# Bibliometric Analysis

## for the U.S. Environmental Protection Agency/Office of Research and Development's Drinking Water Research Program

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency's (EPA) Drinking Water Research Program. For this analysis, 910 papers were reviewed, and they were published from 1996 to 2006. These publications were cited 13,632 times in the journals covered by Thomson's *Web of Science*[1] and Scopus[2]. Of these 910 publications, 783 (86.04%) have been cited at least once in a journal.

Searches of Thomson Scientific's *Web of Science* and Elsevier's Scopus were conducted to obtain times cited data for the drinking water journal publications. The analysis was completed using Thomson's *Essential Science Indicators (ESI)* and *Journal Citation Reports (JCR)* as benchmarks. *ESI* provides access to a unique and comprehensive compilation of essential science performance statistics and science trends data derived from Thomson's databases. For this analysis, the *ESI* highly cited papers thresholds as well as the hot papers thresholds were used to assess the influence and impact of the drinking water papers. *JCR* is a recognized authority for evaluating journals. It presents quantifiable statistical data that provide a systematic, objective way to evaluate the world's leading journals and their impact and influence in the global research community. The two key measures used in this analysis to assess the journals in which the EPA drinking water papers are published are the Impact Factor and Immediacy Index. The Impact Factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal's relative importance, especially when compared to other journals in the same field. The Immediacy Index is a measure of how quickly the "average article" in a journal is cited. This index indicates how often articles published in a journal are cited within the same year and it is useful in comparing how quickly journals are cited.

The report includes a summary of the results of the bibliometric analysis, an analysis of the 910 drinking water research papers analyzed by *ESI* field (e.g., chemistry, microbiology, pharmacology & toxicology), an analysis of the journals in which the drinking water papers were published, a table of the highly cited researchers in the Drinking Water Research Program, and a list of patents and patent applications that have resulted from the program.

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[1] Thomson Scientific's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,830 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

[2] Scopus is a large abstract and citation database of research literature and quality Web sources designed to support the literature research process. Scopus offers access to 15,000 titles from 4,000 different publishers, more than 12,850 academic journals (including coverage of 535 Open Access journals, 750 conference proceedings, and 600 trade publications), 27 million abstracts, 245 million references, 200 million scientific Web pages, and 13 million patent records.

## SUMMARY OF RESULTS

1. More than one-fifth of the drinking water publications are highly cited papers. 193 (21.21%) of the drinking water papers qualify as highly cited when using the *ESI* criteria for the top 10% of highly cited publications. This is 2.12 times the 10% of papers expected to be highly cited. 26 (2.86%) of the drinking water papers qualify as highly cited when using the *ESI* criteria for the top 1%, which is 2.86 times the number expected. 1 (0.11%) of these papers qualify as very highly cited when using the criteria for the top 0.1%, which is exactly the number anticipated. None of the papers actually meet the 0.01% threshold for the most highly cited papers, which is not surprising given that the number of papers expected to meet this threshold for this program is 0.09.

2. The drinking water papers are more highly cited than the average paper. Using the *ESI* average citation rates for papers published by field as the benchmark, in 14 of the 19 fields in which the 910 EPA drinking water papers were published, the ratio of actual to expected cites is greater than 1, indicating that the drinking water papers are more highly cited than the average papers in those fields. For all 19 fields combined, the ratio of total number of cites to the total number of expected cites (13,632 to 8,944.60) is 1.52, indicating that the drinking water papers are more highly cited than the average paper.

3. More than one-third of the drinking water papers are published in high impact journals. 411 of the 910 papers were published in the top 10% of journals ranked by *JCR* Impact Factor, representing 45.16% of EPA's drinking water papers. This number is 4.52 times higher than the expected 91 papers. 278 of the 910 papers appear in the top 10% of journals ranked by *JCR* Immediacy Index, representing 30.55% of EPA's drinking water papers. This number is 3.06 times higher than the expected 91 papers.

4. Fourteen of the drinking water papers qualify as hot papers. Using the hot paper thresholds established by *ESI* as a benchmark, 14 hot papers, representing 1.54% of the drinking water papers, were identified in the analysis. Hot papers are papers that were highly cited shortly after they were published. The number of drinking water hot papers identified is 15.4 times higher than the expected 0.91 hot papers.

5. The authors of the drinking water papers cite themselves much less than the average author. 661 of the 13,632 cites are author self-cites. This 4.85% author self-citation rate is well below the accepted range of 10-30% author self-citation rate.

6. Twenty of the authors of the drinking water papers are included in *ISIHighlyCited.com*, which is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999.

7. There was 1 patent issued to an investigator from 1996 to 2006 for research that was conducted under EPA's Drinking Water Research Program. This patent was cited by another patent.

## Highly Cited Drinking water Publications

All of the journals covered by *ESI* are assigned a field, and to compensate for varying citation rates across scientific fields, different thresholds are applied to each field. Thresholds are set to select highly cited papers to be listed in *ESI*. Different thresholds are set for both field and year of publication. Setting different thresholds for each year allows comparable representation for older and younger papers for each field.

The 910 drinking water research papers reviewed for this analysis were published in journals that were assigned to 19 of the 22 *ESI* fields. The distribution of the papers among these 19 fields and the number of citations by field are presented in Table 1.

**Table 1. Drinking Water Papers by *ESI* Fields**

| ***ESI* Field** | **No. of Citations** | **No. of DW Papers** | **Average Cites/Paper** |
|---|---|---|---|
| Agricultural Sciences | 130 | 18 | 7.22 |
| Biology & Biochemistry | 354 | 27 | 13.11 |
| Chemistry | 1,360 | 73 | 18.63 |
| Clinical Medicine | 1,575 | 104 | 15.14 |
| Computer Science | 6 | 1 | 6.00 |
| Economics & Business | 57 | 4 | 14.25 |
| Engineering | 442 | 55 | 8.04 |
| Environment/Ecology | 2,800 | 267 | 10.49 |
| Geosciences | 9 | 5 | 1.80 |
| Immunology | 569 | 26 | 21.88 |
| Materials Science | 0 | 1 | 0.00 |
| Microbiology | 2,212 | 106 | 20.87 |
| Molecular Biology & Genetics | 712 | 44 | 16.18 |
| Multidisciplinary | 199 | 4 | 49.75 |
| Neuroscience & Behavior | 204 | 14 | 14.57 |
| Pharmacology & Toxicology | 2,835 | 142 | 19.96 |
| Physics | 27 | 2 | 13.50 |
| Plant & Animal Science | 33 | 8 | 4.12 |
| Social Sciences, general | 108 | 9 | 12.00 |
| | **Total = 13,632** | **Total = 910** | **14.98** |

There are 193 (21.21% of the papers analyzed) highly cited EPA drinking water papers in 15 of the 19 fields—Agricultural Sciences, Biology & Biochemistry, Chemistry, Clinical Medicine, Economics & Business, Engineering, Environment/Ecology, Geosciences, Immunology, Microbiology, Multidisciplinary, Neuroscience & Behavior, Pharmacology & Toxicology, Physics, and Social Sciences—when using the *ESI* criteria for the **top 10% of papers**. Table 2 shows the number of drinking water papers in those 15 fields that meet the **top 10% threshold in *ESI***. Twenty-six (2.86%) of the papers analyzed qualify as highly cited when using the *ESI* criteria for the **top 1% of papers**. These papers cover 7 fields—Chemistry, Clinical Medicine, Engineering, Environment/Ecology, Microbiology, Multidisciplinary, and Pharmacology & Toxicology. Table 3 shows the 26 papers by field that meet the **top 1% threshold in *ESI***. The citations for these 26 papers are provided in Tables 4 through 10. There was 1 (0.11%) very highly cited drinking water paper in the field of Multidisciplinary. The paper, which met the **top 0.1% threshold in *ESI*,** is listed in Table 11. None of the drinking water papers met the **top 0.01% threshold in *ESI***, which is not surprising given that the expected number of papers that should meet this threshold for this analysis is 0.09.

**Table 2. Number of Highly Cited Drinking Water Papers by Field (top 10%)**

| ***ESI* Field** | **No. of Citations** | **No. of Papers** | **Average Cites/Paper** | **% of Papers in Field** |
|---|---|---|---|---|
| Agricultural Sciences | 73 | 4 | 18.25 | 22.22% |
| Biology & Biochemistry | 156 | 4 | 39.00 | 14.81% |
| Chemistry | 942 | 28 | 33.64 | 38.36% |
| Clinical Medicine | 736 | 16 | 46.00 | 15.38% |
| Economics & Business | 48 | 2 | 24.00 | 50.00% |
| Engineering | 319 | 19 | 16.79 | 34.55% |
| Environment/Ecology | 1,579 | 66 | 23.92 | 24.72% |
| Geosciences | 2 | 1 | 2.00 | 20.00% |
| Immunology | 193 | 2 | 96.50 | 7.69% |
| Microbiology | 1,266 | 18 | 70.33 | 16.98% |
| Multidisciplinary | 199 | 2 | 99.50 | 50.00% |
| Neuroscience & Behavior | 57 | 1 | 57.00 | 7.14% |
| Pharmacology & Toxicology | 1,638 | 24 | 68.25 | 16.90% |
| Physics | 27 | 1 | 27.00 | 50.00% |
| Social Sciences, general | 100 | 5 | 20.00 | 55.56% |
| | **Total = 7,335** | **Total = 193** | **38.00** | **21.21%** |

**Table 3. Number of Highly Cited Drinking Water Papers by Field (top 1%)**

| *ESI* Field | No. of Citations | No. of Papers | Average Cites/Paper | % of EPA Papers in Field |
|---|---|---|---|---|
| Chemistry | 43 | 2 | 21.50 | 2.74% |
| Clinical Medicine | 87 | 1 | 87.00 | 0.96% |
| Engineering | 95 | 3 | 31.67 | 5.45% |
| Environment/Ecology | 232 | 11 | 21.09 | 4.12% |
| Microbiology | 318 | 2 | 159.00 | 1.89% |
| Multidisciplinary | 199 | 2 | 99.50 | 50.00% |
| Pharmacology & Toxicology | 761 | 5 | 152.20 | 3.52% |
| | **Total = 1,735** | **Total = 26** | **66.73** | **2.86%** |

**Table 4. Highly Cited Drinking Water Papers in the Field of Chemistry (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 20 | Tufenkji N | Breakdown of colloid filtration theory: Role of the secondary energy minimum and surface charge heterogeneities. *Langmuir* 2005;21(3):841-852. |
| 23 | Richardson SD | Water analysis: emerging contaminants and current issues. *Analytical Chemistry* 2005;77(12):3807-3838. |

**Table 5. Highly Cited Drinking Water Paper in the Field of Clinical Medicine (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 87 | Lindesmith L | Human susceptibility and resistance to Norwalk virus infection. *Nature Medicine* 2003;9(5):548-553. |

**Table 6. Highly Cited Drinking Water Papers in the Field of Engineering (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 57 | Rice EW | Evaluating plant performance with endospores. *Journal American Water Works Association* 1996;88(9):122-130. |
| 23 | Xu JL | Microbial degradation of perchlorate: principles and applications. *Environmental Engineering Science* 2003;20(5):405-422. |

| No. of Cites | First Author | Paper |
|---|---|---|
| 15 | Budde WL | Analytical mass spectrometry of herbicides. *Mass Spectrometry Reviews* 2004;23(1):1-24. |

**Table 7. Highly Cited Drinking Water Papers in the Field of Environment/Ecology (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 59 | Styblo M | The role of biomethylation in toxicity and carcinogenicity of arsenic: a research update. *Environmental Health Perspectives* 2002;110(Suppl 5):767-771. |
| 59 | Simpson JM | Microbial source tracking: state of the science. *Environmental Science & Technology* 2002;36(24):5279-5288. |
| 51 | Metcalfe CD | Distribution of acidic and neutral drugs in surface waters near sewage treatment plants in the lower Great Lakes, Canada. *Environmental Toxicology and Chemistry* 2003;22(12):2881-2889. |
| 26 | Glassmeyer SD | Transport of chemical and microbial compounds from known wastewater discharges: potential for use as indicators of human fecal contamination. *Environmental Science & Technology* 2005;39(14):5157-5169. |
| 4 | Chiu WA | Issues in the pharmacokinetics of trichloroethylene and its metabolites. *Environmental Health Perspectives* 2006;114(9):1450-1456. |
| 4 | Craun GF | Observational epidemiologic studies of endemic waterborne risks: Cohort, case-control, time-series, and ecologic studies. *Journal of Water and Health* 2006;4(Suppl 2):101-120. |
| 5 | Colford J | A review of household drinking water intervention trials and an approach to the estimation of endemic waterborne gastroenteritis in the United States. *Journal of Water and Health* 2006;4(Suppl 2):71-88. |
| 5 | Craun GF | Assessing waterborne risks: an introduction. *Journal of Water and Health* 2006;4(Suppl 2):3-18. |
| 5 | Calderon RL | Estimates of endemic waterborne risks from community-intervention studies. *Journal of Water and Health* 2006;4(Suppl 2):89-100. |
| 6 | Craun MF | Waterborne outbreaks reported in the United States. *Journal of Water and Health* 2006;4(Suppl 2):19-30. |
| 8 | Groffman P | Ecological thresholds: the key to successful environmental management or an important concept with no practical application? *Ecosystems* 2006;9(1):1-13. |

**Table 8. Highly Cited Drinking Water Papers in the Field of Microbiology (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 208 | Fayer R | Epidemiology of Cryptosporidium: transmission, detection and identification. *International Journal for Parasitology* 2000;30(12-13):1305-1322. |
| 110 | Morgan-Ryan UM | *Cryptosporidium hominis* n. sp (Apicomplexa : Cryptosporidiidae) from *Homo sapiens*. *Journal of Eukaryotic Microbiology* 2002;49(6):433-440. |

**Table 9. Highly Cited Drinking Water Papers in the Field of Multidisciplinary (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 65 | Xu P | The genome of *Cryptosporidium hominis*. *Nature* 2004;431(7012):1107-1112. |
| 134 | Abrahamsen MS | Complete genome sequence of the apicomplexan, *Cryptosporidium parvum*. *Science* 2004;304(5669):441-445. |

**Table 10. Highly Cited Drinking Water Papers in the Field of Pharmacology & Toxicology (top 1%)**

| No. of Cites | First Author | Paper |
|---|---|---|
| 183 | Styblo M | Comparative toxicity of trivalent and pentavalent inorganic and methylated arsenicals in rat and human cells. *Archives of Toxicology* 2000;74(6):289-299. |
| 134 | Thomas DJ | The cellular metabolism and systemic toxicity of arsenic. *Toxicology and Applied Pharmacology* 2001;176(2):127-144. |
| 153 | Mass MJ | Methylated trivalent arsenic species are genotoxic. *Chemical Research in Toxicology* 2001;14(4):355-361. |
| 187 | Kitchin KT | Recent advances in arsenic carcinogenesis: modes of action, animal model systems, and methylated arsenic metabolites. *Toxicology and Applied Pharmacology* 2001;172(3):249-261. |
| 104 | Hughes MF | Arsenic toxicity and potential mechanisms of action. *Toxicology Letters* 2002;133(1):1-16. |

**Table 11. Very Highly Cited Drinking Water Paper (top 0.1%)**

| *ESI* Field | No. of Cites | First Author | Paper |
|---|---|---|---|
| Multidisciplinary | 134 | Abrahamsen MS | Complete genome sequence of the apicomplexan, *Cryptosporidium parvum*. *Science* 2004;304(5669):441-445. |

## Ratio of Actual Cites to Expected Citation Rates

The expected citation rate is the average number of cites that a paper published in the same journal in the same year and of the same document type (article, review, editorial, etc.) has received from the year of publication to the present. Using the *ESI* average citation rates for papers published by field as the benchmark, in 14 of the 19 fields in which the EPA drinking water papers were published, the ratio of actual to expected cites is greater than 1, indicating that the drinking water papers are more highly cited than the average papers in those fields (see Table 12). For all 19 fields combined, the ratio of total number of cites to the total number of expected cites (13,632 to 8,944.60) is 1.52, indicating that the drinking water papers are more highly cited than the average paper.

**Table 12. Ratio of Actual Cites to Expected Cites for Drinking Water Papers by Field**

| *ESI* Field | Total Cites | Expected Cite Rate | Ratio |
|---|---|---|---|
| Agricultural Sciences | 130 | 95.80 | 1.36 |
| Biology & Biochemistry | 354 | 323.92 | 1.09 |
| Chemistry | 1,360 | 668.55 | 2.03 |
| Clinical Medicine | 1,575 | 1,166.73 | 1.35 |
| Computer Science | 6 | 4.02 | 1.49 |
| Economics & Business | 57 | 18.30 | 3.11 |
| Engineering | 442 | 194.77 | 2.27 |
| Environment/Ecology | 2,800 | 1,734.88 | 1.61 |
| Geosciences | 9 | 18.33 | 0.49 |
| Immunology | 569 | 514.70 | 1.10 |
| Materials Science | 0 | 0.22 | 0.00 |
| Microbiology | 2,212 | 1,357.75 | 1.63 |
| Molecular Biology & Genetics | 712 | 1,135.17 | 0.63 |
| Multidisciplinary | 199 | 14.06 | 14.15 |
| Neuroscience & Behavior | 204 | 221.60 | 0.92 |
| Pharmacology & Toxicology | 2,835 | 1,400.67 | 2.02 |

| *ESI* Field | Total Cites | Expected Cite Rate | Ratio |
|---|---|---|---|
| Physics | 27 | 7.80 | 3.46 |
| Plant & Animal Science | 33 | 38.23 | 0.86 |
| Social Sciences, general | 108 | 29.10 | 3.71 |
| **TOTAL** | **13,632** | **8,944.60** | **1.52** |

## *JCR* Benchmarks

*Impact Factor*. The *JCR* Impact Factor is a well known metric in citation analysis. It is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal's relative importance, especially when compared to others in the same field. The Impact Factor is calculated by dividing the number of citations in the current year to articles published in the 2 previous years by the total number of articles published in the 2 previous years.

Table 13 indicates the number of drinking water papers published in the top 10% of journals, based on the *JCR* Impact Factor. Four hundred eleven (411) of 910 papers were published in the top 10% of journals, representing 45.16% of EPA's drinking water papers. This indicates that nearly one-half of the drinking water papers are published in the highest quality journals as determined by the *JCR* Impact Factor, which is 4.52 times higher than the expected percentage.

**Table 13. Drinking Water Papers in Top 10% of Journals by *JCR* Impact Factor**

| Drinking Water Papers in that Journal | Journal | Impact Factor (IF) | *JCR* IF Rank |
|---|---|---|---|
| 2 | Science | 30.927 | 6 |
| 1 | Nature | 29.273 | 11 |
| 1 | Nature Medicine | 28.878 | 12 |
| 1 | Lancet | 23.878 | 17 |
| 1 | Nature Biotechnology | 22.738 | 20 |
| 1 | Chemical Reviews | 20.869 | 23 |
| 1 | Mass Spectrometry Reviews | 13.273 | 60 |
| 1 | Genome Biology | 9.712 | 106 |
| 1 | Drug Discovery Today | 7.755 | 151 |
| 1 | Nucleic Acids Research | 7.552 | 162 |
| 1 | FASEB Journal | 7.064 | 181 |

| Drinking Water Papers in that Journal | Journal | Impact Factor (IF) | *JCR* IF Rank |
|---|---|---|---|
| 1 | Progress in Nuclear Magnetic Resonance Spectroscopy | 6.462 | 201 |
| 1 | Molecular Microbiology | 6.203 | 213 |
| 1 | Bioinformatics | 6.019 | 224 |
| 1 | Journal of Biological Chemistry | 5.854 | 232 |
| 2 | AIDS | 5.835 | 234 |
| 24 | Analytical Chemistry | 5.635 | 242 |
| 29 | Environmental Health Perspectives | 5.342 | 257 |
| 3 | Mutation Research—Reviews in Mutation Research | 5.333 | 259 |
| 2 | Emerging Infectious Diseases | 5.308 | 264 |
| 5 | Journal of Virology | 5.178 | 278 |
| 5 | Carcinogenesis | 5.108 | 288 |
| 3 | American Journal of Epidemiology | 5.068 | 290 |
| 1 | Critical Reviews in Toxicology | 5.000 | 297 |
| 1 | Free Radical Biology and Medicine | 4.971 | 303 |
| 10 | Journal of Infectious Diseases | 4.953 | 307 |
| 1 | Bioscience | 4.708 | 336 |
| 1 | Cancer Epidemiology Biomarkers & Prevention | 4.460 | 378 |
| 1 | Pediatrics | 4.272 | 420 |
| 1 | Current Opinion in Infectious Diseases | 4.258 | 425 |
| 4 | TrAC - Trends in Analytical Chemistry | 4.088 | 460 |
| 55 | Environmental Science & Technology | 4.054 | 467 |
| 3 | International Journal of Epidemiology | 4.045 | 470 |
| 5 | Epidemiology | 4.043 | 471 |
| 1 | Drug Metabolism and Disposition | 4.015 | 481 |
| 9 | Infection and Immunity | 3.933 | 506 |
| 46 | Applied and Environmental Microbiology | 3.818 | 544 |
| 1 | Ecological Applications | 3.804 | 548 |
| 1 | Current Opinion in Drug Discovery & Development | 3.778 | 555 |
| 1 | Langmuir | 3.705 | 569 |

| Drinking Water Papers in that Journal | Journal | Impact Factor (IF) | *JCR* IF Rank |
|---|---|---|---|
| 1 | Journal of Nutrition | 3.689 | 574 |
| 1 | Human Reproduction | 3.669 | 581 |
| 11 | Journal of Analytical Atomic Spectrometry | 3.640 | 591 |
| 5 | Journal of the American Society for Mass Spectrometry | 3.625 | 594 |
| 1 | Methods | 3.591 | 610 |
| 9 | Journal of Clinical Microbiology | 3.537 | 630 |
| 2 | Ecosystems | 3.455 | 661 |
| 3 | International Journal for Parasitology | 3.346 | 695 |
| 8 | Mutation Research-Fundamental and Molecular Mechanisms of Mutagenesis | 3.340 | 697 |
| 14 | Chemical Research in Toxicology | 3.339 | 700 |
| 1 | Journal of Economic Geography | 3.222 | 733 |
| 1 | Microbiology-SGM | 3.173 | 751 |
| 1 | Archives of Biochemistry and Biophysics | 3.152 | 762 |
| 21 | Toxicology and Applied Pharmacology | 3.148 | 765 |
| 1 | Reproduction | 3.136 | 768 |
| 7 | Journal of Chromatography A | 3.096 | 779 |
| 30 | Toxicological Sciences | 3.088 | 781 |
| 1 | Critical Reviews in Environmental Science and Technology | 3.080 | 786 |
| 1 | Virology | 3.080 | 786 |
| 7 | Cancer Letters | 3.049 | 801 |
| 45 | Water Research | 3.019 | 810 |
| 8 | Analyst | 2.858 | 877 |
| 1 | Environment International | 2.856 | 879 |
| **Total = 411** | | | |

*Immediacy Index*. The *JCR* Immediacy Index is a measure of how quickly the *average article* in a journal is cited. It indicates how often articles published in a journal are cited within the year they are published. The Immediacy Index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year.

Table 14 indicates the number of drinking water papers published in the top 10% of journals, based on the *JCR* Immediacy Index. Two hundred seventy-eight (278) of the 910 papers appear in the top 10% of journals, representing 30.55% of the drinking water papers. This indicates that nearly one-third of the drinking water papers are published in the highest quality journals as determined by the *JCR* Immediacy Index, which is 3.06 times higher than the expected percentage.

**Table 14. Drinking Water in Top 10% of Journals by *JCR* Immediacy Index**

| Drinking Water Papers in that Journal | Journal | Immediacy Index (II) | *JCR* II Rank |
|---|---|---|---|
| 1 | Lancet | 7.347 | 5 |
| 1 | Nature Medicine | 6.600 | 6 |
| 2 | Science | 6.398 | 7 |
| 1 | Nature | 5.825 | 11 |
| 1 | Nature Biotechnology | 5.210 | 16 |
| 1 | Chemical Reviews | 4.523 | 23 |
| 1 | Mass Spectrometry Reviews | 2.220 | 76 |
| 3 | International Journal of Epidemiology | 1.791 | 111 |
| 10 | Journal of Infectious Diseases | 1.547 | 145 |
| 1 | Molecular Microbiology | 1.402 | 170 |
| 1 | Nucleic Acids Research | 1.391 | 173 |
| 2 | International Journal of Toxicology | 1.309 | 193 |
| 5 | Epidemiology | 1.298 | 198 |
| 1 | Journal of Biological Chemistry | 1.265 | 208 |
| 1 | Genome Biology | 1.230 | 221 |
| 1 | FASEB Journal | 1.181 | 238 |
| 4 | Mutation Research-Reviews in Mutation Research | 1.143 | 251 |
| 1 | Drug Discovery Today | 1.125 | 257 |
| 1 | Progress in Nuclear Magnetic Resonance Spectroscopy | 1.111 | 266 |
| 3 | American Journal of Epidemiology | 1.099 | 271 |
| 5 | Journal of Virology | 1.059 | 284 |
| 1 | Pediatrics | 1.005 | 309 |
| 1 | Harmful Algae | 0.976 | 331 |
| 29 | Environmental Health Perspectives | 0.955 | 346 |

| Drinking Water Papers in that Journal | Journal | Immediacy Index (II) | *JCR* II Rank |
|---|---|---|---|
| 1 | Bioinformatics | 0.944 | 354 |
| 2 | AIDS | 0.937 | 360 |
| 5 | Carcinogenesis | 0.935 | 362 |
| 2 | Emerging Infectious Diseases | 0.840 | 440 |
| 1 | Archives of Biochemistry and Biophysics | 0.774 | 495 |
| 1 | Drug Metabolism and Disposition | 0.733 | 534 |
| 1 | Bioscience | 0.731 | 538 |
| 6 | Science of the Total Environment | 0.731 | 538 |
| 14 | Chemical Research in Toxicology | 0.729 | 542 |
| 1 | Methods | 0.720 | 558 |
| 24 | Analytical Chemistry | 0.713 | 569 |
| 1 | Free Radical Biology and Medicine | 0.696 | 585 |
| 1 | Human Reproduction | 0.693 | 596 |
| 8 | Mutation Research-Fundamental and Molecular Mechanisms of Mutagenesis | 0.682 | 604 |
| 4 | TrAC - Trends in Analytical Chemistry | 0.679 | 610 |
| 1 | ATLA-Alternatives to Laboratory Animals | 0.676 | 615 |
| 1 | Mental Retardation and Developmental Disabilities Research Reviews | 0.667 | 628 |
| 1 | Virology | 0.664 | 638 |
| 1 | Current Opinion in Drug Discovery & Development | 0.662 | 642 |
| 5 | Journal of the American Society for Mass Spectrometry | 0.649 | 660 |
| 9 | Infection and Immunity | 0.648 | 663 |
| 4 | Human and Ecological Risk Assessment | 0.628 | 698 |
| 30 | Toxicological Sciences | 0.617 | 715 |
| 1 | Langmuir | 0.610 | 723 |
| 1 | Journal of Nutrition | 0.598 | 741 |
| 1 | Current Opinion in Infectious Diseases | 0.585 | 767 |
| 1 | Microbiology-SGM | 0.571 | 800 |

| Drinking Water Papers in that Journal | Journal | Immediacy Index (II) | *JCR* II Rank |
|---|---|---|---|
| 7 | Journal of Exposure Analysis and Environmental Epidemiology | 0.571 | 800 |
| 8 | Analyst | 0.546 | 861 |
| 1 | Diagnostic Microbiology and Infectious Disease | 0.546 | 861 |
| 1 | Ecological Applications | 0.543 | 869 |
| 55 | Environmental Science & Technology | 0.541 | 874 |
| **Total = 278** | | | |

## Hot Papers

*ESI* establishes citation thresholds for hot papers, which are selected from the highly cited papers in different fields, but the time frame for citing and cited papers is much shorter—papers must be cited within 2 years of publication and the citations must occur in a 2-month time period. Papers are assigned to 2-month periods and thresholds are set for each period and field to select 0.1% of papers. There were no hot papers identified for the current 2-month period (i.e., March-April 2007), but there were a number of hot papers identified from previous periods.

Using the hot paper thresholds established by *ESI* as a benchmark, 14 hot papers, representing 1.54% of the drinking water papers, were identified in four fields—Economics & Business, Environment/Ecology, Multidisciplinary, and Pharmacology & Toxicology. The number of drinking water hot papers is 15.4 times higher than expected. The hot papers are listed in Table 15.

**Table 15. Hot Papers Identified Using *ESI* Thresholds**

| Field | *ESI* Hot Papers Threshold | No. of Cites in 2-Month Period | Paper |
|---|---|---|---|
| Economics & Business | 3 | 3 cites in November 2002 | Irwin EG, Bockstael NE. The problem of identifying land use spillovers: measuring the effects of open space on residential property values. *American Journal of Agricultural Economics* 2001;83(3):698-704. |
| | 4 | 4 cites in November 2002 | Irwin EG, Bockstael NE. Interacting agents, spatial externalities and the evolution of residential land use patterns. *Journal of Economic Geography* 2002;2(1):31-54. |
| Environment/ Ecology | 7 | 10 cites in July-August 2004 | Styblo M, et al. The role of biomethylation in toxicity and carcinogenicity of arsenic: a research update. *Environmental Health Perspectives* 2002;110(Suppl 5):767-771. |

| Field | *ESI* Hot Papers Threshold | No. of Cites in 2-Month Period | Paper |
|---|---|---|---|
| Environment/ Ecology | 6 | 12 cites in December 2006-January 2007 | Glassmeyer ST, et al. Transport of chemical and microbial compounds from known wastewater discharges: potential for use as indicators of human fecal contamination. *Environmental Science & Technology* 2005;39(14):5157-5169. |
| | 3 | 3 cites in September 2006 | Chiu WA. Issues in the pharmacokinetics of trichloroethylene and its metabolites. *Environmental Health Perspectives* 2006;114(9):1450-1456. |
| | 3 | 4 cites in June 2006 | Craun GE, Calderon RL. Observational epidemiologic studies of endemic waterborne risks: cohort, case-control, time-series, and ecologic studies. *Journal of Water and Health* 2006;4(Suppl 2):101-120. |
| | 3 | 5 cites in June 2006 | Colford Jr. JM, et al. A review of household drinking water intervention trials and an approach to the estimation of endemic waterborne gastroenteritis in the United States. *Journal of Water and Health* 2006;4(Suppl 2):71-88. |
| | 3 | 5 cites in June 2006 | Craun GF, et al. Assessing waterborne risks: an introduction. *Journal of Water and Health* 2006;4(Suppl 2):3-18. |
| | 3 | 5 cites in June 2006 | Calderon Rl, Craun GF. Estimates of endemic waterborne risks from community-intervention studies. *Journal of Water and Health* 2006;4(Suppl 2):89-100. |
| | 3 | 6 cites in June 2006 | Craun, et al. Waterborne outbreaks reported in the United States. *Journal of Water and Health* 2006;4(Suppl 2):19-30. |
| | 3 | 3 cites in May-June 2006 | Groffman P, et al. Ecological thresholds: the key to successful environmental management or an important concept with no practical application? *Ecosystems* 2006;9(1):1-13. |
| Multidisciplinary | 9 | 9 cites in September-October 2004 | Abrahamsen MS, et al. Complete genome sequence of the apicomplexan, *Cryptosporidium parvum*. *Science* 2004;304(5669):441-445. |
| Pharmacology & Toxicology | 6 | 7 cites in November-December 2002 | Thomas DJ, et al. The cellular metabolism and systemic toxicity of arsenic. *Toxicology and Applied Pharmacology* 2001;176(2):127-144. |
| | 9 | 11 cites in August-September 2004 | Nesnow S, et al. DNA damage induced by methylated trivalent arsenicals is mediated by reactive oxygen species. *Chemical Research in Toxicology* 2002;15(12):1627-1634. |

## Author Self-Citation

Self-citations are journal article references to articles from that same author (i.e., the first author). Because higher author self-citation rates can inflate the number of citations, the author self-citation rate was calculated for the drinking water papers. Of the 13,632 total cites, 661 are author self-cites—a 4.85% author self-citation rate. Garfield and Sher[3] found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts[4] claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation. Kovacic and Misak[5] recently reported a 20% author self-citation rate for medical literature. Therefore, the 4.85% self-cite rate for the drinking water papers is well below the range for author self-citation.

## Highly Cited Researchers

A search of Thomson's *ISIHighlyCited.com* revealed that 20 (0.93%) of the 2,142 authors of the drinking water papers are highly cited researchers. *ISIHighlyCited.com* is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999. The highly cited researchers identified during this analysis of the drinking water publications are presented in Table 16.

**Table 16. Highly Cited Researchers Authoring Drinking Water Publications**

| Highly Cited Researcher | Affiliation | *ESI* Field |
|---|---|---|
| Allen, Herbert E. | University of Delaware | Environment/Ecology |
| Anderson, Melvin E. | CIIT Centers for Health Research | Pharmacology |
| Birnbaum, Linda S. | U.S. Environmental Protection Agency | Pharmacology |
| Boobis, Alan R. | Imperial College London | Pharmacology |
| Brusseau, Mark L. | University of Arizona | Environment/Ecology and Engineering |
| Dubey, Jitender P. | U.S. Department of Agriculture/ Agricultural Research Services | Plant & Animal Science |
| John, Giesy P. | University of Saskatchewan | Environment/Ecology |
| Glass, Roger I. | Centers for Disease Control and Prevention | Microbiology |
| Groffman, Peter Mark | Institute of Ecosystem Studies | Environment/Ecology |

[3] Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-210.

[4] MacRoberts MH, MacRoberts BR. Problems of citation analysis: a critical review. *Journal of the American Society of Information Science* 1989;40(5):342-349.

[5] Kavaci N, Misak A. Author self-citation in medical literature. *Canadian Medical Association Journal* 2004;170(13):1929-1930.

| Highly Cited Researcher | Affiliation | *ESI* Field |
|---|---|---|
| Johnson, Kenneth M. | University of Texas Medical Branch at Galveston | Pharmacology |
| Kimber, Ian | Syngenta Central Toxicology Laboratory | Pharmacology |
| Lindsay, David S. | Virginia Polytechnic Institute and State University | Plant & Animal Science |
| Liu, Jie | National Institute of Environmental Health Sciences | Pharmacology |
| Paerl, Hans E. | University of North Carolina–Chapel Hill Institute of Marine Sciences | Plant & Animal Science |
| Pearson, William R. | University of Virginia | Biology & Biochemistry |
| Schwartz, Joel D. | Harvard School of Public Health | Environment/Ecology |
| Thurman, E. Michael | U.S. Geological Survey | Environment/Ecology and Engineering |
| Truhlar, Donald G. | University of Minnesota | Chemistry |
| Turner, Monica G. | University of Wisconsin | Environment/Ecology |
| Wiens, John A. | Nature Conservancy | Environment/Ecology |
| **Total = 20** | | |

## Patents

There was 1 patent issued to an investigator during the period 1996 to 2006 for research that was conducted under EPA's Drinking Water Research Program. This patent has been cited by one other patent. The patent and the patent that cites it are listed in Table 17.

**Table 17. Patent from the Drinking Water Research Program (1996-2006)**

| Patent No. | Inventor(s) | Title | Patent Date | Patents that Referenced This Patent |
|---|---|---|---|---|
| 6,365,048 | Masten SJ<br>Yavich AA | Method for treatment of organic matter contaminated drinking water | 4/2/02 | Referenced by 1 patent:<br>(1) 6,893,559 System and method for removing organic compounds from waste water by oxidation |

This bibliometric analysis was prepared by
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