

Perspective

News coverage of controversial emerging technologies *Evidence for the issue attention cycle in print and online media*

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ABSTRACT. This study analyzes the issue attention cycle for print and online media coverage of a scientific publication examining the deaths of Chinese factory workers due to lung damage from chronic exposure to nanoparticles. The results of the nanoparticle study, published in 2009, embody news values that would make the study a prime candidate for press coverage, namely, novelty, negativity, controversy, and potential widespread impact. Nevertheless, mentions of the event in traditional English-language print media were nearly nonexistent. Online media, on the other hand, gave the story greater coverage. This case study exemplifies why online media may not be bound to the same issue attention cycle that print media are for controversial scientific events.

Key words: Science news, nanotechnology, online media, print media, controversy, issue attention cycles, emerging technology

How online media sources portray scientific issues has recently taken on growing importance as the number of journalists and traditional media outlets that cover scientific issues

decline.¹ Extensive research has examined the routines that print journalists undertake when they cover scientific issues, including how they rely on expert sources and on scientific journals that embargo their studies.^{2,3} However, little is known about the practices of online media sources when reporting on scientific

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issues. This case study examines how the results of one scientific study were portrayed in online and traditional print media, exemplifying the differences between media platforms with regard to the issue attention cycle, or the cyclical nature of public interest and media attention, for controversial scientific issues. The study opens by describing the release of a scientific journal article connecting nanoparticle inhalation to the deaths of two workers in a Chinese factory. The episode embodies news values, such as novelty and the potential impact that an emerging technology would have on large numbers of people and society, that would make it likely to end up in traditional media coverage. However, the results presented here demonstrate the prevalence and persistence of the story in online media but not in print media, indicating that online media are playing an increasingly important role for drawing attention to scientific issues. These findings indicate that online media sources may not be bound to the same issue-attention cycle present for traditional news sources.

A controversial scientific event

Nanotechnology is an interdisciplinary field comprising scientific work at the nanoscale of up to 100 nanometers. Each nanometer is one billionth of a meter (for perspective, a sheet of paper is 100,000 nanometers thick). Nanoparticles are bits of material in which dimensions are measured at the nanoscale and can be engineered as byproducts of such processes as industrial manufacturing or combustion; nanoparticles can also be generated naturally through processes such as sea spray or erosion.⁴ Materials can behave in different ways when manipulated at the nanoscale, allowing for new applications such as delivering drugs directly to cancer cells and building nearly invisible surveillance devices. As an object of study, nanotechnology is representative of increasingly complex emerging technologies and its study tends to be multidisciplinary in nature, implicating biomedicine, information technologies, and cognitive science, among other fields.⁵ The National Nanotechnology Initiative, a federal government agency that organizes research and development of nanotechnology in the United States, has spent an estimated \$18 billion since being established in 2001.⁶ Nanotechnology is becoming more commonplace and is now used in the

production of more than 1,300 consumer products, including durable and lightweight sporting equipment, such as tennis rackets, or clothing items with silver nanoparticles, which have antimicrobial properties.⁷

On August 19, 2009, a scientific article written by researchers based in Beijing was published in the *European Respiratory Journal* that documented two fatal cases of nanoparticle exposure in factory workers in China.⁸ The study is the first documentation of permanent lung damage in humans due to nanoparticle exposure. Seven women, who were repeatedly exposed to nanoparticles while spraying paste that contained nanoparticles in the factory where they worked for up to 13 months, were hospitalized and two of the women died.⁸ The women worked in a small, unventilated room and did not wear or have access to gauze masks.⁸ The researchers who treated the women found the same nanoparticles used in the factory materials in excess fluid surrounding the cavities in their lungs and hearts.⁸

This published paper claimed to be the first documented case of nano-caused deaths, something that has been a concern among scientists in the laboratory setting. Previous scientific research has demonstrated the toxicity of nanoparticles in animals, yet the *European Respiratory Journal* study was the first that attributed damage in humans. Experts later wrote that the workers, despite the attribution of lung damage by nanoparticles, probably would not have had such problems with proper ventilation and working conditions, including the use of protective masks.⁹ Therefore, the study was as much a story about workplace safety as it was about harmful nanoparticle exposure.

The release of the study was covered soon after in traditional print media, online news media, and in blogs. For instance, *Nature* mentioned the issue in its online news section on August 18, 2009, and *Reuters* filed on August 19, 2009 in Hong Kong. Prominent science blogs in the United States, such as *2020 Science: A Clear Perspective on Emerging Science and Technology* and *ICON Blog: The International Council on Nanotechnology*, also posted about the nanoparticle-related deaths as early as August 18, 2009. However, the story was for the most part embargoed, limiting the study's findings to prominent science blogs and traditional journalists while others, including less popular blogging sites and the academic community at large, could not access the article until it was officially published.¹⁰

Embargoes are common in science journalism so that journalists have a chance to do initial reporting before studies are widely released without concern that a colleague who is less thorough will scoop the story.³ Eventually, the journal article was made available to all—but not until after the embargo was lifted.¹⁰

A search in the Web of Knowledge database shows this study has been cited in the scientific literature at least 70 times since it was published. A review of those abstracts shows that most of the articles that cite the study address it as part of the wider literature on toxicity of nanoparticles. The *European Respiratory Journal* published three letters and one editorial response in its January 2010 issue and one letter in its July 2010 issue.^{11,12,13,14,15} The authors have published two follow-up articles, although neither has received much, if any, press or blog attention.^{16,17} A search in the *EurekAlert!* database reveals that neither of these two follow-up articles was accompanied by a press release, which likely plays a role in why they were not covered in traditional media or blog sources.

A case study in newsworthiness

The case of the first nanoparticle-induced deaths appears to be a natural candidate for coverage in the media. Releases of groundbreaking scientific findings in peer-reviewed journal articles are typically covered in science journalism. This study was the first documented case of harmful effects of nanoparticles in human lungs, although other cases have been documented in studies on rats.¹⁸ In terms of news values, the story embodied two of the most prominent: negativity and controversy.¹⁹ The most obvious negative aspect of the case concerns the deaths of the factory workers, which are controversial due to the nature of their nanoparticle-attributed cause. As discussed, nanotechnology is used in many consumer products, and documented evidence of its toxicity in humans could have a large impact on society for both manufacturers of the affected products and consumers who use the products. Moreover, the deaths could easily be dramatized and portrayed as a human interest story, which carries journalistic value.¹⁹

Yet, the human interest element intertwined in the release of this study—the stories of the two women who died—may not have been accessible to most journalists due to geographic, cultural, and language

constraints. Certain aspects of newsgathering structures, including available technology and reporting, or the political relations of the countries involved, often affect how news organizations cover international news stories.²⁰ Moreover, other story relevant details, such as the company that used the products made in the plant, were not identified in the scientific study.

The story was certainly novel, an important feature of newsworthy events, and contained an element of surprise.²¹ Again, this was the first evidence of nanoparticle toxicity of this nature in humans. Yet, there is a dearth of nanotechnology specialists in journalism,²² a situation that might have resulted in the story being framed as a worker safety problem. This speaks to the ambiguity the story faced, given that science bloggers later uncovered that the deaths would likely not have occurred if the factory had been properly ventilated and workers had all worn protective face masks.¹⁰ In other words, the possible news frames, central ideas, and organizing story lines that provide meaning for controversial issues were not straightforward.²³ Even if journalists had pursued a frame of worker safety, the story may have been too culturally distant to catch on widely given that it occurred in China.

Despite nanotechnology's importance as an emerging technological issue, with more than 1,300 consumer product applications, we know little about its influence on worker and consumer health. Consumers are increasingly interested in the health dimensions of the technology, as indicated by the large number of health-related searches for nanotechnology online.²⁴ The potential health hazards related to nanoparticle exposure also make this story an ideal candidate for media coverage.²⁵ Finally, journalists often rely on tapping a familiar story or theme to present an emerging unfamiliar story to the public.¹⁹ In 2008, news coverage raised related concerns about possible lung damage from nanoparticles following the publication of a scientific article written by British and American based researchers in *Nature Nanotechnology*, which identified asbestos-like properties of nanoparticles in a study on rodents.²⁶ Therefore, the link between nanoparticles and lung damage was already a somewhat familiar item on the news agenda.

The issue attention cycle

Based on analysis of the deaths in relation to news values, there were good reasons to expect that this event would be covered in the news. However, media agendas are built on a number of dynamic elements, including journalistic preference for objectivity and fairness, relationships between journalists and sources, and the character of the community in which the news appears, rather than a simple transfer of information from policymakers or experts to media sources.²⁷ Issues are subject to an *issue attention cycle*, or a cyclical process of issue salience (and decline) as different topics garner public interest and media attention.²⁸ Scholarship has used the issue attention cycle to understand how scientific issues end up in mass media and how they are framed.

As described by Downs, the issue attention cycle explains a cyclical pattern of public attention (originally to environmental issues), which eventually declines with public realization of the costs associated with solving the problem, relegating subsequent media attention to occasional recurrences.²⁸ In recent years, scholars have applied the issue attention cycle to various scientific contexts, including climate change and plant biotechnology.^{29,30}

Media research has also identified various frames associated with different stages of the attention cycle. For instance, McComas and Shanahan found that as attention to climate change increases, journalists tend to use a narrative of “implied danger” or “consequence,” whereas narratives tend to focus more on controversy among scientists when media coverage enters a maintenance phase with consistent coverage.²⁹ Nisbet and Huges introduced a model of mediated issue development. Using biotechnology as an example, they describe how news coverage ebbs during an administrative policy phase when reporters who specialize in science cover scientific developments using technical frames, while news coverage increases during an overt policy discussion when political and opinion journalists tend to cover an issue using dramatic frames.³⁰

Differences have been found in the issue attention cycle based on other factors, such as type of issue or cultural differences across national news media. For instance, an analysis of health epidemics found that news coverage emphasizes different narratives at different stages of the issue development cycle depending

upon the disease being covered.³¹ Moreover, while empirical research demonstrates a cyclical pattern of climate change coverage in the U.S., media coverage in other countries, such as France, are not subject to the same patterns, a difference possibly linked to varying journalistic practices.³² Despite differences found for the issue attention cycle in relation to science news, little research has examined how the issue attention cycle translates to the online media environment.

Issue cycles and online media

The ostensibly bottom-up nature of online media sources raises questions about whether there may also be differences in the issue attention cycle for traditional news and online media sources. Online media, such as blogs, are thought to be democratic tools that enable citizen control of the public agenda rather than exclusively promoting an elite-driven media agenda.^{33,34} While blogs and other online-only outlets tend to rely on information from the mainstream media, the relationship between agendas in both mainstream media and less traditional online media, such as blogs, is bidirectional and complex.³⁵ Rather than one setting the agenda for the other, it is more likely a dynamic relationship where each takes turns sustaining coverage in the other. Thus, examining how issue attention cycles play out in the online environment may yield interesting insights about intermedia agenda-setting.

The unique qualities the online setting adds to the media environment raises the question of whether online media follow the same attention cycles that print media do. In other words, are online media sources bound to the same attention dynamics as traditional news media?

Method

To assess whether there were differences in how traditional and online media covered the release of the scientific study on nanoparticle-related deaths, we identified articles about the story in print media and online media, and subsequently compared the volume of coverage from each source.

Data collection for print coverage was conducted in Lexis-Nexis for news stories published between August 5, 2009 (two weeks before the event) and September 30, 2009 (six weeks after). A previously developed Boolean search term designed to capture all stories

regarding nanotechnology-related instances in print media was used during this time period in major U.S. and world English-language publications (see the Appendix for the Boolean search term used).²² All resulting stories were examined by a content coder for any reference to or mention of the event.

Stories in online media were collected using a query in the online search engine Google. The use of a single search engine to collect data only reveals the specific pages that search engine has indexed, which may only be a small percentage of the total pages available given that no search engine indexes more than one-third of the Web.³⁶ Furthermore, search engines are not updated with any degree of regularity that would allow researchers to rely on any single search engine as the most up-to-date source for Web-based research.³⁷ However, Google appears to be the most widely used search engine, accounting for more than 65 percent of all Internet searches.³⁸ Bing, in comparison, garnered just under 14 percent of all Internet searches at the time of this research.³⁸ Considering the popularity of Google, we relied on Google for the analysis of online media sources. Supporting this decision, survey research has shown that individuals will turn first to a search engine if they want information about a scientific issue.³⁹ By relying on Google for the content analysis, we followed a user-centric approach to assessing online media by analyzing sources people would likely encounter if they turned to the Internet for information about nanotechnology. This is different from other approaches, such as those that would use Lexis-Nexis to analyze a limited number of blogs that the service indexes.

This analysis searched for content related to nanotechnology in Google using an approach similar to the method communication scholars use in Lexis-Nexis to collect content analysis data. Since broad queries for simply “nanotechnology” or “nanoparticle” in an online indexing search engine can bring up millions of Web pages often containing unrelated information, the search term queries were systematically refined. First, an advanced date-specific query under Google’s search options was used to isolate Web pages published between August 5 and September 30, 2009. Second, the prefix “nano” was used to encompass all nanotechnology related content, including content that may only use the word nanoparticle. However, given other uses of the term *nano*, the search string was further refined to include nanotechnology-only references. To accom-

plish this, the search string eliminated results that contained the words iPod, mp3, and Tata. The first two words, iPod and mp3, are references to Apple’s popular music player, the iPod Nano. The last word, Tata, is a reference to an automobile in India named Tata Nano. In order to eliminate all references to content about these products, a minus sign was inserted before the word in our search query.

Following this, specific words related to the event, including “China,” “lung,” “women,” and “factory,” were added to the search query. The final search query was written exactly as: nano china lung women factory - iPod - mp3 -Tata. The search was conducted on October 25, 2009, an important detail to note when using Google to collect online data for content analysis considering Google’s ongoing indexing of Web pages, which can increase the number of results at later dates. All of the search results were manually examined by the content coder to find all Web pages that mentioned the event. This method of data collection of online sources resulted in a set of media sources distinct from those collected in Lexis-Nexis, with just two online sources having an association with a traditional print media outlet.

Results

Of the 256 Web pages that appeared in the Google results, 94 actually mentioned the event. In comparison, 246 print stories appeared in the Lexis-Nexis results, but only eight of the stories mentioned the event (see the Appendix for a list of the titles). A variety of online sites, including blogs and *boingboing*—a site in which users submit and vote on news articles online—mentioned the event. Mentions in the print media, on the other hand, occurred in non-U.S. sources. All but one of the print media mentions occurred within two weeks of the event. Online media mentions began at the same time as print media, August 18, 2009, but tended to occur over a longer time span than print media coverage (see Figure 1).

On the first day of coverage, four mentions of the event appeared in online sources, while only one mention of the event appeared in print sources. Online media mentions did not peak until nearly one month after the event, with 15 mentions on September 14 and 12 mentions on September 15. The third highest point in coverage in online sources occurred on August 20,

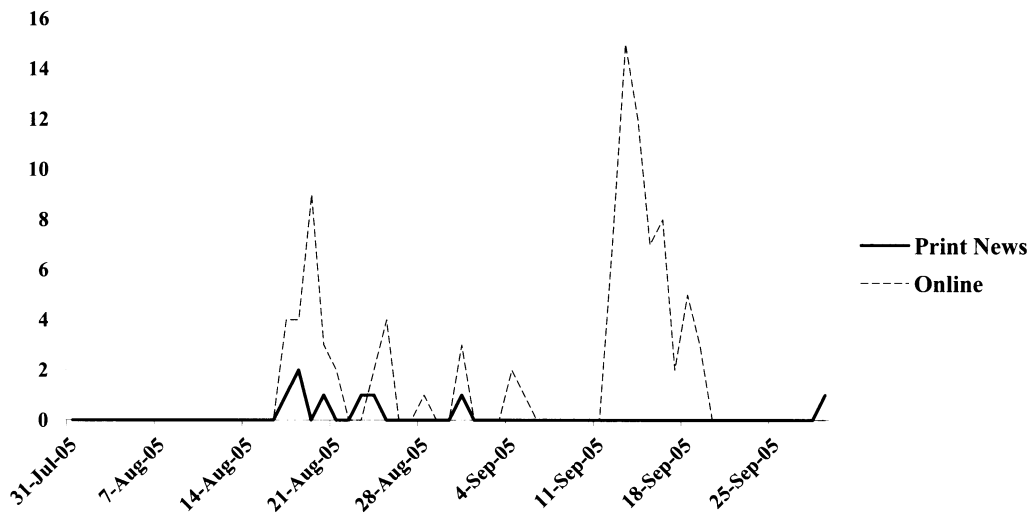


Figure 1. Number of event mentions in online and print news.

one day after the event. The last mention of the event, on September 30, occurred in the print media.

A closer look at the online stories that mention the *European Respiratory Journal* study appear to center around the news value of urgency. Peaks in coverage occurred when the study was first released and approximately one month later. Issues often do not reach the broader public agenda until they have spent some time on the media agenda.⁴⁰ In the case of the release of the nanoparticle study, it is possible the blogosphere followed a similar time lag pattern. The first peak indicates that initial coverage is closely tied to the release of the study, and conforms to the conventions of breaking news. The second bump of coverage was primarily centered around the release of an editorial regarding the usage of nanotechnology in a vaccine for H1N1, a new strain of the Swine Flu first detected in 2009 that was considered dangerous for its potential to cause a pandemic outbreak.⁴¹ This editorial, or parts of it, were picked up and repeated by others in the blogosphere, including the blogs *newresearchfindingsst-wo.blogspot.com* and *blog.puppetgov.com*. Without this shared agenda and online interaction, coverage of this issue arguably would not have been as prominent.

Discussion

The goal of this case study has been to analyze the occurrence of media coverage for a specific event, the

release of a scientific study linking nanoparticles to lung damage and human deaths, to assess whether online media sources are bound to the same issue attention cycle typically associated with scientific issues. As our analysis found, the study was covered ten times more in the online environment than in the print context. The continued appearance of the event in online-only media nearly one month after it occurred suggests the online environment does not restrict controversies surrounding emerging technologies to conventional issue attention cycle dynamics. Like print sources, online media may immediately respond to events surrounding emerging technologies, such as the release of the controversial *European Respiratory Journal* study, but the attention they give to a scientific issue may be more enduring.

Previous work has identified issue attention cycles for emerging technological issues, such as plant biotechnology, where coverage is either declining or low when the issue is primarily in administrative and technical arenas (in which regulatory and policy decisions are made) and increasing or high when the issue is primarily in an “overtly political policy arena” (p. 8).³⁰ Due to its specialized nature, coverage of nanotechnology may be stalled in a technical phase or simply restricted to the handful of full-time science writers who notice the issue when a significant development occurs.

News waves can occur when journalists observe a theme prominently covered in other news organizations and subsequently perceive that theme to be

relevant for their own coverage.⁴² The case presented here provides evidence that nanotechnology may not conform to the same issue attention cycle in online media as it does in traditional news media. Indeed, other anecdotal evidence similarly points to the prevalence of nanotechnology in online media even when coverage in traditional news media is scant.

The release of a letter in 2008 in *Nature Nanotechnology* providing evidence that carbon nanotubes cause damage similar to that of asbestos in the lungs of mice further illustrates the difference in online and traditional media coverage.⁴³ This study certainly received coverage in traditional print media, including the *Washington Post*, *Christian Science Monitor*, and *Los Angeles Times*. Nonetheless, online media sources sustained a greater volume of coverage of the study over the course of several months, while print media coverage declined shortly after the release of the study.

According to the model of mediated issue development, even a story that embodies widely recognized news values, such as the case of the nanoparticle-related deaths and anecdotal evidence from the asbestos comparison study, will not be covered as heavily in traditional media if the issue is in an administrative, technical phase.³⁰ Online-only media, on the other hand, do not seem to be bound to this same cycle.

To the extent that this story is representative of other newsworthy developments involving emerging technologies, the short attention span of traditional media to the nanoparticle-related deaths has important implications for democratic citizenship. If traditional media outlets do not cover issues while characterized by an administrative or technical phase of the issue attention cycle, public attention to important issues may be lost. On the other hand, online media sources, which members of the public often turn to for information about scientific issues, may engage public attention after the issue disappears from print media. Thus, online media will likely play an increasingly important role in maintaining public attention to and awareness of scientific issues.

While our analysis demonstrates a clear difference in the online and print coverage of this particular case, our findings may not be generalizable to other cases. Future research should examine how print and online media cover other controversial scientific events.

In addition to online media sources, blog coverage tends to be quite different from that of traditional media sources. In traditional media outlets, issues and

events are filtered through a series of organizational routines and news personnel before ending up on the news agenda.⁴⁴ The overall structure of the news agenda is based on the newsworthiness of top stories for that day and how much space traditional media organizations have in their publication or broadcast.⁴⁴ Blogs, on the other hand, are not bound to this same process. While blogs are often recognized for the democratizing potential of their user-generated content, they lie outside of the structure and routines of traditional news organizations with which consumers tend to associate certain quality standards. The diversity of online media also requires users to become more savvy news consumers as they navigate various information sources and formats.

Concerning the role of issue-attention cycles in coverage of nanotechnology, there are a few alternative explanations. Our initial analysis had primarily looked at the role of news values, particularly urgency, when evaluating the newsworthiness of the story. Recently, however, science sections of newspapers have begun to close and science reporters have been laid off.¹ The odds of this story drawing coverage in traditional media science sections were therefore relatively small. As of 2008, the numbers of American journalists who regularly covered nanotechnology numbered just seven.²² Nevertheless, research on intermedia agenda setting shows that if a story is covered in an elite publication, such as the *New York Times* or *Wall Street Journal*, editors at smaller regional newspapers may cover it as well. Since the journalists who cover nanotechnology work for these elite media, we could assume that coverage would originate at these publications and ripple out to other media.²² Additionally, the sheer number of outlets available online compared to traditional media outlets may explain why a scientific event would be covered more prolifically online than in traditional news media. Future research should examine not only the volume of coverage of cases such as this, but also how issues are framed in both online and traditional news media to better understand the issue attention cycle across different news sources and platforms.

Another explanation may be found in the scholarship on news agendas, which has identified “carrying capacities” of news outlets that limit how much attention they can dedicate to any given social problem.⁴⁵ The intense focus by traditional news outlets on the national health care debate in the fall of 2009, for example,

almost surely hampered the ability of media organizations to focus heavily on other social or health-related issues during that time. Online journalists and bloggers, on the other hand, are often more specialized and do not have the space limitations or agenda restrictions associated with traditional media organizations.

Nevertheless, online media producers of smaller websites and blogs generally have fewer resources than traditional news organizations, which necessitates that they must rely on their networks of other Web sources when writing posts. Considering this lack of resources, bloggers are more likely to cover news releases or to repost stories produced elsewhere. Indeed, it is possible that the issue attention cycle as formulated for traditional media does not apply to online media because of the tendency for bloggers to link to each other and other sources, sustaining greater attention to issues over a longer period of time.

The widespread coverage and sustained attention that the *European Respiratory Journal* study received in online sources provides evidence that online media sources are not bound to the same issue attention cycles that traditional media are. Despite the waning of print media, the networked nature of online communication may contribute to more prolific attention to scientific issues than was possible in the pre-online era.

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Appendix

Boolean search string used in Lexis Nexis: atleast3(nano-tech!) OR nanosci! OR nanoscal! OR nanocrystal* OR nanotube*OR nanomat! OR (nanometer* NOT W/15 light or laser or wavelength or UV) OR nanodot* OR nanomed! OR nanopart! OR nanowir! OR nanoeng! OR nanocomp! OR nanoelectric! OR nanoelectronic! OR nanobot* OR nanomachine* OR fullerene* OR buckminsterfullerene* OR fullerite* OR buckyball* OR buckypaper* OR buckytube* OR molecular assembl! OR molecular manufactur! OR micromachine* OR quantum dot* OR quantum wire* OR quantum well* OR sub micron OR (individual atom* w/5 manipulate or move or build) OR (scanning w/3 microscope*) OR (tunneling w/3 microscope*) AND NOT nanosecond* AND NOT apple AND NOT ipod AND NOT mp3 AND NOT digest AND NOT news w/2 brief* AND NOT business w/2 brief* AND NOT news summary

Print media sources that appeared in the Lexis-Nexis results:

The Belfast Telegraph
ENDS Report
The Express
GP Magazine
The Guardian

Domain names of online media sources that appeared in Google Blog Search results:

2020science.org
absventures.wordpress.com
asia-cast.com
autism-prevention.blogspot.com
blacklistednews.com
blogs.healthfreedomalliance.org
blog.puppetgov.com
blog.noahthedocumentary.net
blogs.discovermagazine.com*
boingboing.net
cdc.gov/NIOSH/blog
community.safenano.org
community.safenano.org/blogs
contendingfortruth.com
dochand.wordpress.com
dprogram.net
eveorganics.typepad.com
factbooster.com/blog
frogheart.ca
globalgulag.com

globalresearch.ca
gntis.edu.au
gulagblog.com
heidilore.wordpress.com
holisticchick.com
iconnanoblog.blogspot.com
infiniteunknown.net
informationliberation.com
inpursuitofhappiness.wordpress.com
insidvtnknowledgeworks.com
inthesenewtimes.com
knowthelies.com
labvirus.wordpress.com
legalplanet.wordpress.com
lifeinthemixtalk.com
litallee.com/blog
nanohype.blogspot.com
nanorisk.blogspot.com
newresearchfindingstwo.blogspot.com
newstheobet.blogspot.com
noliesradio.org
nwoobserver.wordpress.com
nwopolicestate.blogspot.com
mastermarketer.info
miller-mccune.com
pacificfreepress.com
pubget.blogspot.com
revolutionradio.org
salutedomani.com
samsedershow.com
singing2thechoir.wordpress.com
sott.net
spectrum.ieee.org/blog*
stemcellbiology.blogspot.com
survivalstation.org/blog
switchboard.nrdc.org/blogs
technologystrategyboard.start4all.com
this-week-in-nanotechnology.blogspot.com
thepumphandle.wordpress.com
truinternational.blogspot.com
truthcoalitionireland.org
truth-pills.wordpress.com
workers-compensation.blogspot.com
worldgenocidewatch.blogspot.com

*Indicates the online site is also associated with a traditional print source.