Reporting on Antibiotic Resistance in Two US Newspapers Before and During Covid-19

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ABSTRACT
Antibiotic resistance (AR) is a growing health crisis that has remained underrepresented in coverage across major news publications in the U.S. despite increasing rates of related disease outbreaks and mortality worldwide. This study used content analysis to examine the coverage of AR in two major U.S. news publications before the COVID-19 pandemic (2018-2019) and during it (2020-2021). Coverage of AR in The New York Times (NYT) and The Washington Post (WP) was analyzed according to the use of frames, the quantity of articles published, and a number of other variables including stakeholders, diseases, and terms referring to AR. These factors were used to assess how coverage of AR differed before and during the COVID-19 pandemic, and how it differed between the two newspapers. Pre-COVID-19 coverage focused on AR as an isolated pandemic, while coverage during the early years of the COVID-19 pandemic often used AR as a supplementary component of the coverage to the main topic of COVID-19. This study found that both before and during the outbreak of COVID-19, the majority of the observed articles did not fully explain the scope, severity, or solution for the AR crisis. Instead, they provided readers with baseline information, framing AR as a contemporary issue and generally encouraging action but included very few tangible suggestions for every day, individual action for readers.

KEYWORDS
Superbugs; Frames; Antibiotic Resistance; Coronavirus; COVID-19; Media Coverage; Health Crises; Medicine

INTRODUCTION

Antibiotic resistance (AR) occurs when bacteria develop the ability to fight off the drugs designed to kill them, rendering the drugs ineffective.[1] Bacteria can gain this resistance and then spread it to other bacteria by transferring plasmids, or genetic information, between cells. This results in the exponential growth of these super-strains of borderline-invincible bacteria, also known as Superbugs. Note that certain fungi can also become resistant to drugs similar to bacteria and, in many parts of the world, this problem is referred to as antimicrobial resistance (AMR) rather than antibacterial resistance (AR) as it is commonly used in the United States. Superbugs continue to threaten the efficiency and reliability of modern medicine, adding risk to common surgeries and hospital procedures.[2] For nearly a century, antibiotics have helped to eradicate and alleviate common illnesses by blocking vital bacterial processes and helping the human immune system fight off infections. However, doctors, pharmaceutical companies, and most importantly patients are now facing a looming global health issue: resistance to these vital drugs.

Antibiotic resistance has escalated to a slowly growing health crisis, impacting roughly three million people and killing 35,000 annually in the United States, according to a 2019 Centers for Disease Control and Prevention (CDC) report.[3] Human behavior has acted as a catalyst for global outbreaks of various antibiotic resistant bacteria. One of the most prevalent acts is through antibiotic over prescription or inappropriate prescription.[4] A CDC study, using machine-learning modeling data from around 42 million U.S. patient visits for antibiotic-inappropriate acute respiratory infections, discovered that around 11% of those visits (over 4 million people) were inappropriately prescribed antibiotics. This occurred despite insufficient diagnosis codes for acute respiratory infections requiring antibiotics.[5] Overuse in the agricultural industries, especially in livestock,[6] has also exacerbated the problem, leading to the development and rapid reproduction rate of Superbugs through excess exposure to these antibiotics. Bacterial evolution is currently moving faster than pharmaceutical companies can develop new antibiotics to combat it. Problems in the drug pipeline, with not enough new antibiotics being researched by large drug companies that see no profit in it, combined with over-prescription and overuse, pose a possible grim future for the health of many populations.

While Superbugs have been spreading slowly for the last few decades, COVID-19, a strain of Coronavirus, spread quickly across global populations in only a few years. According to a 2024 dashboard update by the World Health Organization (WHO), COVID-19 has claimed more than seven million lives since 2020.[7] COVID-19 was declared a Public Health Emergency of International Concern (PHEIC) in January 2020, and the public watched case numbers oscillate and kept track of updates using social media and news platforms.

This study assessed how the AR coverage changed with the COVID-19 pandemic by comparing the coverage of AR in two major U.S. newspapers before the COVID-19 outbreak and after its onset in early 2020. Media coverage during the COVID outbreak is particularly interesting because it allows for the comparison between a slow-moving pandemic in antibiotic resistance and a fast-moving pandemic in COVID-19. This comparison also allows for an observation of how media coverage of creeping health crises can be overshadowed by other, more heavily covered topics, especially that of another pandemic. To evaluate these factors, we examined U.S. media's coverage on the development of AR in the widely distributed New York Times (NYT) and Washington Post (WP) in both print and online versions. We collected and coded articles in these publications over four years, looking at the two years preceding the onset of the COVID-19 pandemic, and during the pandemic's first two years to analyze the overall coverage of AR and how it changed with the addition of an immediate public health emergency.

LITERATURE REVIEW

Public Awareness of Antibiotic Resistance

Despite continuous rises in reported outbreaks and overall death tolls, major countries including Canada, Brazil, France, Germany, China, the United States, and more have yet to make antibiotic resistance a priority, as observed by the Global Coalition on Aging and the Infectious Diseases Society of America (IDSA). In a 2018 survey performed by the European Center for Disease Prevention and Control (ECDC) of over 18,000 healthcare workers, fewer than 60% were able to answer questions about antibiotics correctly, and only 58% agreed that they played an important part in preventing antibiotic resistance. The survey also noted that about 50% of respondents were uncertain about their country's plan to help prevent antibiotic-resistant infection outbreaks.[8]

A 2021 survey shows that only 46% of the public in Brazil, 51% in the United States, 63% in China, and 68% in India recognize AMR as a term.[9] This lack of public awareness is alarming in that it suggests that highly populated areas in major countries remain highly unprepared or unequipped to take measures against the spread of antibiotic resistant infectious diseases.

There have been some recent efforts to combat this lack of awareness, accompanied by specific calls for action to major countries detailing steps that can be taken against AR. A 2019 report by The Wellcome Trust emphasized the severity of antibiotic resistance by stating the death tolls and the impact that it has had on lower and middle income countries. It also proposed ways that different nations can mitigate the effects of bacterial development and drug failure including changing the ways in which antibiotics are dispensed, funding new drug development, educating communities about the problem in strategic ways, strengthening hospital and doctoral stewardship, and pioneering ways to detect the development of Superbugs in livestock.[10] Another call for action has been to pass the PASTEUR Act, a bill currently being presented to the U.S. congress that would allow the federal government to create more financial incentives for advancements in drug development and new antimicrobial treatments.

Media Influence on Infectious Disease Outbreaks

Hope for intervention is not all lost; coverage of infectious diseases across mass media platforms can help eliminate this lack of awareness through its effect on public opinion and forcing action against infectious diseases. A study at McMaster University found people tend to view diseases that are highly covered in the media as more severe than those that are less covered. Increasing rates of reporting of outbreaks also play an important role in perception of risk in a population.[11] Another report used theoretical projections based on psychology to find that, in general, during large outbreaks of infectious diseases with high mortality rates, individuals closely follow the news. As a result, they make efforts to minimize their exposure by isolating, which has a modest impact on overall morbidity. Media influence was strongest when media coverage was earlier in the outbreak; however, an increase in media exposure was found to minimize the severity of the infectious disease even when introduced later into the outbreak.[12]

The Impact of Journalistic Framing

Drawing public attention to media coverage of issues such as antibiotic resistance can be aided by a journalistic tool called framing. Differing representations or "frames" play a large role in situational analysis and perception of a given issue by an audience. Framing is a tool that is a key aspect of journalism as a whole, and it is particularly important when referring to health crises or trends within the mass media. "Specifically, news frames may be conceptualized as principles of selection, emphasis, and presentation composed of little tacit theories about what exists, what happens, and what matters…." The subject of often intense

negotiation between journalists and their editors, as well as their sources, frames help to render "an infinity of noticeable details" into meaningful categories.[13] Framing was investigated in a study related to opioid research in media, where it was found that most news stories were framed as "facts," however, in reality, it was rare that the presented information was sufficiently evaluated for its validity. The study mentions that many of the articles published in the mass media on opioid research often took findings from scientific journals out of context and inaccurately conveyed a lack of research in a given topic, or framed related research as controversial.[14]

This misinformation amongst audiences and its effect on reader understanding in regards to AR was also investigated in a recent study. Here, the impact of framing on public perception of AR overuse in livestock was examined using a survey. It was found that multiple frames, including the "blame frame," which described AR as a result of antibiotic overuse as an effort to combat animal welfare issues, had notable impacts on consumer trust. It was also found that readers were more likely to trust information when it was framed in a way that took the blame off of themselves, and rather placed the blame on the agricultural industry.[15] These findings exemplify how a media portrayal may alter the perception of major health events of crises and ultimately affect resulting outcomes in terms of audience impression.

Present Study

This study analyzed coverage on antibiotic resistance over two time periods in the NYT and the WP in terms of how and to what extent it was being covered. We sought to analyze how antibiotic resistance was presented and described in each given WP and NYT article, which stakeholders were represented within the articles, and the suggested actions that could be taken away from each article to help fight against the health threat. Building on past reports on AR published by PEW Charitable Trust,[2] the World Health Organization,[7] the Centers for Disease Control and Prevention[3], as well as the Wellcome Trust,[10] we aimed to answer the following research questions:

1. *What journalistic frames were most predominant across publications? How does this affect the overall perception of antibiotic resistance?*
2. *What happened to the coverage of antibiotic resistance once COVID-19 became a major coverage topic?*
3. *Were multiple terms used to discuss AR? Which were the most prevalent?*
4. *Was the coverage driven by different diseases or outbreaks?*
5. *What groups or organizations (stakeholders) were most often cited in the articles?*
6. *Were any actions suggested to improve or combat the situation?*
7. *Were there differences in coverage between the two national newspapers in the coverage of AR?*

METHODS AND PROCEDURES

To better understand antibiotic resistance both as a concept and health threat, we initially researched the threats that AR poses to public health, why it is important that people be informed about these threats, and how and to what capacities they are being conveyed and reported on in major media outlets. We reviewed reports on antibiotic resistance and various programs sponsored by the CDC, FDA, WHO, and the Wellcome and Pew Trusts.

We patterned part of our study on "Reframing Resistance," a study done by the Wellcome Trust Foundation in 2019,[9] which examined media coverage of AR in five countries including the United States. The Wellcome Trust is a global charitable foundation based out of the UK that is dedicated to health-based research in the topics of mental health, climate and health, and infectious disease. The Wellcome Trust conducted a robust study of frames across antibiotic resistance coverage by various media outlets. *Reframing Resistance* was a qualitative analysis that categorized AR coverage into five major frames. The results of the study suggested changes to the ways in which antibiotics are dispensed, funding new drug development, educating communities about the problem in strategic ways, strengthening hospital and doctoral stewardship, and pioneering ways to detect the development of Superbugs in livestock. We were particularly interested in seeing how our two newspaper findings compared to those of the Wellcome Trust's earlier U.S. findings.

The Wellcome Trust coded AR media coverage under the following frames: Undermining Modern Medicine, Explain the Fundamentals Succinctly, Emphasis that this is a Universal Issue, Focus on the Here and Now, and Encourage Action. We utilized these frames in our coding research, and added additional frames (Apocalyptic, Political, Personal, Optimistic, and Economic) based on our review of the literature to further categorize the articles that we observed. The first frame we used in this study was "Undermining Modern Medicine," in which articles described bacterial-resistant infections as lessening the effectiveness of modern treatment options, including those not directly related to the bacterial-resistant infections themselves. The second frame used was "Universal Issue," in which articles stated antibiotic resistance affects everyone, and is a threat to all. The third frame used was "Here and Now," which described antibiotic resistance as a problem that is occurring now, as opposed to an issue in the far-future. Words and phrases like "urgent," "today," and "right now" were some examples of key indicators for this frame.

The fourth frame was "Encourage Action," which focuses on preventing unnecessary death and suffering, and more specifically a push to take action. Words and phrases like "take action" and "act upon" were key indicators of this frame. "The fifth frame we considered was "Apocalyptic," in which articles described antibiotic resistance as a threat to "return to dark ages." The sixth frame was "Political," in which articles focused specifically on government action or inaction in regards to preventing AR. The seventh frame was "Personal," which focused on consumerism, individual examples of antibiotic overuse, and a lack of public awareness on AR. The eighth frame was "Optimistic," in which articles encouraged more research, called for the development of new antibiotics, and approached AR with a hopeful mindset. The ninth frame was "Economic," which focused on economic damage as a result of AR, increases in the cost of healthcare, and pharmaceuticals. Any articles with frames that did not fall under these categories were placed in an "Other" category.

We developed an analytical codebook to categorize articles that were collected from ProQuest after our initial research. These categories allowed us to obtain a detailed outline and understanding of the desired parameters of coding for each variable, which led us to more precise results and analysis. Relevant articles were coded for 32 variables, including present stakeholders, different diseases mentioned, and the words used to refer to antibiotic resistance. We cataloged the stakeholders, that is, the types of persons and organizations involved in mitigating the fallout of future Superbugs, the scope of the future resistance-based pandemics, and the ways in which this issue was framed by these major newspapers. We used the codebook that we developed to compare the coverage and framing of AR before and after the onset of COVID-19.

We used the ProQuest database to gather relevant articles from the NYT and WP. We chose to look at these publications specifically because they are both major sources of many people's daily health information. Using ProQuest, we conducted advanced, targeted searches to find all of the articles mentioning a series of key search terms pertaining to antibiotic resistance and used the codebook to break down coverage within relevant articles. The first search, focusing on articles published between Jan. 1, 2018 and Dec. 31 2019, avoided COVID-19 as a confounding factor. Articles for the pre-COVID-19 search (2018-2019) were obtained using the following search terms:-((antibiot* OR "antimicro* OR antifun* OR drug) NEAR/5 resistan* OR "superbug*) for dates from Jan. 1, 2018 to Dec. 31, 2019. We then repeated the process for a second search, focusing on articles published in the two newspapers during 2020 and 2021 after the initial coronavirus outbreak. We added additional coding categories to collect COVID-19-related information. These categories were related to whether COVID-19 was mentioned in the article, what terms were used to reference COVID-19 and how it was framed, if a connection was made between COVID-19 and AR, and if antibiotics or ventilators were involved in the treatment of COVID-19. No book reviews or obituaries were included in the final article count and irrelevant or duplicate articles were eliminated from the final coding. All articles were coded by two people to ensure accuracy. Coding disagreements were negotiated by the coders, with occasional faculty assistance.

We then input all of the coded data into Excel spreadsheets and checked them with one another to ensure intercoder reliability. Using Excel, we compared and sorted through our data by putting them into graphs to visualize and analyze the data that we collected. SPSS 29 was used to analyze the data, focusing on differences between the two newspapers and between pre-COVID and during COVID coverage. Chi-square contingency tests showed no statistical significance in data comparison between the NYT and WP. However, there were some significant differences in the number of articles and the major frames used based on the timeframe. Standardized adjusted residuals were used for post-hoc analysis of the significant chi-square tests. These findings will be detailed below in the results section.

RESULTS

Compiled Results from 2018-2021

The total number of articles found in the NYT and the WP regarding antibiotic resistance was relatively small: 176 articles in the NYT and 112 in the WP from 2018-2021. Comparing the total article count in both publications by year, 39 articles were published in 2018, 145 were published in 2019, 50 in 2020, and 52 in 2021, with notable spikes in both newspapers in April 2019, August 2019, and December 2019 (see Table 1). A goodness of fit test comparing the number of articles in each of the four years showed significant differences between them ($\chi 2$ (3, 288) = 102.86. p<.001). A goodness of fit comparing pre- and post-COVID-19 articles likewise revealed statistically significant differences in the number of articles between these two time periods ($\chi 2$ (1, 288) = 23.36. p<.001)

There were notable spikes in antibiotic resistance coverage during select months in the study. In April 2019, a total of 14 articles appeared in both publications about antibiotic resistance. It can be inferred that this increase in articles came as a result of an outbreak of the infection *Candida auris*. In August 2019, 14 articles were published by the NYT, and six were published by the WP. This increase can be attributed to the development of a successful treatment for an antibiotic strain to tuberculosis, which was covered in 32 articles by the NYT. In December 2019, the NYT published 18 articles about antibiotic resistance, and the WP published 11. The NYT coverage looked at a variety of topics including the bankruptcy of pharmaceutical companies trying to improve the drug pipeline, the use of antibiotics in the swine industry, and the bacteria in the Ganges River. This increase in 2019

coverage comes as a result of a NYT series of articles about antibiotic resistance titled, "Deadly Germs, Lost Cures." The series was primarily written by reporters Matt Richtel and Andrew Jacobs, and it covered a wide range of topics surrounding the issue of antibiotic resistance. The series started in 2019, had occasional articles throughout the year and three articles from this series were published in December 2019. Each article was accompanied by several summarizing briefs and sidebar stories about the issue. Since the articles within the series were so dispersed over the year, with different authors, it would have been difficult for readers to identify it as a significant coverage effort on the AR topic.

The degree of discussion about AR differed across articles. In all coded articles, 57.64% (n = 166) "only briefly discuss/mention AR and were on another topic," 40.28% (n= 116) "mostly discuss AR," and 2.08% (n = 6) "were listings of various articles; briefs." In the 211 articles that only mentioned AR (did not mention COVID-19), 50.24% (n = 106) "only briefly discuss/mention AR and were on another topic," 47.87% (n = 101) "mostly discuss AR," and 1.90% (n = 4) "were listings of various articles; briefs." In the 77 articles that mentioned both AR and COVID-19, 77.92% (n = 60) "only briefly discuss/mention AR and were on another topic," 19.48% (n = 15) "mostly discuss AR," and 2.60% (n = 2) "were listings of various articles; briefs."

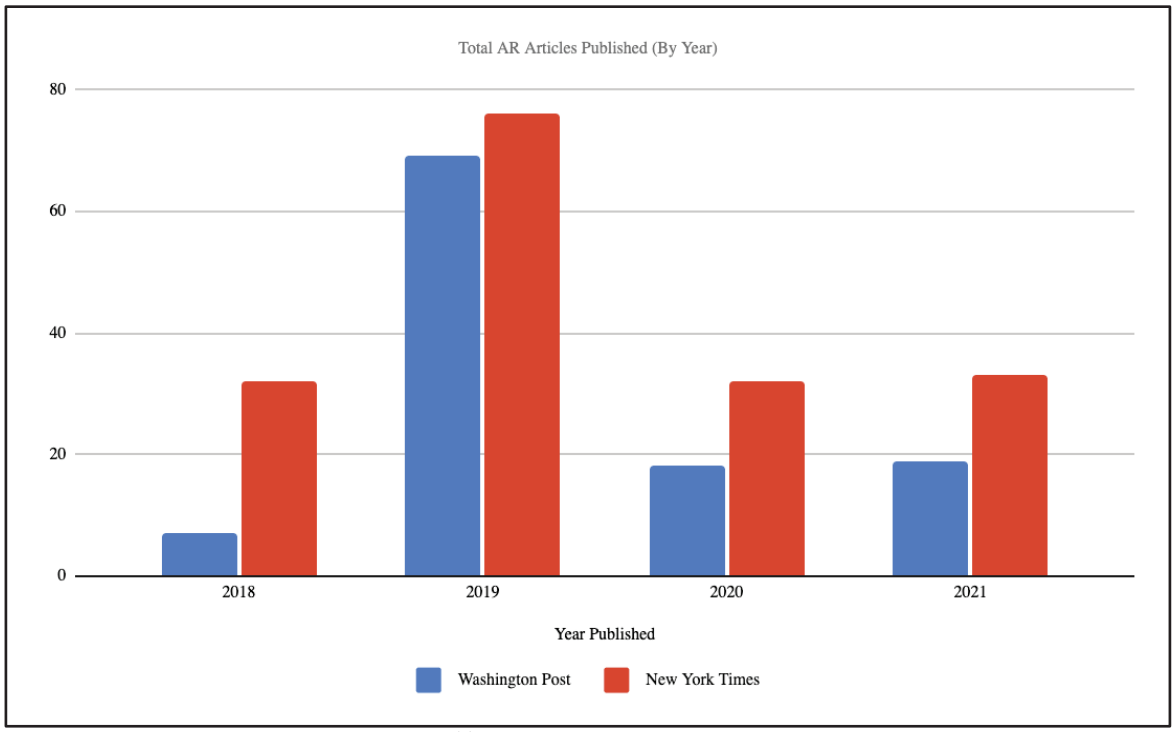

Figure 1. Total antibiotic resistance articles by year.

Major Frames

Overview of Results: The five major frames included in the 2019 Wellcome Trust search as well as four additional frames were included in this study. Of these, two were the most prevalent, dominating all of the others in both newspapers in our study. The most common major journalistic frame used was to "Encourage Action," which focuses on preventing unnecessary deaths or suffering. The second most common major frame used was a "Focus on Here and Now," which emphasizes that this issue is not a far-future problem, but rather a problem occurring now; it is immediate. The least common journalistic frame found was "Economic" which focused on a return to "dark ages," doom and gloom, and an impending sense of doom centered around pandemics and epidemics.[9]

Year by Year Comparison: There were significant differences between the major frames used in 2018-2019 compared to 2020-2021 ($\chi 2$ (8, 288) = 32.74 p<.001). In 2018, the most common frame in both the NYT and WP was "Encourage Action" and in the years 2019-2021, the most common frame in both the NYT and WP was "Focus on Here and Now." Post-hoc tests with the Bonferroni correction suggested three significant pairwise comparisons. Concretely, the "Encourage Action" frame appeared more frequently in the COVID-19 period compared to the pre-COVID-19 period than would be expected by chance; the "Apocalyptic" frame appeared more frequently in the pre-COVID-19 period than the COVID-19 period than would be expected

by chance; and none was present more frequently in the pre-COVID-19 period than the COVID-19 period than would be expected by chance. See Table 1 for a summary of this data.

FRAMES	2018-2019	2020-2021	Total	Significance
Undermining Modern Medicine (*n*, %)	22, 11.9%	10, 9.7%	32	Z = -.6, p = .59
Here and Now (*n*, %)	44, 23.8%	16, 15.5%	60	Z= -1.7, p = .09
Encourage Action (*n*, %)	28, 15.1%	33, 32.0%	61	Z = 3.4, p < .001*
Apocalyptic (*n*, %)	20, 10.8%	1, 1.0%	21	Z = -3.1, p = .002*
Political (*n*, %)	10, 5.4%	4, 3.9%	14	Z = -.6, p = .59
Personal (*n*, %)	17, 9.2%	15, 14.6%	32	Z = 1.4, p = .16
Optimistic (*n*, %)	19, 10.3%	18, 17.5%	37	Z = 1.8, p = .07
Other (*n*, %)*	7, 3.8%	5, 4.9%	12	Z = .4, p = .67
None (*n*, %)*	18, 9.7%	1, 1.0%	19	Z = -2.9, p = .003*

Table 1*:* Comparison of Major Frame Prevalence between 2018-2019 and 2020-2021. *Note.* For chi-square analyses and cell comparisons using Z-scores, we used Bonferroni Correction, such that significant p-value was set to p < .005. * = statistically significant group differences at p < .01 level.

During 2018, prior to the outbreak of the COVID-19 pandemic, only one article had an Encourage Action frame, meaning that antibiotic resistance was not viewed as a health crisis that required immediate personal action in 2018. However, in the following years, during the onset of the COVID-19 pandemic, the number of articles across both publications using this frame increased and remained relatively steady. In 2019, before COVID-19 became a major topic in the news, 27 articles across both publications used the Encourage Action frame. In 2020, after COVID-19 was declared a pandemic, 12 articles used this frame; and in 2021, 21 articles had Encourage Action as the dominant major frame.

Conversely, the second most prominent frame, Focus on the Here and Now, was most prominent in the earlier years of the study and waned in the following years, as the COVID-19 pandemic began to dominate the media. In 2018, there were 22 articles across both publications that primarily looked at antibiotics under the Focus on the Here and Now lens. In 2019, there were 22 total articles; in 2020, there were six; in 2021, there were 10 articles across both newspapers that used the Focus on the Here and Now frame. Overall, the NYT published more articles under both frames, and the two most prominent major frames had inverse trends in the observed media outlets over the course of the measured years.

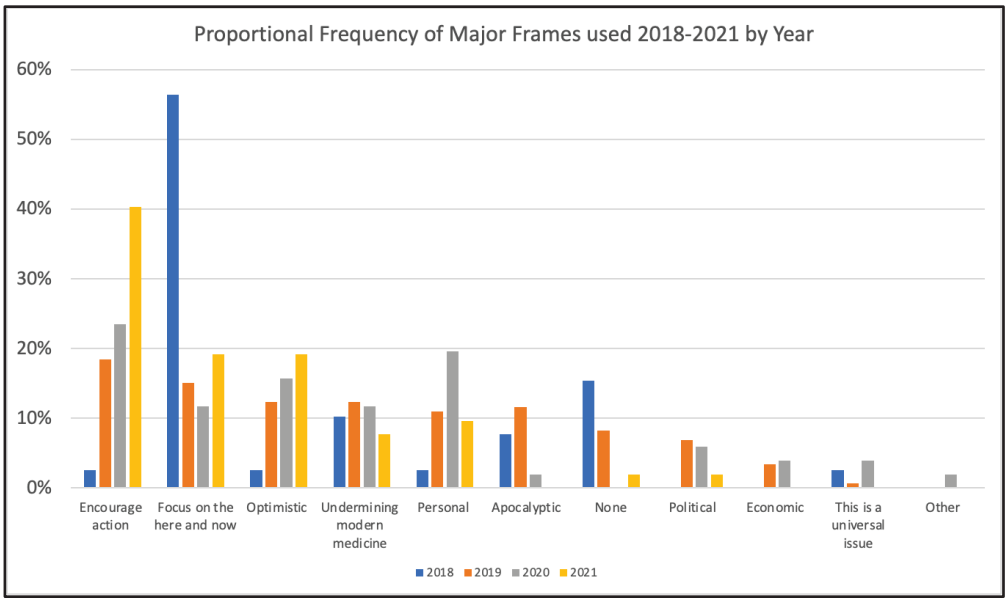

Figure 2. Proportional frequency of major frames used to characterize antibiotic resistance in articles published, broken down by year.

Description of Antibiotics

Overview of Results: Having an understandable and relatable definition of antibiotic resistance for readers was important for luring them into reading the articles. The newspaper articles described antibiotic resistance for their readers in several ways. The most common description was "antibiotics have become ineffective or stopped working," which states that antibiotic resistance is when antibiotics have become obsolete for treatment purposes. The "Ineffective Antibiotics" description was found in 119 of 288 total articles, or 41.32% of total articles. The second most common description was a more scientifically accurate description of the situation that concerned bacteria and their development of resistance to antibiotic drugs, their behavior and evolution. This was discussed in 92 articles over the four years of the study. As shown in Figure 3, there was a lower frequency of articles describing antibiotic resistance as issues related to overuse of antibiotic drugs by doctors, hospitals, consumers or in agriculture or farming.

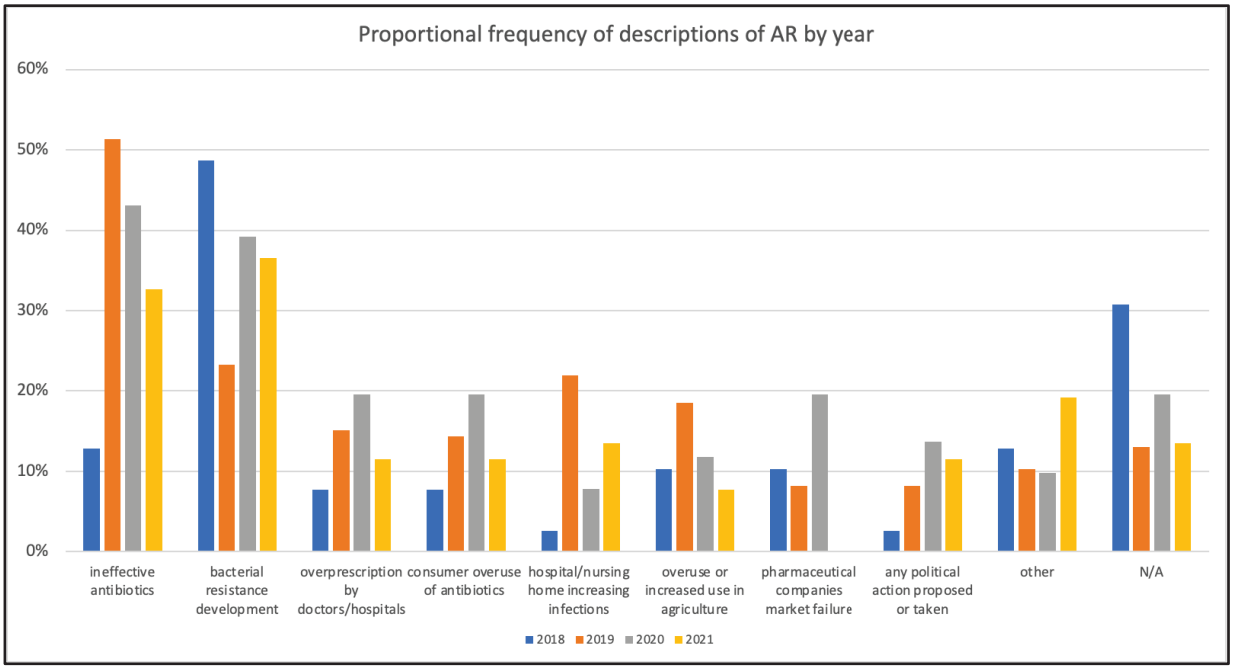

Figure 3. Proportional frequency of descriptions of antibiotic resistance in articles published, broken down by year.

Diseases Mentioned

Overview of Results: The most prominent disease mentioned in both publications from 2018 to 2021 was HIV, with 12.11% of all articles (n = 50) detailing the relationship between antibiotic resistance and HIV. Another commonly mentioned disease was tuberculosis or "TB." This was mentioned in 11.86% of total articles (n = 49). *Candida auris* also appeared in a notable number of articles; mentioned in 7.51% of all articles (n = 31). Seventy-nine of the articles across both publications from 2018-2021 discussed other diseases or very specific infections relevant to antibiotic resistance.

Year by Year Comparison: HIV representation saw consistent numbers across all years in terms of articles it was mentioned in relative to articles published. As for tuberculosis, there was a spike in its frequency, appearing in 24 articles in 2019 across both publications and only 25 total articles across both publications over the years 2018, 2020, and 2021. There was also a spike in both publications for *Candida auris*, as it was mentioned in 29 articles in 2019 across the WP and the NYT and just 2 total articles in both publications in the years 2018, 2020, and 2021.

Terms Referring to AR

Overview of Results: The most prominent term used to describe antibiotic resistance in both publications from 2018 to 2021 was, "drug-resistant infections," with 129 of the total 473 articles (28%) using this term to refer to the health crisis. The second most used term was "antibiotic resistance or AR," with 126 articles (27%) of the total article count from 2018-2021) across both media outlets using this term.

Stakeholders

Overview of Results: Many types of groups of people deal with AR and have a stake in how it is treated and researched and how antibiotics are used. The most prevalent group of stakeholders mentioned or appealed to within the articles dealt with medical professions: doctors, patients, and hospitals. As stakeholders, doctors appeared in 48.26% total articles (n = 139); patients appeared in 48.26% total articles (n = 139); and hospitals appeared in 50.35% (n = 145). This trend remained relatively static across the years 2018-2021, with doctors, patients, and hospitals staying as some of the most present stakeholders across all years. Another prevalent stakeholder within these publications was the CDC, which remained relatively constant in terms of frequency across all years. It appeared as a stakeholder in 32.29% of articles (n = 93). Universities were also a prevalent stakeholder across all years, appearing in 37.5% of articles (n = 108). There was a general lack of representation given to agricultural companies as a stakeholder for antibiotic resistance, despite the amount of antibiotics used by the agriculture industry. Agricultural companies appeared as a stakeholder in only 10.76% of total articles across all years between both publications (n = 31).

Suggested Actions

Overview of results: Outside of related topics regarding antibiotic resistance and important stakeholders, descriptions, and providing general information on the crisis, reporters also tried to present some possible solutions to the situation. The most commonly suggested action to combat antibiotic resistance across the articles was a call for a "Search for New Drugs." This was a suggested action in 32.64% total articles (n= 94). This was followed by the suggested action of "More Funding or Resources for Research," which was present in 27.78% of total articles over 2018-2021 in both publications (n = 80).

New York Times versus Washington Post Coverage

Looking at major journalistic frames in NYT and WP articles, the "Encourage Action" frame was the major journalistic frame for 37 of 176 NYT articles (21.02%) and 24 of 112 WP articles (21.43%). There was a small but interesting change in the major frames during the study years. The major journalistic frame within the articles in 2018 was a "Focus on Here and Now," accounting for 62.5% of the NYT articles (n=20) and 28.57 (n=2) of the WP articles. The major journalistic frame in 2019 articles across both publications was "Encourage Action," which applied to 18.18% NYT articles (n=14), and 18.84% of the WP articles (n=13).

The leading major frame in 2020 NYT articles was "Encourage Action," which accounted for 29.41% (n=10) of the articles, and the major journalistic frame in 2020 WP articles was a tie between "Drug-Resistant Infections are Undermining Modern Medicine," "Focus on the Here and Now," "Political" (Government Action or Inaction), and "Personal," with each being applicable to 17.63% (n= 3). This makes the most prevalent major journalistic frame across both WP and NYT articles "Encourage Action," which applies to 23.53% (n=12) of the articles (23.53%).

In the 2021 articles, the most common major journalistic frame in the NYT was Encourage Action, accounting for 36.36% (n=12) of the published articles. The most common major journalistic frame in the WP in 2021 articles was also Encourage Action, which was applicable to 47.37% (n=9). This makes Encourage Action the most prevalent major journalistic frame across all 2021 articles; applicable to 40.38% (n=21) of the total articles from both publications released in 2021.

When describing antibiotics within the publications, "Ineffective Antibiotics" was the most common description in both the NYT and WP in articles published from 2018-2021. This description was used in 34.09% (n=60) of the NYT articles, and 52.68% (n=59) of the WP articles.

The terms used to describe antibiotic resistance somewhat varied between the NYT and the WP. "Drug-resistant infections" was used more frequently in articles published by the NYT in 2018 and 2019, found in 33% in 2018 and 34% in 2019 of the articles published during these years. This description was used fewer times in 2020 and 2021, with only 14-21% of the articles using it to describe antibiotic resistance. The same term was not used at all in the WP in 2018. However, in 2019, 2020, and 2021, the number of articles published by the WP that used this term was relatively close to the number of articles published by the NYT that used this term to refer to antibiotic resistance.

Connecting the effects of antibiotic resistance with other diseases somewhat differed between newspapers. From 2018-2021, significantly more articles were published by the NYT that mentioned HIV, but the number of articles published each year across both publications that mentioned HIV was relatively consistent. This was the same for tuberculosis and *Candida auris*, which also showed relatively consistent numbers in articles mentioned when comparing the NYT to the WP.

As for stakeholders, both the NYT and WP followed the same general patterns, exhibiting minimal differences in their coverage. Doctors, patients, and hospitals remained the most prevalent stakeholders in both the NYT and WP articles across all years. Universities remained a top stakeholder in both the NYT and WP, appearing in 41.48% of the NYT articles (n = 73) and 31.25% of WP articles (n = 35). The CDC was a prevalent stakeholder across all years in both publications as well, including 28.41% of total NYT articles (n = 50) and 38.39% of 112 WP articles (n = 43). In both the NYT and WP, agricultural companies saw minimal representation, including mentions in just 10.80% of total NYT articles (n = 19) and 10.71% of total WP articles (n = 12).

Like stakeholders, the NYT and WP presented similar patterns of suggested actions. The most suggested action to combat antibiotic resistance in the NYT and the WP was a call for a "Search for New Drugs." This was a suggested action in 31.18% of NYT articles (n = 56) and 33.93% of WP articles (n = 38) . This was followed by the suggested action of "More Funding or Resources for Research," including 28.41% of total NYT articles (n = 50) and 26.79% of WP articles (n = 30).

DISCUSSION

Overview

The coverage of antibiotic resistance over time showed observable patterns in both journalistic framing and future direction. When looking at the media outlets and organizations involved in this study, there was a consistent pattern in which healthcare providers were posed heavily at being at fault for the spread of antibiotic resistance. The articles observed undermined antibiotic resistance as a problem requiring systemic change across multiple sectors, including governments, nonprofit organizations and the public, and instead focused primarily on just one branch of potential sources of error that has boosted antibiotic resistance in recent years. The blame overwhelmingly dealt with healthcare professionals rather than individual action, leaving the vast majority of readers unaware of their role in the issue or how it may affect them on a personal level. It seemed that the coverage was somewhat limited to healthcare-related issues, which may leave readers more likely to place fault on mistakes within the healthcare system rather than feeling motivated to make changes in their daily lives and actions to help reduce antibiotic resistance; essentially ignoring other prevalent sources of interest that contribute to AR. Although intervention dedicated to ensuring antibiotic prescription only when necessary, can be largely beneficial to physicians[16] and others working in pharmaceuticals,[17] there is still a notable discrepancy in the representation of other sectors that play a role in antibiotic resistance.

There was also a notable lack of attention given toward the agricultural sector of antibiotic resistance. Despite being one of the major contributors to antibiotic resistance, there was a minimal amount of coverage on the food industry as a whole, and minimal information on how factors like an overuse in antibiotics in animals may increase AR relative to human-based factors across both publications.

This overwhelming focus on systematic change rather than individual change is supported by the results seen when concerning suggested actions, with the most prevalent being a "Search for New Drugs" and "More Funding or Resources for Research." These are temporary solutions to the problem, as bacteria will continue to adapt to newly discovered/ distributed antibiotics. Temporary solutions are important; however, the articles did not focus as much on preventative and definitive measures for slowing antibiotic resistance.

The suggested actions also exhibit the same issue seen in the stakeholders section, in which there is a lack of attention given to other sectors that influence antibiotic resistance including more public information/understanding, more/better media coverage

of the situation, reduced use of broad spectrum antibiotics, etc. It is also important to note that a "Search For New Drugs" and "More Funding or Resources for Research" offer systematic change rather than providing information on individual actions that can be taken by readers within their everyday life.

Comparison to the Wellcome Trust

Our findings differ from the findings of the robust framing study conducted by The Wellcome Trust in timeframe, including newspapers, variables, and framing outlines. The Wellcome Trust found that in terms of sheer volume, the United States only published 366 articles from 10 different news outlets about antimicrobial resistance in the 12-month period between 2018 and 2019.[10] The Wellcome Trust found that the most compelling frame used to describe Antibiotic Resistance was the "Undermining Modern Medicine" frame, because it gives readers the sense that they are being set back in time, and the most effective frame was the "Explain the Fundamentals Succinctly" frame, which is not a frame that we included in our study, but they found that it gave readers a straightforward explanation for what the issue is.

The Trust found through quantitative studies that headlines that used more negative statements and statistics, about subjects such as death tolls, were less compelling to individuals, which aligns with the low number of articles that we found in our study that utilized the "Apocalyptic" frame. Even though they deemed it less effective than sharing straightforward facts, the Wellcome Trust acknowledged that many current communications around antibiotic resistance in the media focus on projections and warnings, thus falling into the "Focus on the Here and Now" frame, which was one of the most prominent major frames that we found in our study.[10]

The study done by the Wellcome Trust found that pneumonia, diarrhea, colitis, and gonorrhea were the most common diseases mentioned in articles in the United States that were influenced by drug-resistant infections, while our study found that HIV, TB, and *Candida auris* were the most commonly mentioned diseases in the WP and the NYT in the time period that we observed.[10] The Wellcome Trust found that a wide variety of terms were used to describe AR, and they were divided by tone.

The NYT and the WP had the fewest percentage overall of articles covering AR compared to other US publications, according to the Wellcome Trust, which may explain the lack of statistical evidence in our study for the findings of the Wellcome Trust. The Wellcome Trust studied a diverse set of mainstream print and online publications across the UK, US, and Germany totaling 1621 news items, including duplicate pieces. This is a notable difference in comparison to the 288 total articles in this study, not including duplicate pieces. The Wellcome Trust collected data from articles published from January 31, 2017 to January 31, 2018, contrasting from the timeline of January 2018 to December 2021, which encompasses different public health outbreaks (COVID 19 in particular) across a longer period of time.

CONCLUSIONS

The articles published between 2018 and 2021 in the NYT and the WP informed readers briefly and generally about what antibiotic resistance is, where these strains of bacteria are found, and how they are being treated in the current world.

Articles published in 2018 and 2019 contained significantly more informational content about the factors that contribute to the development of antibiotic resistant infections. The articles that focused on AR went into more depth about the science of Superbugs, detailing how cell plasmids transport these infections between organisms, giving readers background information about the topic and making information about the issue accessible. These articles established connections between the contributing factors, stakeholders, risks, and action plans involved in the study of AR, allowing readers to glean a holistic understanding of this issue as a looming public health crisis. Several of these articles used narrative, or feature storytelling, techniques to engage the senses and emotions of the readers to convince them of the severity of this health crisis. However, these informative articles made up only a small fraction of these collected articles.

The majority of the articles across both time periods only briefly mentioned antibiotic resistance, or used it as a supporting element, or mentioned risk, in the discussion of a different topic. As a result, these articles often did not serve the readers in that they did not fully explain the scope, severity, or solutions for the oncoming AR crisis. Across all 288 coded articles, over half were determined to "only briefly discuss/mention AR." This indicates that the articles were not likely to give sufficient or extended coverage of AR, but were rather supplementing it to support a separate topic, such as a new medical practice or other health crises (COVID-19, for example). This problem became even more apparent in articles after the start of the pandemic, with 60 of 77 total articles that mention both COVID-19 and AR falling under the category of "only briefly discuss/mention AR." There is a notable discrepancy in sample size between articles only mentioning AR and articles mentioning both COVID-19 and AR, however, this pattern can be investigated further to compare this potential shift in media coverage pre-pandemic and post-pandemic. To improve coverage, these articles could have included additional resources and information to better communicate the scope and severity of AR.

All articles tended to provide baseline information about antibiotic resistance and its expected rise within the near and extended future. There was minimal information given within the articles as to how to slow the spread, and instead they tended to focus on various alarming statistics and shortcomings in current approaches. Despite a journalistic frame calling for action, there were typically little-to-no specifics about how readers can become involved in the movement on an individual level. As mentioned previously, antibiotic resistance was often a secondary focal point across coded articles. Readers of the NYT and the WP would have benefited greatly from more articles with a primary focus on providing information about antibiotic resistance and a deeper analysis of how audiences can become involved in the fight against its spread on both a systemic and individual scale.

Newsworthiness describes whether a topic is relevant or interesting enough to cover in the media. It is directly related to the timeliness of a given issue being covered. The relationship between prevalence and popularity results in a pattern where more immediate, or trending, topics receive more coverage. This trend was observed in our assessment of the coverage of COVID-19, a fast-acting, global health crisis, and AR, a slowly advancing health threat. We found COVID-19 received notably more media attention than AR, despite increasing reports of global AR outbreaks and mortality projections far greater than the then-current COVID-19 death count. A report by WHO estimating by 2050, the AR annual mortality rates will reach up to 10 million.[18] According to our results, the media outlets we looked at began to shift away from framing AR as a crisis that required immediate action. Articles mentioning COVID-19 and AR, tended to refer to AR as a supporting example of a looming epidemic, comparing it to the COVID-19 outbreak, or as a result of early COVID-19 treatment. Seeing as how this coincided with rising COVID-19 cases, it can be inferred that COVID-19 drew public attention away from AR. While COVID-19 was an important topic to cover, a more balanced media focus on both crises could have yielded more informative, impactful coverage.

In a post-COVID-19 world, major publications such as the NYT and the WP will continue to give the most media attention to the most imminent health crises that are impacting the largest populations. The onset of the COVID-19 pandemic drew attention away from the issue of AR because it was fast acting and directly affecting the daily lives of populations globally. As a result, AR was mentioned more briefly and in less depth across major media outlets. As Superbugs spread and continue to render antibiotics unsuccessful, AR will become a more imminent issue facing society. If regulations to manage the careless use of antibiotics are not put in place and there is a continued lack of progress and attention to the development of new antibiotic drugs, AR will become a more serious issue. There is a continuous fight against time to inform the public and put preventative measures into action, with COVID-19 serving as just one example of the speed and sudden nature of pathogenic evolution and development. Implementing a dedicated mission to spread awareness of AR in the U.S. and globally could yield more effective media coverage and ultimately leave people more equipped to combat infectious diseases going forward.

This study had several limitations, the most prevalent of which dealt with the small number of articles found in the newspapers. The study was also directly affected by the COVID-19 pandemic and related COVID-19 protocols and health and safety restrictions. All group meetings were held virtually over Zoom, which created some difficulty in forming a consistent workplace environment. Future studies on mass media coverage of antibiotic resistance in the United States could explore how AR is covered in different types of media outlets including television and social media, particularly X and TikTok.

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REFERENCES

1. Martin MJ, Thottathil SE, Newman TB. (2015) Antibiotics Overuse in Animal Agriculture: A Call to Action for Health Care Providers. *American Journal of Public Health Volume 105 Issue 12, 2409-2410. doi: 10.2105/AJPH.2015.302870*
2. Cahill, K. (2022) Superbugs: A Global Health Threat, PEW Charitable Trust, *https://www.pewtrusts.org/en/trust/archive/winter-2022/superbugs-a-global-health-threat* (accessed June 2022)
3. *Antibiotic Resistance Threats in the United States 2019, https://stacks.cdc.gov/view/cdc/82532* (accessed June 2022)
4. Llor C, Bjerrum L. (2014) Antimicrobial resistance: risk associated with antibiotic overuse and initiatives to reduce the problem. *Therapeutic Advances in Drug Safety Volume 5, Issue 6, 220-254. doi: 10.1177/2042098614554919*
5. Antibiotic Use in the United States, 2022 Update: Progress and Opportunities (2022), Centers for Disease Control and Prevention, *https://www.cdc.gov/antibiotic-use/stewardship-report/current.html* (accessed June 2022)
6. Sustaining Global Action on Antimicrobial Resistance, *https://wellcome.org/sites/default/files/sustaining-global-action-on-antimicrobial-resistance.pdf* (accessed Jan. 2022)
7. WHO Coronavirus (COVID-19) Dashboard, *https://covid19.who.int/* (accessed June 2022)
8. Survey of healthcare workers' knowledge, attitudes and behaviours on antibiotics, antibiotic use and antibiotic resistance in the

EU/EEA *(2018), https://www.ecdc.europa.eu/sites/default/files/documents/survey-of-healthcare-workers-knowledge-attitudes-behaviours-on-antibiotics.pdf* (accessed June 2022)
9. *2021 AMR Preparedness Index, https://globalcoalitiononaging.com/wp-content/uploads/2021/06/GCOA-AMR-Preparedness-Index_FINAL.pdf* (accessed June 2022)
10. Reframing Resistance: How to communicate about antimicrobial resistance effectively, *https://cms.wellcome.org/sites/default/files/2020-11/reframing-resistance-report.pdf* (accessed June 2022)
11. Young ME, Norman GR, Humphreys KR. (2008) Medicine in the popular press: the influence of the media on perceptions of disease. *PLoS One Volume 3, Issue 10, e3552. doi: 10.1371/journal.pone.0003552*
12. Mummert A, Weiss H. (2013) Get the news out loudly and quickly: the influence of the media on limiting emerging infectious disease outbreaks. *PLoS One Volume 8, Issue 8, e71692. doi: 10.1371/journal.pone.0071692*
13. Anderson A, Allan S, Wilkins C. (2005) The Framing of Nanotechnologies in the British Newspaper Press. *Science Communication Volume 27, Issue 2, 200-220. doi: 10.1177/1075547005281472*
14. Matthias L, Fleerackers A, Alperin JP. (2020) Framing Science: How Opioid Research Is Presented in Online News Media. *Frontiers in Communication, Vol. 5, 64 doi: 10.3389/fcomm.2020.00064*
15. Steede GM, Meyers C, Li N, Irlbeck E, Gearhart S. (2020) The Influence of Framing Effects on Public Opinion of Antibiotic Use in Livestock. *Journal of Applied Communications, Volume 104, Issue 2. doi: 10.4148/1051-0834.2291*
16. Wasylyshyn AI, Kaye K, Chen J, Haddad H, Nagel J, Petrie J, Gandhi T, Petty L. (2022) Improving antibiotic use for sinusitis and upper respiratory tract infections: A virtual-visit antibiotic stewardship initiative. *Infection Control & Hospitality Epidemiology Volume 45 Issue 6, 1890-1893. doi: 10.1017/ice.2022.19*
17. Shinoda Y, Ohashi K, Matsuoka T, Yoshimura T. (2022) Analysis of pharmacological interventions among hospitalised patients with COVID-19: A focus on severe cases. *Biomed Reports Volume 18 Issue 2, No. 11 doi: 10.3892/br.2022.1593*
18. Antimicrobial resistance. *https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.* (accessed Jan. 2024)

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PRESS SUMMARY

This study found antibiotic resistance to be a health crisis generally under-reported by two major media outlets. This is most likely because it is a slow-moving crisis, as opposed to more immediate and seemingly more newsworthy pandemic outbreaks such as COVID-19. In both The New York Times and The Washington Post, pre-COVID-19 coverage of antibiotic resistance focused on it as an isolated pandemic, while coverage after the start of the COVID-19 pandemic typically included antibiotic resistance as a supplemental component of each article, focusing on COVID-19 as the main topic. Using content analysis to assess the coverage of antibiotic resistance, the study found that the vast majority of observed articles provided readers with baseline knowledge and explanation of antibiotic resistance but ultimately failed to characterize the scope, severity, or possible solutions for this important health crisis.