1-1-2014

A quantitative analysis of the mass media coverage of genomics medicine in China: A call for science journalism in the developing world

Feifei Zhao

Yan Chen

Siqi Ge

Xinwei Yu

Shuang Shao

See next page for additional authors

Authors

Feifei Zhao, Yan Chen, Siqi Ge, Xinwei Yu, Shuang Shao, Michael Black, Youxin Wang, Jie Zhang, Manshu Song, and Wei Wang

A Quantitative Analysis of the Mass Media Coverage of Genomics Medicine in China: A Call for Science Journalism in the Developing World

Feifei Zhao,[1,3] Yan Chen,[2] Siqi Ge,[1,3] Xinwei Yu,[1,3] Shuang Shao,[1,3] Michael Black,[4] Youxin Wang,[1,3]
Jie Zhang,[1,3] Manshu Song,[1,3] and Wei Wang[1,3,4]

Abstract

Science journalism is a previously neglected but rapidly growing area of scholarship in postgenomics medicine and socio-technical studies of knowledge-based innovations. Science journalism can help evaluate the quantity and quality of information flux between traditional scientific expert communities and the broader public, for example, in personalized medicine education. Newspapers can play a crucial role in science and health communication, and more importantly, in framing public engagement. However, research on the role of newspaper coverage of genomics-related articles has not been readily available in resource-limited settings. As genomics is rapidly expanding worldwide, this gap in newspaper reportage in China is therefore an important issue. In order to bridge this gap, we investigated the coverage of genomics medicine in eight major Chinese national newspapers, using the China Core Newspapers Full-text Database (CCND) and articles in scientific journals in PubMed from 2000 to 2011. Coverage of genomics medicine in these eight official government Chinese newspapers has remained low, with only 12 articles published per newspaper per year between 2000 and 2011. Between 2000 and 2011, over a 40-fold difference was observed in the number of genomics medicine-related articles in PubMed, as compared to that in newspapers. The numbers of genomics-related articles among the eight major newspapers from 2000 to 2011 were significantly different ($p = 0.001$). Commentary/mini reviews and articles about gene therapy for specific diseases were most frequently published in 2006 and 2011. In parallel, we observed that "cancer gene therapy," "new susceptibility gene locus," and "gene technology revolution" were the top three thematic strands addressed in the newspapers, even though their volume remained low. This study reports on the under-representation of newspaper coverage of genomics medicine in China, despite the vast growth of scientific articles in journals in this knowledge domain. This underscores the need to enhance collaboration between scientists, medical professionals, and journalists as an important strand of overall communications efforts in disseminating genomic medicine knowledge to larger audiences. Yet a substantive question remains to be examined: would traditional journalism, alone, be adequate to address the advances and challenges in genomics medicine in the media? Conversely, should we invest in science journalism programs as a subspecialty in biomedicine so scientists and clinicians acquire the twin scholarship of science/clinical medicine and journalism in their formative education?

Introduction

WITH ADVANCES IN VARIOUS DATA-INTENSIVE 'Omics' fields (e.g., genomics, transcriptomics, proteomics, glycomics, lipidomics, and metabolomics), we have entered an era of postgenomics medicine (Trifonova et al., 2013). The completion of the Human Genome Project in 2003 now serves as a basis for the investigation of human health and disease (Jasanoff, 2011).

Since then, significant progress in human genomics medicine has been made, from the exploration of human genetic variation through the International HapMap Project

---

[1]School of Public Health, Capital Medical University, Beijing, China.
[2]Chinese Academy of Inspection and Quarantine, Beijing, China.
[3]Municipal Key Laboratory of Clinical Epidemiology, Beijing, China.
[4]School of Medical Sciences, Edith Cowan University, Joondalup, Australia.

(International HapMap Consortium, 2003; Tsui et al., 2003) and the 1000 Genomes Project (Abecasis et al., 2010; 2012), to the mapping and definition of genetic regulatory regions and mechanisms in the ENCODE Project (de Souza, 2012). These advances in human genomics research have led to the development of powerful tools for discovering and quantifying genetic factors that contribute to common diseases and subsequent development of therapeutic and preventive strategies. This approach is encompassed in the term 'personalized medicine' (PM).

PM has the potential to create more powerful medical treatments customized for the individual patient. This approach would enable a lifelong health maintenance strategy tailored to a person's unique genome allowing treatments as individualized as the patient (Denecke and Spreckelsen, 2013; Hong and Oh, 2010). This includes personalized pharmacotherapy targeting genomic aberrations in an individual's unique molecular and genetic profile, while at the same time decreasing adverse drug reactions caused by altered drug metabolism encoded by the patients' genome. Personalized medicine could then potentially reduce disease incidence and mortality, and increase therapeutic efficacy, as well as impact other aspects of health care (Ackerman et al., 2013; Whirl-Carrillo, 2012). To establish PM in the community at the grassroots level, public engagement and citizen participation in genomics medicine (GM) are essential. Accordingly, contextualized knowledge regarding GM must be shared with the public in a readily understandable format.

Analyzing the importance of news media has been the subject of numerous studies, as it has been found to be the key intermediary for the dissemination of information on medicine and health (Du and Rachul, 2012; Gao et al., 2013; Steele et al., 2005; Whitley and Berr, 2013; Xu et al., 2013). However, studies about the dissemination of information on genomics to the lay public and the medical professionals are extremely limited. Research has shown that output of scientific articles have increased by 15% between 1990 and 2001, with a total output of over 650,000, but fewer than 0.013%–0.34% of such literature have gained the attention from the mass media (Sugawara et al., 2012; Suleski and Ibaraki, 2009). While web-based sources like blogs, wikis, and vlogs (video blogs) are the new frontier of modern journalism, newspapers are still recognized as the primary medium to disseminate information about genomics medicine by many medical professionals in China. However, since studies on newspaper coverage in China are limited, the role of print media remains uncertain. In China, we have a comprehensive newspaper database, the China Core Newspapers Full-text Database (CCND), which covers articles in the 700 major national and local newspapers. Utilizing this resource, we investigated newspaper coverage of GM in China.

The objective of the present study therefore was to characterize the number of articles related to GM and analyze content published by the eight major Chinese newspapers within an 11 year period (from 2000 to 2011) that is available from the current version of CCND.

Methods

Target newspapers

We analyzed the eight national newspapers in China (K: *Science and Technology Daily*; X: *Xinhua Daily Telegraph*;

Z1: *China Pharmaceutical News*; J: *Health News*; D: *Popular Science News*; G: *Guang Ming Daily*; R: *People's Daily*; Z2: *China High-tech Industry Herald*). We selected these official newspapers because they are regarded as the major credible sources of health information in China (Hays, 2008).

Data extraction

We extracted all relevant articles from CCND that have been published in eight targeted newspapers since 2000. Additionally, we extracted Chinese terms to define the following keywords:

- *JiYinZu/JiYinZuXue/RanSeTiZu* (genome),
- *RenLeiJiYinZu/RenLeiRanSeTiZu/RenLeiJiYinTuPu* (human genome),
- *RenLeiJiYinZuJiHua* (human genome project),
- *JiYinZuYiXue/JiYinYiXue/JiYinZhiLiao/GeTiHuaZhi-Liao/GeTiHuaYongYao/GeTiHuaYiXue* (genomics medicine, personalized medicine, made-to-order medicine, and tailor-made medicine).

The contents of articles from 2001, 2006, and 2011 were analyzed in parallel by two medical postgraduates (SQG and SS). The selected newspapers were subsequently scanned for articles that contained the listed Chinese keywords. Annual changes in the numbers of such articles and their contents were also calculated.

We then conducted PubMed searches using the same keywords as above in English, and included the term ''individualized medicine,'' to quantify the number of genomics-related research articles in international academic journals. In parallel we also conducted a PubMed search using the search terms-''genome, human'' ''Human Genome Project'' and ''individualized medicine,'' which were indexed as Medical Subject Headings (MeSH).

We defined the terms ''genomics medicine,'' ''personalized medicine,'' ''made-to-order medicine,'' ''tailor-made medicine,'' and ''individualized medicine'' as genomics medicine-related keywords (Sugawara, et al., 2012). Genomics medicine-related newspaper articles that were published in 2001, 2006 (when the genomics medicine-related article number began to increase), and 2011 (the most recent year available in the database) were extracted and categorized.

Statistical analysis

The statistical significance of the difference in the number of articles across time among the eight targeted newspapers was tested by two-way ANOVA modeling. This was followed by Tukey's multiple-comparison *post hoc* test to correct for multiple testing and confirm the results. Data was entered and analyzed with SPSS version 17. A *p* value of ≤ 0.05 was considered statistically significant.

Results

Total number of articles

The total number of articles published in the eight major newspapers in China averaged 59,376 per year, including 8662 in *Science and Technology Daily*, 11,009 in *Xinhua Daily Telegraph*, 4859 in *China Pharmaceutical News*, 2973 in *Health News*, 2246 in *Popular Science News*, 13,226 in

People's Daily, 8927 in *Guang Ming Daily*, and 3550 in *China High-tech Industry Herald*. Figure 1 shows the change in the total number of articles across the eight major newspapers between the dates of January 1, 2000 to August 31, 2011. While the number of published articles has increased since the early 2000s, there has been almost no obvious distinction between papers until 2006. Since 2006, the total number of articles published in the *People's Daily* has approximately doubled than that of which has been published in *Science and Technology Daily, Xinhua Daily Telegraph,* and *Guang Ming Daily.*

Number of genomics-related articles in the newspapers and genomics medicine-related scientific articles in PubMed

From 2000 to 2011, the total number of genomics-related articles published in the eight newspapers was 9023, including 3147 (34.88%) in *Science and Technology Daily*, 1291 (14.31%) in *Xinhua Daily Telegraph*, 1378 (15.27%) in *China Pharmaceutical News*, 1046 (11.59%) in *Health News*, 600 (6.65%) in *Popular Science News*, 442 (4.90%) in *People's Daily*, 634 (7.03%) in *Guang Ming Daily*, and 485 (5.38%) in *China High-tech Industry Herald*. The number of articles containing the selected keywords in the eight newspapers was: genome, $n = 1539$ (47.78%); human genome, $n = 349$ (10.84%); human genome project, $n = 362$ (11.24%); genomics medicine-related (made-to-order medicine, tailor-made medicine, genomics medicine, personalized medicine), $n = 971$ (30.15%).

Figure 2 demonstrates the change in the number of genomics-related articles published in the eight major

newspapers. The trends in the number of newspaper articles related to the human genome (Fig. 2A) and the human genome project (Fig. 2B) were similar, decreasing since 2000 across all eight major newspapers. Conversely, articles containing genomics medicine-related keywords (Fig. 2C) demonstrated an opposite trend with the number of genomics medicine-related articles published in *Science and Technology Daily, China Pharmaceutical News,* and *Health News* increasing significantly from 2004, peaking between 2006 and 2007.

Figure 2 also shows the change in the number of genomics-related articles published in PubMed. The trends in the number of human genome (Fig. 2A) and genomics medicine-related articles in PubMed (Fig. 2C) were the same; while the number of human genome- and genomics medicine-related articles increased. On the other hand, the number of articles related to the human genome project (Fig. 2B) increased temporarily in 2001, with no obvious change since 2004. The total number of articles containing all genomics-related keywords are shown in Figure 2D.

During 2000–2011, the coverage rates in human genome, human genome project, and genomics medicine in PubMed were 150-fold (61680/409), 10-fold (4315/425), and 40-fold (22991/553) higher, respectively, compared to that of the above mentioned eight newspapers. The numbers of genomics-related articles that were published among the eight major newspapers from 2000 to 2011 were significantly different ($p = 0.001$). Specifically, there were statistically significant differences between *Health News* and other newspapers ($p = 0.001$), as well as between *China Pharmaceutical News* and other newspapers ($p = 0.001$).
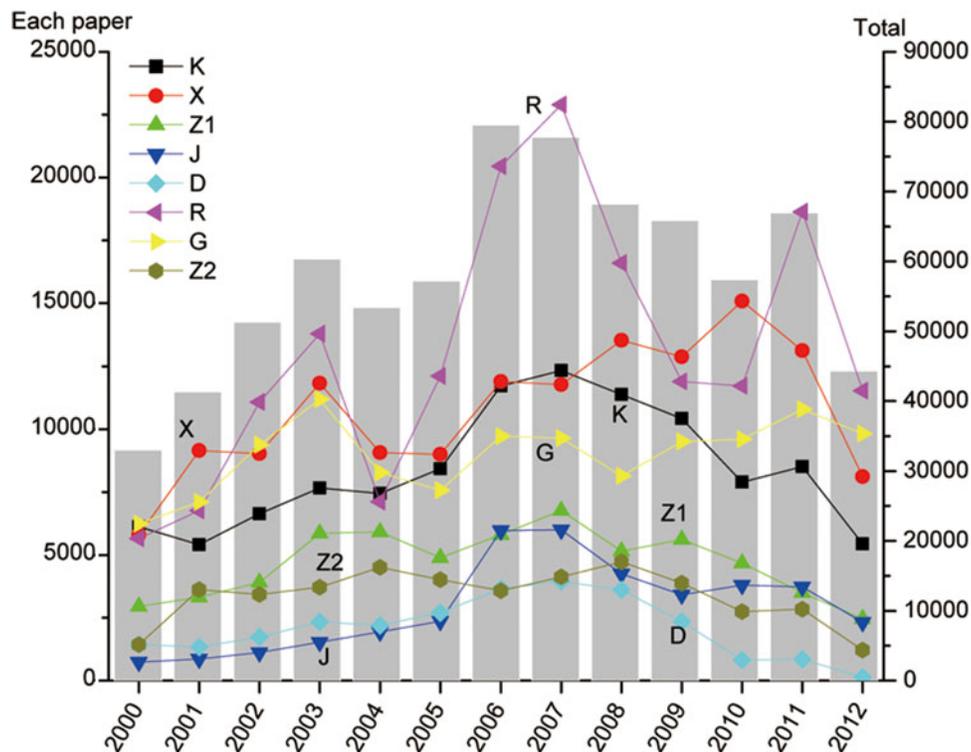

FIG. 1. Total number of articles in eight major newspapers. *Bar*: the eight newspapers taken together.
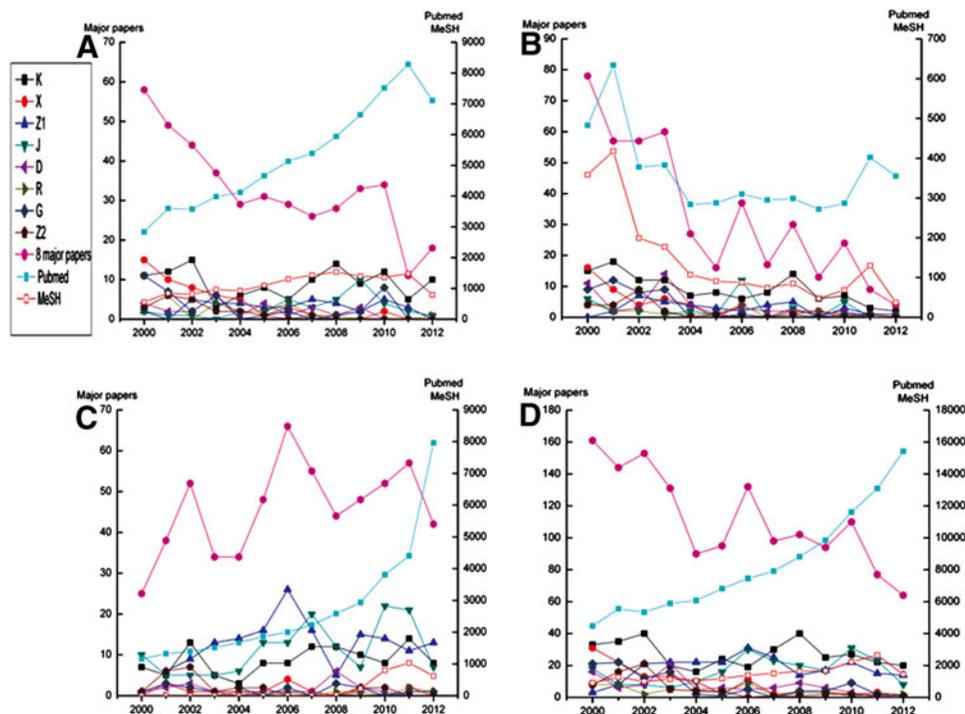
FIG. 2. Number of genome-related articles in eight major newspapers and genomics medicine-related articles in PubMed. **(A)** Articles related to human genome; **(B)** articles related to the Human Genome Project; and **(C)** articles containing genomics medicine-related keywords in eight major newspapers. A PubMed search using the following MeSH terms: ''genome, human,'' ''human genome project,'' and ''individualized medicine'' was conducted in **(A–C)**, respectively. The number of articles related to **(A–C)** in the newspapers and PubMed are shown in **(D)**.

Detailed analysis of the contents of genomics medicine-related articles published in Chinese newspapers

To better understand the news coverage of genomics medicine in China, we analyzed the contents of articles published in 2001 when the working draft of the genome was announced, the content of articles published in 2006 when phase II HapMap Project was launched, and, finally, the content of articles published in 2011, which is the most recent year available in the CCND database. The number of genomics medicine-related articles was 28 in 2001, 51 in 2006, and 41 in 2011. The changes in content over the 3 years selected are also shown in Table 1. General commentary/mini reviews and articles about gene therapy of specific diseases were the two article classifications most frequently published in 2006 and 2011 (36 articles in 2006 and 27 articles in 2011), respectively, with the number of genomics-related articles published overall increasing amongst the eight newspapers (Fig. 2C). Furthermore, we observed that ''cancer gene therapy,'' ''new susceptibility gene loci,'' and ''gene technology revolution'' were the top three thematic strands addressed in the newspapers, even though the overall number of genomics related articles is low.

Discussion

Even though China is a rapidly developing country with the largest population in the world, the Chinese newspaper industry, and science journalism in particular, are still at their infancy. This demonstrates the intrinsically unbalanced development between professional newspapers and economic and scientific progress in China. A previous study concluded that the newspaper density (number of newspapers sold per 1000 inhabitants) in China was only 70/1000 in 2003, increasing from 60/1000 in 2000 but was still lower than the world average ratio of 96/1000 with unbalanced development of professional newspapers reflecting the differential rates of regional development (Wang, 2005).

Study findings

Within this media environment, our study has revealed that article coverage of genomics medicine stories in Chinese newspapers has remained low, with only 12 articles published per newspaper per year between 2000 and 2011. We observed a quantitative reduction in genomics medicine-related articles in the eight major newspapers when assessing the difference in informational available to the wider public compared to the scientific community. We found that major factors that contribute to the low coverage rate of science-based reporting in China include newspapers not having a regular science section and/or employing editors and journalists with nonscientific backgrounds to cover scientific stories. Another factor is that, while scientific researchers have a more profound insight to new emerging genomic discoveries and phenomena, they are extremely sensitive to communicating this information to the lay public. These scientists stand at the forefront of the personalized genomics

TABLE 1. CONTENTS OF GENOMICS MEDICINE-RELATED ARTICLES IN EIGHT MAJOR NEWSPAPERS IN CHINA

Classification	Detailed topic 2001	No. of articles	Detailed topic 2006	No. of articles	Detailed topic 2011	No. of articles
Diseases gene therapies	Construction of human interleukin-10/augmenter of regeneration fused gene for liver cirrhosis	2	B7-2 and DNA vaccine for hepatitis	2	HCV RNA	1
	Transgenic engineering for coronary heart disease	1	Targeting gene-viral therapy of cancer	1	Ad-HGF gene therapy in myocardial ischemia	1
	Chemokines for HIV infection	1	Cancer gene therapy used in clinics	3	AIDS vaccine for anti-SIV infection	1
	Tolerance inducement in rat liver transplantation by constructing retroviral vector containing Fas L gene	1	Glaucoma	1	XALKORI (crizotinib)	1
	Immunotherapy of primary hepatic carcinoma	1	Malignant gliomas	1	Oncolytic viruses for Malignant Gliomas	1
	NK4 for cancer metastatic inhibition	1	Survivin as a target of glioma	1	BRCA1 mRNA	1
			Late malignant melanoma	1	P53 as a target for gene therapy of hepatocellular carcinoma	1
			PLNCX-TNFα transfection for cholangiocarcinoma	1	Gene therapy of HIV with adenovirus vector	2
			hTERT gene used in HeLa treatment	1	CERE-110	1
			New gene therapy for cancer in Russia	1	Erlotinib	1
			Skin cancer treatment by genetic engineering	1	Zelboraf (vemurafenib)	1
Disease gene therapies (cont.)			Adp53 combined hyperthermia for cancer treatment	1	Stem cell and gene therapy	1
			AFP of liver cancer as new target	1	New discovery against Leukemia	1
			L-SIGN-SARS suppressor genes	1	Avastin	1
			Bevasiranib	1		
			Transgenic cell transplantation for analgesia	1		
Heredity predisposing genes	Gene diagnosis for diabetes	1	Bone marrow stem cell combined with gene therapy	1		
			Gene polymorphism for epilepsy	2	FOXA2 and HNF1A	1
			Meningeal blood metastasis	1	Predictors of EGFR-TKI Therapy	1

TABLE 1. (CONTINUED)

Classification	Detailed topic 2001	No. of articles	Detailed topic 2006	No. of articles	Detailed topic 2011	No. of articles
			Hereditary hemorrhagic and thrombosis disease	1	EGFR gene mutation screening	1
			Mutant gene for different depression	1	Radiation-induced thyoid carcinoma	1
			LPL(lipoprotein lipase) gene	1	DNMT3A against Leukemia	1
			New susceptible gene locus of congenital cataract	1	The hotspot research of coronary heart disease	1
Comment/Summary	Commercialized gene therapy	2	Minimally invasive neurosurgery	1	LV-shPKCγ	1
					Diagnosis and treatment guideline of cancer	1
	The development of gene therapeutic agents	1	Pharmacogenomics	2	Proteomics research of nasopharyngeal carcinoma	1
	Pharmacogenomics and personalized medicine	1	Cancer gene therapy	11	Personalized medicine to be the new force of drug development	2
	On the rivalry between USA and Japan in genomics medicine	1	Gene technology revolution	1	Cancer drug development	1
	A prospect for new medicine	1	Gene diagnosis	1	Cancer gene therapy	3
	Cancer gene therapy	1			Tailored therapy	1
	Gene technology revolution	4			Nucleic acid drug	1
Problems during gene therapy	New development on medical genetics	1	Bcl-xL nanometer particle vector	2	Translational medicine	2
	Polymer materials vector	2	AAVP vector for cancer gene therapy	1	Distorted news about epilepsy treatment	1
	New supplementary means (membrane capsule)	1	eGFP gene used in NPC for transplantation	1		
	Transposon and rAAV vector	1	PTFE vascular graft	1		
National strategy for technology progress	France increases the government health investment	1	The current and future situation of biotech industry of Canada	1	DNA chips	1
	Endostatin gene	1	Bio-pharmaceutical industry's status of China	1	Targeted gene radiotherapy	1
	863 program	2	Enterprise cooperation	1	Roche Diagnostics	1
			Innovation & research teams	1	Nanosensor	1
					CCOL2A1	2

movement and are the key to bring together clinicians, research scientists, and the mass media to speed the transition of medical advances from the laboratory to clinical services. Therefore we propose that in China science journalism and citizen engagement subspecialty in biomedicine is developed so that present and future scientists and clinicians acquire the skills in disseminating the latest findings to the general public, not to mention the advanced social science methods for public engagement.

The issue of limited journalism activity grounded in sound science is an important barrier for diffusion of genomics medicine on a worldwide scale. Such scholarship in public engagement in genomics medicine is also essential in the reverse direction—so as to bring the citizens to the scientific design table in order to co-shape the future research agenda with scientists and citizens in a manner that reflects the extant public health needs. Finally, transparency, publicity, and freedom of speech are also major challenges in Chinese journalism. It is crucial that citizens have access to sound science journalism for genomics medicine to come to fruition in China.

As was previously found in Japan (Sugawara et al., 2012), our analysis also demonstrated a trend of transient genomics medicine newspaper coverage. One possible explanation for this trend is what has been termed "the issue attention cycle" (Downs, 1972). This phenomenon is thought to be a major structural problem inherent to the media, particularly with newspapers (Mizuno et al., 2010). Other medical issues, such as childhood obesity, is also subject to this cycle (Barry et al., 2011). In this cycle, even if a medical issue is of critical importance, it rarely sustains high-intensity public interest over an extended period. Therefore, we recommend that scientists and editors/journalists in China should become aware of the issue of attention cycle when they present the information to the public.

In contrast to the cyclical pattern revealed in newspaper articles, the output of articles containing genomics-related keywords in scientific literature has continuously increased, reflecting the constant advances in genomics medicine. It could be argued that this contrast between the consistency of scientific advancement and the transient trend of its reporting in Chinese newspapers reveals that there is a communication gap between the mass media and scientists. Such a gap has the potential to restrict communication of discoveries related to GM to the general public, thus negatively affecting the facilitation of personalized medicine services in the future.

However, some aspects of genomics medicine are consistently popular in the public media. For example, general commentary/mini review articles and articles about gene therapy of specific diseases were the most popular, particularly in relation to cancer (see Table 1). This is probably due to the fact that individuals may only tune in to news about diseases that are personally relevant, and they may not pay close attention to news on diseases with which they have no personal experience. For example, more people closely follow news about influenza and cancer, and fewer people closely follow more specific genomics medicine news (Brodie et al., 2003). We also find that Chinese scientists have been motivated to develop genomics-related new technologies research based on the restricted requirements of Chinese governmental funding bodies such as the National Natural Science Foundation and the National Science Technology of China, which in turn influences the content and style of reporting of scientific research in China.

As different types of media satisfy different audiences, further research is required to understand the role of the wider Chinese media in shaping both public opinion and policy development in a Chinese context. For example, smoking is a highly covered public health topic in different social media, with de Viron et al. (2013) investigating the availability of genetics and smoking in three different social media (YouTube, Facebook, and Twitter).

Considering the fact that genomics medicine is less well known than 'cancer' in the public sphere, it would be difficult to increase the general public's level of awareness. Therefore, we recommend that Chinese health care professionals should become more aware of the different types of media and develop an ability to efficiently communicate and disseminate genomics medicine news to the public audience.

Study limitations

While this study provides valuable insight into newspaper coverage of genomics medicine in China, it has some limitations. Firstly, there is a bias towards what are called "targeted" Chinese newspapers. These newspapers serve as government official newspapers in China (Hays, 2008), so they may not be comprehensively representative of all Chinese print newspapers. The data collected are derived from the year 2000 onwards, owing to the restraints due to lack of available data from earlier periods. Therefore, differences in trends of newspaper coverage in previous years are not available. This may have skewed our results in regards to the Human Genome Project as the first release was during that period. Finally, this study focused only on newspaper media. Expanding this research to other media types would be beneficial. For example, Schnoll et al. (2007) demonstrated that popular magazines also play a significant role in communicating discoveries and information about genomics medicine.

However, the fastest growing alternative media type to further investigate would be online reporting. Online reporting, such as People's Daily Online (2009) has grown to become the second highest source of medical news for the general public (Narimatsu et al., 2008). Online social media represents a new field for local, national, and global conversations and are important platforms for increasing the public's understanding of science. A growing body of research demonstrates that social platforms such as those developed online have the capacity to influence health behavior, irrespective of age, gender, education level, income, and occupation (Hanson et al., 2013).

Social media and the internet are also having an increasing influence on civic culture in China (Chan et al., 2012; Zhang and Pentina, 2012). In fact, China's internet population has experienced exponential growth, up to half a billion users, with Weibo, a Twitter-like social networking service still the top-used medium in China with around 250 million active users since its launch in August 2009 (Chan et al., 2012). Given that the increasing use of Weibo, its effect on population health attitudes and behaviors in China would be an interesting and informative next step.

Conclusion

Our study reveals that the amount of Chinese newspaper coverage on genomics medicine has declined despite

growing scientific output in academic journals. The future communication of information on genomics medicine in China for the establishment of personalized medicine will require improved collaboration and collective learning by scientists, medical professionals, citizens, and journalists in order to disseminate information about genomics medicine in China to a wider audience.

Acknowledgments

Author Disclosure Statement

The authors declare that no conflicting financial interests exist.

References

Abecasis GR, Altshuler D, Auton A, et al. (2010). A map of human genome variation from population-scale sequencing. Nature 467, 1061–1073.

Abecasis GR, Auton A, Brooks LD, et al. (2012). An integrated map of genetic variation from 1,092 human genomes. Nature 491, 56–65.

Ackerman MJ, Marcou CA, and Tester DJ. (2013). Personalized medicine: Genetic diagnosis for inherited cardiomyopathies/channelopathies. Rev Esp Cardiol 66, 298–307.

Anderson AA, Brossard D, and Scheufele DA. (2012). News coverage of controversial emerging technologies. Evidence for the issue attention cycle in print and online media. Politics Life Sci 31, 87–96.

Barry CL, Jarlenski M, Grob R, Schlesinger M, and Gollust SE. (2011). News media framing of childhood obesity in the United States from 2000 to 2009. Pediatrics 128,132–145.

Brodie M, Hamel EC, Altman DE, Blendon RJ, and Benson JM. (2003). Health news and the American public, 1996–2002. J Health Polit Policy Law 28, 927–950.

Chan M, Wu X, Hao Y, Xi R, and Jin T. (2012). Microblogging, online expression, and political efficacy among young Chinese citizens: The moderating role of information and entertainment needs in the use of weibo. Cyberpsychol Behav Soc Netw 15, 345–349.

de Souza N. (2012). The ENCODE project. Nat Methods 9, 1046.

de Viron S, Suggs LS, Brang A, and Van Oyen H. (2013). Communicating genetics and smoking through social media: Are we there yet? J Med Internet Res 15, e198.

Denecke K, and Spreckelsen C. (2013). Personalized medicine and the need for decision support systems. Stud Health Technol Inform 186, 41–45.

Downs A. (1972). Up and down with ecology—The "issue-attention cycle." Public Interest 28, 38–50.

Du L, and Rachul C. (2012). Chinese newspaper coverage of genetically modified organisms. BMC Public Health 12, 326.

Gao J, Fu H, Lin L, Nehl EJ, Wong FY, and Zheng P. (2013). Newspaper coverage of HIV/AIDS in China from 2000 to 2010. AIDS Care 15, 1174–1178. Doi:10.1080/09540121.2012.752785.

Hanson CL, Cannon B, Burton S, and Giraud-Carrier C. (2013). An exploration of social circles and prescription. J Med Internet Res 15, e189.

Hays J. (2008). Chinese newspaper and magazines and their battle against corruption and censorship. URL: http://factsanddetails.com/china.php?itemid=234&catid=7&subcatid=43. Last access: April 2012.

Hong KW, and Oh B. (2010). Overview of personalized medicine in the disease genomic era. BMB Rep 43, 643–648.

International HapMap Consortium. (2003). The International HapMap Project. Nature 426, 789–796.

Jasanoff S. (2011). Genome-sequencing anniversary. A living constitution. Science 331, 872.

Mizuno Y, Narimatsu H, Kishi Y, et al. (2010). Structural problems of medical news reports in newspapers: A verification of news reports on an incident of mass nosocomial Serratia infection. J Infect Chemother 16, 107–112.

Narimatsu H, Hori A, Matsumura T, et al. (2008). Cooperative relationship between pharmaceutical companies, academia, and media explains sharp decrease in frequency of pulmonary complications after bortezomib in Japan. J Clin Oncol 26, 5820–5823.

People's Daily Online. (2009). Chinese spend longest time traveling to work. URL: http://english.peopledaily.com.cn / 90001/ 90782/90872/ 6845283. html. Accessed 2013 Feb 26.

Schnoll RA, Wileyto EP, Hornik R, Schiller J, and Lerman C. (2007). Spiral computed tomography and lung cancer: Science, the media, and public opinion. J Clin Oncol 25, 5695–5697.

Steele WR, Mebane F, Viswanath K, and Solomon J. (2005). News media coverage of a women's health contraversy: How newspapers and TV outlets covered a recent debate over screening mammography. Women Health 41, 83–97.

Sugawara Y, Narimatsu H, and Fukao A. (2012). Coverage of genomic medicine: Information gap between lay public and scientists. Risk Manag Healthc Policy 5, 83–90.

Suleski J, and Ibaraki M. (2009). Scientists are talking, but mostly to each other: A quantitative analysis of research represented in mass media. Public Underst Sci 19, 115–125.

Trifonova O, Lokhov P, and Archakov A. (2013). Postgenomics diagnostics: Metabolomics approaches to human blood profiling. OMICS 17, 550–559.

Tsui C, Coleman LE, Griffith JL, et al. (2003). Single nucleotide polymorphisms (SNPs) that map to gaps in the human SNP map. Nucleic Acids Res 31, 4910–4916.

Wang GQ. (2005). Development orientation of Chinese newspapering enterprises. Youth Journalist 5–9 (in Chinese).

Whirl-Carrillo M, McDonagh EM, Hebert JM, et al. (2012). Pharmacogenomics knowledge for personalized medicine. Clin Pharmacol Ther 92, 414–417.

Whitley R, and Berr S. (2013). Trends in newspaper coverage of mental illness in Canada: 2005–2010. Can J Psychiatry 58, 107–112.

Xu Y, Xu S, Wu Q, and Guo Y. (2013). Tobacco knowledge among adults in Zhejiang Province, China. PLoS One 8, e59172.

Zhang L, and Pentina I. (2012). Motivations and usage patterns of Weibo. Cyberpsychol Behav Soc Netw 15, 312–317.

Address correspondence to:
Manshu Song, PhD
School of Public Health
Capital Medical University
No. 10 Xitoutiao
You An Men Wai
Fengtai District
Beijing 100069
China

E-mail: songms@ccmu.edu.cn

Abbreviations Used

CCND = China Core Newspapers Full-text Database
GM = Genomics medicine
MeSH = Medical Subject Heading
PM = Personalized medicine