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CAN PERSONAL ACCESS TO MEDICAL EXPERTISE OVERCOME VACCINE HESITANCY?

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ABSTRACT

Using data on applicants to Dutch medical schools and their older relatives (i.e., parents, aunts, and uncles ages 60+), we estimate the effect of personal access to medical expertise on vaccine hesitancy. Leveraging variation in lottery outcomes that determine admission to medical schools, we find that having a physician in the family increases the likelihood of complying with government recommendations that anyone over the age of 59 receive a second booster dose of a COVID-19 vaccine. Our estimated effects are strongest for having a female physician in the family, suggesting important gender-based differences in how medical expertise is communicated.

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1. Introduction

COVID-19 vaccines have proven to be safe and effective (Anand and Stahel 2021; Rikin et al. 2022), but there remains substantial hesitancy surrounding their use (Sallam et al. 2022; Lazarus et al. 2024; Carlton et al. 2026). Underlying causes of COVID-19 vaccine hesitancy include concerns about side effects, lack of confidence in medical expertise, and mistrust in government authorities (Silver et al. 2022; Steinert et al. 2022; Trent et al. 2022; Limbu and Huhmann 2023). The World Health Organization (WHO) describes vaccine hesitancy as a key impediment to combatting the COVID-19 pandemic (WHO 2023), which continues to pose a "global public health risk" as new variants emerge (WHO 2025, para. 17).

In this study, we use administrative data on applicants to Dutch medical schools and their older relatives (i.e., parents, aunts, and uncles ages 60+) to explore whether personal access to medical expertise can overcome vaccine hesitancy. Specifically, using an instrumental variables strategy that leverages the outcomes of Dutch medical school admission lotteries, we estimate the causal effect of being related to a physician on the likelihood of receiving a second booster dose of a COVID-19 vaccine. We hypothesize that having a physician in the family should reduce vaccine hesitancy by increasing access to accurate information from a trusted source about the costs and benefits of receiving a COVID-19 booster.

Before the Dutch COVID-19 vaccination campaign began, approximately one quarter of adults in the Netherlands described themselves as hesitant to be vaccinated (Sabat et al. 2024, p. 31). Distrust of the government, pharmaceutical companies, and science was widespread (Yousuf et al. 2021; Wang et al. 2022; Sabat et al. 2024). Despite this distrust, more than 80 percent of adults had received at least one dose of a COVID-19 vaccine by November 2021, when the first booster shots became available (Huiberts et al. 2023; Pijpers et al. 2023). In February 2022, the Health Council of the Netherlands recommended that a second booster dose of a COVID-19 vaccine be administered to anyone over the age of 69. This recommendation was explicitly based on medical studies showing that second booster vaccinations offered members of vulnerable groups additional protection against hospitalization and death (Health Council of the Netherlands 2022a). One month later, the Council recommended that a second booster dose be administered to anyone over the age of 59, and reminder letters were sent out in July (National Institute for Public Health and the Environment 2022a, 2022b). Our interest is in whether having a physician in the family improved adherence to these well-publicized recommendations.[1]

Following Artmann et al. (2022) and Chen et al. (2022), who also examine the effects of personal access to medical expertise, we compare the older relatives of medical school lottery winners who became physicians with those of lottery losers who did not. Our two-stage least squares (2SLS) estimates provide evidence that personal access to medical expertise can indeed overcome vaccine hesitancy: having a physician in the family leads to a 2-3 percent increase in the likelihood of adhering to government recommendations and receiving a second booster dose of a COVID-19 vaccine. This result contrasts with those of Finkelstein et al. (2022), who, using administrative data on Swedish prescription drug purchases, find evidence that personal access to medical expertise reduces adherence to official government guidelines.

When we restrict our attention to the older relatives of male medical school applicants, 2SLS estimates are generally small and, without exception, statistically insignificant. There is, however, strong evidence that having a female physician in the family helps older relatives overcome vaccine hesitancy. Among the parents, aunts, and uncles of female applicants, having a female physician in the family leads to a 4.1 percent increase in the likelihood of receiving a second booster dose of a

[1] See, for instance, Churchill and Lawler (2025) for evidence that government recommendations can affect decision-making by doctors and patients. Churchill and Lawler (2025) examine the United States Preventive Services Task Force's decision to stop recommending mammogram screenings for women ages 40–49. They find that this change in government recommendations led to a 6–10 percent reduction in the likelihood of receiving a mammogram among women ages 40–49. See also Abaluck et al. (2021), who show that promoting stricter adherence to anticoagulation clinical guidelines would lead to a substantial reduction in strokes among atrial fibrillation patients.

COVID-19 vaccine. Among mothers of female applicants, having a female physician in the family leads to a 5.4 percent increase in the likelihood of receiving a second booster. Globally, female physicians tend to engage more with their patients as compared with their male counterparts; they are more emotionally responsive, show greater empathy, and seek patient input at higher rates (Roter et al. 2002; van den Brink-Muinen et al. 2003; Sandhu et al. 2009; Jefferson et al. 2013; Noro et al. 2018; Plichta et al. 2020). In the Netherlands, there is evidence that female physicians spend more time with their patients, express more concern for their patients, and provide more counseling, encouragement, and information (Bensing et al. 1993; van den Brink-Muinen et al. 1998; Liu et al. 2023). Our results suggest that recognizing gender-based differences in how medical expertise is communicated would make outreach efforts aimed at reducing vaccine hesitancy more effective.

The remainder of our paper is organized as follows. We begin by describing previous studies on personal access to medical expertise. Next, we provide background information on the Dutch COVID-19 vaccination campaign. In Section 3, we describe our outcomes, the process of becoming a physician in the Netherlands, and our sample selection criteria. In Section 4, we describe our empirical framework, and in Section 5 we discuss our estimates. Section 6 concludes.

2. Background

2.1. Personal access to medical expertise

Three recently published studies take a quasi-experimental approach to examining the effect of having a physician in the family on health and health-related behaviors. Artmann et al. (2022) focus on the parents of applicants to Dutch medical schools. Comparing the parents of applicants who won the admissions lottery and became a physician to the parents of those who lost and did not, their estimates suggest that personal access to medical expertise is essentially unrelated to longevity and healthcare utilization of (e.g., being admitted to a hospital, visiting a general practitioner, or visiting a specialist), suggesting that the Dutch health care system "provides high-quality health care and information to all parents" (Artmann et al. 2022, pp. 20-21).

Chen et al. (2022) focus on the older relatives of medical school applicants in Sweden. Comparing the relatives of applicants who won an admissions lottery and became a physician to the relatives of those who lost and did not, they find that personal access to medical expertise reduces the likelihood of being diagnosed with heart failure and increases the use of cardiovascular drugs such as beta blockers, blood thinners, and statins. Their results suggest that increasing personal access to medical expertise could substantially attenuate the mortality-income gradient.[2]

Finally, and most closely related to our study, Finkelstein et al. (2022) use Swedish administrative data to examine the effect of having personal access to medical expertise on adherence to government-issued prescription drug guidelines. An individual is defined as having personal access to medical expertise if they, their partner, or any of their parents or children were physicians. Their results suggest that personal access to medical expertise is, on average, associated with looser adherence to government guidelines regarding prescription drug use: controlling for age, education, gender and income, having access to medical expertise is associated with an almost 7 percent reduction in adherence (Finkelstein et al. 2022, p. 516).[3]

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[2] Chen et al. (2022) define family membership broadly. They examine the effect of attending medical school on the health of grandparents, parents, parents-in-law, spouses, children, aunts and uncles, siblings, siblings' children, and cousins. Their outcomes include heart failure, lung cancer, type 2 diabetes, and the use of medication for the amelioration and prevention of chronic diseases such as asthma, diabetes, and hypertension.

[3] Descriptive studies in the medical literature show that physicians are more likely to vaccinate against COVID-19 as compared to their non-physician counterparts (Holzmann-Littig et al. 2021; Leigh et al. 2022; Peterson et al. 2022). Chou et al. (2006), Johnson and Rehavi (2016), and Frakes et al. (2021) provide evidence that physicians are less likely to receive a C-section as compared to non-physicians. Carrera and Skipper (2025) find that Danish physicians are more likely to use newer and more potent cholesterol-lowering statins for themselves than for their patients. Kakani et al. (2025) show that physicians and nurses have fewer avoidable emergency department visits than non-experts and Chen et al. (2025) show that physician-patients suffering from advanced cancer are less likely to undergo surgery, are more likely to receive targeted therapy, and have higher survival rates than their non-physician counterparts.

Finkelstein et al. (2022) argue that having access to medical expertise could provide physicians and their family members the ability and confidence to disregard those government-issued guidelines with the weakest clinical support.[4] There is, however, little clinical ambiguity regarding the effectiveness and safety of COVID-19 vaccines. By the start of Dutch COVID-19 vaccine campaign, high-profile clinical trials had produced unequivocal evidence that the messenger RNA (mRNA) vaccines, including those produced by Moderna and Pfizer-BioNTech, offered strong protection against contracting COVID-19 (Rikin et al. 2022); side effects such as fatigue and headache were reported, but not considered serious (Anand et al. 2021).[5] Within the next few years, multiple studies were published in prominent medical journals showing that a second mRNA booster dose significantly reduced COVID-related hospitalizations and deaths among individuals 60 years of age and older (Arbel et al. 2022; Magen et al. 2022), reduced the severity of COVID-19 symptoms (Bar-On et al. 2022; Canetti et al. 2022; Gazit et al. 2022), and enhanced immune responses among nursing home residents, healthcare workers, and the elderly (Cohen et al. 2022; Nugent et al. 2023; Rouvinski et al. 2023). Our 2SLS estimates, described below, provide evidence that having personal access to medical expertise can enhance compliance with government-issued recommendations when these recommendations have strong scientific support.

2.2. The Dutch COVID-19 vaccination campaign

The Dutch COVID-19 vaccination campaign began on January 6, 2021 with the rollout of the Pfizer-BioNTech vaccine (van Amerongen et al. 2024). Soon after, the AstraZeneca, Johnson &

[4] Finkelstein et al. (2022, p. 509) argue their results provide evidence that "access to expertise gives patients information or confidence that prompts them to disregard guidelines that they do not perceive to be in their clinical interest."

[5] The Pfizer-BioNTech and Moderna mRNA vaccines introduce genetic instructions (mRNA) that cells use to produce a viral protein, stimulating an immune response (Chaudhary et al. 2021). See Bernal et al. (2021) and Rikin et al. (2022) for more information on the effectiveness and safety of the AstraZeneca, Johnson & Johnson, Moderna, and Pfizer-BioNTech COVID-19 vaccines.

Johnson, and Moderna vaccines were approved for use (Health Council of the Netherlands 2021a, 2021b; van Amerongen et al. 2024). Although vaccination was voluntary, a COVID-19 certificate (i.e., a "corona pass") was required to enter bars, restaurants, museums, and other cultural events from September 25, 2021 through February 25, 2022 (van Amerongen et al. 2024).[6] COVID-19 vaccinations were available, free of charge, in hospitals, doctor's offices, nursing homes, and centers run by the Municipal Health Service (Geubbels et al. 2023; Pijpers et al. 2023).

More than 80 percent of adults in the Netherlands had received at least one dose of a COVID-19 vaccine before the first booster shots became available in November 2021 (Huiberts et al. 2023; Pijpers et al. 2023). Receipt of at least one dose was positively associated with age, educational attainment, income, and having an underlying medical condition that could increase the risk of severe COVID-19 (Pijpers et al. 2023). Among individuals ages 50+, living in a neighborhood with a high proportion of right-wing Christian or conservative voters was associated with a lower likelihood of receiving at least one vaccine dose (Labuschagne et al. 2023).

On February 18, 2022, the Health Council of the Netherlands recommended that a second booster dose of an mRNA vaccine be administered to anyone over the age of 69, residents of nursing homes, adults with Down syndrome, and adults with immune disorders (Health Council of the Netherlands 2022a).[7] This recommendation was explicitly based on medical studies showing "that a second booster vaccination would offer these vulnerable groups additional protection against the risk of hospitalisation or death" (Health Council of the Netherlands 2022a, p.2). One month

[6] A COVID-19 certificate provided proof that an individual was vaccinated, received a negative test result, or recovered from COVID-19 (Pijpers et al. 2023).

[7] For most Dutch adults, the second booster dose would have been the fourth in a series of vaccinations. Less than 4 percent of total COVID-19 vaccine doses administered through 2021 were the single-dose Johnson & Johnson vaccine (Andeweg et al. 2023). See de Vries et al. (2022) for evidence that Dutch adults were more receptive to the Moderna and Pfizer-BioNTech mRNA vaccines than the AstraZeneca and Johnson & Johnson vaccines. Beginning in March 2021, there were reports of women, most of whom were under the age of 60, developing blood clots after receiving the AstraZeneca vaccine (Mueller and Grady 2021). After November 1, 2021, the AstraZeneca vaccine was no longer available in the Netherlands (National Institute for Public Health and the Environment 2022a).

later, the Council expanded this recommendation to include anyone over the age of 59 (National Institute for Public Health and the Environment 2022a). Beginning July 8, the National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu) sent letters to adults ages 60+ reminding them to receive a second booster dose of a COVD-19 vaccine (National Institute for Public Health and the Environment 2022b). Even with these reminder letters and extensive media coverage of the government recommendations (Health Council of the Netherlands 2022a, 2022b; RTL News 2022), approximately one third of Dutch adults ages 60+ had not yet received a second booster dose as of July 1, 2024.[8]

3. The Data

Until 1999, the Dutch Minister of Education set strict limits on the number of high school graduates allowed to study medicine. A centralized lottery was conducted to determine which applicants to medical school were accepted on an annual basis. We obtained data on Dutch medical school admissions lottery outcomes for the period 1987-1999 from the Dienst Uitvoering Onderwijs (DUO), a governmental organization under the Ministry of Education.[9] During this period, more than 5,000 high school students competed annually for a place at one of the 8 medical schools in the

[8] Using data from the COVID-vaccination Information and Monitoring System, described in the next section, we calculate that 31 percent of Dutch adults ages 60+ had not yet received a second booster dose of an mRNA COVID-19 vaccine as of July 1, 2024. Fifty-three COVID-19 vaccine boosters per 100 population had been administered in the Netherlands as of September 29, 2023 (WHO 2024). In comparison, an estimated 35.6 COVID-19 vaccine boosters per 100 population were administered worldwide over the same period (WHO 2024).

[9] After 1999, the centralized admissions lottery was replaced with a system that gave medical schools more control over the admissions process (Ketel et al. 2016). In addition to Artmann et al. (2022), four other studies leverage the Dutch medical school admissions lotteries to estimate effects of attending medical school and becoming a physician: Leuven et al. (2013) find that receiving medical training reduces self-reported alcohol consumption and the frequency of physical exercise; Ketel et al. (2016) find that Dutch physicians earn at least 20-50 percent more than applicants who lost the lottery and chose a different occupation; Artmann et al. (2021) find that becoming a physician increases the likelihood of marrying another physician; and Anderson et al. (2023) find that becoming a physician increases the use of prescription medications, including antidepressants, opioids, and sedatives.

Netherlands.[10] Medical school applicants were divided into 6 categories (A, B, C, D, E, and F) based on their high school ("voortgezet wetenschappenlijk onderwijs") GPA. The probability of winning the lottery and being admitted to medical school ranged from 86 percent for applicants in Category A to 36 percent for applicants in Category F (Appendix Table 1). Seventy-two percent of applicants, on average, were eventually accepted (either on their first attempt or in a later round). Of those applicants who lost their first lottery, 72 percent reapplied at least once.[11]

We analyze data on 26,208 *first-time* applicants to medical school during the period 1987-1999 and 129,211 of their older relatives. Medical school applicants were linked to their 60-plus-year-old relatives (i.e., fathers, mothers, aunts, and uncles) using full-count registry data for the Dutch population made available by Statistics Netherlands.[12] We excluded Category A applicants (N = 704) from the analysis because these applicants were all but guaranteed eventual admittance to medical school.[13] Of the 26,208 first-time applicants in our sample, 47 percent won the lottery (i.e.,

[10] Until 1993, the number of students admitted to Dutch medical schools was capped at 1,458 students; during the period 1994-1999, this cap was increased to 2,010.

[11] According to Ten Cate (2007) and Ketel et al. (2016), there are only minor differences in instruction quality and course content across the 8 medical schools in the Netherlands. See Ketel et al. (2016) and Anderson et al. (2023) for more details about the admissions process and the structure of medical training in the Netherlands.

[12] Linkages were made through a database that registers the "legal parents" of individuals. Legal parents were then matched to their siblings to identify the aunts and uncles of medical school applicants. Individual characteristics also come from the Statistics Netherlands registry data.

[13] Likewise, we excluded 2,967 applicants (and their older relatives) from the analysis because these applicants were admitted without taking the Dutch high school exam. We also excluded 953 applicants (and their older relatives) who completed their high school exams in 1986 or earlier to ensure that we have complete lottery histories. Two hundred seventy-one applicants (and their older relatives) were excluded from the analysis because we could not determine the year in which they took their high school exam; 938 were excluded because they were older than 21 at the time of their first recorded lottery; and 98 were excluded because they were from the former colony of the Dutch Antilles and were admitted to medical school through a separate process. Three hundred five applicants had no older relatives registered in the Netherlands in 2021. Conditional on lottery category and year, the excluded applicants were evenly distributed between lottery winners and lottery losers (p-value = 0.463). First-time applicants who lost the lottery were less likely to be registered in the Netherlands as of 2021 than their counterparts who won the lottery (90.7 versus 92.9 percent). We excluded the 1,913 applicants who were not registered in the Netherlands as of 2021 but included their 9,191 older (registered) relatives. The estimates presented below are virtually unchanged if we instead drop these 9,191 older relatives from the sample. Based on data from the Dutch national registry, Anderson et al. (2023) calculate that 26 percent of first-time lottery losers who did not become physicians chose a profession related to healthcare; 14 percent worked in business services (e.g., legal firms and pharmaceutical companies); 12 percent worked in education; 10 percent worked in public administration; 9 percent worked in wholesale/retail; and 7 percent in worked in financial services.

they were admitted to medical school). Eighty-one percent of these winners went on to become registered physicians in the Netherlands, but first-time applicants who lost the lottery were allowed to reapply to medical school the following year.[14] Forty-three percent of first-time lottery losers eventually became physicians.

3.1. Outcome

When someone is vaccinated against COVID-19 in the Netherlands, their name, date of birth, address, date of vaccine administration, and vaccine type are recorded in the national registry for COVID-19 vaccinations, the Information and Monitoring System (CIMS). Vaccine recipients could, however, refuse to share this information with the CIMS, making it impossible to link them to medical school applicants. After the second booster campaign began, an estimated 1-3 percent of all vaccine recipients refused to share their vacation status with the CIMS.[15]

Based on the information contained in the CIMS registry as of June 3, 2024, we construct the following second-stage outcome:

$2^{nd}\ Booster_{j(i)} = 1$ if applicant i's older relative j received a COVID-19 vaccination after the start of the second booster campaign; and

$= 0$ if applicant i's older relative j did not receive a COVID-19 vaccination after the start of second booster campaign began or refused to share their vaccination status with CIMS.[16]

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[14] During the period 1987-1998, there was no limit on how many times applicants could reapply to medical school. After 1998, they were limited to two reapplications.

[15] Information on refusal rates in the early rounds is provided here: https://www.rivm.nl/nieuws/wekelijkse-vaccinatiecijfers-per-wijk-beschikbaar-via-open-data and here: https://data.rivm.nl/covid-19/. For later rounds, information on refusal rates can be found here: https://www.rivm.nl/corona/actueel/vaccinatiecijfers/update-deelname-covid-19-vaccinatie-in-nederland.

[16] For individuals ages 70+, the second round of booster vaccinations began on March 2, 2022. For individuals ages 60-69, the second round of booster vaccinations began on March 26, 2022. Although they received their second booster between March 2nd and March 26th, we coded *2nd Booster* = 1 for less than 10 older relatives ages 60-69. Statistics Netherlands does not allow researchers to provide exact numbers for groups smaller than 10. It is possible that these older relatives were eligible to receive their second booster before March 26th because they lived in a nursing home, had

A disadvantage of this outcome is that we are miscoding $2^{nd}\ Booster = 1$ for any older relatives who delayed their first booster until after the second round of booster vaccinations began. In a robustness check below, we consider an alternative outcome that avoids this issue. The results of this robustness check are very similar to those produced using the $2^{nd}\ Booster$ outcome.

In Table 1, we report the means of $2^{nd}\ Booster$ for our sample of older relatives of Dutch medical school applicants. Among all older relatives without a physician in the family, 81 percent had received a second booster dose of an mRNA COVID-19 vaccine by June 2024. In comparison, 83 percent of all older relatives with a physician in the family had received a second booster. The adherence gap is largest among the mothers of applicants: 84 percent of mothers without personal access to medical expertise received a second booster dose, while 88 percent of mothers with access received a second dose. This 4-point adherence gap could reflect the causal effect of having access to personal medical expertise or could be due to the influence of unobservables correlated with the applicant becoming a physician and his or her mother's booster status.[17]

4. Empirical Strategy

We model the booster status of applicant i's older relative j as function of whether the applicant became a physician ($Physician_i$), a set of observables pertaining to the applicant ($\boldsymbol{X}_i$), a set of observables pertaining to the older relative ($\boldsymbol{Z}_{j(i)}$), and an error term:

Down syndrome, or had severely impaired immunity. The results reported below are essentially unchanged if we instead code $2^{nd}\ Booster = 0$ for these individuals.

[17] Sixty-three percent of applicants who went on to become a registered physician in the Netherlands received a second booster dose of a COVID-19 vaccine. In comparison, only 38 percent of applicants who did not become a physician received a second booster dose.

(1) $$2^{nd}\ Booster_{j(i)} = \beta_0 + \beta_1 Physician_i + \boldsymbol{X}_i\boldsymbol{\beta}_2 + \boldsymbol{Z}_{j(i)}\boldsymbol{\beta}_3 + \varepsilon_{j(i)},$$

where $Physician_i$ is equal to 1 if i went to medical school in the Netherlands and became a registered physician (and is equal to 0 otherwise).[18] Lottery losers were free to reapply to medical school after waiting for a year, and 18.5 percent of first-time applicants who won the admissions lottery did not end up practicing medicine in the Netherlands.[19] To address the potential endogeneity caused by selective reapplication and completion of medical school, we estimate β_1 using two-stage least squares (2SLS). The first-stage equation takes the following form:

(2) $$Physician_i = \alpha_0 + \alpha_1 Lottery\ Win_i + \boldsymbol{X}_i\boldsymbol{\alpha}_2 + \boldsymbol{Z}_{j(i)}\boldsymbol{\alpha}_3 + \upsilon_{j(i)},$$

where the instrument, $Lottery\ Win_i$, is equal to 1 if applicant i was accepted to medical school the first time he or she applied (and is equal to 0 otherwise). The vector $\boldsymbol{X}_i$ includes i's age at first lottery, age squared, i's non-Western immigrant status, and gender. It also includes i's lottery category, the year in which i first participated in the lottery, and lottery category interacted with year of first lottery, ensuring that lottery outcomes are random.[20] The vector $\boldsymbol{Z}_{j(i)}$ is composed of

[18] The physician indicator is equal to 1 for the older relatives of licensed physicians in the Netherlands who were educated abroad. However, our results are qualitatively unchanged if we instead set *Physician* equal to 0 for these individuals or exclude them from the analysis entirely.

[19] Every year, 4-8 percent of lottery winners opted not to pursue a medical degree. Fifteen percent of medical school enrollees during the period 1987-1999 were not registered doctors in 2024.

[20] In Appendix Table 2, we report descriptive statistics for the controls and provide definitions.

indicators to capture birth-year fixed effects of older relatives.[21] The 2SLS estimate of β_1 is interpreted as the local average treatment effect (LATE) for "compliers" – that is, the older relatives of applicants who became registered physicians because they won the admissions lottery.[22]

In Appendix Table 3, we report balancing tests by lottery category for first-lottery winners and losers. Consistent with Ketel et al. (2016), Artmann et al. (2022) and Anderson et al. (2023), these tests support the independence assumption required for valid instrumental variable estimates. Without exception, the characteristics of lottery winners versus losers are statistically indistinguishable at the 5 percent level.[23]

5. RESULTS

2SLS estimates of the effect of having a physician in the family on the likelihood of receiving a second booster dose of a COVID-19 vaccine are reported in Table 2.[24] In the sample composed of parents, aunts, and uncles of applicants, having a physician in the family is associated with an increase of 2.1 percentage points in the likelihood of receiving a second booster, which is 2.6

[21] When we pool relatives (e.g., all older relatives, parents, or aunts and uncles), we also include relative-type fixed effects on the right-hand-side of the estimating equation.

[22] With two exceptions, standard errors are corrected for clustering at the applicant level. For models where fathers or mothers of applicants are considered separately, robust standard errors are reported.

[23] We report the results of additional balancing tests in Appendix Table 4. All characteristics of the older relatives of lottery winners versus losers are statistically indistinguishable at conventional levels.

[24] The first-stage F-statistics reported in Table 2 range from 1,660 to 3,340, clearly meeting the Staiger and Stock (1997) criterion. Estimates from equation (2) are reported in panel A of Appendix Table 5. Standard errors are clustered at the applicant level when we estimate the effect of personal access to medical expertise for all older relatives, parents, aunts and uncles (combined), aunts, and uncles. Robust standard errors are reported when we estimate the effect of access to medical expertise for fathers and mothers separately. Our basic inferences are unchanged when based on permutation tests and Monte Carlo simulation. Among all older relatives, 25,643 were related to more than one medical school applicant. The results reported below are qualitatively unchanged if we exclude these individuals from the analysis. The results reported below are also qualitatively unchanged if we exclude the 5,139 older relatives who were themselves registered physicians.

percent of the sample mean. This estimate is large enough to explain nearly the entire unadjusted adherence gap between the older relatives of physicians and those of non-physicians.[25]

Restricting our attention to the parents of applicants, having a physician in the family is associated with an increase of 2.1 percentage points in the likelihood of receiving a second booster dose, which is 2.4 percent of the mean. Among the aunts and uncles of applicants, it is associated with 2.1 percentage-point increase in the likelihood of receiving a second booster dose, or 2.6 percent of the mean. Among fathers, the 2SLS estimate is positive, but small and statistically insignificant. By contrast, the estimated effect of having personal access to medical expertise appears to be largest for the mothers of applicants. Among mothers, having personal access to medical expertise is associated with an increase of 3.2 percentage points in the likelihood of receiving a second booster, or a 3.7 percent increase relative to the mean.[26] This estimate is large enough to explain over 70 percent of the unadjusted gap between mothers whose child became a physician and those whose child did not.

The 2SLS estimates reported in Table 2 provide evidence that personal access to medical expertise can overcome vaccine hesitancy. However, we cannot rule out the possibility that they are being driven by physicians encouraging older relatives to delay their first booster dose until after the start of the second booster campaign. In an effort to assess whether this is an issue, we estimate the effect of having a physician in the family on the likelihood of receiving the first booster dose of a

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[25] In Appendix Table 6, we report 2SLS estimates of the effect of becoming a physician on the likelihood of receiving a second booster dose. Note that the sample size is reduced from 26,208 to 24,295 because we excluded 1,913 applicants who were not registered in the Netherlands in 2021. Becoming a physician is associated with an increase of 23.7 percentage points in the likelihood of receiving a second booster, which is 44 percent of the mean. This estimate, however, cannot be interpreted as the effect of personal access to medical expertise or training on the likelihood of complying with government recommendations or guidelines. As noted above, medical school applicants under the age of 60 who did not eventually become healthcare workers were not specifically advised to take a booster shot, although they were eligible to request one.

[26] The estimate for mothers reported in Table 2 is statistically different from the estimate for fathers at the 10 percent level. It is, however, statistically indistinguishable from the estimates for aunts and uncles.

COVID-19 vaccine within one month of boosters being made available. These estimates, which we report in Appendix Table 7, are consistently small and statistically insignificant, providing no evidence that having access to medical expertise somehow encouraged the older relatives of applicants to delay their vaccinations.[27] We also consider an alternative second-stage outcome that clearly distinguishes between older relatives who delayed their first booster and those who received a second booster:

$$Shots \geq 4_{j(i)} = \begin{cases} 1 & \text{if applicant } i\text{'s older relative } j \text{ had received at least four COVID-19 vaccinations; and} \\ 0 & \text{otherwise.}^{28} \end{cases}$$

Descriptive statistics for $Shots \geq 4$ are reported in Appendix Table 8 and 2SLS estimates based on this outcome are reported in Appendix Table 9. These 2SLS estimates are very similar to those reported in Table 2.[29]

[27] Similarly, when we examine the effect of having a physician in the family on the likelihood of having received the first booster dose of an mRNA COVID-19 vaccine within two months of booster doses being made available, the 2SLS estimates are consistently small (in absolute magnitude) and statistically insignificant. We also estimated the effects of having a physician in the family on the likelihood delaying the first or second dose of a COVID-19 vaccine. The results of these exercises, which are omitted for the sake of brevity, provide no evidence that having access to medical expertise encourages older relatives to delay their primary COVID-19 vaccinations.

[28] Before mRNA booster shots became available, the single-dose Johnson & Johnson vaccine composed approximately 2 percent of the CIMS observations. If an older relative received the Johnson & Johnson vaccine and two booster doses, we coded $Shots \geq 4$ as equal to 1.

[29] The disadvantage to using $Shots \geq 4$ as an outcome is that, during the first two vaccination rounds, 5-7 percent of vaccine recipients refused to share their information with the CIMS. Because we cannot distinguish between older relatives who refused to share their information with the CIMS and those who were not vaccinated, the 2SLS estimates reported in Appendix Table 9 could, in theory, be driven by physicians encouraging older relatives to share their information. To explore this possibility, we estimated the effect of having a physician in the family on the likelihood of receiving at least one COVID-19 vaccination in 2021, when 5-7 percent of recipients refused to share their information. The 2SLS estimates were, without exception, much smaller in magnitude than those reported in Appendix Table 9 and, without exception, statistically insignificant at conventional levels, providing no evidence that physicians encouraged their older relatives to share their information with the CIMS.

5.1. Estimated effects by applicant gender

Estimating the effect of personal access to medical expertise by applicant gender produces a striking pattern of results (Table 3).[30] The older relatives of male lottery winners who became physicians are, in general, no more (or less) likely to receive a second booster than the older relatives of male lottery losers who did not. By contrast, having a female physician in the family is often associated with statistically significant and large increases in the likelihood of receiving a second booster. For instance, having a female physician in the family is associated with an increase of 3.9 percentage points in the likelihood that parents receive a second booster (or a 4.5 percent relative to the mean), an increase of 4.7 percentage points in the likelihood that mothers receive a second booster (or a 5.4 percent relative to the mean), and an increase of 3.8 percentage points in the likelihood that aunts receive a second booster (or a 4.7 percent relative to the mean).[31]

The estimates reported in Table 3 are consistent with the notion that female physicians are particularly adept at convincing their older relatives that being vaccinated against COVID-19 is safe and effective. As described in the introduction, there is descriptive evidence from the medical literature that female physicians engage more with their patients, are more emotionally responsive and empathetic, and more likely to solicit patient input when compared to their male physician counterparts (Roter et al. 2002; van den Brink-Muinen et al. 2003; Sandhu et al. 2009; Jefferson et al. 2013; Noro et al. 2018; Plichta et al. 2020). In addition, there is evidence that patients speak more freely and are more likely to disclose personal medical information to female, as opposed to male, physicians (Hall and Roter 2002).[32]

[30] First-stage estimates by applicant gender are reported in panels B and C of Appendix Table 5.

[31] In Appendix Table 10, we report estimated effects of personal access to medical expertise by applicant gender using the outcome *Shots* $\geq$ *4*. These estimates are similar to those reported in Table 3.

[32] Van den Brink-Muinen et al. (2003) examine doctor–patient communication in the Netherlands and five other European countries. They find that female physicians expressed more empathy and concern for their patients than did

6. CONCLUSION

Amid rising mistrust of government health advice (Inskeep 2025), the U.S. Food and Drug Administration (FDA) recently approved updated mRNA COVID-19 vaccines for use among individuals ages 65+. Controversially, approval for individuals under the age of 65 was limited to those with an underlying risk factor for contracting severe COVID-19 (U.S. Food and Drug Administration 2025; Whyte and Siddiqui 2025). The Health Council of the Netherlands currently recommends that the COVID-19 vaccine be offered to anyone over the age of 59 (Health Council of the Netherlands 2025), a recommendation that is based on evidence from multiple studies showing that a second booster dose of an mRNA COVID-19 vaccine is associated with substantial reductions in COVID-related deaths and hospitalizations among vulnerable groups (Arbel et al. 2022; Magen et al. 2022; Neto et al. 2024). Despite this evidence, almost a third of Dutch adults ages 60+ have not yet received a second booster dose.

In this study, we explore whether having personal access to medical expertise affects the likelihood of adhering to government recommendations and receiving a second booster dose of an mRNA COVID-19 vaccine. Comparing the older relatives (i.e., the parents, aunts, and uncles ages 60+) of applicants who won the medical school admissions lottery and became a physician to the older relatives of those who lost and did not, we find that having a physician in the family leads to a 2-4 percent increase in the likelihood of receiving a second booster dose. This result contrasts with those of Finkelstein et al. (2022), who find evidence that personal access to medical expertise reduces adherence to government guidelines.

When we restrict our attention to the relatives of male applicants, we find little evidence that having a physician in the family affects the likelihood of receiving a second booster. By contrast,

male physicians. Tates et al. (2017) find that patients at a Dutch university medical center experienced more shared decision making when assigned to female rather than male medical students.

there is evidence that female physicians are particularly adept at convincing their older relatives to be vaccinated against COVID-19. Having a female physician in the family is, for instance, associated with a 4.5 percent increase in the likelihood that parents receive a second booster, and a 5.4 percent increase in the likelihood that mothers receive a second booster. Medical studies provide evidence that, relative to their male counterparts, female physicians are more emotionally responsive, show greater empathy to their patients, and are more likely to share in the decision-making process (Roter et al. 2002; van den Brink-Muinen et al. 2003; Sandhu et al. 2009; Jefferson et al. 2013; Noro et al. 2018; Plichta et al. 2020). Our results suggest that outreach strategies emphasizing trust building, empathy, and empowerment may be more effective at reducing vaccine hesitancy than those providing information and facts alone.

Vaccine hesitancy has been labeled as one of the greatest threats to global health (Williams 2023). Even prior to the COVID-19 pandemic, the WHO listed vaccine hesitancy as a top-ten global health threat, alongside climate change, air pollution, and antimicrobial resistance (WHO 2019). Whether access to accurate information can affect vaccination intentions has been a subject of recent and intense debate (Dubé et al. 2020; Fuławka et al 2024). Our findings indicate that having personal access to accurate medical information can indeed help to overcome vaccine hesitancy, especially when the source of this information is a female relative.

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Table 1. Means of 2^{nd} *Booster* for Older Relatives of Medical School Applicants

	Full sample	Physician in the family	No physician in the family	Statistically different at 5% level?
All older relatives	0.822	0.831	0.810	
	(0.382)	(0.375)	(0.393)	Yes (p-value < 0.001)
	[129,211]	[79,646]	[49,565]	
Parents	0.868	0.880	0.849	
	(0.339)	(0.325)	(0.358)	Yes (p-value < 0.001)
	[41,622]	[25,605]	[16,017]	
Aunts and uncles	0.801	0.807	0.791	
	(0.399)	(0.394)	(0.407)	Yes (p-value < 0.001)
	[87,587]	[54,040]	[33,547]	
Fathers	0.873	0.880	0.862	
	(0.333)	(0.325)	(0.345)	Yes (p-value < 0.001)
	[19,299]	[11,874]	[7,425]	
Mothers	0.863	0.879	0.838	
	(0.343)	(0.326)	(0.368)	Yes (p-value < 0.001)
	[22,320]	[13,729]	[8,591]	
Aunts	0.798	0.805	0.787	
	(0.401)	(0.396)	(0.409)	Yes (p-value < 0.001)
	[44,830]	[27,628]	[17,202]	
Uncles	0.804	0.810	0.794	
	(0.397)	(0.393)	(0.404)	Yes (p-value < 0.001)
	[42,757]	[26,412]	[16,345]	

Notes: Based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, 2^{nd} *Booster*, is equal to 1 if applicant i's older relative j received a COVID-19 vaccination after the start of the second booster campaign (and is equal to 0 otherwise). Means are shown with standard deviations in parentheses and sample sizes in brackets.

Table 2. 2SLS Estimates of the Effect of Having a Physician in the Family on the Likelihood of Receiving a Second Booster Dose of a COVID-19 Vaccine

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Physician	0.021**	0.021*	0.021**	0.006	0.032**	0.015	0.026**
	(0.008)	(0.012)	(0.010)	(0.014)	(0.013)	(0.013)	(0.013)
Mean of dependent variable	0.822	0.868	0.801	0.873	0.863	0.798	0.804
F-test of instrument	2,586	3,340	1,968	2,811	3,243	1,717	1,660
N	129,211	41,622	87,587	19,299	22,320	44,830	42,757

*Statistically significant at 10% level; ** at 5% level.

Notes: Each column represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, 2^{nd} *Booster*, is equal to 1 if applicant i's older relative j received a COVID-19 vaccination after the start of the second booster campaign (and is equal to 0 otherwise). All models control for gender, age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.

Table 3. 2SLS Estimates of the Effect of Having a Physician in the Family on the Likelihood of Receiving a Second Booster Dose of a COVID-19 Vaccine by Gender of Medical School Applicant

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Panel A. Male applicants							
Physician	0.001	-0.003	0.004	-0.022	0.011	-0.016	0.026
	(0.012)	(0.018)	(0.015)	(0.021)	(0.021)	(0.020)	(0.019)
Mean of dependent variable	0.819	0.863	0.797	0.872	0.855	0.791	0.803
F-test of instrument	1,158	1,486	873	1,251	1,427	769	728
N	51,858	17,201	34,656	7,941	9,257	17,749	16,907
Panel B. Female applicants							
Physician	0.034^{***}	0.039^{**}	0.031^{**}	0.027	0.047^{***}	0.038^{**}	0.024
	(0.010)	(0.015)	(0.013)	(0.019)	(0.018)	(0.017)	(0.017)
Mean of dependent variable	0.825	0.871	0.804	0.874	0.870	0.803	0.804
F-test of instrument	1,441	1,857	1,110	1,558	1,808	963	950
N	77,351	24,417	52,930	11,353	13,062	27,079	25,849

**Statistically significant at 5% level; *** at 1% level.

Notes: Each column within each panel represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, 2^{nd} *Booster*, is equal to 1 if applicant i's older relative j received a COVID-19 vaccination after the start of the second booster campaign (and is equal to 0 otherwise). All models control for age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.

APPENDIX

For Online Publication

Appendix Table 1. Share of Medical School Applications and Probabilities of Admittance by Lottery Category

Lottery category	GPA on final exams in high school	Share of applications	Number of applications	Average probability of admittance	Weight
A	GPA $\geq$ 8.5	0.02	815	0.86	2.00
B	8.0 $\leq$ GPA $<$ 8.5	0.06	2,568	0.75	1.50
C	7.5 $\leq$ GPA $<$ 8.0	0.10	4,117	0.60	1.25
D	7.0 $\leq$ GPA $<$ 7.5	0.24	10,030	0.50	1.00
E	6.5 $\leq$ GPA $<$ 7.0	0.25	10,660	0.42	0.80
F	GPA $<$ 6.5	0.34	14,248	0.36	0.67

Appendix Table 2. Descriptive Statistics for Medical School Applicants

	Full sample	Lottery winners	Lottery losers	Statistically different at 5% level?	Description
Female	0.584 (0.493)	0.580 (0.494)	0.589 (0.492)	No (p-value = 0.214)	= 1 if applicant is female, = 0 otherwise
Age at first lottery	18.3 (0.850)	18.3 (0.851)	18.3 (0.850)	No (p-value = 0.431)	Age at which applicant participated in first medical school lottery
Non-Western migrant	0.070 (0.255)	0.072 (0.259)	0.067 (0.250)	No (p-value = 0.123)	= 1 if applicant or one of the applicant's parents was born in a non-Western country, = 0 otherwise
N	26,208	12,329	13,879		

Notes: Weighted means, based on inverse admittance probabilities, are shown with standard deviations in parentheses. Tests of equality were performed by separately regressing *Lottery Win* on each characteristic and controlling for lottery category by year-of-first-lottery fixed effects.

Appendix Table 3. Balancing Tests by First-Lottery Outcome for Medical School Applicants

	First-lottery winners	First-lottery losers	Statistically different at 5% level?
Lottery category B			
Female	0.600	0.607	No (p-value = 0.644)
	(0.490)	(0.489)	
Age at first lottery	17.9	18.0	No (p-value = 0.566)
	(0.646)	(0.686)	
Non-Western migrant	0.044	0.035	No (p-value = 0.603)
	(0.205)	(0.184)	
N	1,411	462	
Lottery category C			
Female	0.624	0.639	No (p-value = 0.746)
	(0.485)	(0.481)	
Age at first lottery	18.0	18.1	No (p-value = 0.363)
	(0.681)	(0.729)	
Non-Western migrant	0.042	0.032	No (p-value = 0.406)
	(0.202)	(0.176)	
N	1,737	1,068	
Lottery category D			
Female	0.590	0.599	No (p-value = 0.532)
	(0.492)	(0.490)	
Age at first lottery	18.2	18.2	No (p-value = 0.626)
	(0.752)	(0.770)	
Non-Western migrant	0.053	0.050	No (p-value = 0.582)
	(0.225)	(0.218)	
N	3,277	3,044	
Lottery category E			
Female	0.575	0.587	No (p-value = 0.370)
	(0.494)	(0.493)	
Age at first lottery	18.4	18.4	No (p-value = 0.805)
	(0.850)	(0.848)	
Non-Western migrant	0.074	0.068	No (p-value = 0.332)
	(0.262)	(0.252)	
N	2,762	3,880	
Lottery category F			
Female	0.557	0.563	No (p-value = 0.650)
	(0.497)	(0.496)	
Age at first lottery	18.6	18.5	No (p-value = 0.051)
	(0.916)	(0.902)	
Non-Western migrant	0.100	0.095	No (p-value = 0.450)
	(0.301)	(0.294)	
N	3,142	5,425	

Notes: Weighted means, based on inverse admittance probabilities, are shown with standard deviations in parentheses. Tests of equality were performed by separately regressing *Lottery Win* on each characteristic and controlling for lottery category by year-of-first-lottery fixed effects.

Appendix Table 4. Balancing Tests by First-Lottery Outcome for Older Relatives of Medical School Applicants

	First-lottery winners	First-lottery losers	Statistically different at 5% level?
Number of older relatives registered in Netherlands in 2021	4.89	4.95	No (p-value = 0.250)
	(3.32)	(3.28)	
Number of parents registered in Netherlands in 2021	1.58	1.59	No (p-value = 0.113)
	(0.619)	(0.610)	
Number of aunts/uncles registered in Netherlands in 2021	3.31	3.35	No (p-value = 0.369)
	(3.14)	(3.11)	
Father registered in Netherlands in 2021	0.733	0.741	No (p-value = 0.227)
	(0.442)	(0.438)	
Mother registered in Netherlands in 2021	0.849	0.854	No (p-value = 0.225)
	(0.358)	(0.353)	
Number of aunts registered in Netherlands in 2021	1.70	1.71	No (p-value = 0.836)
	(1.87)	(1.83)	
Number of uncles registered in Netherlands in 2021	1.61	1.64	No (p-value = 0.175)
	(1.77)	(1.79)	
Average age of older relatives (in year of first lottery)	46.2	46.3	No (p-value = 0.555)
	(4.11)	(3.98)	
Average age of parents (in year of first lottery)	47.7	47.8	No (p-value = 0.712)
	(3.79)	(3.79)	
Average age of aunts/uncles (in year of first lottery)	45.4	45.5	No (p-value = 0.655)
	(4.65)	(4.51)	
Age of father (in year of first lottery)	48.7	48.6	No (p-value = 0.610)
	(4.08)	(4.05)	
Age of mother (in year of first lottery)	46.9	47.0	No (p-value = 0.284)
	(4.02)	(4.05)	
Average age of aunts (in year of first lottery)	45.6	45.8	No (p-value = 0.282)
	(5.18)	(5.11)	
Average age of uncles (in year of first lotter)	45.3	45.3	No (p-value = 0.743)
	(5.03)	(4.89)	
N	12,329	13,879	

Notes: Weighted means, based on inverse admittance probabilities, are shown with standard deviations in parentheses. Tests of equality were performed by separately regressing *Lottery Win* on each characteristic and controlling for lottery category by year-of-first-lottery fixed effects.

Appendix Table 5. First-Stage Estimates: The Effect of Winning Medical School Lottery on Becoming a Physician

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Panel A. All applicants							
Lottery Win	0.350***	0.356***	0.347***	0.355***	0.356***	0.350***	0.345***
	(0.007)	(0.006)	(0.008)	(0.007)	(0.006)	(0.008)	(0.008)
Mean of dependent variable	0.616	0.615	0.617	0.615	0.615	0.616	0.618
F-test of instrument	2,586	3,340	1,968	2,811	3,243	1,717	1,660
N	129,211	41,622	87,587	19,299	22,320	44,830	42,757
Panel B. Male applicants							
Lottery Win	0.368***	0.373***	0.365***	0.374***	0.372***	0.368***	0.363***
	(0.011)	(0.010)	(0.012)	(0.011)	(0.010)	(0.013)	(0.013)
Mean of dependent variable	0.589	0.588	0.590	0.588	0.587	0.589	0.591
F-test of instrument	1,158	1,486	873	1,251	1,427	769	728
N	51,858	17,201	34,656	7,941	9,257	17,749	16,907
Panel C. Female applicants							
Lottery Win	0.338***	0.343***	0.336***	0.343***	0.344***	0.338***	0.334***
	(0.009)	(0.008)	(0.010)	(0.009)	(0.008)	(0.011)	(0.011)
Mean of dependent variable	0.635	0.634	0.635	0.634	0.635	0.634	0.635
F-test of instrument	1,441	1,857	1,110	1,558	1,808	963	950
N	77,351	24,417	52,930	11,353	13,062	27,079	25,849

***Statistically significant at 1% level.

Notes: Each column within each panel represents the results from a separate first-stage regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, *Physician*, is equal to 1 if applicant i went to medical school in the Netherlands and became a registered physician (and is equal to 0 otherwise). All models control for age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. The models in Panel A also control for gender. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.

Appendix Table 6. 2SLS Estimates of the Effect of Becoming a Physician on the Likelihood of Receiving a Second Booster Dose of a COVID-19 Vaccine

	(1)	(2)	(3)
	All applicants	Male applicants	Female applicants
Physician	0.237***	0.232***	0.241***
	(0.019)	(0.029)	(0.025)
Mean of dependent variable	0.534	0.507	0.554
F-test of instrument	3,445	1,457	1,982
N	24,295	9,994	14,301

***Statistically significant at 1% level.

Notes: Each column represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome is equal to 1 if applicant i received at least one COVID-19 vaccination after the start second booster campaign (and is equal to 0 otherwise). All models control for age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. The model in column (1) also controls for gender. Robust standard errors are in parentheses.

Appendix Table 7. 2SLS Estimates of the Effect of Having a Physician in the Family on the Likelihood of Receiving the First Booster Dose of a COVID-19 Vaccine Within a Month of Availability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Physician	-0.002	0.001	-0.003	-0.006	0.006	0.006	-0.012
	(0.010)	(0.018)	(0.011)	(0.021)	(0.020)	(0.015)	(0.015)
Mean of dependent variable	0.443	0.523	0.405	0.525	0.520	0.430	0.378
F-test of instrument	2,586	3,340	1,968	2,811	3,243	1,717	1,660
N	129,211	41,622	87,587	19,299	22,320	44,830	42,757

Notes: Each column represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. For relatives ages 70+, the outcome is equal to 1 if applicant i's older relative *j* received a third COVID-19 vaccination within a month of November 19th, when booster shots first became available to the elderly (and is equal to 0 otherwise). For relatives ages 60-69, the outcome is equal to 1 if applicant i's older relative *j* received a third COVID-19 vaccination within a month of November 23rd, when booster shots first became available to anyone over the age of 59 (and is equal to 0 otherwise). All models control for gender, age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.

Appendix Table 8. Means of $Shots \geq 4$ for Older Relatives of Medical School Applicants

	Full sample	Physician in the family	No physician in the family	Statistically different at 5% level?
All older relatives	0.801	0.810	0.787	
	(0.399)	(0.392)	(0.409)	Yes (p-value < 0.001)
	[129,211]	[79,646]	[49,565]	
Parents	0.850	0.862	0.830	
	(0.357)	(0.345)	(0.376)	Yes (p-value < 0.001)
	[41,622]	[25,605]	[16,017]	
Aunts and uncles	0.778	0.785	0.766	
	(0.415)	(0.411)	(0.423)	Yes (p-value < 0.001)
	[87,587]	[54,040]	[33,547]	
Fathers	0.855	0.863	0.842	
	(0.352)	(0.344)	(0.365)	Yes (p-value < 0.001)
	[19,299]	[11,874]	[7,425]	
Mothers	0.846	0.862	0.819	
	(0.361)	(0.345)	(0.385)	Yes (p-value < 0.001)
	[22,320]	[13,729]	[8,591]	
Aunts	0.776	0.784	0.764	
	(0.417)	(0.412)	(0.425)	Yes (p-value < 0.001)
	[44,830]	[27,628]	[17,202]	
Uncles	0.780	0.787	0.769	
	(0.414)	(0.409)	(0.421)	Yes (p-value < 0.001)
	[42,757]	[26,412]	[16,345]	

Notes: Based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, $Shots \geq 4$, is equal to 1 if applicant i's older relative j received at least four COVID-19 vaccinations (and is equal to 0 otherwise). Means are shown with standard deviations in parentheses and sample sizes in brackets.

Appendix Table 9. 2SLS Estimates of the Effect of Having a Physician in the Family on the Likelihood of Receiving at Least Four COVID-19 Vaccinations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Physician	0.022***	0.018	0.024**	0.005	0.028**	0.018	0.030**
	(0.008)	(0.012)	(0.010)	(0.015)	(0.014)	(0.014)	(0.013)
Mean of dependent variable	0.801	0.850	0.778	0.855	0.846	0.776	0.780
F-test of instrument	2,586	3,340	1,968	2,811	3,243	1,717	1,660
N	129,211	41,622	87,587	19,299	22,320	44,830	42,757

Statistically significant at 5% level; * at 1% level.

Notes: Each column represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, $Shots \geq 4$, is equal to 1 if applicant i's older relative j received at least four COVID-19 vaccinations (and is equal to 0 otherwise). All models control for gender, age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.

Appendix Table 10. 2SLS Estimates of the Effect of Having a Physician in the Family on the Likelihood of Receiving at Least Four COVID-19 Vaccinations by Gender of Medical School Applicant

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All older relatives	Parents	Aunts and uncles	Fathers	Mothers	Aunts	Uncles
Panel A. Male applicants							
Physician	0.002	-0.004	0.006	-0.014	0.003	-0.017	0.031
	(0.013)	(0.018)	(0.016)	(0.022)	(0.022)	(0.021)	(0.020)
Mean of dependent variable	0.798	0.844	0.774	0.853	0.837	0.770	0.779
F-test of instrument	1,158	1,486	873	1,251	1,427	769	728
N	51,858	17,201	34,656	7,941	9,257	17,749	16,907
Panel B. Female applicants							
Physician	0.036***	0.035**	0.036***	0.020	0.046**	0.045**	0.025
	(0.011)	(0.016)	(0.013)	(0.020)	(0.019)	(0.018)	(0.017)
Mean of dependent variable	0.804	0.854	0.781	0.856	0.852	0.780	0.781
F-test of instrument	1,441	1,857	1,110	1,558	1,808	963	950
N	77,351	24,417	52,930	11,353	13,062	27,079	25,849

Statistically significant at 5% level; * at 1% level.

Notes: Each column within each panel represents the results from a separate 2SLS regression based on data from the COVID-vaccination Information and Monitoring System and the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. The outcome, $Shots \geq 4$, is equal to 1 if applicant i's older relative j received at least four COVID-19 vaccinations (and is equal to 0 otherwise). All models control for age at first lottery, age at first lottery squared, migrant status, lottery category fixed effects, year-of-first-lottery fixed effects, lottery category by year-of-first-lottery fixed effects, and birth-year fixed effects for the relative. In columns (1), (2), and (3), the models also control for relative-type fixed effects. Standard errors are corrected for clustering at the applicant level for the models shown in columns (1), (2), (3), (6), and (7). In columns (4) and (5), robust standard errors are reported.