

HEALTH RESEARCH AND INEQUALITIES IN HEALTH OUTCOMES

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Abstract

Despite a changing healthcare landscape and repeated campaigns by public health bodies, there is a remarkable persistence of socioeconomic inequalities in health across the developed world. According to some measurements of health status, these inequalities have widened in the last decades. While there are many potential explanations for the persistence and increase in health inequalities, this whitepaper will focus on the role of health innovations. Case studies show that while there have been many innovations that have increased inequalities, some have unambiguously decreased health inequalities. Several considerations have to be taken into account when evaluating the link between innovations and inequalities: (1) optional take-up versus universal adoption of the innovation matters for the effect on inequalities, (2) the long-run effect on inequalities might differ from the short-run as adoption of innovations settles, and (3) disease-specific innovations affect health inequalities if disease burdens are unequal.

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I Introduction

The fact that low socioeconomic status (SES) individuals have worse health outcomes than high SES individuals, is a finding that has been documented in all developed countries. While there are plenty of reasons for such health inequalities, many authors have argued that new healthcare innovations have measurable effects on health inequalities. On the most basic level, health innovations can increase health inequalities (1) if health innovations are adopted more by high SES individuals or (2) if most health innovations concern diseases that disproportionately affect high SES individuals.

The literature is ambivalent on the overall relationship. Some authors argue that a majority of health innovations will increase the health of the low SES relatively more as low SES individuals are more frequently in bad health, and thus more responsive to improvements in technology (Lichtenberg and Virabhak (2007)). Others argue that, as high SES individuals utilize relatively more specialized and advanced care, they are most likely to benefit from health innovations (Goldman and Lakdawalla (2005)). Other papers show with case studies that the relationship depends on the context, take-up and spread of the innovation. While literature on unequal research funding is sparse, some authors argue that there are several pathways through which this unequal research funding can lead to increasing health inequalities (Best (2012)). Diseases that are more prevalent among high-income individuals are likely to gather more private research funding, as market forces entice firms to fund R&D with a potential to be highly profitable, and advocacy for high SES diseases is likely to be better organized (Best (2012)).

The understanding of the effect on health research and innovations on health inequalities is important, especially as we are in an age of rapid technical change in the medical sector. Currently, more research efforts than ever before are underway, and the collective budget of governments and private sector spent on health research is increasing rapidly. Many health innovations are thus likely to come, and understanding the impact of these health innovations on health inequalities will remain an issue of interest.¹

The whitepaper proceeds in two parts: I first briefly discuss the evidence on health inequalities in developed

¹Note that there is a different debate on the 90/10 gap, which highlights the finding that only 10% of worldwide resources devoted to health research are used for health in developing countries, where over 90% of preventable diseases occur. In this whitepaper, I focus entirely on inequalities within developed countries, as this is the relevant view for the allocation of a majority of research funding.

countries, explaining some of the leading theories that explain the persistence in inequalities. Second, I provide an overview of recent empirical findings on the link between health research and health inequalities.

II Health Inequalities across the Developed World

The persistence of systematic inequalities in health status between individuals with low and high SES is one of the most well documented findings in the public health literature. These inequalities have been shown to exist across a wide variety of countries and time periods: among others, in the UK ([Mackenbach \(2012\)](#)), UK and US ([Banks et al. \(2006\)](#)), and across countries in Europe ([Van Doorslaer et al. \(1997\)](#)). As one of the most objective and easily measurable of outcomes in health is mortality, it should be no surprise that plenty of empirical papers focus on the trends in mortality ([Van Doorslaer et al. \(1997\)](#), [Chetty et al. \(2016\)](#), [Meara, Richards and Cutler \(2008\)](#), [Currie and Schwandt \(2016\)](#)). While these papers all document rapid increasing life span, these gains in life expectancy are unequally distributed across the population, with recent work documenting a continuing trend of increasing life expectancy differences in the 21st century (as by [Chetty et al. \(2016\)](#) in the US). Apart from inequalities in mortality, persistent health inequalities have been found among many other dimensions of health.

Long-run time series on health and socio-economic status are rare, but data from the UK suggests that while the SES gradient in health did in fact decrease in the first part of the 20th century, there were increasing inequalities in the UK ever since the 1950s ([Mackenbach \(2012\)](#)). The fact that the continuing of the building of the welfare states in the latter half of the 20th century has not led to significant decreases in health inequality, despite the decreasing decreasing material inequality (measured by poverty rates and material deprivation), more generous welfare policies and a more standardized health care landscape, is somewhat of a paradox. The persistence and increase in health inequalities have been called one of the greatest disappointments in public health ([Mackenbach \(2012\)](#)), and many public health campaigns have been undertaken attempting to decrease them.

The reasons for the rising health inequalities are heavily debated, as exemplified by [Mackenbach \(2012\)](#) who offers no less than 9 different explanations. Proposed explanations range from increased selection of people with bad health into lower income groups, increased psychological stress in lower income groups, to different diffusion

of health innovations across income groups. Empirical evidence shows that many different reasons are at play, and can explain a different fraction of the (increase in) health inequalities.

It is widely accepted that behavioural differences between individuals with low and high SES individuals are responsible for most of the difference in life expectancy. [Meara, Richards and Cutler \(2008\)](#) argue that differential trends in smoking behavior can account for at least 20 percent of the differential trend in life expectancy. Similarly, [Ho and Fenelon \(2015\)](#) claim that smoking accounts for 50 percent of the differential trend in life expectancy for women, but has not contributed to the differential life expectancy trends for males. Why health behaviors are so different between low and high SES individuals is under debate. [Pampel, Krueger and Denney \(2010\)](#) provides an excellent overview of the literature and provide nine potential explanations. [Cutler and Lleras-Muney \(2010\)](#) shows that income and family background account for 30 percent of the gradient in health behavior, with knowledge and measures of cognitive ability and social networks accounting for another 30 and 10 percent, respectively. While these papers highlight the multidimensionality of health inequalities, an empirical comparison and investigation of multiple mechanisms is still lacking in the literature ([Pampel, Krueger and Denney \(2010\)](#)).

III Literature on Health Research and Health Inequalities

There are several reasons to study the role of health research and innovation on health inequalities. First, existing health innovations are directly impacting health inequalities, and this section will show plenty of examples of such impacts. Second, as the health landscape is changing fast with ever-increasing spending on health research, it is advisable to learn more about the potential impact and pathways of these changes on future health inequalities. Indeed, many papers show that the currently emerging technologies in lifestyle health, genomic health, personalized medicine and electronic applications will contribute to future health inequalities. Third, a large part of health research is publicly funded, and as such, authorities have control over the allocations of these funds. Overseeing that health inequalities are limited in the future should be a consideration for a government that cares about all of its citizens.

This section will first discuss some main existing theories how health research and innovations affect health inequalities, and then give a short overview of some of the main findings in the literature.

III.A Theoretical Pathways

There are two main pathways by which health research and health innovations have a direct effect on health inequalities.

1. The differential knowledge, take-up and use of health innovations by high SES individuals might lead towards changing health inequalities.
2. Health innovations that are disproportionally geared toward diseases of high SES individuals will disproportionally improve the health of that group.

Most of the empirical and theoretical literature on the effect of health innovations on health inequalities concerns the first pathway. Theoretically, two theories on health inequalities relate to this pathway. The *fundamental causes theory* posits that high SES individuals are more likely to deploy their resources (money, knowledge, connections,...) to improve the chance on proper diagnosis and treatment, no matter what mechanisms are relevant at any given time. As health innovations are part of any health care landscape, health innovations will be responsible for differential health trends insofar as these individuals can get a relative advantage.

The *diffusion of innovations theory* is subtly different and posits that innovations are slow to diffuse across the health care landscape. Early adopters, often health practitioners and patients in rich, developed areas within a country, benefit earliest from new innovations, which will lead to health inequalities. However, with innovations diffusing more broadly across the populations, the effect of innovations on health inequalities is merely temporary. These theories thus suggest that even if academic studies find different take-up of health innovations, they might be temporary and not lead to persistent increased health inequalities.

The second pathway, where health research may increase health inequalities if research funding is biased towards disease burden of high SES, is less well documented. However, theoretical papers have asserted that due to the way advocacy affects research funding, diseases more common in high SES individuals are more likely to be overfunded (Best (2012)). For example, advocacy for breast cancer, which disproportionally affects high SES individuals, has been successful in obtaining a large share of the NCI research funding, taking into account its disease burden. Another way in which research funding might have gone disproportionally less to low SES diseases is due to the increased stigmatization of behaviour-related diseases (Best (2012)), which is likely to have

led to decreased funding for eg. lung cancer and liver diseases.

III.B Empirical Papers

Differential Knowledge, Take-Up and Use of Health Innovations

In this section, I will discuss several papers that look at the context-specific effect of an innovation on health inequalities, similar to the overview in [Weiss et al. \(2018\)](#). Their literature review finds that overall, both the access and the actual use of new technologies and innovations may differ across groups. Contextual variations of health innovations thus matter for the evaluation of the effect on health inequalities. While most papers have found an increase in health inequalities due to health innovations, it is unsure whether the selected sample of innovations is representative.

Health innovations may **increase** health inequality when there is a higher take-up of health innovations among high SES individuals. [Lleras-Muney and Lichtenberg \(2005\)](#) show that, controlling for income and insurance status, higher educated are more likely to use the most recently approved drugs for certain chronic conditions, suggesting that the cost of searching for higher-quality treatments is lower for more educated people. [Poloniyo and Carpiano \(2013\)](#) show that HPV-vaccination is more prevalent among high-income individuals. They investigate the mechanisms behind this with a survey, and show that parental vaccine knowledge and receipt of a health recommendation are large factors in the unequal uptake of the vaccine. They argue that these findings fall in line with the fundamental cause theory of health disparities, so that the ensuing health disparities are likely to be persistent. Clearly, differential effects on health can be expected when the use of new innovations are directly decided by the end-user, as end-users may have large differences in knowledge and behaviours relating to health care.

To investigate whether health disparities due to new innovations could also be driven by differential uptake at the doctor's level, [Korda, Clements and Dixon \(2011\)](#) study the diffusion of coronary procedures in people with ischaemic heart disease. The existence of a gatekeeper who decides the use of health innovations does not seem to matter for the effect on health inequalities: even though the use of these procedures is mainly decided by health care personnel, they found that higher SES individuals were first to benefit from novel procedures. Over time, however, the rate at which low- and high- SES individuals benefitted from these procedures equalized, so

that there was only a lag in procedure uptake rather than a persistent difference.

Similarly, [Glied and Lleras-Muney \(2008\)](#) find that higher educated have higher survival advantage in cancers with more health-related technological progress. By using compulsory schooling as a measure of education, they are able to estimate the effect of education on the survival advantage of cancers for which the number of active drug ingredients has increased relatively more. [Groeneveld, Laufer and Garber \(2005\)](#) provide evidence that, controlling on income and education, there are racial differences in the number of novel procedures such as tissue replacement of the aortic valve, internal mammary artery coronary bypass grafting, dual-chambered pacemaker implantation, and lumbar spinal fusion. They find that this is likely to be driven by the type of hospitals that blacks attend: hospitals of which black patients form a large patient group were less likely to perform the aforementioned procedures on both white and black patients. Moreover, racial disparity was larger in hospitals with larger black populations. Findings that health care is drastically different across places, are in line with the findings by [Finkelstein, Gentzkow and Williams \(2016\)](#) who find that 40-60% of differences health care utilization is due to supply-side factors.

Other papers find that health innovations may **decrease** health inequality. [Miller and Tucker \(2011\)](#) show that universal adoption of electronic medical records (EMR) dramatically reduced neonatal mortality, which was mostly driven by a reduction of deaths from conditions that require careful monitoring. Interestingly, they found that this decrease in infant mortality was higher for children of blacks and low-educated, therefore decreasing health inequalities.

Other studies make arguments that health innovations and research can have an **ambiguous effect** on health inequalities. While they argue that in general innovations in healthcare will benefit high SES individuals, as they are heavier healthcare users, [Goldman and Lakdawalla \(2005\)](#) show there is one exception to this rule: simplifying innovative technologies. They show that complicated treatment regimen such as antiretroviral therapy for HIV, has benefited well-educated patients disproportionately. Simplifying drugs for hypertension coincided with a reduction in disparities in cardiovascular diseases. They argue that since the chronically ill group has some of the widest disparities, simplifying treatments for chronic diseases could decrease disparities effectively.

In a study of the efficacy of new drugs, [Lichtenberg and Virabhak \(2007\)](#) make a distinction between equipment-embodied health innovations and pharmaceutical-embodied innovations, where the former is accom-

panied by high costs of implementation due to the necessary purchase of equipment. They make the argument that while equipment-embodied health innovations disproportionately benefit the high SES, drugs do increase post-treatment health primarily for the low-educated, as empirically establish that people with bad initial health benefit most from new drugs, and low SES individuals are more likely to be in bad health.

While most of these studies are in fact providing evidence that high SES individuals are adopting innovations faster, few provide evidence of the pathways by which this quicker adoption materializes. Several causes for the earlier adoption could be knowledge, access to better health care, and more access to healthcare. Moreover, the studies have primarily focussed on healthcare services and technologies rather than currently emerging technologies in lifestyle health, individualized applications and genomics. Several studies suggest that innovations using these electronic technologies might lead to differential take-up and treatment. [Zibrik et al. \(2015\)](#) show that outcomes related to the use of a health information platform in Canada were significantly correlated to age, income and education. Moreover, [Perez et al. \(2016\)](#) found that individuals with low and high SES use the internet differently when searching for healthcare information. While high SES do a more broader search of their disease, low SES individuals were more likely to do a limited and scattered search, which might affect their knowledge of health care treatments.

Differential Research Funding

Certainly at the global level, research documents the skewness of innovations towards diseases of high SES individuals. There are many papers documenting and discussing the 10/90 gap disparities in global health research ([Evans et al. \(1990\)](#)), suggesting that only 10% of the world's health research budget is spent on diseases that afflict 90% of the world's population. [Evans, Shim and Ioannidis \(2014\)](#) show that due to different disease profiles in rich and poor countries, the diseases of poor countries remain underfunded.

However, there is little research that investigates whether within countries, such an unequal allocation of research funding exists. There are several studies that correlate research funding with the burden of disease within countries. For example, [Gross, Anderson and Powe \(1999\)](#) correlate NIH research funding with the US burden of disease and find that research on chronic obstructive pulmonary disease, perinatal conditions, and peptic ulcer was relatively underfunded. Yet, it is unclear whether these diseases disproportionately affect low

or high SES individuals, so that the effect on health inequalities is unclear. Despite this lack of empirical evidence, mechanisms by which diseases of low SES individuals might be underfunded are discussed in [Best \(2012\)](#). Advocacy could lead governments towards funding high SES diseases, as such advocacy groups are more likely to be well organized, and the increased stigmatization of diseases more prevalent with low SES has led towards the decrease in funding [Best \(2012\)](#).

Genetic differences have been posited to be responsible for at least part of inequalities in health outcomes, as many serious diseases differentially affect subpopulations ([Tuckson, Newcomer and De Sa \(2013\)](#)). With the high cost and complexity associated with genomic medicine, there has been a push to fund more genetic research of low SES diseases as it could directly decrease health inequities. [Sankar et al. \(2004\)](#) however claim that the benefits of genetic research on health inequalities are likely overstated so that the funding of genetic research with the main goal of decreasing health inequalities is most likely not effective. They argue that standardizing access to health care and reforming attitudes toward minority patients will do more to decrease health inequalities.

In the allocation of research funding, equity considerations currently seem to play a minor role. [Viergever et al. \(2010\)](#) mention the disease burden as only one of the criteria for allocation health research funding, yet refer to the need for analyzing the effect of the research on health equity.

IV Discussion

The overall conclusion of this literature review is that health research and innovations affect health inequalities through many channels. While many health innovations have the potential to disproportionately benefit low SES individuals as they are on average in worse health, empirical work has repeatedly documented that differential take-up and use of new health innovations leads towards increasing health inequalities. Only a small fraction of case studies have shown that health innovations directly decrease health inequalities, and most of these make up health innovations that were universally adopted. However, several papers posit that effects on health inequalities are merely temporary as health innovations diffuse more widely. Yet, with many future innovations in personalized and electronic medicine likely to benefit high SES disproportionately, studying the effect of health innovations on health inequalities will remain an important topic of interest.

Whether there are less research efforts for diseases that afflict low SES individuals disproportionately, is less

well established in the literature. Given the potential long-run effects of differential research funding, this seems a fruitful area for future research.

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