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The effect of household hospitalizations on the educational attainment of youth

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ABSTRACT

We utilize data from the NLSY97 to investigate the effect of week-long hospitalizations of household members on the educational attainment of youth. These significant household health events could result in a combination of financial and time constraints on the household, limiting the educational opportunities available to survey respondents. We find that household hospitalizations lead to reductions in the likelihood of completing high school, attending college and completing a bachelor's degree. These negative effects are disproportionately experienced by male respondents. Respondents with higher pre-hospitalization ability appear to be insulated from these health events. Birth-order and the gender composition of siblings also appear to play a role. We find that the oldest children in the household bear the burden of a hospitalization, substantially lowering the educational attainment of these respondents, while insulating their younger siblings. Similarly, the presence of a brother appears to insulate respondents from the negative impacts of household hospitalizations.

1. Introduction

Using data from the National Longitudinal Survey of Youth 1997 (NLSY97), we estimate the relationship between week-long hospitalizations of another household member and educational attainment. We argue that hospitalizations of this length could be related to educational attainment through their effects on household expenditures or other household resources. We find that these substantial hospitalizations of household members lower the educational attainment of youth within the household, conditional on pre-hospitalization background controls. Furthermore, we find that the effects are concentrated among male youths, youth without older siblings and youth without brothers, suggesting a possible protective role for male and older siblings in response to the hospitalization event.

In the United States, hospitalizations are not infrequent occurrences, occurring at a rate of 936.7 per 10,000 people in 2007 (Hall, DeFrances, Williams, Golosinskiy, & Schwartzman, 2010). However, only 13% of hospitalizations result in a length of stay exceeding a week.[1] Week-long hospitalizations of other household members most likely reflect severe health shocks, and could be related to the educational attainment of healthy youth in these households through a variety of channels. The hospitalization of household members may impose psychological stress on the children in the afflicted families. Alternately, illnesses of household members could affect household income or put constraints on the available time of household members because of care needs or changes in labor market behavior. Thus, hospitalizations may limit financial and time investments in children, which could negatively impact the educational outcomes of youth. In addition to restricting the resources available to be

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[1] All length of stay calculations performed by authors' using the 2002 National Hospital Discharge Survey.

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invested in children, the adverse health event may place direct requirements on children by requiring them to actively care for the afflicted member or participate in the labor market to offset resulting income reductions. Consistent with these concerns, a recent survey of high school dropouts conducted by the Bill and Melinda Gates Foundation found that 22% of these students reported that the primary reason for their dropout was the necessity of caring for a family member (Bridgeland, DiIulio, & Morison, 2006).

This paper builds on a nascent literature by providing a longitudinal study of the effects of a significant household hospitalization event on the educational attainment of children in the NLSY97, a large scale, representative sample in the United States. Our identification strategy combines the timing of the questions with the rich set of individual and household covariates available in the NLSY97. The respondent youth are initially surveyed in 1997 and provide information about household finances, respondent and household health, household characteristics, and are administered the Armed Services Vocational Aptitude Battery (ASVAB). Respondents are then asked whether any member of the household has experienced a week-long hospitalization in follow-up surveys. Thus, the base year data on respondent and household health, respondent ability and household finances, as well as other characteristics represent pre-hospitalization controls. Our identifying assumption is that given the rich base year controls, the household hospitalizations represent conditionally exogenous health events of household members.

We find that a week-long household hospitalization during the respondent's adolescence lowers educational attainment in the form of lower years of schooling, as well as lower likelihoods of completing high school and attending college. We also find lower likelihoods of completing college, even among the sample of high school completers. Furthermore, we find some evidence that household hospitalizations restrict the college choice set of students.[2] Given the evidence in the literature of large economic returns to college completion, we would expect household hospitalizations to negatively affect future earnings, which we find in the data.

We also find evidence of heterogeneity in the effects of household hospitalizations on educational attainment. The negative effects of household hospitalizations appear to be particularly large for male respondents. Additionally, we find evidence that households appear to shift the burden of household health events differentially across children within the household based on birth order and gender composition. The negative effects of a household hospitalization are concentrated among the oldest children within the household. For example, having an older sibling appears to reduce the magnitude of the estimated effects. Similarly, the presence of a brother in the household also diminishes the impact of a household hospitalization. Thus, it appears that older children and male children bear the brunt of the negative effects of the health event, but in doing so these youth insulate their siblings from the detrimental effects of a household hospitalization.

We begin with a background discussion in Section 2 and a discussion of our empirical methodology and data in Section 3. We present initial results in Section 4 of the effect of household hospitalizations on educational attainment, using a variety of empirical specifications. In Section 5, we investigate how the effects are mediated or accentuated based on characteristics of the respondent or the respondent's household and discuss the implications for the mechanisms linking household hospitalizations to child educational outcomes. Section 6 examines the impact of hospitalizations on the choice of college attended for the subsample of college attendees, and briefly looks at labor market earnings. Section 7 concludes.

2. Background

A large literature has focused on linkages between socioeconomic status (SES) and health. (See Currie, 2009 for a survey.) This literature documents correlations between parental SES and children's health, and a reciprocal link between child health and the subsequent SES of the child in adulthood. A similarly large literature has examined the impact of various household resources on educational attainment, investigating the role of family income (Belley & Lochner, 2007; Cameron & Heckman, 1998, 2001; Carneiro & Heckman, 2002), parental education (Altonji & Dunn, 1996) and housing wealth (Lovenheim, 2010; Lovenheim & Reynolds, 2013). In general, this literature has found that lower resources lead to lower educational attainment of youth, but the exact mechanisms are still being uncovered. The evidence suggests that the impact of household resources may differ depending on the age of the child or the student's point in the educational path. For example, differences in resources at young ages can lead to substantial long-run differences in educational attainment (Cunha & Heckman, 2007; Cunha, Heckman, Lochner, & Masterov, 2006).[3] Given large and increasing returns associated with education (Autor, Katz, & Kearney, 2008), understanding the complex ways in which household health events affect educational attainment is a matter of importance for policy purposes.

Some literature directly investigating the effects of family health events on the educational and labor market outcomes of children has recently emerged. Sun and Yao (2010) use rural data from China to examine the effects of

[2] There is increasing evidence of negative effects on the educational attainment and labor market earnings of two-year college attendees (Bound, Lovenheim, & Turner, 2010; Kane & Rouse, 1995; Long & Kurlaender, 2009; Reynolds, 2012), but there could also be consequences for students if the limited choice set lowers the match quality between the student and college (Light & Strayer, 2000).

[3] A related literature has investigated whether credit constraints limit college enrollment for some students. Carneiro and Heckman (2002), Cameron and Taber (2004) and Stinebrickner and Stinebrickner (2008) find that credit constraints do not play a large role in college enrollment and completion for most students, while Belley and Lochner (2007) find evidence of an increasing role over time for family income in both college attendance and college choice decisions. However, this discussion is largely not about whether household resources matter, but instead is focused on whether there is a role for short-run credit constraints late in the educational path, given long-term differences in household resources.

health events to adult family members on the educational outcomes of children, finding significant negative effects on the enrollment of primary school students. Choi (2011) uses Russian data to document lower probabilities of labor force participation and lower educational attainment of daughters, associated with changing health status of their fathers. A working paper by Bratti and Mendola (2011) suggests that the children of mothers who experience health declines are less likely to be enrolled in secondary and tertiary education in a Bosnian data set. All of the previous studies use data from countries undergoing economic transitions and therefore the policy relevance for the United States is unclear. In contrast, a 2010 paper by G. Brant Morefield uses the Child Development Supplement of the Panel Study of Income Dynamics to investigate the effect of negative parental diagnoses of specific health events on children in the United States. Morefield finds no significant effect on children's cognitive skills, but finds small negative effects on children's behavior. Adverse parental diagnoses are shown to have more pronounced negative effects on son's behavior in comparison to daughter's, and are more pronounced when the diagnosed parent is the father.[4]

We investigate week-long hospitalizations which likely reflect serious health events. The National Hospital Discharge Survey administered by the Centers for Disease Control and Prevention documents that the median length of hospitalization in 2002 was 3 days for all diagnoses. Diagnoses resulting in hospitalizations approaching a week in duration, representing only 13% of all hospitalizations, include malignant neoplasms (6 days median length of stay), femur fracture (5.0 days) and septicemia (6.0 days). In comparison, the median length of stay for acute myocardial infarction was 4 days, for appendicitis was 2 days, for childbirth was 2 days, and most elective surgeries are performed on an outpatient basis. As a result, our measure likely captures serious diagnoses or extremely acute occurrences of conditions like myocardial infarction.

Week-long hospitalizations typically reflect important health events with the potential to reduce household resources. For example, following a heart attack an individual may return to work within two weeks to three months depending on the severity of the heart attack, and treatment of cancer can have on-going serious physical effects on patients and force children to take on more responsibilities within the household.[5] Our measure is similar in spirit to Sun and Yao (2010) who use large medical outlays, approximately twice the average rural income in China, as a measure for severe health events in households in rural Chinese households. However, length of hospitalization is likely a better measure than medical outlays for severe health events in the United States, given the complex role that insurance coverage could have on medical expenses.[6]

3. Methodology and data

We begin with a simple framework for how household health events can impact educational attainment of respondent youth. In the initial period t, we observe a set of background characteristics about the respondents (X_t) and the household (W_t). In period $t+1$, the household may experience a health event of a household member (Z_{t+1}) and then we observe a level of educational attainment in period $t+2$. Thus, the future educational attainment of respondents can be modeled as

$$E_{t+2} = f(Z_{t+1}, X_t, W_t) \quad (1)$$

where E is a measure of educational attainment. In our empirical approach we consider a variety of educational outcomes including years of schooling and measures of education milestones such as degree attainment.

This framework requires a dataset with several measures: first, measures of household health events, second, educational outcomes, and third, a rich set of covariates providing background controls for the respondent and household prior to the health event.[7] All three categories of variables are available in the NLSY97, a nationally representative sample of youth aged 12–18 in 1997. The project initially interviewed 8984 individuals and their parents in 1997, providing detailed background information on the sample respondents and their families. In the base year, respondents are also given a battery of standardized tests. Importantly, these background characteristics and tests occur before the household health events are observed in the data, thus these measures can help to control for the initial ability of the respondents and

[4] A number of small scale studies in the medical and child psychology literature also investigate the behavioral and emotional outcomes of children whose parents are diagnosed with acute illnesses. Visser, Huizinga, van der Graaf, Hoekstra, and Hoekstra-Weebers (2004) provide a meta-analysis of 52 studies of the children of cancer patients, finding increased emotional problems and incidence of depression among the children. Spath (2007) surveys 6 studies investigating the effectiveness of psychological counseling for children in families with members diagnosed with serious illness, finding some evidence that counseling was beneficial in the children's psychological adjustment to the diagnosis. Sieh, Meijer, Oort, Visser-Meily, and Van der Leij (2010) perform a meta-analysis of 19 studies of the children of chronically ill parents, providing evidence that problem behavior is more prevalent in the children of the diagnosed parents. The studies surveyed in the Visser et al. (2004), Spath (2007) and Sieh et al. (2010) papers suffer from small sample sizes, with the largest individual study considered involving 336 participants, while the vast majority of the studies considered utilize sample sizes under 100 children.

[5] Information gathered from the family resource sections of the websites of the American Heart Association (www.heart.org) and the National Cancer Institute (www.cancer.gov).

[6] For example, elective surgeries may not be covered by insurance and therefore would cause a large outlay without substantial change in health. Additionally, the measure of health shock in Sun and Yao (2010) also includes conditions resulting in any inpatient care, possibly including less acute conditions resulting in short stays that would not be included in our measure.

[7] Datasets with detailed health questions typically do not have student educational outcomes or measures of pre-shock human capital, such as standardized test scores. Educational datasets have detailed information either do not have health information, or the health information included is subjective or self-reported. Subjective, self-reported measures of health status are argued by Bound (1991) to suffer from endogeneity problems. In contrast, objective, self-reported measures of health status (regarding specific conditions rather than general well-being) are vulnerable to measurement error as demonstrated in Bound (1991), as well as Baker, Stabile, and Deri (2004).

characteristics of households. The respondents have been interviewed annually since 1997, providing researchers detailed histories of educational choices and outcomes.

In the 2002 survey year, respondents were asked whether anyone in their household had been hospitalized for at least a week in the previous 5 years. Conditional on answering "yes" to this question, respondents were asked about the identity of the individual hospitalized. Our main variable of interest is an indicator that takes a value of one if any member of the respondent's household, other than the respondent themselves, experienced a one-week hospitalization in the previous five years. In our regression sample, approximately 17% of respondents report such an event in their households. We initially focus on any hospitalization within the household but we also consider whether the impacts are different depending on which member of the household was hospitalized.

There are several advantages to this particular measure of a health event. First, as discussed previously, hospitalizations of this length are likely to be associated with substantial health events or significant changes in the health of household members. Second, this measure is less subjective than the health information in many other surveys because it only requires respondents to identify length of hospitalization, and not the severity of the health event that led to the hospitalization. Moreover, the respondent is responding to questions regarding other members of their household, rather than providing a self-report, which is likely to be less susceptible to endogeneity problems.

There are some limitations of the measure, however. First, because the question deals with only week-long hospitalizations, we may miss important health events that result in frequent hospitalizations of short duration. Second, we do not know whether the hospitalized individual had multiple hospitalizations. Thus, while we are likely capturing significant health events due to the length of hospitalization, we cannot distinguish additional levels of severity. To the extent that our measure does not detect potentially serious health events, the results presented below may attenuate the effect of a household hospitalization.[8] An additional limitation of the measure is that we do not know when during the five-year period the hospitalization occurred. This limits our ability to identify immediate impacts of the hospitalization on respondent behavior and educational choices. We instead examine how the effects of hospitalizations are manifest in educational attainment.

The primary identification concern is that the hospitalization of another household member is correlated with the unobserved determinants of the respondent's educational attainment. Given the impossibility of a randomized control study on hospitalization events, our identification strategy relies on using an extensive set of base year controls for the respondent (X_t) and the household (W_t), measured 1997 before the household hospitalization. For the household, we include measures of base year household health including measures of parental Body-Mass Index (BMI) as categories (normal weight, underweight, overweight and obese) as well as an indicator for whether the parent is limited by health from working. Additionally, there is an extensive literature linking parental socioeconomic status to child health, and child health to subsequent educational and labor market attainment (see Currie, 2009 for a detailed survey of this literature).[9] Therefore, we include base year household income and household net worth as two measures of financial resources of the household. These measures capture differences in resources available to households and also will capture long-term differences across households that may affect respondent educational attainment, such as prior health problems not captured by our direct health measures or differences in household discount rates affecting savings decisions. Finally, one might be concerned that there are effects of parental socio-economic status that are not captured by the income variable, consequently we also include the years of schooling of the respondent's mother and father separately.

In addition, NLSY97 respondents are asked detailed questions with regard to individual ability, health and other demographics prior to a household hospitalization. We control for respondent ability using the score on the Armed Forces Qualifying Test (AFQT), a subcomponent of the ASVAB which provides a comprehensive test of cognitive skills, and is given to youth in the first year of the survey. It has been argued in the literature (Belley & Lochner, 2007; Cameron & Heckman, 1998, 2001; Carneiro & Heckman, 2002) that AFQT scores represent long-term resources invested in children. Thus, the respondent's score on this test can be interpreted as measuring investments made in the respondent prior to the hospitalization and would include any long-run household health conditions that limit such investments in the respondent.

The respondent health controls include the same categories of BMI as for the parents, as well as indicators for respondents who have health limitations or chronic conditions.[10] We also include basic demographics of race and gender of the youth, as well as the number of the respondent's siblings. Because we are interested in educational outcomes, we also control for characteristics

[8] If a household member has a serious decline in health but is not hospitalized for at least a week during the five-year window in our data, they will appear in the non-hospitalization sample. If the effect of this condition is to lower the educational attainment of the respondent in these families, this measurement error will attenuate our estimated effect of a household hospitalization.

[9] Currie and Moretti (2007) document intergenerational correlations in birth weight. Papers linking low birthweight to diminished schooling attainment and labor market outcomes using studies of twins include Behrman and Rosenzweig (2004), Black, Devereux, and Salvanes (2007), Royer (2009) and Fletcher and Lehrer (2009). Natural experiments indicating fetal origins of later life health include Banerjee, Duflo, Postel-Vinay, and Watts (2010) and Almond and Mazumder (2011). Finally, a large literature finds general infant health to also be a strong predictor of educational and labor market outcomes, including Case, Fertig, and Paxson (2005), Oreopoulos, Stabile, Walld, and Roos (2008), Currie, Stabile, Manivong, and Roos (2010) and Fletcher (2011). See Currie (2009) for a detailed survey of this literature. Eide and Showalter (2011) provide an overview of recent developments.

[10] These controls include indicators for whether the respondent is limited in their ability to work for pay or do schoolwork because of a health condition, and indicators for specific conditions including asthma, a heart condition, anemia, diabetes, cancer or other chronic condition.

of the respondent's high school to capture other unobserved differences in educational opportunities. In particular, we include measures of whether the respondent's high school is public and an indicator for large student–teacher ratio, exceeding 22 students per teacher.[11] We further include indicators for living in the non-central city portion of a Metropolitan Statistical Area (MSA) or living outside a MSA at age 17. Finally, we include age indicators to account for any differences across cohorts in educational experiences or hospitalizations, such as variations in the business cycle (Ruhm, 2003).

Our identifying assumption is that the hospitalization event is exogenous conditional upon these controls, which capture both differences in household characteristics and individual health conditions. This precludes, for example, nonrandom hospitalizations due to effects of long-term household health conditions that may also impact respondent educational attainment, as such long-term conditions would be captured in the base year controls. Any bias in our estimates of household hospitalization's effect on respondent educational attainment must be due to unobserved effects that are residual to the extensive pre-hospitalization household characteristics that we include in the model, including our extensive set of parental and respondent health measures, household income and net worth and respondent test scores. Furthermore, we will also present evidence that the negative effects of household hospitalizations are concentrated among male respondents, respondents without older siblings and respondents without brothers. Thus, any bias due to unobserved effects must not only be residual to our extensive pre-hospitalization controls, but must also operate in such a way as to only emphasize male respondents, or respondents without older siblings or brothers. While such selection is possible, we believe that it is unlikely given the extensive set of covariates that we employ. However, we further investigate the possibility of selection bias in Section 4.3.

One limitation of the NLSY97 data set is item nonresponse. Given the primacy of the household hospitalization variable, we limit the sample to those respondents who respond to the hospitalization question, which removes 1101 observations, or roughly 12% of the sample. Note that all but 13 cases of missing information regarding hospitalization are due to those respondents who did not participate in the 2002 survey. Because of the critical importance of the base year health measures, respondent ability and household income and wealth variables, we exclude all respondents for whom this information is missing, a restriction that is common in the literature (Belley & Lochner, 2007; Cameron & Taber, 2004; Carneiro & Heckman, 2002). This removes an additional 3514 observations missing some combination of these variables. For parental education, we include an indicator for missing education but restrict the sample to those respondents for whom at least one parent has reported education. Restricting the sample to respondents that report the additional controls produces a final sample of 3862 individuals. As a robustness check, we estimated all of our main specifications using multiple imputation of the AFQT, household income and household net worth, the three variables for which we have the most missing data, by multiple imputation by chained equation (MICE) developed by Van Buuren, Boshuizen, and Knook (1999).[12] This results in a sample of 6034 observations. As we will discuss, results from this procedure are not substantially or substantively different, but in many cases are stronger, than our estimates reported in the main paper based on dropping observations with missing data.

Summary statistics are provided for the full regression sample in the first two columns of Table 1. As discussed above, 16.6% of respondents experience a one-week hospitalization of a household member in the 5 years before 2002 while 11.8% of respondents experience a one-week hospitalization of a member of their nuclear family. The summary statistics also suggest little difference in observable characteristics between the hospitalization and non-hospitalization samples. The difference in means is generally not statistically significant, with the exception of some of the respondent and household base year health measures. However, most of these differences between the hospitalization and non-hospitalization samples are small. While the estimates of the effects of household hospitalizations presented below control for these differences by employing our extensive set of pre-hospitalization background controls, there is scant evidence that there is selection into the hospitalization sample based on observable characteristics.

4. The effect of household hospitalizations on educational outcomes

4.1. OLS estimates of years of schooling

We begin by estimating the effect of household hospitalizations on respondent educational attainment with an OLS regression of total years of schooling on our household hospitalization indicator and the full set of base year controls previously discussed, including respondent and parental health measures, household income and wealth, parental educational attainment, and student ability.[13] The estimated coefficient on the household

[11] It is possible that household hospitalizations affect the type of high school that the respondent attends, in which case we are controlling for an endogenous variable. We investigated this issue and found little evidence that household hospitalizations affect the characteristics of the high school that the respondent attends. However, to the extent that hospitalizations lead to lower quality educational options for respondents during high school, our specification will underestimate the true effects of a hospitalization on respondent educational attainment.

[12] The NLSY97 provides a rich set of covariates upon which the imputation can be performed. In addition to the variables used in the empirical analysis, we also use high school GPA, the PIAT math exams scores, household income when students are 17, homeownership, house value and MSA-level means of all covariates. The imputation procedure is implemented using the STATA module "ICE" (Royston, 2004) with ten cycles of regressions and performed five separate times.

[13] All models in the paper are estimated using appropriate sampling weights. Furthermore, standard errors are reported in the tables in parentheses below point estimates or marginal effects. We cluster the standard errors by household to account for multiple respondents from the same household in the data.

Table 1
Summary statistics of selected variables and educational outcomes.

Variable	Full sample		Hospitalization sample		Non-hospitalization sample		Difference
	Mean	St. Err.	Mean	St. Err.	Mean	St. Err.	
Hospitalization	0.166	0.006					
Nuclear family hospitalization	0.118	0.006	0.712	0.019			
AFQT score	52.156	0.495	50.587	1.216	52.468	0.542	−1.881
Family income ($10,000)	6.991	0.100	6.622	0.262	7.065	0.108	−0.443
Family net worth ($10,000)	23.103	1.064	21.486	2.679	23.425	1.160	−1.939
Female	0.501	0.009	0.514	0.021	0.499	0.010	0.015
White	0.712	0.007	0.686	0.018	0.717	0.008	−0.031
Black	0.133	0.005	0.144	0.012	0.130	0.005	0.014
Hispanic	0.110	0.004	0.109	0.011	0.110	0.005	−0.001
Other race	0.046	0.004	0.062	0.011	0.042	0.004	0.019
Mother years of schooling	13.059	0.044	13.025	0.117	13.066	0.048	−0.041
Father years of schooling	13.080	0.052	12.935	0.134	13.109	0.056	−0.173
Number of siblings	1.354	0.019	1.355	0.047	1.353	0.021	0.002
Youth health limitation	0.080	0.005	0.104	0.013	0.075	0.005	0.028**
Youth underweight	0.195	0.007	0.197	0.017	0.195	0.008	0.002
Youth overweight	0.118	0.005	0.128	0.014	0.116	0.006	0.013
Youth obese	0.052	0.004	0.068	0.010	0.049	0.004	0.019*
Parent health limitation	0.142	0.006	0.201	0.017	0.130	0.007	0.070***
Parent underweight	0.016	0.002	0.017	0.005	0.015	0.002	0.001
Parent overweight	0.311	0.008	0.304	0.019	0.312	0.009	−0.008
Parent obese	0.240	0.007	0.279	0.019	0.232	0.008	0.047**
Youth has chronic condition	0.114	0.006	0.138	0.015	0.110	0.006	0.028*
Youth has asthma	0.093	0.005	0.112	0.014	0.089	0.005	0.023
Youth has heart condition	0.008	0.002	0.013	0.005	0.007	0.002	0.006
Youth has anemia	0.002	0.001	0.002	0.001	0.002	0.001	0.000
Youth has diabetes	0.003	0.001	0.002	0.002	0.004	0.001	−0.002
Youth has cancer	0.002	0.001	0.002	0.002	0.002	0.001	0.001
Youth has other chronic condition	0.010	0.002	0.008	0.003	0.011	0.002	−0.003
HS, public	0.891	0.005	0.891	0.013	0.891	0.006	0.000
HS, student–faculty ratio 22+	0.140	0.006	0.155	0.016	0.137	0.006	0.018
Outcomes							
HS diploma	0.817	0.007	0.777	0.017	0.825	0.007	−0.048***
Attend college	0.628	0.008	0.579	0.021	0.637	0.009	−0.058**
BA	0.280	0.008	0.234	0.018	0.289	0.009	−0.055***
Years of schooling	13.716	0.046	13.454	0.115	13.768	0.050	−0.314**
Observations	3862		652		3210		

Notes: Summary statistics are calculated with sampling weights. The last column presents the difference in mean value for the hospitalized and non-hospitalized samples.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

hospitalization variable is presented in column (1) of the top panel of Table 2 and indicates that such an event reduces total years of schooling by 0.142 years, although the effect is not statistically significant at conventional levels. However, the point estimate represents a substantial effect of a household hospitalization on the educational outcomes of NLSY97 respondents relative to the contribution of other covariates. Comparing the magnitudes of the effects suggests that a household hospitalization has the equivalent effect of having approximately $30,000 lower household income or approximately $80,000 lower household net worth. Similarly, a hospitalization is equivalent to having between a 3 and 4 point decrease in the percentile score on the AFQT, roughly equivalent to a 0.10–0.15 standard deviation decrease.

In column (2), we present the estimates including an interaction between the household hospitalization indicator and an indicator for female. The estimates in column (2) indicate that a household hospitalization is associated with a reduction of 0.316 years of schooling for male respondents. The interaction term indicates that this entire effect is eliminated for female respondents, suggesting that male respondents are more susceptible to the hospitalization of a household member. There are many possible reasons that such a gender pattern could emerge. One possibility is simply that male respondents are an increasingly at-risk population with respect to educational attainment (Goldin, Katz, & Kuziemko, 2006) and therefore are more likely to have their academic careers disrupted by the health event. Alternately, it is possible that male respondents bear the burden as households reallocate responsibilities following the hospitalization. Evidence suggests that women are more likely to provide care for household members while men may be more likely to provide financial assistance, resulting in differential gender effects depending on how households respond to the hospitalization of a member (see, for example, Byrne, Goeree, Hiedemann, & Stern, 2009; Checkovich & Stern, 2002; Engers & Stern, 2002). In Section 4, we provide some evidence that, in fact, male respondents may be sheltering

Table 2
Estimates of the effects of household member hospitalizations on youth educational attainment.

	Years of schooling		HS diploma		Attend college		BA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS								
Hospitalization	−0.142	−0.316***						
	(0.100)	(0.133)						
Hospitalization × female		0.341*						
		(0.196)						
Probit marginal effects								
Hospitalization			−0.016		−0.032		−0.040*	
			(0.017)		(0.024)		(0.023)	
Hospitalization, male				−0.051*		−0.032		−0.066***
				(0.028)		(0.036)		(0.023)
Hospitalization, female				0.015		−0.031		−0.007
				(0.021)		(0.033)		(0.035)
Observations	3831		3008		3676		3862	

Notes: Standard errors are clustered by household and provided below point estimates (columns (1) and (2)) or marginal effects estimated at the mean (columns (3)–(8)). For interaction terms in the probit models, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. Regressions include AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and age indicators. All regressions are estimated using sampling weights. High school completion is measured by age 20 and the sample is restricted to those youth aged 12–15 in the base year. College completion is measured by age 21 and the sample is restricted to those youth aged 12–16 in the base year.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

their siblings by shouldering an additional burden following a hospitalization.[14]

4.2. Probit estimates of education milestones

Using total years of schooling completed to measure respondent education assumes that each year of schooling has the same impact on educational attainment. However, this linearity assumption ignores the possibility of sheepskin effects associated with degree attainment and that household hospitalizations could have different effects along the educational career, the knowledge of which is important for developing policy responses. Therefore, as an alternative, we estimate our model using probit regression for three binary educational outcomes: completion of a high school degree before age 20, college attendance before age 21 and completion of a bachelor's degree.

There is an ancillary identification issue particular to the high school completion and college attendance outcomes. Given the age range in our data, older respondents in the base year may complete these two outcomes before 2002 and thus the reported hospitalization could occur after the educational attainment has been measured. To limit this possibility, we impose age restrictions so the only respondents included in the regression are those for whom the educational attainment is measured after the hospitalization period. For example, the hospitalization is known to occur between 1997 and 2002 and we measure whether a high school diploma is achieved before age 20. Thus, we limit the regression sample to those respondents aged 12–15 in the base year, who are therefore aged 17–20 in 2002, ensuring that the high school completion is measured after the period in which the hospitalization took place. Similarly, we measure college attendance by age 21, so we limit the regression sample for this outcome to those respondents aged 12–16 in the base year. Because BA attainment occurs after 2002 for the entire sample, we do not place any age restriction on that outcome.[15]

We estimate the probit model, and report marginal effects, both for the full sample and with an interaction of our household hospitalization indicator and an indicator for female. The marginal effects we report for the interacted model correspond to the marginal effect of

[14] As discussed previously, the results are similar and often stronger when we estimate all of our main results in Table 2 using multiple imputation (see Appendix Table A1).

[15] There is a potential related timing concern associated with respondents dropping out of high school prior to the hospitalization. The age restrictions we employ limit, but do not eliminate, this possibility. We have estimated several auxiliary regressions and find no evidence that this concern is driving our results. In particular, as a falsification test we estimated a regression of high school completion by age 18 in the sample of respondents aged 16–17 in the base year, for whom any hospitalization is more likely to follow high school completion. If such a timing pattern was driving our estimates we would expect to find a negative effect of hospitalization, but instead we find a *positive* but statistically insignificant effect of hospitalization on high school graduation. Similarly, in the sample of high school dropouts, we estimate that hospitalizations are associated with more years of schooling and higher grade point averages, although neither is statistically significant, suggesting that those respondents who experience household hospitalizations are not predisposed to dropping out relative to the non-hospitalization sample. Furthermore, we later present evidence in Appendix Table A.2 that hospitalizations are associated with decreased likelihoods of college completion, even among those respondents who successfully complete high school.

hospitalization experienced by male and female respondents.[16] The marginal effects in column (3) of the bottom panel of Table 2 suggest that a household hospitalization reduces the likelihood of completing high school by 1.6 percentage points, although the estimate is not statistically significant. However for male respondents, the marginal effect of a household hospitalization lowers the likelihood of high school completion by a statistically significant 5.1 percentage points while the marginal effect for female respondents is small and not statistically significant. We further find that a household hospitalization reduces the likelihood of all respondents attending college by −3.2 percentage points (column (5)) and a similar magnitude effect for both male and female respondents (column (6)), but the effect is not statistically significant for the full sample or for either gender.

Additionally, in column (7) we find that a household hospitalization lowers the likelihood of completing a BA by 4.0 percentage points. Similar to the estimates for years of schooling and high school completion, in column (8) we find a strong gender effect in the estimates. For male respondents a household hospitalization lowers the likelihood of BA completion by 6.6 percentage points but there is not substantive or statistically significant effect for female youth. Additionally, the magnitudes of the marginal effects suggest that the effect of hospitalizations on BA attainment does not operate solely through students dropping out of high school. In fact, in Appendix Table A2 we present the estimates of the effects of hospitalizations on BA attainment in the sample of high school graduates and find that hospitalizations have a substantially negative and statistically significant impact on BA attainment even among high school graduates.[17]

Additionally, the marginal effects presented in Table 2 represent large changes in educational attainment relative to the baseline outcome probabilities, particularly for the college outcomes for which the baseline probabilities are lower. The baseline likelihoods of completing high school and attending college in the regression samples is 81.7 and 62.8%, respectively. Therefore, a household hospitalization lowers the likelihood of high school completion by 2.0% (=−0.020/0.817 × 100) relative to the baseline, and lowers the likelihood of college attendance by 5.1% (=−0.035/0.628 × 100). Additionally, the likelihood of completing the BA is reduced by 14.3% (=−0.037/0.280 × 100) relative to the average BA completion rate in the sample. Combined with the relatively high frequency of these health events in the data, the estimates in Table 2 suggest that significant household hospitalizations could be an important obstacle to educational attainment.[18]

4.3. Evidence on selection bias

Despite our extensive set of pre-hospitalization controls, there is the possibility that some of the estimated effects of hospitalizations on educational outcomes in Table 2 are due to selection based on some unobserved characteristic. To address this possibility we perform two checks for possible selection bias. First, the NLSY97 contains several measures of respondent health surveyed in 2007, five years after the household hospitalization variable is assessed, allowing a straightforward test of the conditional exogeneity of the household hospitalization indicator with respect to respondent health. We estimated probit regressions of indicators of future health of the respondent on the control variables and the household hospitalization indicator. We considered two dependent variables: a binary indicator of reported self-reported good health and week-long hospitalizations of the respondents in the five year period after the household hospitalization event. In both regressions, the marginal effect of a household hospitalization has the opposite sign from what we would expect if hospitalizations were proxying for poor respondent or household health, although neither result is statistically significant.[19] These results demonstrate that the hospitalization indicator is not capturing family specific effects, such as poor family health status, which result in diminished respondent health, subsequently causing lower educational attainment.[20] Rather, the household hospitalization indicator identifies a conditionally exogenous change which affects the respondent's educational attainment, independent of the respondent's health status.

Second, as a sensitivity check, we conduct the procedure suggested by Altonji, Elder, and Taber (2005) that uses the magnitude of the selection on observable characteristics as a basis for considering the potential problem of

[16] As noted in Ai and Norton (2003), the correct marginal effect of an interaction variable in a nonlinear model is conditional on the independent variables and is not equal to the marginal effect of the interaction term. We report the marginal effect of changing hospitalization from zero to one while holding female to 0, and subsequently holding female to 1, evaluated at the sample averages for all other covariates.

[17] It is possible that hospitalizations differentially impact youth by age. For instance, 12 year olds may be more negatively affected if they are at a more critical developmental period. Alternatively, if youth respond to hospitalizations through increased labor force participation or home responsibilities, then hospitalizations may have a larger negative impact on older youth. Since we cannot identify the point during the five-year hospitalization period at which the hospitalization occurs, we are limited in our ability to investigate the age impacts in the NLSY97 sample. We later present results suggesting that younger siblings may be insulated by the presence of an older sibling, indicating that birth order is important. Further refining the effects of hospitalization by age remains a potential area for future research.

[18] As a further robustness check, we replicate our previous estimates for all outcomes using propensity score matching (Rosenbaum & Rubin, 1983, 1984). We use kernel matching with an Epanechnikov kernel with the bandwidth selected by leave-one-out cross validation. Standard errors are produced by bootstrapping the procedure using 1000 replications. We perform the entire method separately for each outcome, as well as separately for male and female youths. The results from this exercise are presented in Appendix Table A.3 and are not substantively different than those found using OLS and probit regression.

[19] The marginal effect of a hospitalization on future reported self-reported health being rated as "excellent" or "very good" is 0.007 (0.012) and the marginal effect on a future week-long hospitalization of the respondent is −0.019 (0.014).

[20] In our data, 95% of those respondents experiencing a household hospitalization event only have a single household member hospitalized during the five-year observation period. This provides additional evidence that there is not a correlation in hospitalizations within households, which would be suggestive of unobserved household characteristics driving hospitalizations.

selection on some unobserved characteristics. We find that a substantial, and arguably implausible, amount of selection into hospitalization based on unobserved characteristics that are correlated with lower educational attainment would be required to explain away our main results. Specifically, to explain the negative effect on high school completion, there would need to be 0.48 times as much selection based on the unobserved characteristics as there is for the entire set of observed characteristics. The observed characteristics include a large variety of variables that are known to be strong predictors of student success, including test scores, family income, family wealth, parental education and high school characteristics, as well as our set of respondent and household health measures. Similarly, there would need to be 1.11 and 0.73 times as much selection on unobserved characteristics as the set of observed characteristics to eliminate the college attendance and BA completion estimates, respectively. Given the extensive set of observed pre-hospitalization covariates, and the fact that any potential selection on unobserved characteristics would have to be orthogonal to this set of observed controls, we argue that selection on unobservable characteristics is unlikely to invalidate the negative impact of household hospitalization on educational attainment found throughout this paper.

4.4. Ordered probit estimates

As a further robustness check, in Table 3 we estimate the overall impacts of household hospitalizations on final

Table 3
Ordered probit estimates of the effect of household hospitalizations on youth educational attainment by gender and by member of household hospitalized.

Coefficients	(1)	(2)	(3)
Hospitalization	−0.113**	−0.202***	
	(0.056)	(0.076)	
Hospitalization × female		0.176	
		(0.109)	
Father hospitalization			−0.234
			(0.151)
Father hospitalization × female			0.238
			(0.229)
Mother hospitalization			−0.203
			(0.130)
Mother hospitalization × female			0.619***
			(0.175)
Sibling hospitalization			−0.376**
			(0.145)
Sibling hospitalization × female			0.203
			(0.268)
N	3862	3862	3862

Marginal effects	(1a) Less than HS	(1b) BA	(2a) Less than HS	(2b) BA	(3a) Less than HS	(3b) BA
Hospitalization	0.020**	−0.034**				
	(0.010)	(0.017)				
Hospitalization, male			0.045**	−0.051***		
			(0.018)	(0.018)		
Hospitalization, female			0.004	−0.008		
			(0.012)	(0.026)		
Father hospitalization, male					0.053	−0.058*
					(0.038)	(0.034)
Father hospitalization, female					−0.001	0.001
					(0.026)	(0.056)
Mother hospitalization, male					0.045	−0.051*
					(0.032)	(0.030)
Mother hospitalization, female					−0.047***	0.149***
					(0.011)	(0.050)
Sibling hospitalization, male					0.091**	−0.087***
					(0.041)	(0.028)
Sibling hospitalization, female					0.030	−0.052
					(0.043)	(0.064)

Notes: Ordered probit is estimated with sampling weights on four categories of educational attainment: less than HS, HS diploma, AA, and BA. Marginal effects are calculated at the mean of all variables for the lowest category (“less than HS diploma”) and highest category (“completed BA”). For interaction terms, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. Standard errors are clustered by household and are reported in parentheses under coefficients and marginal effects. The model includes AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and a quadratic in age.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

outcomes using an ordered probit model with four categories of degree attainment: less than high school, high school diploma, associate's degree, bachelor's degree. All outcomes are measured in 2008. Column (1) in the top panel shows that the household hospitalization indicator produces a statistically significant negative coefficient, consistent with the results in Table 2 that hospitalizations reduce educational outcomes. The bottom panel presents the marginal effects of a hospitalization on not completing high school in column (1a) and completing a BA in column (1b). The marginal effects indicate that a household hospitalization increases the likelihood of not completing high school by 2.0 percentage points and reduces the likelihood of completing the BA by 3.4 percentage points. These impacts are very similar to the estimates in Table 2 except that they are slightly more precisely estimated given the larger sample size. Column (2) presents the coefficients including the interaction of the hospitalization indicator with the indicator for females. The marginal effects in columns (2a) and (2b) in the lower panel again demonstrate that male respondents are hurt more by household hospitalizations and the magnitudes of the marginal effects are similar to those found previously in Table 2.

In column (3) of Table 3, we investigate whether the negative impact of a hospitalization depends on which member of the household is hospitalized. In particular, we include separate indicators for the hospitalization of the respondent's mother, the respondent's father or the respondent's sibling. These three categories of household members comprise over 70% of hospitalizations of household members in our sample. Given the evidence that hospitalizations have a differential impact based on the gender of the respondent, we also include interactions with an indicator for whether the respondent is female. The estimates in column (3) show that the hospitalization of any member of the respondent's nuclear family is associated with substantial negative impacts for men and smaller impacts for women. The previous literature in this area has focused primarily on the impact of parental health events (Bratti & Mendola, 2011; Choi, 2011; Morefield, 2010; Sun & Yao, 2010), however the results in column (3) demonstrate that sibling hospitalizations also have a significant negative effect on respondent educational attainment. There is little difference in the estimated effects by member hospitalized for either men or women, suggesting that the negative effects of hospitalization are not driven by the family member hospitalized, but are experienced differentially by the gender of the child.

5. Identifying the transmission mechanisms of household hospitalizations

The estimates in the preceding section suggest a role for policy intervention to offset the substantial negative effects of household hospitalizations on youth educational outcomes. However, constructing appropriate policy requires identifying the mechanisms through which household health events affect youth educational attainment. As discussed previously, such mechanisms could be quite complex to identify, requiring either strong modeling assumptions or specialized data. For instance, given that the hospitalization is of a household member, one might immediately wonder whether access to health insurance moderates the potential negative effects. To fully investigate the role of health insurance would require information on the existence of coverage, in addition to detailed information on the extent of coverage of the affected household member. For example, because hospitalizations could affect either income or time resources, researchers would need to know about the size of out-of-pocket costs, whether in-home care is covered, or whether the affected member has long-term care and/or disability insurance. Unfortunately, in the NLSY97 health insurance data is limited to whether or not the respondent (and not the affected household member) is covered by health insurance (fully 90.3% of respondents are covered) and the source of that coverage (employer-provided, government-provided, or privately purchased). Estimates including an indicator for coverage and an interaction with the hospitalization indicator proved insignificant for all outcomes, consistent with our expectations given the data limitations.

We would also ideally want to observe the changes in household income and labor force behavior of household members following the hospitalization. However, household income after the base year suffers from large item non-response in the NLSY97 and detailed data on hours worked after the base year are only available for the respondent. We find that hours worked by the respondent during high school, regardless of gender, were not significantly affected by hospitalizations. However, we cannot separately identify the hours worked before and after the hospitalization, limiting our ability to draw conclusions about hospitalization effects on respondent labor supply decisions.[21] The results of these regressions, as well as those using the health insurance coverage of the respondents, are available from the authors upon request.

Despite the data limitations and the complexities of the underlying human capital formation function, we can begin to unravel some of the potential transmission mechanisms with the data available in the NLSY97. We attempt to reveal some of the mechanisms by investigating how the effects of household hospitalization are mediated or magnified by other characteristics of the respondent or the household.

5.1. The role of student ability and household income

We begin by considering the influence of household income and respondent ability, the latter of which

[21] There is some information about why respondents choose to dropout of school in the NLSY97. Among dropouts in the hospitalization sample, men are somewhat more likely to list "Financial difficulties, couldn't afford to go", "Entered the military", and "Offered a job" than women (19.2% compared to 9.3%) particularly if the male respondent is the oldest (23.1% compared to 9.8% among oldest female respondents). While not conclusive, this evidence is suggestive that men may be more likely to shoulder the burden of a hospitalization through the labor market.

measures long term household investments made in the respondent. In either case, one might suspect that respondents that are higher up in these two distributions may be more insulated from the negative effects of the hospitalization of a household member. To consider this possibility, we create indicators for whether the respondent is in the top quartile of the respective distributions in the base year and then include that indicator as well as an interaction of the top quartile indicator with the household hospitalization indicator in our ordered probit model. Similar to the results in Table 3, in top panel of Table 4 we present both the coefficients of the household hospitalization and the interaction term, and we present the relevant marginal effects of the household hospitalization in the bottom panel for completing high school and completing a BA.

Overall, we do not find strong evidence that the base year income or ability of the respondent insulates them from a household hospitalization. The interaction term of our household hospitalization indicator and an indicator for being in the top quartile of the ability distribution is negative in column (1) suggesting larger negative effects of a hospitalization among higher ability respondents. However, the results are not statistically significant, likely capturing the fact that lower ability respondents are already constrained from completing higher levels of education due to their ability. Therefore a household hospitalization does not further lower their educational attainment.

In column (2) there is limited evidence that higher base year income may insulate respondents as the coefficient on the interaction term is positive and the marginal effects of a household hospitalization are only statistically significant for those youth outside of the top quartile of household income. However, while not statistically significant, the marginal effects of a household hospitalization are of a similar magnitude among those respondents in the top income quartile. This result may simply represent the fact that the effects of means-tested government programs, college aid, and tax code provisions related to low-income households or health care expenditures make it difficult to identify the true at-risk population from a simple household income variable. Overall, the results do not indicate that higher levels of

Table 4
Ordered probit estimates of factors mitigating the impact of household hospitalizations on youth educational attainment.

Coefficients	(1)	(2)	(3)	(4)
Hospitalization	−0.086	−0.112*	−0.198**	−0.231**
	(0.060)	(0.061)	(0.081)	(0.095)
Hospitalization × top AFQT quartile	−0.103			
	(0.141)			
Hospitalization × top income quartile		0.018		
		(0.147)		
Hospitalization × has older sibling			0.166	
			(0.110)	
Hospitalization × has brother				0.187*
				(0.115)
N	3862	3862	3862	3862

Marginal effects of hospitalizations	(1a) Less than HS	(1b) BA	(2a) Less than HS	(2b) BA	(3a) Less than HS	(3b) BA	(4a) Less than HS	(4b) BA
Below top AFQT quartile	0.021	−0.022						
	(0.015)	(0.015)						
Top AFQT quartile	0.016	−0.074						
	(0.012)	(0.050)						
Below top income quartile			0.022*	−0.031*				
			(0.013)	(0.016)				
Top income quartile			0.014	−0.031				
			(0.021)	(0.043)				
No older sibling					0.038**	−0.056**		
					(0.017)	(0.022)		
Has older sibling					0.006	−0.009		
					(0.013)	(0.022)		
No brother							0.043**	−0.066***
							(0.019)	(0.026)
Has brother							0.008	−0.013
							(0.013)	(0.020)

Notes: Ordered probit is estimated with sampling weights on four categories of educational attainment: less than HS, HS diploma, AA, and BA. Marginal effects are calculated at the mean of all variables for the lowest category (“less than HS diploma”) and highest category (“completed BA”). For interaction terms, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. Standard errors are clustered by household and are reported in parentheses under coefficients and marginal effects. The model includes AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and a quadratic in age.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

household income protect respondents from the negative effects of a household hospitalization.

5.2. The role of siblings

The negative effects of household hospitalizations could vary based on birth order and family size. If someone in the household becomes ill, then resources may be adjusted differentially across members of the household. In particular, additional responsibility may fall upon older siblings, either because they must spend time on care of other household members or they may need to increase labor market participation. Younger siblings may not be old enough to work or to be able to help with household responsibilities, for example, because they may lack a driver's license.[22]

Because we can identify birth order among siblings in the data, we are able to test for a differential impact of household hospitalizations depending on whether the respondent has siblings and where the youth falls in the birth order.[23] We create an indicator variable for whether the respondent has any older siblings, including it and the interaction of the older sibling indicator with household hospitalizations in our ordered probit model.[24] In this specification, the hospitalization indicator without the interaction represents the effect of a hospitalization for those respondents who are either the oldest of the children in the household or who are only children. The results in column (3) of Table 4 indicate that the negative effects of a household hospitalization are concentrated among those children without an older sibling as the coefficient on the hospitalization indicator is negative and statistically significant. The marginal effects in column (3a) show that a household hospitalization increases the likelihood of not completing high school by 3.8 percentage points among oldest or only children while the marginal effect for those respondents with older siblings is small not economically or statistically significant. Similarly, the results in column (3b) demonstrate that a hospitalization of a household member reduces the probability of completing a bachelor's degree by 5.5 percentage points for only and oldest children while the marginal effect for those respondents having an older sibling is −0.9 percentage, a result which is not statistically significant. These marginal effects among oldest and only children represent substantial declines in educational attainment, despite the fact that those respondents who are the oldest or are the only child have higher overall attainment compared to those respondents who are not first in the birth order. For example, in our sample 84.4% of older siblings complete high school compared to 81.8% of those respondents without older siblings. Similarly, of those respondents who do not have an older sibling, 29.2% complete a bachelor's degree, compared to 26.8% completing a bachelor's degree among those respondents with an older sibling.

In contrast, for those individuals with older siblings, the effect of a household hospitalization appears to be moderated. The interaction of household hospitalization and the older sibling indicator produces a positive and statistically significant coefficient in the top panel. The magnitude of the older sibling effect largely cancels the otherwise negative effect of a household hospitalization. The marginal effects in the lower panel show a similar pattern of moderating the impact of hospitalizations on not completing college in column (3a) and completing a bachelor's degree in column (3b). The results suggest that while those individuals earlier in the birth order may experience higher overall educational attainment, these same individuals also appear to be more vulnerable to the negative effects of a household hospitalization. As discussed, these results are consistent with older siblings insulating younger siblings from the negative effects of household health events.

Position in the birth order is not the only way that siblings may impact the effect of household hospitalizations on respondent educational attainment. Given the estimates previously presented in Tables 2 and 3 suggesting that household hospitalizations disproportionately affect male youths, it is also possible that the gender composition of siblings could be important. Households could respond to a health event through increased home care responsibilities or increased labor force participation of the children, but could choose to allocate these changing responsibilities differently by gender. In column (4) of Table 4, we test this directly by including an indicator for whether the respondent has a brother, as well as an interaction with the hospitalization indicator.

The coefficients in the top panel in column (4) indicate that respondents without brothers experience a decrease in educational attainment following a household hospitalization, while those respondents with a brother are largely sheltered from the negative impact of a hospitalization. Similarly, in the lower panel in column (4a) the marginal effect of a household hospitalization for those respondents without a brother is a 4.3 percentage point increase in the likelihood of not completing high school. This effect is reduced to a statistically insignificant 0.8 percentage points if the respondent has a brother. Similarly, for those respondents without a brother, a hospitalization reduces the likelihood of completing a bachelor's degree by 6.7 percentage points in column (4b)

[22] A large literature has investigated the role of birth order on educational attainment (Black, Devereux, & Salvanes, 2005; Hanushek, 1992; Kantarevic & Mechoulan, 2006). In general, the literature has found that older siblings have higher educational attainment than younger siblings. Conversely, in our context the oldest child may be most vulnerable to a household health shock.

[23] One might be concerned that birth order is correlated with age in the NLSY97 sample, if hospitalization affects children differentially across ages. However, we compared the age distributions among the "only", "oldest" and "younger" children, but we found no evidence that "older siblings" are actually older respondents in the base year.

[24] Separately including indicators for "only child", "oldest child" and "has older sibling" in our ordered probit model produces marginal effects of hospitalizations on not completing high school of 0.019 (0.044) for only children, 0.032 (0.024) for oldest siblings, and 0.006 (0.013) for younger siblings. Similarly, we find the marginal effects of hospitalizations on BA completion of −0.029 (0.061) for only children, −0.047 (0.031) for oldest siblings, and −0.011 (0.022) for younger siblings. While sample sizes reduce the precision of the estimates, these results separating only from oldest children suggest our estimates are not being driven by only children.

while the marginal effect for those respondents with a brother is only −1.3 percentage points and is not statistically significant.[25]

6. The effect of household hospitalizations on other youth outcomes

6.1. College choice

Household health events could affect educational attainment, not only through college attendance, but also through college choice. There is increasing evidence that college quality affects degree completion (Black & Smith, 2004, 2006; Brewer, Eide, & Ehrenberg, 1999; Hoekstra, 2009; Light & Strayer, 2000). Additionally, there is evidence that college choice is affected by household resources (Belley & Lochner, 2007; Lovenheim & Reynolds, 2011, 2013). Lower household resources could lead to students choosing lower-quality but less-expensive colleges. In this section, we investigate the possibility that household hospitalizations affect college choice among the set of respondents that attend college.

As there are many dimensions upon which students could change college decisions, we consider two different college choice measures. First, we estimate how household hospitalizations affect the likelihood of attending a two-year college instead of a four-year institution. Two-year colleges may be an attractive option for respondents from households with hospitalizations for several reasons. Primarily, two-year colleges are significantly cheaper than four-year colleges. In-state tuition and required fees at public two-year colleges during the 2009–2010 academic year averaged $2136 compared to $6695 at public four-year colleges. Additionally, students may be more likely to live at home and therefore not pay the additional $8319 in room and board fees at public four-year colleges.[26] In addition to cost savings, two-year colleges also may provide more flexible schedules, which may be helpful for students who have had to increase labor supply to supplement household income, or for students who need to provide care for a household member. Switching from the four-year to the two-year sector is of particular concern because there is growing evidence that two-year college attendance is associated with large negative effects on educational attainment (Kane & Rouse, 1995; Long & Kurlaender, 2009; Reynolds, 2012).

We construct an indicator that takes a value of one if the first college attended is a two-year college and then use this as the dependent variable in a probit on the household hospitalization indicator and previous set of covariates.[27] We estimate the model for those respondents who attend college, consequently the marginal effects in the first column of Table 5 can be interpreted as the effect on the likelihood of attending a two-year college relative to a four-year college.[28] As expected, higher household income and respondent ability is associated with a lowered likelihood of two-year college attendance. Additionally, a one-week hospitalization of a household member increases the likelihood of two-year college attendance by 5.4 percentage points. Given that the 40.5% of college attendees in our sample begin their college

Table 5
Effect of household member hospitalizations on future college choice.

Variables	(1) Two-year first	(2) Miles to college	(3) Miles to college
Hospitalization	0.054*	−8.765	−79.653**
	(0.032)	(22.048)	(34.516)
Hospitalization × In MSA			80.819*
			(41.842)
In MSA			−53.590**
			(27.078)
AFQT score	−0.007***	0.610*	0.544
	(0.001)	(0.377)	(0.377)
Household income ($10,000)	−0.004	2.945	2.347
	(0.003)	(2.082)	(2.128)
Household net worth ($10,000)	−0.000*	−0.067	−0.055
	(0.000)	(0.127)	(0.126)
Youth health limitation	0.069	26.729	25.838
	(0.053)	(44.287)	(44.077)
Parent health limitation	0.049	18.146	17.847
	(0.039)	(33.915)	(33.643)
Observations	2400	2360	2384

Notes: Standard errors are clustered by household and provided below marginal effects estimated at the mean (column (1)) or point estimates (columns (2) and (3)). All regressions also include sex and race indicators, indicators for youth and parental weight (underweight, overweight, and obese), indicators for chronic conditions, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, and age fixed effects. The model in columns (1) and (2) also include indicators for whether the student lives in a non-MSA or a non-central portion of a MSA. All regressions are estimated using sampling weights.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

[25] We also estimate models including interactions of the sibling variables with respondent gender. We find a 6.2 and 6.4 percentage point decrease in the likelihood of completing high school and college, respectively, for male respondents without an older sibling. Similarly large effects are found for male respondents without brothers. We find statistically insignificant effects for female respondents without older siblings or brothers. As we have discussed, these results could reflect male youth being an at-risk population or may suggest that increased care responsibilities, typically associated with women, may not be the primary mechanism through which household hospitalizations impact youth educational attainment. Results available from the author's upon request.

[26] Author's calculations from the *Digest of Education Statistics, 2010.*

[27] There is a potential timing concern in which hospitalizations could temporally follow college choice, similar to concerns for high school completion and college attendance we have previously discussed. Restricting the ages of the college attendance limits this possibility but further limits a small sample, so we choose to not use age restrictions in the results that we report. However, imposing age restrictions does not substantively change our results suggesting that this timing concern is not driving our estimates.

[28] Because one might be concerned about bias arising from excluding non-attenders when estimating the effect of household hospitalizations on two-year college attendance, we also estimated a multinomial logit model using non-attendance, two-year attendance and four-year attendance as our outcomes. The results of this model are consistent with the estimates we present in Table 5 from the probit regression. For simplicity, we only present the probit results but the multinomial logit results are available upon request.

career at a two-year college, the estimated effect is equivalent to a 13.3% (=0.056/0.405 × 100) change relative to the baseline. This is a substantial change in the likelihood of two-year college attendance, equivalent to a substantial decrease in household income or AFQT score, both of which have been identified as important determinants of two-year college attendance (Belley & Lochner, 2007; Lovenheim & Reynolds, 2011).

College type is only one margin on which a household hospitalization could alter the educational choices of respondents. To attempt to capture the myriad ways in which the college choices of respondents are changed by household hospitalizations, we also investigate college location. A household health event could force respondents to attend a college closer to home for a variety of reasons. Nearby colleges may be cheaper either because respondents qualify for in-state or in-district tuition and fees, which are lower than out-state tuition, or because the nearby colleges may be lower quality schools, such as two-year college or commuter public four-year institutions that also are less expensive. Additionally, respondents may need to live at home and commute to a nearby college, either to further reduce expenses or because they need to aid in the care of a sick household member. In any case, having the choice set limited to nearby colleges could result in lower-quality options or in a lower-quality match between student and college.

To investigate the potential change to the college choice set, we estimate the effect of a household hospitalization on the distance between the college attended and the location of the household. We measure the distance as the crow flies based on the population-weighted centroids of the county of residence of the youth at age 17 and the county in which the college attended is located. The second column of Table 5 presents the results of an OLS regression of college distance, measured in miles, on the set of explanatory variables used in our previous models. The results show that household hospitalizations do not affect the distance to college for the average respondent experiencing a household hospitalization.

However, distance to college attended is a function not only of the choice of the respondent but also the availability of local colleges where the respondent lives. Respondents in larger cities will have more local college options than respondents in smaller cities or rural areas and, therefore, may be more likely to find quality matches among nearby institutions. Thus, respondents in larger cities are less likely to be constrained by having to attend a college closer to home. To account for this difference, we replace the indicators for suburban and rural household location with a single indicator for whether the respondent lives in a MSA. We then interact the MSA indicator with the hospitalization indicator to differentiate the behavioral response to a hospitalization event for respondents based on access to local college options. The results of this specification are presented in column (3) of Table 5. The MSA indicator indicates that respondents in a MSA on average attend a college that is 54 miles closer than respondents in non-MSAs, consistent with respondents in a MSA having greater local options for college attendance. This differential access affects the impact of a hospitalization on college choice.

Table 6
Effects of household member hospitalizations on future income.

Variables	ln(hourly wage) (1)	ln(hourly compensation) (2)	ln(income) (3)
HH hospitalization	−0.042	−0.057*	−0.086*
	(0.028)	(0.030)	(0.048)
AFQT score	0.003***	0.003***	0.006***
	(0.001)	(0.000)	(0.001)
Household income ($10,000)	0.011***	0.010***	0.013***
	(0.003)	(0.003)	(0.004)
Household net worth ($10,000)	0.000	0.000	0.001*
	(0.000)	(0.000)	(0.000)
Youth health limitation	−0.106**	−0.084	−0.113*
	(0.051)	(0.055)	(0.082)
Parent health limitation	−0.016	−0.044	−0.116**
	(0.034)	(0.033)	(0.054)
Observations	3112	3058	2979

Notes: Standard errors are clustered by household and provided below point estimates (columns (1) and (2)) or marginal effects estimated at the mean (columns (3)–(8)). For interaction terms in the probit models, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. All regressions also include sex and race indicators, indicators for youth and parental weight (underweight, overweight, and obese), indicators for chronic conditions, father and mother years of schooling, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and age indicators. All regressions are estimated using sampling weights. Income and educational attainment variables are measured in 2007.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

Respondents outside of MSAs, who have fewer local college options, are likely to attend a college that is 80 miles closer, following a household hospitalization. This effect largely disappears for respondents in a MSA following a household hospitalization. We take this as further evidence that the college choice sets of respondents are affected by household hospitalizations, leading to lower-quality matches between student respondents and colleges. These poor matches may be manifest in lower degree attainment and subsequent labor market earnings.

6.2. Future earnings

The declines in educational attainment and changes in college choice should have substantial impacts on future earnings given the large returns to educational attainment and college choice found in the literature. To document exactly how much future earnings could be affected, we estimate OLS regressions of earnings on household hospitalizations, including in the specification the same covariates used to estimate the educational attainment effects. To measure earnings, we calculate hourly wage, hourly compensation (hourly wage plus overtime and performance pay), and annual income all in 2007.[29] As our interest is in

[29] Income data from the 2008 survey year is retrospective from 2007. Additionally, use of 2007 income data avoids distortionary effects of the recent recession on measured income.

measuring the total impact of hospitalizations occurring between 1997 and 2002, we do not control for mediating variables that are impacted by household hospitalizations such as the educational attainment of the respondent. We use the natural log of these variables as dependent variables in the specifications and report the results in Table 6. The estimates show large negative effects of household health events during adolescence on all three measures of future income. Future earnings are 4–9% lower for those respondents for whom a household member was hospitalized for at least a week. It is important to note that these estimated effects are relatively early in the career (the respondents are approximately 22–28 years old in 2007), and it is possible that the effects could be magnified over the course of their careers. While the previous literature has focused on the role of parental socio-economic standing and youth health on subsequent earnings (see Currie, 2009), the results in Table 6 present a different pathway through which a family health event can impact future earnings.

7. Conclusion

We add to a small but growing literature investigating how health events afflicting other household members impact the educational attainment of the children living in the household. We find evidence that a one-week household hospitalization significantly lowers the probability of graduating from high school, of attending college, and of graduating from college. The magnitude of the estimated hospitalization effect is comparable to a large decrease in annual household income or respondent test scores in its impact on the probability of completing college, suggesting economically serious consequences for respondents in households experiencing hospitalizations. Additionally, we find the negative impact of hospitalizations on high school and college completion to be particularly large for male respondents. We also find evidence that these hospitalization events may restrict the college choices of respondents who attend college and lower future earnings of all respondents who experience hospitalizations, as would be expected given the changes in educational outcomes of the respondent. We find no evidence that our hospitalization measure is proxying for poor unobserved respondent or household health, conditional on the controls, and sensitivity analyses suggest that an implausibly large selection on unobservable characteristics would be required to eliminate our results.

The size of the estimated effects of a household hospitalization on respondent's attainment of various educational outcomes suggest that interventions targeted at shielding at-risk youth might be highly cost-effective policies. To correctly formulate policy, researchers need to identify the channels through which household health events affect youth educational outcomes. We present initial evidence about potential mechanisms by interacting the household hospitalization indicator with respondent and household characteristics. We demonstrate that the presence of an older sibling in the family provides considerable protection for younger family members. However, this protection is provided at significant cost to the oldest sibling. Similarly, having a brother appears to insulate the respondent from some of the negative effects of a hospitalization, particularly for male respondents. This provides some evidence that the transmission mechanism might occur through the oldest child or male children increasing labor force participation, increasing time devoted to home care, or otherwise shouldering the additional burden on the family.

To fully identify the many channels through which youth are affected by a hospitalization event requires additional research. The data requirements to do so are significant; researchers will need detailed income and insurance information, time use surveys, and labor force participation data. However, disentangling the complex transmission channels has critical policy implications. Should the primary transmission be through the cost of the hospitalization or subsequent convalescence, more extensive health or disability insurance might be the appropriate policy response. If, instead, the main mechanism is through lowered household income, then a means-based transfer program, such as student aid, may be more effective. It is also possible that the detrimental effects operate by diminishing the available time for direct parental investment in child human capital or by placing obligations on the child, which lowers time available to study. In these cases, the appropriate policies could include school based interventions such as tutoring or additional counselor involvement with students who have experienced household health events. While the data limitations of the NSLY97 prevent the investigation of these issues, our initial estimates of the substantial and detrimental effects of a household hospitalization on the educational attainment of youth suggest that this is an important area for continuing research.

Acknowledgements

This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the view of the BLS.

Appendix A

See Tables A1–A3.

Table A1
Estimates of the effects of household member hospitalizations on youth educational attainment in the imputation sample.

	Years of schooling		HS diploma		Attend college		BA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS								
Hospitalization	−0.159**	−0.393***						
	(0.079)	(0.106)						
Hospitalization × female		0.468***						
		(0.157)						
Probit								
Hospitalization			−0.023		−0.039*		−0.032*	
			(0.014)		(0.020)		(0.017)	
Hospitalization, male				−0.068***		−0.047		−0.060***
				(0.025)		(0.031)		(0.018)
Hospitalization, female				0.017		−0.030		0.003
				(0.018)		(0.026)		(0.027)
Observations	5216		4627		5692		6034	

Notes: Standard errors are clustered by household and provided below point estimates (columns (1) and (2)) or marginal effects estimated at the mean (columns (3)–(8)). For interaction terms in the probit models, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. Regressions include AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and age indicators. All regressions are estimated using sampling weights.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

Table A2
Estimates of the effects of household member hospitalization on youth educational attainment for those youth with a high school diploma.

	All HS graduates				HS graduates by 2002			
	Years of schooling		BA		Years of schooling		BA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS								
Hospitalization	−0.082	−0.275**			−0.069	−0.239		
	(0.100)	(0.132)			(0.110)	(0.151)		
Hospitalization × female		0.364*				0.313		
		(0.193)				(0.213)		
Probit marginal effects								
Hospitalization			−0.045				−0.050	
			(0.028)				(0.031)	
Hospitalization, male				−0.084***				−0.083**
				(0.031)				(0.035)
Hospitalization, female				−0.004				−0.017
				(0.041)				(0.044)
N	3109		3127		2784		2798	

Notes: Standard errors are clustered by household and provided below point estimates (columns (1) and (2)) or marginal effects estimated at the mean (columns (3)–(8)). For interaction terms in the probit models, we report the marginal effect of hospitalization evaluated at each of the values of the binary interaction term. Regressions include AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and age indicators. All regressions are estimated using sampling weights. High school completion is measured by age 20 and the sample is restricted to those youth aged 12–15 in the base year.

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

Table A3
Propensity score matching estimates of the effects of household member hospitalizations on youth educational attainment.

	Years of schooling		HS diploma		Attend college		BA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospitalization	−0.129*		−0.025		−0.028		−0.029*	
	(0.092)		(0.019)		(0.019)		(0.016)	
Hospitalization, male		−0.283**		−0.069**		−0.031		−0.045**
		(0.136)		(0.027)		(0.026)		(0.020)
Hospitalization, female		0.068		0.020		−0.017		−0.006
		(0.136)		(0.026)		(0.026)		(0.025)
Observations	3831		3008		3676		3862	

Notes: Standard errors are provided below point estimates. Propensity score matching estimates are produced using kernel matching with an Epanechnikov kernel. The propensity score is estimated using a logit including AFQT scores, household income and net worth, youth and parent health measures, including indicators for chronic conditions, sex and race indicators, father and mother years of schooling, number of siblings, measures of high school type and teacher–student ratio, indicators for living in a rural area of non-central city, and age indicators. The bandwidth is selected using leave-one-out cross – validation. Standard errors are bootstrapped using 1000 replications. High school completion is measured by age 20 and the sample is restricted to those youth aged 12–15 in the base year. College completion is measured by age 21 and the sample is restricted to those youth aged 12–16 in the base year.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

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