Cash Benefits, Health Care Utilization, and Health

Protocol and Analysis Plan

November 14, 2022

ClinicalTrials.gov Identifier: NCT05622903

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A. Introduction

Unrestricted and unconditional cash benefits, sometimes referred to as a basic income, have emerged as a potential solution to several social issues, including poverty, food insecurity, income volatility, and mental illness, with small pilot studies suggesting improvements in these and other outcomes.[1–3] It is an old idea for which there has been renewed interest.[4–7] In this study, we investigate the effect of basic income on health care utilization, for which there is less evidence and little to none from a randomized study design.[8–11] Theoretically, a cash benefit could increase health care utilization by improving access, or it could decrease health care utilization by improving health. The effect of a cash benefit on health care utilization is therefore an empirical question.

Using data from the Chelsea Eats program, we propose to study a randomized controlled trial in which the City of Chelsea, Massachusetts held a lottery to allocate cash benefits to its residents for ten months during the first two years of the COVID-19 pandemic.[12] We will analyze the impact of the cash benefit on health care utilization and health. This proposal and analysis plan detail the intervention, randomization, and data source. Importantly, while this analysis plan is specified after the conduct of the trial, it does pre-specify the outcomes and statistical analysis prior to analysis of the data. No analyses of post-intervention outcomes were conducted prior to gaining access to the data.

B. Treatment

Chelsea, Massachusetts, a city of 40,000 people just north of Boston, was among the places in the country hardest hit by COVID-19, both from a health and an economic perspective. Its heavily Latino population is concentrated in sectors of the economy that were shut down when the pandemic hit, and Chelsea residents are also disproportionately likely to be front-line service workers exposed to infection risk.[13] In April 2020, local community organizations and the City of Chelsea responded to the economic crisis facing jobless Chelsea residents by mounting an unprecedented food distribution effort.

In September 2020, after five months of running its food distribution sites, the City redirected its efforts toward distributing financial support so that residents could purchase their own food through a program called Chelsea Eats. By combining city general revenue funds, state aid, and philanthropic contributions, the City assembled enough resources to distribute Chelsea Eats debit cards to approximately 2,000 households and to replenish the cards on a monthly basis for a total of six months, that was later extended to ten months. The card amounts vary with household size. Most households received $400 per month, but one- and two-person households received $200 and $300, respectively. Spending from the cards was not restricted to food but could be spent on anything and anywhere Visa was accepted. In total, 3,615 households applied for the cards, and 2,074 were chosen to receive the cash assistance cards via a lottery. The debit cards were credited with the first payment on November 18th, 2020 and the second payment on December 18th, 2020. The program continued with monthly credits through August 2021.

C. Randomization and Participant Eligibility

Between July 27, 2020 and August 17, 2020, the City accepted applications for the Chelsea Eats cash assistance cards. Multilingual information about the cards was distributed to individuals using the city-run food distribution sites. Additionally, information and applications were disseminated to community-based organizations, food pantries, faith groups, health care organizations, and low- and moderate-income housing complexes. Direct outreach to residents by city staff occurred in multiple locations, including food pantry lines, COVID-19 testing lines, and social service agencies. Applications could be submitted online via the city's website or on paper by dropping them off or mailing them to City Hall. In practice, most applications were submitted by residents attending one of the various city or community partner food pantries, where city staff, equipped with tablets, assisted residents with the application.

Eligibility criteria included:

- Resident of Chelsea, Massachusetts
- Household income at or below 30% of the U.S. Department of Housing and Urban Development's Area Median Income

The lottery was a weighted lottery. Specifically, a household could receive additional lottery tickets by meeting any of the following criteria:

- No one in the household was currently working
- The household was not receiving unemployment insurance
- The household was not receiving food assistance (e.g., SNAP benefits)
- There was a disabled household member
- There was a household member over 65 years of age
- There was a household member who was a veteran
- There was a household member who was under 6 years of age
- There was a household member between the ages of 6 and 17

The total number of lottery tickets per application ranged from 1 to 8. Although it was the city's intention to restrict households to a single application, some households managed to enter the lottery with more than one application. In these cases, the household still received only a single Chelsea Eats card. Records for the duplicate applicants will be combined into a single record, summing the lottery tickets across the duplicate records to determine the household's overall probability of winning the lottery. We account for the differential probability of winning the lottery across households in the statistical analysis (see section E.2).

Of note, some households never picked up their Chelsea Eats cards. The city then gave these unused cards to households from a randomly generated waitlist that was created at the time of random assignment. All waitlisted households ultimately received Chelsea Eats cards and are therefore part of the treatment group. The waitlist households received their cards approximately one month later than the primary lottery winners, but the cards were credited with both the

payments for the first and second months – so the total payments received by waitlist households are the same as initial lottery winners.

D. Data, Study Sample, Outcomes, and Other Variables

D.1. Data and Study Samples

The two closest emergency departments to the City of Chelsea are Cambridge Health Alliance's Everett Hospital and Massachusetts General Hospital. Participants in the study will be matched to their electronic health record at Cambridge Health Alliance (CHA) and Mass General Brigham (MGB) using a probabilistic algorithm based on name, year of birth, gender, address, and phone number.

There are two additional/secondary study samples. The first will be a subsample of study participants who received their primary care at CHA or MGB at baseline. The second will be children of the participants, identified using address and phone number of the participants as well as dependency relationships available through the electronic health record data.

D.2. Planned Outcomes

Outcomes will be assessed on a per-household basis and measured using the electronic health record data over the ten months of the trial.

1. <u>Primary Outcome</u>
    a. Emergency department use
        i. We will use the electronic health record data to count visits to the emergency department. Our primary outcome will be assessed on a monthly basis over the duration of the cash benefit and is therefore specified as a frequency variable.
        ii. We will also characterize the nature of these visits including by pre-specified diagnosis categories and whether it resulted in a hospital admission, as secondary outcomes (see below).
        iii. Our primary outcome is count-based and not binary (i.e., any versus none) in order to maximize power. To understand general access to emergency department care versus intensity in emergency department use, we will separately assess a dichotomized version of the outcome.

2. <u>Secondary Outcomes</u>
    a. Emergency department use by pre-specified categories:
        i. Behavioral health-related ED visit
        ii. Substance use disorder-related ED visit
        iii. Potentially avoidable vs non-avoidable (categorized using the previously validated New York University algorithm)

iv. Resulting in admission to the hospital
v. As above, we will separately assess count-based and binary versions of these outcomes.

b. Outpatient service use
    i. Outpatient service use includes office visits and other types of outpatient care such as imaging and procedures. We will also assess outpatient service use disaggregated according to type of service (i.e., office visits to primary care, cancer screening tests).
    ii. As above, we will separately assess count-based and binary versions of these outcomes.

c. COVID vaccination
    i. The first COVID vaccine received emergency use authorization on December 11, 2020. Vaccination status will be a binary variable for having received at least one dose of any COVID vaccine by the end of the trial period.

d. Clinical measures: hemoglobin A1c, blood pressure, weight, and cholesterol
    i. These are continuous measures available in the electronic health record. We will use the latest available reading or result during trial period.
    ii. Given potential changes in access to care (see outcomes above) that could affect the set of participants for whom we have data for these measures, we have also specified a sensitivity analysis below using the subsample for patients who received their primary care at CHA or MGB at baseline.

D.3. Patient Characteristics

The data includes information on participants' household size, disability status, veteran status, work status, income, receipt of other benefits or assistance, and utilization/spending prior to randomization. These characteristics come from the lottery application form or electronic health records and are assessed prior to randomization. In the event that there are high levels of missingness for any key covariate (i.e., >2%), multiple imputation methods will be used.

E. Statistical Analysis

E.1. Evaluation of randomization, balance, and attrition

We will test for balance between treatment and control based upon observable baseline characteristics for the overall study population.

Because differential attrition correlated with treatment, for example due to death, could introduce bias into our results, we will also evaluate the attrition rate and assess for balance between treatment and control based upon both baseline characteristics for the final analytic sample (and attritors) and potential causes of attrition.

E.2. Statistical specification

Our primary analytic approach is an analysis based on the intent-to-treat principle that compares outcomes for those randomized into the treatment group to those who were randomized into the control group. Specifically, we will estimate the following linear regression model:

$$y_i = \beta_0 + \beta_1 \text{CASH}_i + \beta_3 \mathbf{X}_i + \epsilon_i,$$

where y_i is the utilization or clinical outcome for individual or household i. See section D.2. for a list of our primary and secondary outcomes. "$CASH_i$" is an indicator for whether individual i won the lottery and was thus randomized into the treatment group. $\boldsymbol{X_i}$ is a vector of covariates, specifically patient characteristics, including baseline (pre-randomization) values of the outcome variable, which are not explicitly necessary since they should be unrelated to treatment status, but they may increase the precision of our estimates to the extent that they explain some of the variance in the outcome.

The coefficient on CASH_i, β_1, is our main coefficient of interest; it provides the difference in means between the treatment groups and the control group. In addition to our primary specification above that corresponds to testing for a level shift, we will also include an interaction term between an indicator for time and treatment status to test for changes in slope.

As described in section C, a household could receive additional lottery tickets by meeting specific criteria. Observations will thus be weighted by the inverse probability of winning the lottery so that β_1 is an unbiased estimate of the relationship between winning the lottery and the outcome. An alternative specification that includes indicators for number of lottery tickets is discussed below. Standard errors will be clustered at the household level and adjusted for heteroskedasticity.

E.3. Subgroup analyses

To examine heterogenous effects of the cash benefits, we will repeat our analyses for four pre-specified subgroups, each defined based on data from the pre-randomization period. The subgroups are: (1) chronic disease at baseline, (2) history of acute care utilization, (3) financial distress at baseline, and (4) poor self-reported health at baseline.

Specifically, we use electronic health record data to define participants by whether they have a known chronic disease (e.g., diabetes, hypertension, depression, anxiety) for which she/he/they is prescribed a regular medication. We will also use the electronic health record data to define participants by whether the participant had any acute care utilization in the year prior to randomization.

For a subset of the participants, we have baseline survey data that enables subgroup analyses by level of financial distress and self-reported health. Financial distress is defined as an affirmative answer on a survey question asking the participant whether she/he/they had any bills, expenses,

or needs that they were unable to pay. Poor self-reported health is defined as a positive screening (score≥3) on the 2-question version of the Patient Health Questionnaire, a positive screening (score≥3) on the 2-question version of the Generalized Anxiety Disorder questionnaire, or a fair/poor response on the 5-point scale of self-rated health.

E.4. Alternative specifications and sensitivity analyses

Our primary specification includes patient characteristics and baseline values of the outcome in the model to improve power as well as any chance imbalance between the study arms after randomization. As described in section E.1., we will compare covariates between the treatment and control groups, and we will explore whether our results are sensitive to inclusion of these covariates in the model. Importantly, our primary specification accounts for differential probability of winning the lottery using inverse probability weights. As an alternative approach, we will include the set of covariates that are correlated with treatment probability into the model, specifically indicators for number of lottery tickets. Finally, as a sensitivity check, we will also conduct our analyses on the subpopulation of participants with established primary care at MGB or CHA at baseline.

To ensure our estimates are robust to method of estimation, we will also estimate generalized linear models assuming a negative binomial distribution for the count utilization outcomes and a generalized linear model with a Bournoulli distribution and logit link function for the binary outcomes. In a final robustness check, we will Winsorize the utilization measures to ensure that our estimates are not sensitive to outliers.

E.5. Statistical significance and adjustments for multiple comparisons

Statistical significance was defined as two-sided $P<0.05$ for the primary outcome. Because we have one prespecified primary outcome, we will not make any adjustments for multiple inference. For our secondary outcomes, we will the Benjamini-Hochberg procedure or similar to calculate adjusted p-values that account for testing of multiple outcomes.

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