



CRISPR in the North American popular press

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Purpose: CRISPR is often called one of the century's most important discoveries and is commonly discussed in terms of its momentous potential impacts. This study analyzed how CRISPR is discussed in the North American popular press, including how it is defined, and which benefits and risks/concerns are attributed to the technology.

Methods: Using the Factiva database, we identified 228 relevant, nonduplicated articles containing either "CRISPR" or "C.R.I.S.P.R.," published in popular US and Canadian news sources between 1 January 2012 and 12 July 2017. Content analysis was performed on the articles.

Results: CRISPR is most often discussed in the context of human health (83.8%), compared with animals (26.3%) and plants (20.6%). Nearly all articles (96.1%) presented CRISPR's potential benefits; 61.4% of articles presented CRISPR-related risks/concerns, the vast

majority of which focused on the uncertainty surrounding CRISPR, specifically with respect to germline modifications.

Conclusions: Overall, the discourse suggests a strong promotion of CRISPR, but an element of caution is also evident. Technical as well as ethical, legal, and social risks/concerns play a prominent role. This media portrayal of CRISPR might help facilitate more sophisticated and balanced policy responses, where the scientific potential of the technology is highlighted alongside broader social considerations.

Genetics in Medicine (2019) 21:2184–2189; <https://doi.org/10.1038/s41436-019-0482-5>

Keywords: CRISPR; gene editing; biotechnology; media; ELSI

INTRODUCTION

News media coverage is one of the primary means by which the public learns about health and science, including emerging biotechnologies such as CRISPR.¹ Despite issues of trust and accuracy,¹ general news outlets play a role in shaping public perceptions² and policy debates.³ CRISPR has been called one of the century's important discoveries⁴ and is often discussed in terms of its momentous potential impacts.⁵ We sought to study the portrayal of CRISPR in the popular North American press to assess, in a systematic manner, how it is presented and discussed. This included determining how CRISPR is defined and the benefits as well as risks/concerns attributed to the technology.

MATERIALS AND METHODS

Using the Dow Jones Factiva news database,⁶ we identified a total of 228 relevant, nonduplicated articles containing either "CRISPR" or "C.R.I.S.P.R." published in popular US and Canadian news sources between 1 January 2012 and 12 July 2017. Factiva is a publication database owned by Dow Jones with nearly 33,000 sources,⁶ including the vast majority of North American newspapers. Factiva's search

engine permits elaborate search inquiries using keywords and search formulas whereby corresponding text—in this case, news articles—can be downloaded. We designed our search based on the most popular North American news publications, which we defined using, in the United States, (1) a top 25 list of daily newspapers based on circulation,⁷ (2) a top 25 ranking of newspapers in local audience for print and online combined,⁸ and (3) a top 25 ranking of news publications by digital traffic for January 2015 (ref. ⁹). Online British publications were not included. For Canadian sources we included the top 26 (print and digital) English language newspapers in Canada by audience and reach as compiled by the Vividata database.¹⁰

The search terms "CRISPR" and "C.R.I.S.P.R." were deemed adequate to capture all articles surrounding the emerging CRISPR technology as no discursive synonyms for CRISPR were observed in academic or popular literature. Content analysis¹¹ of the articles was then performed using methods developed by our team in previous research.^{12,13} This included first constructing a coding frame by analyzing a sample of articles and then systematically applying this frame to the entire data set. The coding frame mapped out the related contexts and

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Submitted 5 December 2018; accepted: 27 February 2019

Published online: 12 April 2019

topics, how CRISPR was defined, and the discourse surrounding its potential benefits and risks/concerns.

The complete coding frame can be found in the Supplementary Materials. Because news publications and articles have varied manners of discussing topics, including those pertaining to biotechnologies, some aspects of the coding categories were designed to be specific while others are more general. For example, when coding for benefits (question 13 in the frame), our sample analysis showed that it was common to describe CRISPR's efficiency by focusing on its affordability (code 7), its ease of use (code 8), its versatility (code 9), and its precision (code 10). As the objective was to focus on the biotechnology of CRISPR, these specifics were deemed important. In contrast, no clear patterns were evident nor were they deemed highly important in the case of describing CRISPR's potential for financial profits (question 13, code 16), such as whether those benefits pertained to, e.g., company growth, stock options, etc. Further, some categories needed to be expansive to capture broad aspects of the discourse. It was a common occurrence, for example, for articles to simply state that “designer babies” was an issue. Others specified issues pertaining to the potential designing of aesthetics, talents, intelligence, etc. in future children. All of these risks and/or critiques of CRISPR (question 16) were captured by code 6 (“Negative impacts of parents using CRISPR to design babies”). For the same question, code 7 was designed to code for concerns related to particular communities (e.g., screening out deaf or autistic children), code 12 would capture all specific concerns around eugenics, and code 13 would capture all issues concerning consent. Metadata including publication source, author, word count, and publishing date were captured by Factiva. To account for subjective variance, 14.5% ($n = 33$) of the articles were tested for coding reliability using Cohen's kappa, resulting in excellent agreement levels ($\kappa = 0.848$) (ref. ¹⁴).

RESULTS

The overall portrayal of CRISPR in the articles is presented in Table 1. Regarding overall context, most news articles discuss CRISPR in the context of human health (83.8%) while considerably fewer do so in the contexts of animals (26.3%) and plants (20.6%). The ethical, legal, and social issues related to CRISPR—including discourse specifically on the legal battles around CRISPR patents (16.7%)—had a large presence in the context in which CRISPR was portrayed (40.8%), considerably larger than articles presenting CRISPR in a context of business interests (17.1%). CRISPR was almost universally defined as a gene-editing tool (98.7%), and it was common for CRISPR's editing functions to be explained in greater detail (49.6%). Metaphors and similes were used often, such as “(molecular) scissors,” a “(molecular) scalpel,” a “cut-and-paste” or a “search-and-replace” tool like a “word processor.” Function-describing verbs included common uses of “snip,” “edit,” “replace,” and “alter.” Nearly a quarter of the articles (24.1%) defined CRISPR as a research tool, and in

Table 1 Overall portrayal of CRISPR

Aspect of CRISPR discourse	# of articles (% of N = 228)	Aspect of CRISPR discourse	# of articles (% of N = 228)
Context		Mentions of policy	87 (38.2)
Human and human health	191 (83.8)	Legislative measures incl. regulation	42 (18.4)
ELSI (ethical, legal, social issues)	61 (26.8)	Research or research ethics guidelines	32 (14.0)
Animal	60 (26.3)	General, unspecified policy	29 (12.7)
Plant	47 (20.6)	Harmonization of regulatory principles	16 (7.0)
Business	39 (17.1)	Clinical guidelines	3 (1.3)
Patent debates	38 (16.7)	Inevitability of coming into use	25 (11.0)
Other ^a	10 (4.4)	Need for public discussions on CRISPR	46 (20.2)
Defining		Tone	
Gene-editing tool	225 (98.7)	Positive	86 (37.7)
Gene therapy tool	45 (19.7)	Mostly positive	62 (27.2)
Research tool	55 (24.1)	Neutral	65 (28.5)
Details of functions (incl. metaphors)	113 (49.6)	Mostly negative	14 (6.1)
Acronym expanded	42 (18.4)	Negative	1 (0.4)
Comparing with related technologies	42 (18.4)	Better than or an improvement on	
Benefits and risks/concerns		With benefits	219 (96.1)
With benefits	219 (96.1)	Without benefits	9 (3.9)
Without benefits	9 (3.9)	Prediction of benefits to take place	33 (14.5)
With risks/concerns	140 (61.4)	Hesitancy of benefits taking place	15 (6.6)
Without risks/concerns	88 (38.6)		

^aScience-related developments (4), technology (3), rhetoric (2), health-care budgets (1).

18.4% of the articles CRISPR was compared with similar, often earlier, gene-modifying technologies (e.g., TALENs, zinc fingers). When such comparisons were made, CRISPR was usually depicted as better or as an improvement (78.6%).

Nearly all articles (96.1%) presented CRISPR's potential benefits (Fig 1a.), the three most common of which were developing treatments for genetic disorders and diseases (46.9%), aiding and improving scientific research (34.2%), and eliminating or eradicating disease (26.3%). (See Fig 1b for all benefits present in at least 3% of the articles.) Benefits concerning prevention of disease, disability, and/or improved screening were much less frequently discussed (3.5% of the articles). Similarly, increased food quality and creating more virus-resistant animals had a low presence (in 2.6% and 2.2% respectively).

CRISPR was overwhelmingly presented as beneficial in relation to the health topics appearing in articles. That is, a

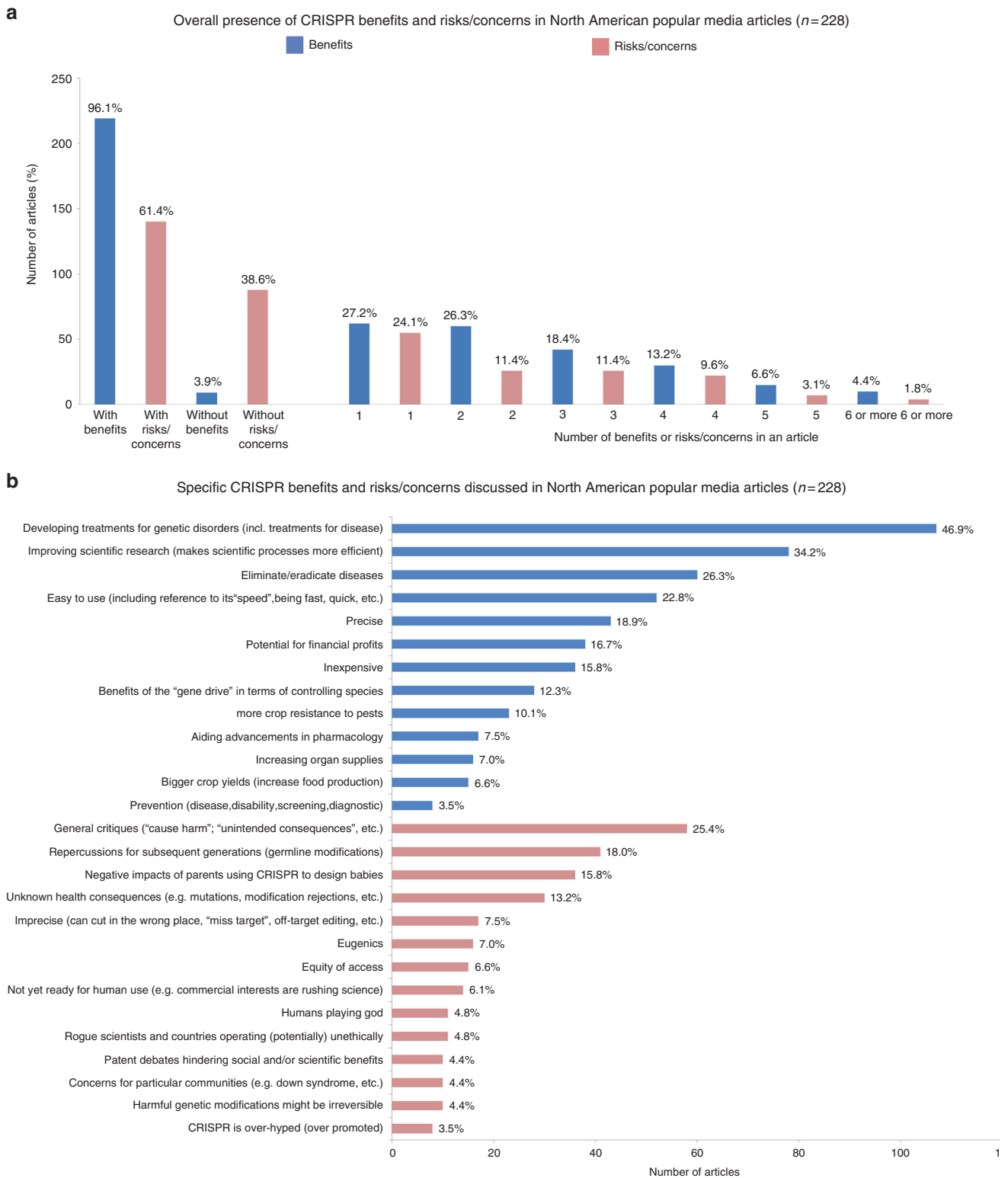


Fig. 1 CRISPR benefits and risks/concerns in North American popular press articles (*n* = 228). (a) Overall presence of CRISPR benefits and risks/concerns in North American popular press articles (*n* = 228). (b) Specific CRISPR benefits and risks/concerns in North American popular press articles (*n* = 228).

direct connection was evident between the health topic and CRISPR’s potential effectiveness in providing improvements. In all, 73 health topics were presented, totaling 521 instances (the total number of times each health topic was mentioned).

Table 2 presents all health topics appearing in at least 3% of the articles. In 76.6% (*n* = 400/521) of all instances, CRISPR was presented as potentially beneficial. In numerous cases, such as in the contexts of sickle cell disease, organ supplies,

Table 2 Presence of health topics (appearing in at least 3% of total articles) and relation to CRISPR benefits

Health topic	# of articles (% of N = 228)	# and (%) of cases when portrayed as beneficial
Human embryos	61 (26.8)	14 (23.0)
Cancer	41 (18.0)	37 (90.2)
Malaria	34 (14.9)	32 (94.1)
General (unspecified) diseases	31 (13.6)	29 (93.5)
Sickle cell disease	28 (12.3)	28 (100)
Muscular dystrophy	26 (11.4)	25 (96.2)
Cystic fibrosis	25 (11.0)	23 (92.0)
Blood disorders	22 (9.6)	18 (81.8)
Physical baby traits	20 (8.8)	6 (30.0)
Baby personality traits (+IQ)	20 (8.8)	7 (35.0)
HIV/AIDS	16 (7.0)	14 (87.5)
Organ supplies	16 (7.0)	16 (100)
Huntington disease	15 (6.6)	13 (86.7)
Blindness	13 (5.7)	13 (100)
Zika	12 (5.3)	9 (75.0)
Alzheimer disease	11 (4.8)	8 (72.7)
Dengue fever	8 (3.5)	7 (87.5)
Infertility	7 (3.1)	7 (100)

blindness, and infertility, CRISPR was uniformly presented as beneficial (100%). Only three health topics appearing in at least 3% of the articles did not present CRISPR as having positive potential: human embryos (23.0%), physical baby traits (30.0%), and baby personality traits (35.0%). Also, it was regarding these topics that many CRISPR risks/concerns were raised, as will be discussed in the following paragraphs.

It was uncommon for an article to make a specific time prediction as to when CRISPR-related benefits will occur (14.5%). When specific time predictions of CRISPR’s benefits were made, it was most commonly in relation to the advancements in food production already taking place, or the potential benefits to be obtained from clinical trials underway. In a few articles (6.6%) there was also explicit hesitation regarding when or if the benefits would ever materialize (See Table 1). Overall, however, the tone of the articles demonstrates a generally positive portrayal of CRISPR, with 37.7% of the articles being positive and 27.3% being mostly positive (Fig. 2).

In total, 61.4% of articles presented CRISPR-related risks/concerns. (See Fig. 1b for all risks/concerns present in at least 3% of the articles.) General, unspecified critiques such as “causing harms” or “unintended consequences” (25.4%) were

Tone of the articles with regards to CRISPR (n=228)

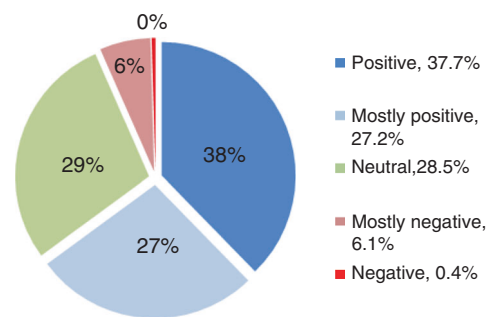


Fig. 2 Tone of the articles with regards to CRISPR (n = 228).

the most common, followed by risks/concerns with respect to germline modifications (18.0%), designer babies (15.8%), and unknown health consequences, including unforeseen variants and/or an organism’s potential rejection of CRISPR’s modifications (13.2%).

Lastly, a fairly large percentage of articles mentioned policy or policy-related implications of the technology (38.2%). As displayed in Table 1, 18.4% of the articles discussed legislative measures (including regulation), 14.0% discussed research and/or research ethics guidelines, and 7.0% discussed a harmonization of regulatory principles. The expressed need for more public discussions around CRISPR was present in 20.2% of the articles, though in some cases not expressed in relation to a specific policy response.

DISCUSSION

In the North American popular press, CRISPR is primarily discussed in the context of human health despite many current CRISPR applications also applying to animals and agriculture.¹⁵ Overall, the discourse suggests a strong promotion of CRISPR, highlighted in the tone of the articles with respect to CRISPR, and CRISPR’s portrayal as potentially beneficial for nearly every health topic with which it is associated. Only in relation to the health topics of human embryos (23.0%), physical baby traits (30.0%), and baby personality traits (35.0%) was CRISPR portrayed as non-beneficial and problematic. This is not surprising given the heated ethical and social debate regarding germline gene editing and embryos.^{16–18} Indeed, recent studies on the public perception of gene editing show less public support for germline gene editing, especially for human enhancement.¹⁹ It should also be emphasized that numerous articles could be characterized as being overly optimistic, indicating the presence of inappropriate science hype. In some of the articles the use of CRISPR was uniformly portrayed as potentially beneficial, such as for infertility (100% of 7 cases) and Alzheimer disease (73% of 11 cases). In fact, CRISPR’s application in these areas remains speculative.

It was not common for articles to state when CRISPR-related benefits would occur (14.5%), unlike what has been observed in some cases for other emerging biomedical

technologies.¹³ There were a few instances, however, where bold predictions were evident. For example, one article stated that “XLH will be a thing of the past” in “a few short years,” while another claimed that developments are “on track to reversing the aging process...in the next five years or so.” One article suggested that repairing pathogenic variants with CRISPR might be available to patients within a decade, and an article from 2016 included the following opening paragraph:

“Geneticist Jennifer Doudna, 52, is waiting for the day when she reads about the first baby whose genes have been altered in a lab. ‘It’s only a matter of time,’ says the professor of chemistry and molecular biology at the University of California, Berkeley—within the next 10 years, she thinks, or even sooner. The idea excites and worries her because she has been so deeply involved in the technology that would make it possible.”²⁰

The above quotation highlights a tension between promoting and encouraging the technology while simultaneously acknowledging the ethical, legal, and social issues that accompany that progression. Doudna’s prediction may have been considered unrealistic or unfathomable at the time, but appears to have taken place with the case of He Jiankui. Throughout this analysis, though not quantified, we observed that well-known figures in the gene-editing field, such as Doudna, Emmanuelle Charpentier, Feng Zhang, and George Church featured predominantly in the articles, and were often quoted or referenced straddling this tension. Church, for example, was the author of one article in the data set titled “Eight Questions to Ask Before Human Genetic Engineering Goes Mainstream,” which raised numerous issues associated with the technology. Indeed, while nearly every article (96.1%) detailed potential CRISPR benefits, 61.4% of the articles presented risks/concerns associated with the technology, making the CRISPR discourse somewhat diverse, with multiple, varied perspectives. After general critiques (25.4%) the second and third most common risk/concerns were related to germline modifications (18.0%) and designer babies (15.8%), which reflect issues foregrounded in the relevant academic literature,^{16,17} as well as the research on the public perception surrounding the therapy-enhancement and the somatic-germline distinctions.¹⁹ Compared with the media discourse surrounding other recent biomedical topics, such as stem cells, precision (or personalized) medicine, or non-invasive prenatal screening (NIPS), where the media representation has shown promotion with very little detailing of issues,^{12,13,21} the current media portrayal of CRISPR includes a higher percentage of articles containing risks/concerns.

Given the well-documented public concern around genetically modified organisms,²² an historic concern around the reproductive technologies of cloning,²³ and research ethics conflicts around gene therapies, for example in the case of Jesse Gelsinger,²⁴ this plurality of perspectives around CRISPR demonstrates perhaps a constructive trend in the

public discourses around emerging biotechnologies that possess enormous scientific potential but that also cause public concern. It is hoped this portrayal of CRISPR will help play a role in facilitating more sophisticated and balanced policy responses. With biomedical technologies progressing rapidly, effectively informing the public and policy makers remains of utmost importance, despite the challenges accompanying such efforts.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the following Genome Canada projects for their generous support: PACEOMICS, PEGASUS 1, and PEGASUS 2. Additionally, the authors thank Robyn Hyde-Lay for assisting with the testing of coding reliability.

DISCLOSURE

The authors declare no conflicts of interest.

Publisher’s note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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