


# BMJ Open NIH funding of COVID-19 research in 2020: a cross-sectional study

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## ABSTRACT

**Objective** This study aims to characterise and evaluate the National Institutes of Health's (NIH's) grant allocation speed and pattern of COVID-19 research.

**Design** Cross-sectional study.

**Setting** COVID-19 NIH RePORTER Dataset was used to identify COVID-19 relevant grants.

**Participants** 1108 grants allocated to COVID-19 research.

**Main outcomes and measures** The primary outcome was to determine the number of grants and funding amount the NIH allocated for COVID-19 by research type and clinical/scientific area. The secondary outcome was to calculate the time from the funding opportunity announcement to the award notice date.

**Results** The NIH awarded a total of 56 169 grants in 2020, of which 2.0% (n=1108) was allocated for COVID-19 research. The NIH had a US\$45.3 billion budget that year, of which 4.9% (US\$2.2 billion) was allocated to COVID-19 research. The most common clinical/scientific areas were social determinants of health (n=278, 8.5% of COVID-19 funding), immunology (n=211, 25.8%) and pharmaceutical interventions research (n=208, 47.6%). There were 104 grants studying COVID-19 non-pharmaceutical interventions, of which 2 grants studied the efficacy of face masks and 6 studied the efficacy of social distancing. Of the 83 COVID-19 funded grants on transmission, 5 were awarded to study airborne transmission of COVID-19 and 2 grants on transmission of COVID-19 in schools. The average time from the funding opportunity announcement to the award notice date was 151 days (SD: ±57.9).

**Conclusion** In the first year of the pandemic, the NIH diverted a small fraction of its budget to COVID-19 research. Future health emergencies will require research funding to pivot in a timely fashion and funding levels to be proportional to the anticipated burden of disease in the population.

## INTRODUCTION

The National Institutes of Health (NIH) is the world's largest funder of biomedical research, employing over 20 000 people with a US\$45.3 billion budget in 2020, 41.7 billion appropriated by Congress with an additional 3.6 billion in COVID-19 supplementary funding.<sup>1–3</sup> Prior research suggested that the NIH research funding has not been proportionately aligned with disease burden in the

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Our study is the first study to characterise and evaluate the National Institutes of Health's (NIH's) under funding of COVID-19 clinical research in the year the pandemic hit the USA.
- ⇒ We conducted a cross-sectional study using the NIH Research Portfolio Online Reporting Tools Expenditures and Results (RePORTER) datasets of all COVID-19 grants, including grants funded by COVID-19 supplemental appropriations.
- ⇒ We calculated the number of grants and funding the NIH allocated towards COVID-19 in 2020 to different research types and clinical/scientific areas, and the time from funding opportunity announcement to award notice date.
- ⇒ We only reviewed abstracts and did not review the entire funded proposals. There were other barriers to clinical research that were not captured here, including slow institutional review boards and long journal peer-review times.

population.<sup>4–7</sup> Throughout the 1990s, NIH funding patterns were under major scrutiny from Congress and the scientific community due to concerns that funding allocations by the NIH failed to adequately reflect the burden of disease on society.<sup>6</sup> In 1998, the Institute of Medicine (IOM) released a groundbreaking report guiding the NIH to improve and develop disease-specific funding processes.<sup>8</sup> A landmark study published in the *New England Journal of Medicine* as well as a follow-up study by Gillum *et al* in 2011 revealed that the NIH disease-specific funding levels were not correlated with several measures of disease burden.<sup>5 6</sup>

The COVID-19 pandemic tested the NIH's ability to fund critical research to answer research questions that significantly affect public health and require urgent scientific clarity. We analysed the relative weight and composition of the NIH research funding of COVID-19 research in 2020 to evaluate the responsiveness of the agency to the pandemic.

## METHODS

### Study design and settings

We conducted a cross-sectional study using the NIH Research Portfolio Online Reporting Tools Expenditures and Results (RePORTER) datasets of all COVID-19 grants, including grants funded by COVID-19 supplemental appropriations.<sup>9 10</sup> We also reviewed the NIH Fiscal Year 2020 budget and NIH Fiscal Year 2020 supplemental appropriations to identify spending on NIH COVID-19 research.<sup>11</sup>

We reviewed all grants funded for COVID-19 research between 1 January 2020 and 31 December 2020. For each grant, we collected the date of funding opportunity announcements (NIH's advertisements of available grant support), award notice date and the amount awarded as listed in the NIH RePORTER dataset.<sup>12</sup> The date of the Funding Opportunity Announcement was obtained from the NIH COVID-19 grant opportunities.<sup>13</sup>

We categorised each grant into one of six research types: basic science, clinical science, translational science, public health, infrastructure and education and other (online supplemental appendix 1). Each NIH-funded grant was screened to identify one or multiple clinical/scientific areas of focus within the abstracts (online supplemental appendix 2). In order to create comprehensive definitions, we adapted definitions for research areas and subcategories of primary research subjects from NIH Research, Condition and Disease Categorization (RCDC) thesaurus and supplemented them using definitions from the Association of American Medical Colleges, National Cancer Institute, Economic Social Research Council, the Department of Health and Human Services and Methods in Educational Research.<sup>14–20</sup>

Each grant was independently reviewed and categorised by at least two independent reviewers (LB, SH, CD, CK, AM, BC). For grants that were categorised differently, a study group discussed the aims of the grant and made a final decision.

### Patient and public involvement

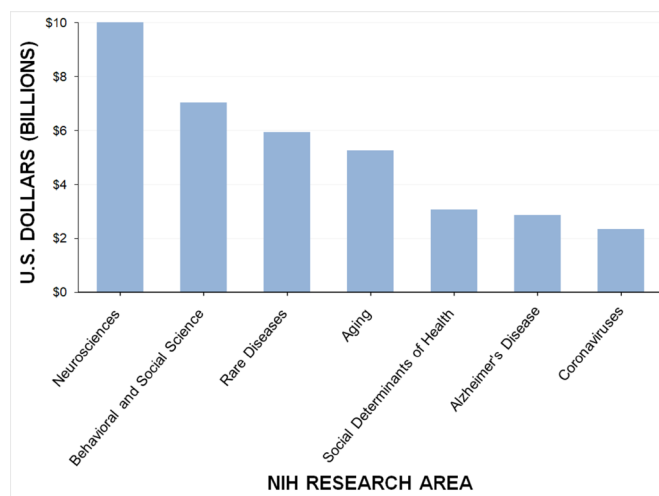
No patients were involved in this study.

### Data source

RePORTER is an electronic tool developed by the NIH that works in conjunction with the NIH's RePORT website. This tool allows users to generate lists of funded NIH studies based on specific search criteria, such as funding source and research area.<sup>11</sup> To obtain a list of all the grants that funded COVID-19 research in 2020, we used the NIH's pregenerated COVID-19 RePORTER dataset.<sup>9 11</sup> The information describing 2020 NIH funding by research was found on the RCDC RePORTER database.<sup>21</sup>

### Outcomes

The primary outcome for this analysis was to calculate the number of grants and funding the NIH allocated towards COVID-19 in 2020 to the six research types and each



**Figure 1** National Institutes of Health funding by research area (2020).

clinical/scientific area. The secondary outcome was to calculate the time from funding opportunity announcement to award.

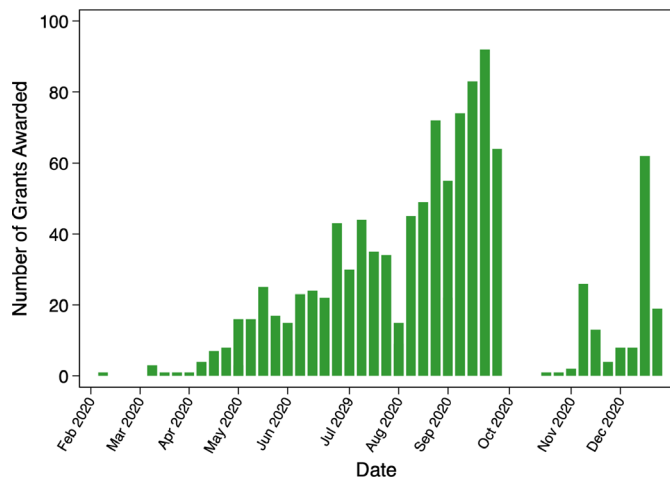
### Statistical analysis

We calculated the funding amount for research areas by compiling each grant's total funding amount allocated by the NIH. The funding amount for the clinical/scientific area was calculated based on each grant's categorization. We plotted the weekly number of COVID-19 grants awarded during 2020. Data cleaning and statistical analyses were conducted using Stata (V.16.0).

## RESULTS

In 2020, COVID-19 research accounted for 4.9% (US\$2.2 billion) of the annual NIH budget of US\$45.3 billion.<sup>3 22</sup> Of the US\$2.2 billion that the NIH spent on COVID-19 research, 91.0% was allocated from congressional special appropriations, while the remaining 9.0% of COVID-19 funding originated from the regular NIH annual budget that year. We found that several disease and condition-specific research areas were funded at levels much greater than COVID-19 (figure 1). Rare Diseases research received 2.5-fold more funding than coronavirus research and ageing research received 2.2-fold more research funding than coronavirus research.<sup>21</sup>

There were 1419 NIH COVID-19 grants from the year 2020 in the NIH RePORTER dataset. Of these, we identified 1108 COVID-19 grants with relevance to COVID-19 research, 24 were duplicates appearing in different places and 287 were categorised COVID-19 research; however, COVID-19 was not mentioned in the grant abstract or was not the focus of the grant. Of the 1108 COVID-19 grants identified, 266 grants were able to be matched to their funding opportunity announcement. The remainder had their funding opportunity announcements linked to ongoing projects and were unable to be matched with a current COVID-19 funding opportunity announcement.



**Figure 2** Number of COVID-19 grants approved by National Institutes of Health in 2020.

The average COVID-19 grant was issued funding 151 days (SD:±57.9) after its funding opportunity announcement, with a median of 137 days (IQR: 109–196) and range from 43 to 295 days. In a randomly selected pre-COVID sample of 20 grants in 2018 and 2019, the average time from the funding opportunity announcement to the awarded date was 606 days. There were 535 (48.3%) grants funded through regular 2020 appropriations and 573 (51.7%) funded through supplemental COVID-19 funding.

In the first 3 months of the global pandemic, a total of six grants were awarded for COVID-19 research. In the first half of 2020, a total of 240 grants were awarded funding (figure 2). Accordingly, in the first 3 months of 2020, the NIH spent a total of 0.04% of its annual budget on COVID-19 research. In the first half of 2020, the NIH spent 1.1% of its annual budget on COVID-19 research. The months with the most COVID-19 research grants awarded were August and October.

Regarding the type of COVID-19 research funded, basic science research comprised the greatest number of grants funded by the NIH with a total of 313 grants, comprising 6.9% of total COVID-19 research funding. There were 231 grants awarded for public health research and 231 grants awarded for clinical research, accounting for 5.7% and 26.8% of NIH COVID-19 funding, respectively. The NIH allocated the largest dollar amount to

infrastructure and education research with 55.5% of all COVID-19 funds going to these purposes with 216 grants, accounting for 2.7% of the NIH’s annual budget (table 1).

There was an average of 1.9 (SD:±1.0) clinical/scientific areas per grant awarded by the NIH. The most common clinical/scientific areas of research were social determinants of health (n=278 grants, 8.5% of COVID-19 funding), immunology (n=211 grants, 25.8% of COVID-19 funding) and pharmaceutical interventions (n=208 grants, 47.6% of COVID-19 funding) (table 2). Of the 208 grants dedicated to pharmaceutical intervention research, 85 grants focused on novel therapeutics development (6.4% of COVID-19 funding), 79 grants focused on existing therapeutics (28.2% of COVID-19 funding) and 69 grants on vaccine development (32.2% of COVID-19 funding). Of the 211 immunology grants, 41 grants studied immunity gained after infection of COVID-19 and 15 grants studied immune response from vaccination. Of 64 neurological grants, 13 grants focused on changes of tastes or smell.

There were 132 grants awarded for COVID-19 testing, comprising 8.5% of all COVID-19 funding. There were 83 grants on COVID-19 transmission, representing 3.5% of COVID-19 funding. Of these, 5 studied airborne transmission, and two grants studied COVID-19 transmission in schools.

A total of 104 grants focused on non-pharmaceutical interventions, with six grants on the efficacy of social distancing and two grants on the efficacy of face masks. Additionally, 92 grants studied the effects of COVID-19 infection in paediatric populations, 10 of which examined inflammatory syndrome in children. Geriatric health and COVID-19 was awarded 68 grants and maternal health and COVID-19 was awarded 41 grants. There were no grants dedicated to studying the efficacy of face masks in children.

## DISCUSSION

Despite the escalating public health threat and poorly understood mechanism of transmission of the novel coronavirus in 2020, the NIH only spent 5.3% of their total budget that year on COVID-19 research, extending the prior literature that the NIH funding priorities

**Table 1** National Institutes of Health (NIH) grants for COVID-19 research by research type (2020)

	Number of COVID-19 grants (%)	Dollars spent, US\$	Percent of all COVID-19 funding (%)	Percent of total NIH annual budget (%)
Basic science	313 (28.25%)	151 252 564	6.85	0.33
Translational	81 (7.31%)	85 436 684	3.87	0.19
Clinical	231 (20.85%)	591 533 574	26.77	1.31
Infrastructure and education	216 (19.49%)	1 235 403 053	55.92	2.73
Public health	231 (20.85%)	124 813 879	5.65	0.28
Other	36 (3.25%)	20 946 874	0.95	0.05
Total	1108	2 209 386 628	100.00	4.88

**Table 2** National Institutes of Health (NIH) grants for COVID-19 by clinical/scientific area (2020)\*

	Number of grants	Dollars spent, US\$	Percent of COVID-19 funding, %	Percent of NIH annual funding, %
Social determinants of health	278	188 229 016	8.52	0.42
Immunology	211	570 461 693	25.82	1.26
Pharmaceutical interventions	208	1 051 790 057	47.61	2.32
Impacts on other disease	133	40 865 572	1.85	0.09
Diagnosis and testing	132	186 846 477	8.46	0.41
Risk factor analysis	111	55 501 547	2.51	0.12
Non-pharmaceutical interventions	104	115 971 759	5.25	0.26
Paediatric health	92	63 635 942	2.88	0.14
Transmission	83	77 675 659	3.52	0.17
Other research	83	515 823 132	23.35	1.14
Virology	79	33 601 202	1.52	0.07
Geriatric health	68	467 815 039	21.17	1.03
Neurology	64	21 705 014	0.98	0.05
Pulmonology	61	37 068 124	1.68	0.08
Maternal health	41	19 633 841	0.89	0.04
Gastroenterology	31	12 081 004	0.55	0.03
Cardiology	18	32 997 172	1.49	0.07
Nephrology	14	8 386 775	0.38	0.02

\*Each grant can have multiple areas.

misaligned with disease burden in the population.<sup>6 8</sup> The NIH's slow start in funding COVID-19 research was also noted in a February 2021 study in *Health Affairs* by Sampat and Shadlen.<sup>7</sup> They described the current low investment in COVID-19 research as 'small compared with the potential value of these interventions for ameliorating or preventing the disease and securing a return to normalcy'. A stronger research effort could have helped reduce transmission of the infection before a vaccine became available.

Infrastructure and education accounted for 55.9% of NIH COVID-19 funding, yet many of the major clinical questions surrounding COVID-19 transmission were unanswered at that time, such as transmission among children. Significant restrictions have been placed on the nation's 52 million school-aged children, including school closures, 6-foot distancing requirements and outdoor masking while distancing; however, only a few grants were dedicated to studying these questions in this unique population, creating challenges for evidence-based policymaking. It is also concerning that we have identified 287 grants that are categorised as COVID-19 where COVID-19 was not mentioned in the grant abstract or was not the focus of the grant.

The lack of rapid clinical research funding to understand COVID-19 transmission may have contributed to the politicisation of the virus. Some of the most basic questions that were being asked of medical professionals in early 2020, such as how it spreads, when infected individuals are

most contagious, and whether masks protect individuals from spreading or getting the virus, went unanswered. In the absence of evidence-based answers to the common questions the public was asking, political opinions filled that vacuum. Patient and public involvement in research prioritisation of funding could help direct a more urgent, focused and equitable response to health emergency.

The social and political climate of the COVID-19 pandemic has been plagued with misinformation hindering important mitigation efforts. Significant funding was made to Biomedical Advanced Research and Development Authority. However, this funding was focused on vaccines and therapeutics rather than clinical research on characteristic COVID-19.<sup>9</sup> A resilient healthcare system in times of crisis should be able to pivot funding towards specific grants answering critical gaps in knowledge. NIH may consider developing procedures to rapidly pivot funding and guidelines for reviewing targeted proposals relevant to addressing a public health emergency.

Our study has several limitations. The type of research and the clinical/scientific areas studied were based on definitions that may not be collectively exhaustive and mutually exclusive. In addition, we only reviewed abstracts and did not review the entire funded proposals, and we did not separate the share of new grants vs continued grants in the analysis. There were other barriers to clinical research that were not captured here, including slow institutional review boards and long journal peer-review

times. A rapid research protocol that protects research subjects with standard ethical principles for research could be developed for the next health emergency.

## CONCLUSION

NIH funding patterns for COVID-19 grants did not align with COVID-19 disease burden and were allocated slowly. The NIH should develop mechanisms to rapidly pivot funding to address scientific unknowns associated with a sudden, large-scale health emergency. Supporting sound clinical research aimed at developing evidence-based recommendations is important for public policy and promotes public trust in the medical profession during a pandemic.

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**Competing interests** None declared.

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## REFERENCES

- 1 Baye R. Nih plans to move 3,000 employees to Bethesda campus. *Washington examiner*, 2012. Available: <https://www.washingtonexaminer.com/nih-plans-to-move-3-000-employees-to-bethesda-campus> [Accessed 13 Oct 2021].
- 2 National Institutes of Health (NIH). Frequently asked questions, 2014. Available: <https://www.nih.gov/about-nih/frequently-asked-questions> [Accessed 13 Oct 2021].
- 3 National Institutes of Health. Supplementary Appropriation Data Table for History of Congressional Appropriations, Fiscal Years 2020 - 2021.
- 4 Institute of Medicine. *Scientific opportunities and public needs: improving priority setting and public input at the National Institutes of health*. National Academies Press, 1998.
- 5 Gross CP, Anderson GF, Powe NR. The relation between funding by the National Institutes of health and the burden of disease. *N Engl J Med* 1999;340:1881-7.
- 6 Gillum LA, Gouveia C, Dorsey ER, et al. Nih disease funding levels and burden of disease. *PLoS One* 2011;6:e16837.
- 7 Sampat BN, Shadlen KC. The COVID-19 innovation system. *Health Aff* 2021;40:400-9.
- 8 Institute of Medicine. *For the Public's Health: The Role of Measurement in Action and Accountability*. The National Academies Press, 2011.
- 9 National Institutes of Health. Report. Available: <https://reporter.nih.gov/search/14E9CE024F8FC5D27598B8961CAA4A01A2FFCEB861BF/projects?shared=true&legacy=1> [Accessed 13 Oct 2021].
- 10 National Institutes of Health. NIH-Wide strategic plan for COVID-19 research, 2020. Available: <https://www.nih.gov/sites/default/files/research-training/initiatives/covid-19-strategic-plan/coronavirus-strategic-plan-20200713.pdf>
- 11 grants.nih.gov. Coronavirus disease 2019 (COVID-19): information for NIH applicants and recipients of NIH funding]. Available: <https://grants.nih.gov/policy/natural-disasters/corona-virus.htm> [Accessed 13 Oct 2021].
- 12 NIH Grants & Funding. Understand funding opportunities. Available: <https://grants.nih.gov/grants/how-to-apply-application-guide/prepare-to-apply-and-register/understand-funding-opportunities.htm#:~:text=NIH%20advertises%20availability%20of%20grant,of%20our%20generic%20parent%20announcements>
- 13 National Institutes of Health. Funding Opportunities Specific to COVID-19. NIH Grants & Funding. Available: <https://grants.nih.gov/grants/guide/COVID-Related.cfm> [Accessed 13 Oct 2021].
- 14 AAMC. Basic science. Available: <https://www.aamc.org/what-we-do/mission-areas/medical-research/basic-science> [Accessed 13 Oct 2021].
- 15 National Cancer Institute. Definition of clinical research - NCI Dictionary of Cancer Terms, 2011. Available: <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/clinical-research> [Accessed 13 Oct 2021].
- 16 RFA-RM-07-007: institutional clinical and translational science Award (U54). Available: <https://grants.nih.gov/grants/guide/rfa-files/rfa-rm-07-007.html> [Accessed 13 Oct 2021].
- 17 Research infrastructure - Economic and Social Research Council. Available: <https://esrc.ukri.org/research/future-of-social-science-insights-opportunities-and-expectations/research-infrastructure/> [Accessed 13 Oct 2021].
- 18 Lodico M, Spaulding D, Voegtli K. *Methods in educational research: from theory to practice*, 2nd edition | Wiley. Wiley.com. Available: <https://www.wiley.com/en-us/Methods+in+Educational+Research%3A+From+Theory+to+Practice%2C+2nd+Edition-p-9780470588697> [Accessed 13 Oct 2021].
- 19 Lapinski S. Research guides: participating in health research studies: types of health research. Available: <https://guides.library.harvard.edu/c.php?g=389023&p=2639516> [Accessed 13 Oct 2021].
- 20 health.gov. Social Determinants of Health - Healthy People 2030. Available: <https://health.gov/healthypeople/objectives-and-data/social-determinants-health> [Accessed 13 Oct 2021].
- 21 National Institutes of Health. Estimates of funding for various research, condition, and disease categories (RCDC), 2021. Available: <https://report.nih.gov/funding/categorical-spending/#/>
- 22 Fy 2020 by the numbers: extramural investments in research - NIH extramural nexus. Available: <https://nexus.od.nih.gov/all/2021/04/21/fy-2020-by-the-numbers-extramural-investments-in-research/> [Accessed 13 Oct 2021].