10 most prolific authors publishing in forensic science journals between 1981–93. Four belonged to the toxicology section of AAFS, one was a member of the pathology section and 5 were not listed in the AAFS membership directory for 1994.

Science Watch also searched their database for the names of scientists who published significantly and were also relatively highly cited for what they published (>15 papers during the period 1981–93 and cited on a per paper basis above 5.00). With these criteria, E.J. Cone of the National Institute of Drug Abuse in Baltimore produced most highly cited papers, being credited with 30 publications over the period earning him an average citation count of 7.77 cites/paper. However, the highest impact author in the forensic sciences was C.V. Wetli from the Dade County Medical Examiners Office in Miami who penned 17 papers over the same period scoring an average of 11.88 cites per paper. Of the top-10 authors in the list, 7 were from USA, one from Japan (M. Asano), one from the United Kingdom (A.C. Moffat) and two from the Netherlands (R.A. de Zeewe and J.P. Franke). However, these

latter two scientists from the Netherlands were coauthors on many of the same papers.

The report by Science Watch appears to be the first attempt to evaluate the work published by leading Forensic Science Journals in a quantitative way. However, compared with scientific journals specializing in basic and clinical research, forensic science journals as well as the articles they publish don't normally attract many citations [1,2]. The Journal Impact Factor, which is a measure of the frequency with which the average published article in a journal is cited in a given time period is surprisingly low, being 0.655 for Journal of Forensic Sciences and 1.63 for the Journal of Analytical Toxicology according to the 1992 edition of Journal Citation Reports, also prepared by ISI [1].

Bibliometric indicators are becoming increasingly used to assess the work of individual scientists and the impact of their publications. Indeed, government funding agencies and university appointment boards are beginning to take a closer look at quantitative indicators of performance in addition to the traditional peer-review procedures. Counting the number of papers on a bibliography reflects the quantity of work produced but the quality is perhaps better judged by the number of times the work is cited by other scientists and the significance of the journals where the articles appeared, as judged by the impact factor. Citation counting has become an increasingly important yardstick for judging the merits of work produced by individual scientists, research groups, and entire university departments. However, comparisons should not be made across scientific disciplines and it would not be correct

to compare the citation record of a biochemist with that of a forensic pathologist or the impact factor of a journal specializing in biochemistry with one devoted to forensic medicine.

Another confounding aspect of citation analysis concerns the practice of self-citation which tends to inflate citation rates and also negative citations, that is, citing an article to highlight flaws in the work or an opposing viewpoint. Furthermore, author inflation, as reflected by an increase in the number of papers with multiple authorship, a trend especially evident over the past few decades, makes it difficult to attribute credit to one individual author. The first author, however, has often made the biggest contribution towards completion of the work and therefore deserves most credit. The results of the survey presented by Science Watch might have looked somewhat different if adjustments had been made for the frequency of self-citations, negative citations, and the variable number of co-authors on highly cited paper.

References

- [1] Jones, A. W., "The Impact of Forensic Science Journals," *Forensic Science International*, Vol. 62, 1993, pp. 173-178.
- [2] Chariot, P. and Durigon, M., "The Impact of Forensic Science Journals," *Forensic Science International*, Vol. 66, 1994, pp. 213-215.

A. W. Jones, Ph.D., D.Sc.
Dept. of Forensic Toxicology
National Laboratory of Forensic Medicine
University Hospital
581 85 Linköping
Sweden