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Short Communication

U.S National Institutes of Health funding towards SARS-CoV-2 prevention and therapeutic scientific efforts: Is it enough?

Sophie Alfaro [a], Brendon Sen-Crowe [a], Mark McKenny [a,b], Adel Elkbuli [a,*]

[a] Department of Surgery, Division of Trauma and Surgical Critical Care, Kendall Regional Medical Center, Miami, FL, USA
[b] Department of Surgery, University of South Florida, Tampa, FL, USA

The COVID-19 pandemic has been one of the deadliest and costliest crises in our nation's history. By the end of the 2020, COVID-19 became the 3rd leading cause of death and was responsible for 598,932 deaths in the United States (U.S), translating to 11.3% of deaths (Fig. 1a) [1,2]. Between the Gross Domestic Product (GDP) lost, and the cost of long-term health impairment and deleterious mental health effects, the burden of COVID-19 has been estimated to amount to more than $16 trillion, or 90% of the entire nation's GDP [3]. In April 2020, 20.5 million jobs were lost, completely negating the employment progress made in the past decade as the unemployment rate hit 14.7%, the largest single-month increase in unemployment rate observed since the Bureau of Labor Statistics began tracking unemployment statistics in 1948 [4]. As COVID cases spread rampantly and drained facilities of their resources, there was a shortage of ICU beds, personal protective equipment (PPE), and respiratory ventilators [5,6]. Consequently, patients with comorbid conditions were excluded from access to intensive care units for COVID-19 care due to resource scarcity [7]. Small and rural hospitals disproportionately suffered significant economic losses due to the decrease in elective and outpatient services seen with the rise of COVID-19 [8]. Many were at risk for closure, and those that remained open struggled to maintain appropriate staffing levels [8]. To make matters worse, the out of pocket costs of admission for respiratory conditions is significantly straining COVID-19 patients [9]. COVID-19 took the world by surprise and produced 119% of the deaths that were expected to occur by the end of 2020 [2]. COVID-19 inflicted more damage than anticipated and continues to be a growing burden on a national and global scale. Given the sheer scale and destruction of COVID-19, one would expect the National Institutes of Health (NIH) to mobilize large amounts of funding, proportional to its impact, to study the virus and effective strategies for combatting it. This does not seem to have been the case.

Over the past decade, the total funding the Centers for Disease Control and Prevention allocated towards public health and emergency preparedness decreased while the overall NIH funding for prevention intervention simultaneously increased during the same time period [10]. With COVID-19 exhibiting such a high mortality rate as well as the substantial impacts on healthcare systems and patient costs, one would expect the NIH to have dedicated a significant amount of research funding towards SARS-CoV-2 containment strategies. In 2020, the amount and percentage of the NIH budget allocated to COVID-19 appears to be severely mismatched with its burden, and only comprises $2.355 million (0.88%) of the 2020 NIH budget (Fig. 1bc) [11]. Although this allocation amount may have been approved and appropriated prior to observation of the true impact of COVID-19, the estimated 2021 budget still only allocates $2.447 million [11]. Modifications should be made to match the budget amount with the impact and severity of the pandemic. For example, the budget allocated towards COVID-19 research is severely dwarfed by the estimated total cost of $16 trillion that is expected to be inflicted by the pandemic [3]. Although the NIH budget is allocated in an annual timeframe, the current budget only represents 0.01% of the estimated cost this virus will inflict. Thus, revision of the budget cap and/or transfer of funds from distributions related to public health prevention and emergency preparedness to COVID-19 research funding may warrant further investigation.

Of the top 10 leading causes of death, NIH funding allocated towards Cancer and Coronaviruses amounted to $7.065 billion (2.88%) and $2.355 billion (0.88%) of the 2020 NIH budget, respectively (Fig. 2ab) [11]. In addition, the research funding allocated to Alzheimer's disease was greater than what was allocated to COVID-19, despite the COVID-19 accounting for over 2.5x the deaths of Alzheimer's disease (Fig. 1abc) [2,11]. Furthermore, the budget allocated to many diseases with a lower mortality rate than COVID-19 was similar or higher [2,11]. One example is digestive diseases, which had a similar budget to COVID-19 (0.85% vs. 0.88%), yet accounted for 97,700 deaths in 2019 [11,12].

An important, cost-effective suggestion for the allocation of

* Corresponding author. Department of Surgery, Kendall Regional Medical Center, 11750 Bird Road. Miami, FL, 33175, USA.
E-mail address: Adel.Elkbulli@HCAHealthcare.com (A. Elkbuli).

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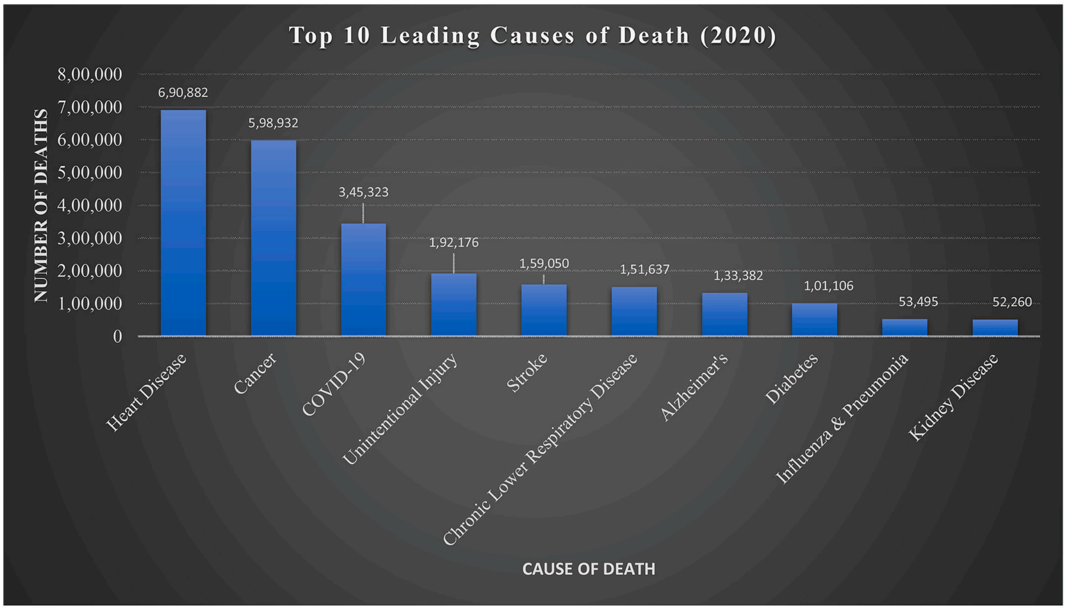
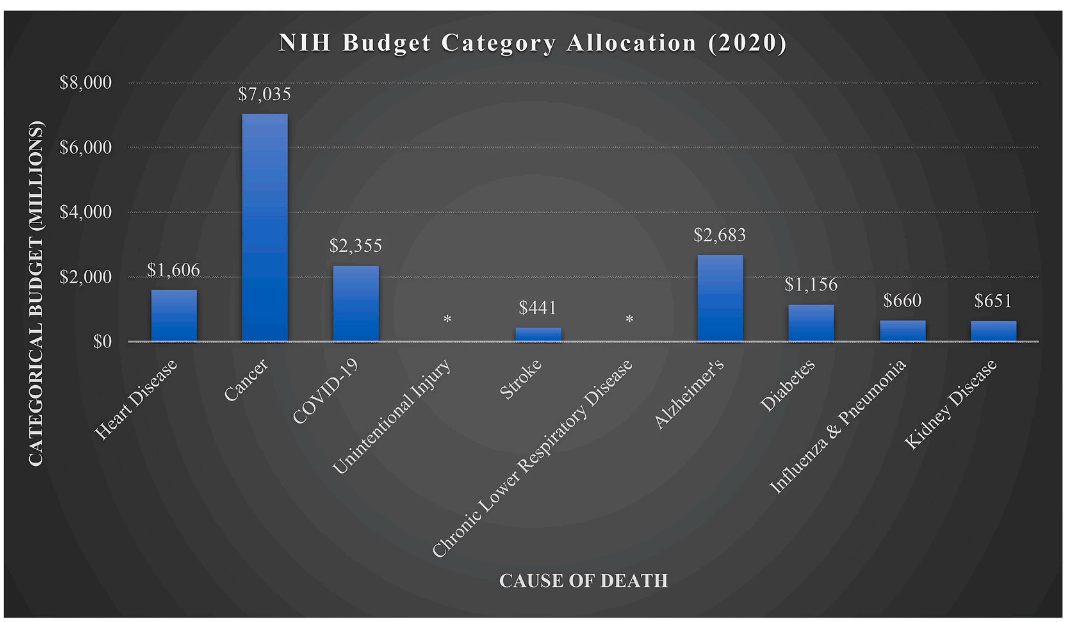


A. Top 10 Leading Causes of Death in 2020.

Fig. 1A. Top 10 leading causes of death in 2020.

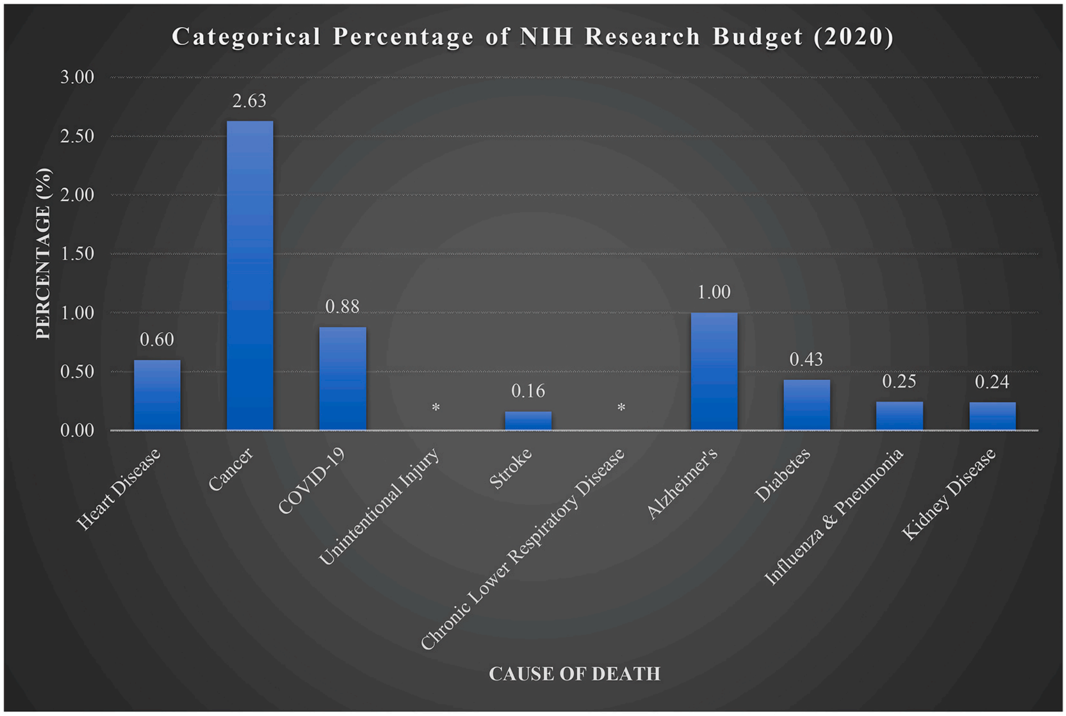


B. Categorical Allocation of NIH Budget Towards the Leading Causes of Death in 2020.
*Indicates lack of directly comparable NIH Funding Category

Fig. 1B. Categorical Allocation of NIH Budget Towards the Leading Causes of Death in 2020.
*Indicates lack of directly comparable NIH Funding Category.

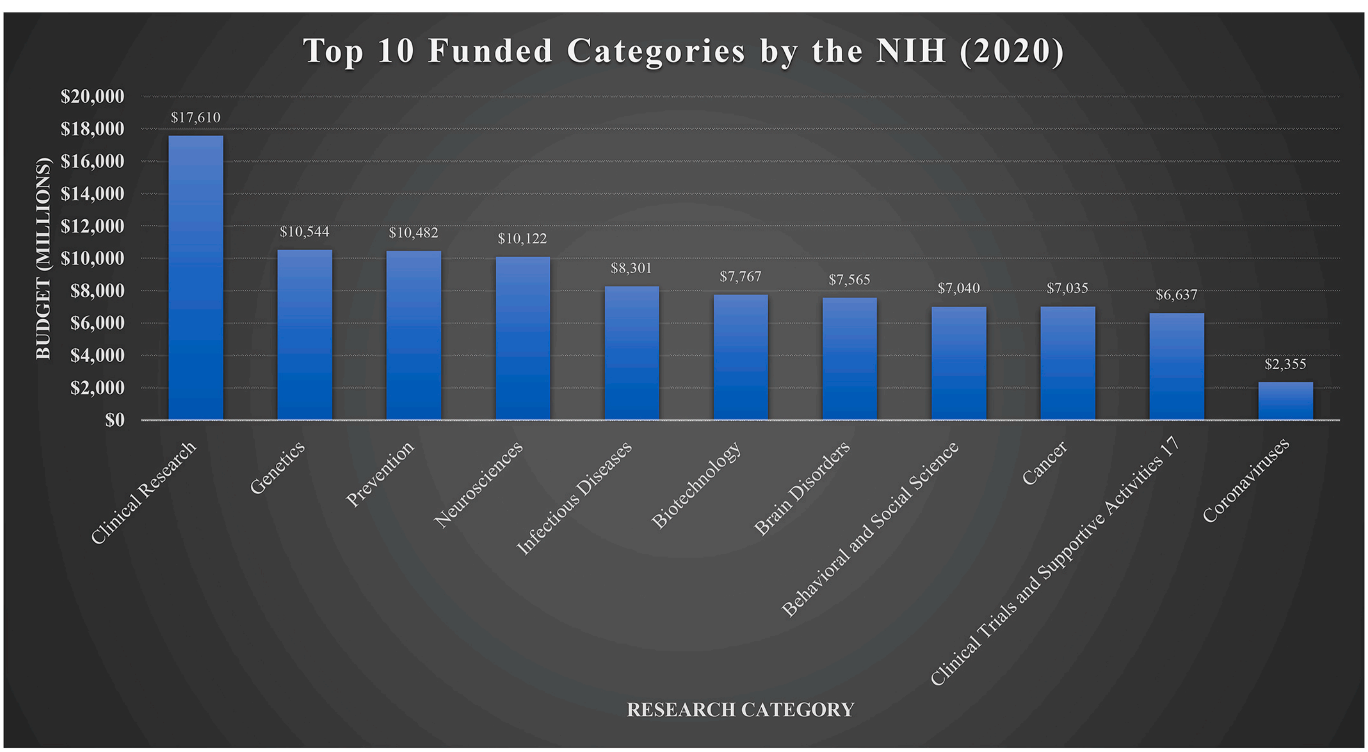
additional NIH funds is Coronavirus vaccinations [13]. One study estimating the cost of vaccine development against epidemic infectious diseases suggests that the cost of technology required for COVID-19 vaccines do not differ substantially in costs from well-established technologies that are currently in use [14]. Thus, increasing the budget for COVID-related research may support the swift development of "prototype" vaccines and/or vaccine boosters that may protect against COVID variants that have the potential to initiate future waves of cases [15,16]. Furthermore, funding directed towards the research of antibody titers of vaccinated persons may be useful to determine a threshold for cross-immunity that can be used as a clinically predictive marker for the risk of breakthrough infection [17]. Widespread application of these antibody thresholds in combination with adequate outbreak surveillance has the potential to reveal populations at high-risk of breakthrough infections for targeted intervention.

In addition, increased funding for COVID-19 research may aid in the development of new diagnostic strategies and overall surveillance. For example, there is some evidence that the testing of sewage for COVID-19



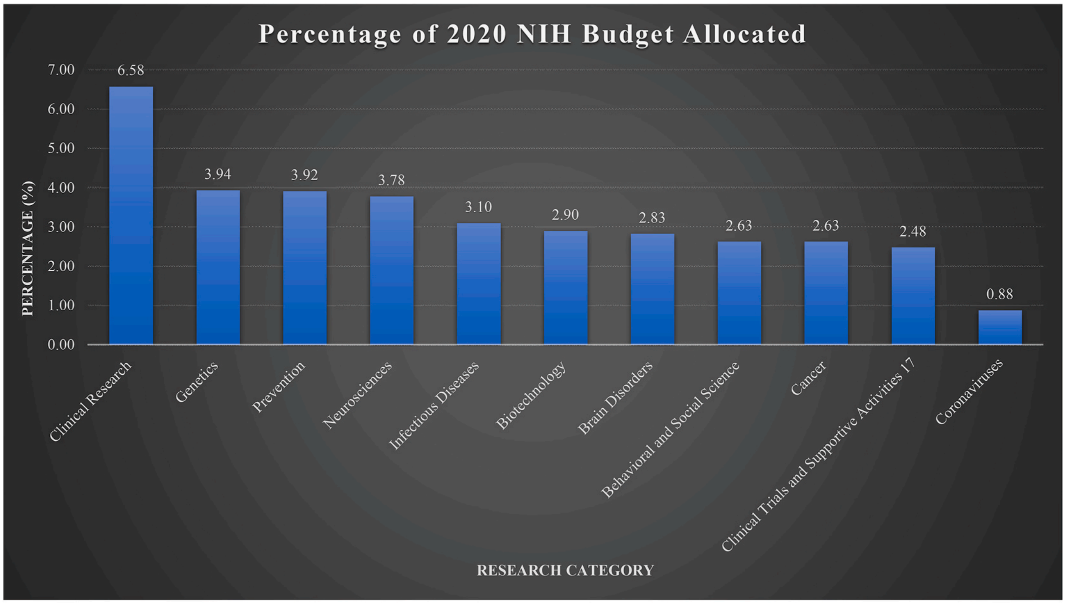
C. Percentage of NIH Budget Allocated to Top 10 Leading Causes of Death in 2020.
*Indicates lack of directly comparable NIH Funding Category

Fig. 1C. Percentage of NIH Budget Allocated to Top 10 Leading Causes of Death in 2020.
*Indicates lack of directly comparable NIH Funding Category.



A. Top 10 Funded Categories by the NIH in 2020.

Fig. 2A. Top 10 funded categories by the NIH in 2020.



B. Percentage of the NIH Budget Allocated to the Top 10 Funded Categories in 2020.

Fig. 2B. Percentage of the NIH budget allocated to the top 10 funded categories in 2020.

genomic material has the potential to predict a rise in cases multiple days before it is observed in the local hospital [18,19]. Development of similar technology and optimal placement/distribution of sampling locations may serve as a means to monitor the local area for the risk of a surge in cases. By doing so, infection surveillance can be standardized into a constant and ongoing process to proactively identify areas at risk of an outbreak and proactively allocate resources to these areas, rather than merely reacting after disaster strikes.

Moreover, the goals of initiatives such as "Safe Return to School Diagnostic Testing" should be targeted by the budget for nationwide implementation to control Coronavirus spread in children and help those exposed to the virus return to the classroom quicker than the current 10-day quarantine [20]. Other projects focused on diagnostic testing should also receive increased funding to cut down on the financial burden of COVID-19 complications. One example is the low-cost RAPID COVIDX point-of-care screening technology that can detect SARS-CoV-2 antigen and antibodies simultaneously [21]. This is designed for low infrastructure screening in both symptomatic and asymptomatic persons, which would be a game-changer for hospitals that are suffering financially or areas in which access to high quality care is limited.

The importance of allocating resources towards COVID-19 research cannot be overstated, as mental health, disparities in racial minorities, treatment of other diseases, and mortality rates continue to be gravely impacted [22–24]. There is a lot to learn from countries that tested their population proactively, rather than reacting after COVID-19 cases were surging. For example, shortly following the release of the COVID-19 genome from China, South Korea promptly employed mass production of testing kits to increase diagnostic capacity. In addition, utilization of mobile phone alerts to notify the public about locations to avoid (e.g. infection hot spots) likely played into the country's low case fatality ratio (CFRs) [25]. Advancement of these surveillance techniques may be a realistic possibility with increased funding towards projects such as the COVID-19 Control, an application that can be used by individuals to record their temperature and associated symptoms in order to map out regions at risk of an outbreak [26]. As our mass testing and surveillance modalities become more advanced, other diagnostics could be developed, which may at least partially alleviate the financial burden of hospitalizations due to COVID-19. It is time for the NIH to match COVID-19 funding with the burden inflicted on the nation in order to develop mass testing and surveillance strategies, in addition to emergency preparedness protocols, that conserve hospital resources and prevent this disease or any other from once again bringing our healthcare system to the brink of collapse.

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Study design and conception: AE.
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Manuscript preparation: SA, BS, AE, MM.
Critical revision of manuscript: SA, AE, BS, MM.
All authors read and approved the final manuscript.

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Declaration of competing interest

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