Do Strong Treatment Protocols Reduce Disparities in Care?

The Case of Asthmatic Children

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Abstract

Treatment guidelines require physicians to take special care of infants with asthma. Can such treatment protocols help to reduce disparities in access to care and health outcomes? We address this question using longitudinal hospital and ER records for pediatric asthma patients in the state of New Jersey. We find that among privately insured patients, the guideline appears to have little impact on the probability that children with known asthma are admitted. However, among asthmatic children with public insurance, the probability that a child presenting at the emergency room with asthma is admitted to hospital falls 7.7 percentage points after the first birthday. The gap in treatment is even greater in high flu season, when pediatric beds are at a premium. However, this drop in admissions for publicly insured patients at one year does not seem to have measureable health consequences, suggesting that strong treatment protocols do equalize hospital care, but may not necessarily affect health disparities.

The Patient Protection and Affordable Care Act of 2010 is the latest in a long series of measures that have expanded public health insurance coverage under the Medicaid program to additional groups of low income individuals. Increases in the number of publicly insured children have had positive effects on the utilization of care and children's health (Currie and Gruber, 1996a,b; Dafny and Gruber, 2005; Selden and Hudson, 2006; Howell and Kenney, 2012; Meyer and Wherry, 2012; Brown et al., 2014). However, concerns about disparities in access to care and the possible resulting disparities in health outcomes are of long standing and remain unresolved.

The Institute of Medicine (Smedley et al., 2003) has flagged the use of evidence-based protocols as a way to reduce disparities in care, but there is little previous empirical evidence on this question.[1] One exception is Weissman et al. (2013) who compare the quality of hospital care received by nonelderly adults covered by Medicaid and by private insurance, respectively, for three major conditions: heart attack, congestive heart failure, and pneumonia. The authors find that for these conditions, the quality of hospital care is very similar for privately and publicly insured patients. They argue that this similarity reflects the existence of strong protocols that leave little room for provider discretion.

However, it is difficult to tell if similarities (or differences) in the treatment of the privately and publicly insured reflect the existence (or absence) of such protocols or whether they reflect other differences between the patients. Publicly insured patients may be needier since on average they come from families with lower income and education, factors that are

[1] Recommendation 5-6 of this report is that "To the extent possible, medical care allocative decisions should be driven by evidence-based clinical guidelines to insure consistency of care. These guidelines should be published along with their supporting evidence base to allow public and professional scrutiny." In the Executive Summary the authors argue that "The application of evidence to healthcare delivery, such as through the use of evidence-based guidelines, can help to address the problem of potential underuse of services resulting from capitation or per case payment methods.

independently associated with poorer health. Similarly, publicly insured patients may be more likely to delay medical attention, and so may be in worse health when they do seek care. On the other hand, if publicly insured patients use hospital emergency rooms as a source of routine care, then they may be less sick on average when they present at these venues. And publicly insured patients may be less likely to be hospitalized at all, conditional on medical condition.

The growing use of protocols is controversial. Doctors often argue that decisions about treatment should be tailored to the needs of individual patients, and that sensitivity to patient characteristics is not enhanced through adherence to simple rules.   In a recent New York Times editorial cardiologist Sandeep Jauhar argued that "… guidelines and checklists are unpopular among most American physicians. Instead of being allowed to deliver "patient-centered" care, many physicians feel they are being co-opted by regulations… Guidelines are supposed to assist and advise. But all too often, recommended care in certain situations becomes mandated care in all situations." (New York Times, Dec. 11, 2014).

In order to investigate the effects of protocols on treatment disparities, we focus on a "bright line" rule of pediatric practice, which dictates that infants with asthma should be treated with more care than children over a year old. According to asthma guidelines issued by expert panels in 1997 and again in 2007, "Infants require special attention, especially due to their greater risk for respiratory failure" (National Asthma Education and Prevention Program, 1997, 2007, p. 376).

We use a unique data set based on the health records of all children less than two years old who presented at a New Jersey hospital Emergency Room (ER) with asthma between 2006 and 2012. We concentrate on asthma because it is one of the most common chronic conditions in children, accounting for approximately 774,000 visits to the emergency room in 2009

(American Lung Association, 2012). Hence, emergency room doctors treating a child with asthma must frequently decide whether or not the child needs to be hospitalized.

We find that among privately insured patients, the guideline mandating greater care for infants appears to have little impact on the probability that children with asthma are admitted to hospital from the emergency room. However, among asthmatic children with public insurance, the probability of admission falls 7.7 percentage points after the first birthday.

We also link the differential treatment of the privately insured and publicly insured to the opportunity cost of a hospital bed. We confirm that public insurance pays providers less than private insurance in our sample, but there is no exogenous source of variation in this payment gap over our sample period (and the payment gap is relatively constant across hospitals and over time). However, demand for a pediatric bed does vary with seasonal influenza. We find that in high flu seasons, hospitals become even less likely to admit publicly insured asthma patients over the age of one, suggesting that they are acting to preserve vacant beds for needier (and/or higher paying) patients.

However, we are unable to find any negative health consequence of this large change in the probability of hospitalization. In a regression discontinuity framework, we find that not being admitted has no impact on the probability of returning to the ER within 30 days. These results suggest that the strong treatment protocols that exist for infants result in more care for the publicly insured, but do not necessarily reduce health disparities.

The rest of our paper proceeds as follows. We first discuss background literature about the effects of public and private insurance. We then provide an overview of our data and research methods. Results are presented in section 5, and section 6 provides a discussion and conclusions.

2. Background

While some have argued that public insurance is worse than no insurance at all, there is little evidence to support this view (Gottlieb, 2011). The uninsured fare worse on most measures of access to care (Institute of Medicine, 2001). However, the question of whether publicly insured children on Medicaid/CHIP have worse access to care than the privately insured continues to be controversial. Since Medicaid/CHIP typically reimburses providers at lower rates than private health insurance plans, many doctors do not accept patients with public insurance or limit the number of these patients in their practices (Sloan, Mitchell, and Cromwell, 1978; Mitchell, 1991; Fossett et al., 1992; Newacheck et al., 1998; Decker, 2012). Nevertheless, a recent Department of Health and Human Services report concluded that privately and publicly insured children were similarly likely to have had a primary care visit in the past year (DHHS, 2012), a finding that is echoed in another recent study (Kenney and Coyer, 2012).

There may however be more subtle ways in which Medicaid/CHIP children suffer worse access. For example, Kenney and Coyer (2012) found that publicly insured patients were less likely to have a usual source of care with non-standard hours, which is one reason why they may be more likely to use emergency rooms. A great deal of concern has also focused on inferior access to specialist care (Bisgaier and Rhodes, 2011; Skinner and Mayer, 2007; U.S. GAO 2011; Wang et al., 2004).

Much less research has been devoted to the question of access to quality hospital care, even though many low income children rely on hospital emergency rooms for primary care (Garcia, 2010; Kangovi, 2013; Rhodes, 2013). Merrick et al. (2001) study children who were admitted to the hospital for asthma in California, Georgia, and Michigan. They note that asthma is the most common reason for hospitalization among children on public insurance, and that hospitalization rates are significantly higher for publicly insured than for privately insured children. They find that publicly insured children received inpatient care of similar quality to privately insured children, conditional on being admitted.

However, children with public health insurance may be less likely to be admitted to hospital than children with private health insurance, other things being equal. Dafny and Gruber (2005) examine child hospitalizations and find that expansions of eligibility for public insurance to additional groups of low income children were associated with increases in hospitalizations for non-preventable conditions, suggesting that access to hospital care for these conditions improved when previously uninsured children obtained public health insurance coverage.

In this study, rather than examine the overall reduced form effect of public health insurance coverage, we focus on a single treatment decision: Whether or not to admit a child who presents at the emergency room with asthma.[2] Infants and toddlers have small airways so that even a moderate amount of swelling due to causes such as viral infections can block the flow of air and cause an asthma attack. Children admitted to a hospital for asthma will typically receive oxygen and medication (such as albuterol, often using a nebulizer or aerosol mist) several times a day until their symptoms are relieved and may also be given fluids if dehydrated (Oymar and Halvorsen, 2009). A patient treated in the ER and then discharged, would likely be given one round of medication, and parents might be instructed to purchase and administer additional doses.

Since publicly insured children may be in better or worse health than privately insured children when they present at the emergency room, we adopt a regression discontinuity design

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[2] In order to identify asthmatic patients, we run the data through the HCUP Clinical Classifications Software (CCS). Developed by the Agency for Healthcare Research and Quality, this clinical grouper is a tool designed to cluster patient diagnoses and procedures into a manageable number of clinically meaningful categories. The CCS code for asthma (8.3) contains 14 separate ICD-9-CM codes

which focuses on changes in treatment around the one year of age threshold emphasized in the protocol. As discussed above, doctors are expected to treat infants with greater care than older children, although we do not expect any sharp discontinuity in underlying health at the first birthday. Thus, we can look at whether the protocol causes infants to be treated more similarly than older children.

Our design is reminiscent of work by Almond, Doyle, Kowalski and Williams (2010) who focus on differences in the treatment of newborns above and below a birth weight cutoff that defines infants at high risk. Similarly, Almond and Doyle (2011) exploit differences in maternal length of stay that are determined by whether a child is born before or after midnight. These analyses focus on the health consequences of treatment decisions above and below these thresholds, and thus demonstrate the importance of treatment protocols for the care of mothers and newborns. Our analysis emphasizes the impact of the protocol itself on disparities in access to care.

3. Data

The data come from the New Jersey Uniform Billing Records, from 2006-2012. Since our focus is on admission through the emergency room, our estimation sample consists of all records from general medical and surgical hospitals where the patient spent time in the emergency room (regardless of whether they were eventually admitted);[3] that is we include all records where there is an emergency room revenue code on the billing record. Because we are interested in how admission decisions are impacted by a child turning one, we further narrow our sample to visits where the patient is within a 200-day window around their first birthday. The

[3] General medical and surgical hospitals were identified using data from the American Hospital Association. We have dropped special hospitals such as psychiatric hospitals.

youngest children in our sample are almost six months old, well beyond the critical neonatal period. Our estimates are not sensitive to the exact cutoff chosen, and are quite similar if we use a 275 day window.

We link patient records by matching patient records across visits by sex, date of birth, and first and last names.[4] This process creates a unique patient identifier, so that we can follow each child over time and across hospitals. This is a particular strength of our data -- as we can match patients across time and across different hospitals, we can tell if they later returned to any hospital in New Jersey. The matching algorithm does a good job catching slight misspellings without lumping people together who look separate from a manual inspection. More details on the matching process and the quality of the algorithm can be found in the appendix.

We use this longitudinal structure to determine if a particular episode is the first time a child is diagnosed with asthma, or if the child is known to have asthma because they have been previously diagnosed. It is difficult to diagnose asthma in very young children, and a doctor facing a patient with no history of asthma may have considerable discretion in even making a diagnosis. In much of what follows, we often focus on children who have already been diagnosed with asthma ("known asthma") to avoid issues related to ambiguity of diagnosis, though we also show results with the full sample of asthma patients.

The hospital discharge data includes up to three detailed payer code variables for each visit (primary, secondary, and tertiary), which reflect the specific type of insurance used. Each payer code is classified into seven payer types: Medicare, Medicaid, Commercial, Blue Cross, HMO, Self-Pay, and Other. We re-categorize this information into two groups based on the primary payer: The first category, "public", consists of Medicaid (Medicaid and Medicaid

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[4] The Levenshtein edit distance is used to match names, because of problems with typos and misspellings (stata command strgroup -- http://fmwww.bc.edu/repec/bocode/s/strgroup.html).

HMOs), NJ FamilyCare (New Jersey's Children's Health Insurance Program (CHIP)), and the indigent. (Indigent children make up just 0.5% of the public insurance category, and all results are robust to their exclusion. We include them in the public category because their expenses are likely to eventually be paid by public insurance even if they are not publicly insured at the time of admission.) The "private" category consists of Blue Cross, non Medicaid/NJ FamilyCare HMOs, and other commercial insurers. Those with military insurance (CHAMPUS) are classified as "private" since their coverage is similar to that of the privately insured. One strength of the data is that we can identify both Medicaid fee for service and Medicaid HMO patients as publicly insured patients. Further details about the construction of the categories can be found in the appendix.

Information about the intensity of demand from influenza patients is created from the discharge data, using patients aged 0-13. This choice of age range is designed to mimic the population that uses pediatric beds; the influenza variable is meant to capture influenza-related capacity constraints relevant to young patients. The influenza intensity variable is created at the hospital-week level, following the definition of high influenza intensity from the U.S. Centers for Disease Control.[5]

Table 1a provides an overview of patient characteristics by the type of insurance. In this population of young children, about half are covered by public insurance. African Americans and boys are over-represented among visits for asthma, and overall 36% of asthma visits are accounted for by children with known asthma. A fifth of children are admitted to the hospital,

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[5] The mean reported percent of visits due to ILI [influenza-like-illness] for the current week are compared to the mean reported percent of visits due to ILI for non-influenza weeks. The CDC defines 10 levels corresponding to the number of standard deviations below, at or above the mean for the current week compared to the mean of the non-influenza weeks. We follow the CDC and define a particular week at a particular hospital a "high flu week" if the flu level is 8 or greater. http://www.cdc.gov/flu/weekly/overview.htm

although stays are typically short, confirming the importance of asthma as a reason for pediatric hospitalization.

Table 1a also indicates that there are mean differences in the probability of admission between the publicly and privately insured: 19.1% of publicly insured children and 24.6% of privately insured children are admitted, respectively. During high flu seasons, this disparity rises, so that 20.3% of publicly insured children are admitted compared to 27.5% of privately insured children. Publicly insured children are also more likely to return to the ER for asthma within 30 days (11.9% vs. 9.8%) suggesting that there may be a health consequence associated with not being admitted at the first visit.

One reason that publicly and privately insured patients might be treated differently is that they tend to use different hospitals. Therefore, Table 1b examines largely the same variables at the hospital level, dividing the sample into those with high and low public health insurance caseloads. Table 1b shows that admission rates for asthma patients are actually a little higher in hospitals with high concentrations of publicly insured children. Hospitals with high public insurance caseloads have many more asthma ER visits (648.9 vs. 386.8) than those with low caseloads, and also have a higher fraction of patients who return to the ER with asthma within 30 days (8.9% vs. 7.7%).

While list charges are available for all observations, billing charges (the amount the hospital actually bills the insurer) are not well reported. In fact, most hospitals report the same number for the list charge and the billing charge. Billing charges are sensitive information; hospitals negotiate rates with insurers, and may not want insurers to know the amount other insurers are being charged for the same service. However, eight hospitals do report billing charges. These charges are consistently much lower than the list charges as one would expect given that insurers negotiate deep discounts from the list prices.

We use billing data from these eight hospitals to explore the differences between list and actual charges for Medicaid and privately insured patients, and to model the expected difference between list and actual charges in the other 65 New Jersey hospitals. We do this by estimating the following model using the eight hospitals that report billing data:

$$Billing\_charges = b_0 + b_1 age + b_2 age^2 + b_3 any\_procedure + b_4 white + b_5 black + b_6 hispanic + b_7 female + b_8 previous\_respiratory\_visit + b_9 previous\_respiratory\_hospitalization + b_{10} previous\_nonrespiratory\_visit + b_{11} previous\_nonrespiratory\_hospitalization + b_{11} list\_charge\_BC + \text{alpha}_{primary\_payer\_type} + \text{alpha}_{diagnosis} + \text{alpha}_{year} + \text{alpha}_{month} + \text{alpha}_{dayofweek} + e,$$

where *age* is age in days; *any procedure* is an indicator equal to one if the child received any procedure; the variables *female, white, black*, and *hispanic* denote characteristics of the child; the next four variables control for the child's previous medical history (in order to take account of the fact that patient population varies between hospitals); *list_charge_BC* refers to the mean list charge for a child with no procedures and Blue Cross as the payer (in order to control for how expensive the hospital is) and the alphas denote vectors of fixed effects for payer type, diagnosis, year, month, and day of the week of the admission.

After estimating this regression, we use it to predict billing charges for the whole sample. This model does a good job of explaining the variation in billing charges for admitted patients, with an adjusted R-squared of 0.50. It has a harder time fitting the variation in billing charges for patients who are not admitted, and the adjusted R-squared drops to 0.11.[6] For our purposes, however, being able to predict billing charges for admitted patients is the most important, as this

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[6] Both adjusted R-squares increases slightly when the sample is restricted to patients with known asthma (0.55 and 0.12, respectively).

is what determines incentives for admission. Note that all charges are expressed in real 2010 dollars.

Table 2 shows a comparison of list and billing charges for privately and publicly insured patients, and for patients who are admitted and not admitted, respectively. Panel (a) shows figures that include imputed billing charges, while Panel (b) shows comparable figures only for the hospitals that report separate list and billing charges. The table suggests that while list charges are quite similar for publicly and privately insured patients, the actual billing charges are consistently 24-30% higher among the privately insured.

One reason charges might differ is that public and private patients could be treated differently conditional on admission status. Hence, Panels (c) and (d) show charges only for patients without procedures (this is the majority of the sample; medications such as nebulizer treatments are typically not listed as procedures in the hospital discharge records[7]) As Panel (d) shows, the difference in billing charges is over 34% of the private charges, which suggests that patients are being treated similarly, but billed differently. These figures suggest that hospitals do have strong financial incentives to treat privately insured rather than publicly insured patients, so that differences in expected revenue provide a possible explanation for disparities in treatment.

4. Framework and Methods

Our focus is on the effect of treatment protocols on disparities in care. We have seen that the publicly insured are less likely to be admitted for asthma than the privately insured, although

[7] "Other respiratory therapy" is the most common procedure listed (which includes respiratory medication administered by nebulizer). Of patients with at least one procedure listed, 70% have received this procedure. However, this is only 10% of the full sample.

this might be because of other differences between these patients rather than insurance status per se. The question is whether a strong treatment protocol tends to narrow this disparity? One way to think about the protocol is that if doctors derive utility from following the protocol, either because of the avoidance of legal liability, or because they derive benefit from following professional norms, then the non-pecuniary benefit of admitting an infant is higher than the non-pecuniary benefit of admitting an older child:

(1) $NPB_{inf} > NPB_{ch}$.

We assume that these non-pecuniary benefits are the same regardless of insurance status and that in the absence of a treatment protocol the non-pecuniary benefits of admission would be the same for infants and children.

Providers also receive pecuniary benefits -- the price the provider receives for the services – which differ depending on the type of insurance, but do not change discontinuously at age one, as demonstrated below. Suppose we have two types of patients, those with public insurance and the privately insured, where the privately insured patients pay more than the publicly insured patients. Let N represent the number of patients and P represent the prices they pay.

In the short run, the hospital has a limited number of beds, B, and given the pool of patients who arrive at the ER, it wishes to maximize total pecuniary and non-pecuniary benefits from admitted patients. In the short run, the variables that it can choose are the numbers of privately insured and publicly insured patients who are less than one (infants) and greater than one (children). That is, the hospital can choose patients from four pools defined by insurance status and age):

(2) Max $(NPB_{inf} + P_{PI})*N_{PI\_inf} + (NPB_{inf} + P_{M})*N_{M\_inf} + (NPB_{ch} + P_{PI})*N_{PI\_ch}$

$+ (NPB_{ch} + P_M)*N_{M\_ch}$

s.t. $B = N_{PI\_inf} + N_{M\_inf} + N_{PI\_ch} + N_{M\_ch}$.

Hospitals facing these incentives should first fill their beds with privately insured infants, and should be least likely to admit publicly insured child patients. The relative ranking of publicly insured and privately insured children will depend on whether $(NPB_{inf} + P_M) > (NPB_{ch} + P_{PI})$. In the absence of the protocol, we might still observe a disparity in the probability of admission between the privately and publicly insured, but would not expect the disparity to depend on child age.

The fact that providers have more discretion in their admission decisions for patients older than one than for infants leads to the prediction that the probability of admission should drop for patients after this age cut-off. If it drops more for publicly insured than privately insured patients, then the disparity in treatment will be greater in the absence of a strong protocol.

We estimate the discontinuity in the probability that a child is admitted after he or she turns one, allowing the trend functions for the expectation of admission conditional on age to be quadratic, and to differ on either side of the discontinuity.

(3) $A_i = b_0 + b_1 before1 + b_2 age*before1 + b_3 age + b_4 agesquared*before1 + b_5 agesquared + b_6 X + e$,

where A_i is an indicator variable equal to one if the child is admitted, *before1* is an indicator variable equal to 1 if the child is less than 1 and zero otherwise, the child's age is measured in days, and the vector *X* includes dummies for year, month, day of week, and hospital; median income in the child's zip code; and the child's gender, race, and ethnicity (white, black, Hispanic).[8] The coefficient of interest is b_1, which measures the discontinuity in admission at age one. We estimate several versions of equation (3), using the whole sample, children with public insurance only, and children with private insurance only.

We also estimate equation (3) using only admissions during high flu and low flu weeks. Since the opportunity cost of a bed is higher at these times, we expect that the discontinuity in the probability of admission at age 1 will be greater for the publicly insured patients, if the disparity is in fact driven by differences in expected payments.

Finally, we incorporate this discontinuity in the probability of admission by age into a fuzzy regression discontinuity design, and use it to estimate the impact of admission on the probability that the child returns to the emergency room within 30 days, on the total list charges, and the number of days that the child spends in the hospital. The result is a research design in which the discontinuity becomes an instrumental variable for treatment status (Angrist and Pischke, 2009).

The structural equation is:

(4) $ReturntoER_i = d_0 + d_1 A_i + d_2 X_i + e_i$,

where the X_is are the same as before, as well as age in days. Including age allows the relationship between admission and return to the emergency room to vary by age. The coefficient of interest is d_1, the impact of admission on the probability that a child returns to the ER within 30 days. We estimate d_1 using 2SLS, where the first stage is given by equation (3).

The coefficient of interest, d_1, is a local average treatment effect, capturing the causal effect on compliers – children whose treatment status changes as we move from just to the left of the discontinuity to just to the right of the discontinuity (Hahn, Todd, and van der Klaauw, 2001). Thus, the RD estimate provides an estimate of the impact of admission on children whose

[8] The estimates are very similar if we omit hospital fixed effects.

admission is impacted by the discontinuity – in our case, primarily children over a year old with public insurance.

We also estimate the reduced form, which is obtained by substituting the first stage into the structural equation:

(5) $ReturntoER_i = c_0 + c_1 before1 + c_2 age{*}before1 + c_3 age + c_4 agesquared{*}before1 + c_5 agesquared + c_6 X + e_i$,

where *ReturntoER* is returning to any ER in New Jersey within 30 days, or one of the other outcomes.

The main assumption underlying the regression discontinuity approach is that the one-year threshold only impacts admission and future outcomes through the rule of thumb about being more careful with infants. This condition requires that nothing else that impacts admission or outcomes changes discontinuously at the one-year threshold.

One worry might be that the type of insurance coverage changes at this threshold; for example, perhaps there is a mechanical reason that children leave public health insurance at one year. The eligibility rules for Medicaid and NJ FamilyCare give little indication that children would leave public insurance discontinuously at exactly age one. Infants whose births were covered by public insurance are covered under their mother's insurance for up to 60 days after the birth, after which time, they must have their own coverage. Coverage must be renewed each year, suggesting that if anything, there might be a discontinuity at around 14 months of age. Between Medicaid and FamilyCare, New Jersey children aged 0 to 19 are covered up to 200% of the federal poverty line (FPL) with no premium, and up to 350% of the FPL with a small premium. If the family is between 133% and 200% of the FPL, they transition from Medicaid to CHIP after the first year of coverage (if below 133% FPL, they will stay on Medicaid, and if above 200% they will stay on CHIP). However, there is a joint Medicaid/CHIP renewal form, and the insurance plan options are the same, so transitioning between the two programs should not cause any additional disruption of care beyond the requirement to renew coverage (see the appendix for further details).

In some states, there is a lot of churning on and off the program at renewal due to administrative hurdles. The state of New Jersey has been at the forefront of streamlining the process to maximize retention. For example, since at least March 2009, New Jersey has allowed administrative renewals – where the state checks available data sources and sends a notice of ongoing eligibility rather than requiring a form to be submitted. New Jersey also allows online renewals.[9]

Although we think it unlikely that there would be a large drop in public insurance coverage at exactly age one, Figure 1a examines the question empirically. Figure 1a plots the raw number of asthma visits in our sample that are covered by public insurance by age, and there is no visual evidence of a discontinuity at one year.

Figure 1b examines the fraction of children leaving public insurance, by age. In order to determine whether someone left public insurance, we must first observe them in public insurance, so this analysis includes only children with at least one publicly insured visit and one subsequent visit. Since older children have longer intervals between hospital visits, and therefore have more time in which they could have dropped public health insurance, Figure 1b plots residuals of the fraction of children leaving public insurance, from a regression controlling for time between visits. Again, there is no evidence of a discontinuity at age one.

[9] Sources used include the NJ Department of Labor Wage Report, Unemployment Insurance Benefits, Temporary Disability Insurance Benefits, and Social Security Disability or Survivor Benefits. (http://www.state.nj.us/humanservices/dmahs/info/resources/medicaid/2009/09_20_NJ-FamilyCare_Medicaid_Administrative_Renewals.pdf)

Another important assumption is that there is no discontinuity in the prices that hospitals expect to receive at one year of age. This condition also holds in the data as can be seen from Figure 2. This figure shows predicted billings for publicly and privately insured patients in four groups: All patients, patients with known asthma, all patients without procedures, and known asthma patients without procedures. Patients with known asthma and without procedures may be the most homogeneous group. The figures show that there is little evidence of a decline in billing at the one year of age threshold. The predicted billing total from admission does not change discontinuously at the one-year threshold. It is also clear from this figure (as in Table 2) that the expected pecuniary benefit of admitting a publicly insured patient is significantly lower than for privately insured patients. As discussed above, lower fees are an important reason why hospitals have an incentive to treat publicly insured patients differently than privately insured patients.

5. Results

Figure 3a shows the probability that an asthma patient arriving at the ER is admitted to hospital, by age. The first panel suggests that when we consider all patients together regardless of insurance status, there is little change in the probability of admission at the one year threshold. The second and third panels, however, suggest that there is considerable heterogeneity by insurance status. Publicly insured patients face a large drop in the probability of admission when they turn one, whereas privately insured patients appear to experience a slight increase in the probability of admission.

As discussed above, a physician facing a child with respiratory symptoms but without a history of asthma may have considerable discretion in terms of whether they even diagnose asthma. Hence, it may be more informative to focus on the subset of children who have already received an asthma diagnosis. Figure 3b shows figures analogous to Figure 3a, but focusing on this subset of children with known asthma. In this sample, there is an overall sharp drop in the probability of admission at age one and this drop is completely accounted for by publicly insured patients. There is little evidence of any change in the probability of admission among privately insured patients.

Table 3 shows estimates of the effects of age on the probability of admission from regressions based on equation (3). The first two columns show the results for publicly insured children with known asthma and any asthma, while the second two columns show estimates for the same two groups of privately insured children. The estimates replicate what is seen in the figures: Among publicly insured children with known asthma there is a 7.7 percentage point drop in the probability of admission when they turn one, while there is no significant change in the probability of admission among the privately insured. When we look at all asthma cases, publicly insured children experience a 3.4 percentage point drop in the probability of admission when they turn one, and again, there is no difference among the privately insured.

Table 3 also shows that African-American and Hispanic children are less likely to be admitted conditional on insurance status. This difference could reflect better health (if for example, these children are more likely to rely on Emergency Rooms as a usual source of care); less generous insurance (though such an explanation would hold only within the privately insured group only since all publicly insured children have fairly similar insurance); or discrimination. Estimating these models separately by race indicates similar discontinuities among the publicly insured for African-Americans alone.

a) The discontinuity in admissions at one year in high influenza periods

Hospitals faced with an ER patient who is a candidate for admission must decide whether to admit the patient, or hold the bed open. Holding the bed open has an option value in that the next patient to arrive may have higher needs. Thus, we predict that any discontinuity in admissions at age 1 ought to be greater in periods when there are likely to be many high needs patients arriving at the ER; when the stakes are higher, publicly insured patients over a year old may be even more likely to be turned away rather than admitted. Periods with high influenza prevalence are one example. Flu season can be thought of as an exogenous shift in the demand for beds which places hospitals closer to their capacity constraints. Moreover, since influenza seasons vary greatly in severity, this is not merely a seasonal effect (and all regressions include month of year effects in any case).

Table 4 shows that during high flu weeks, the discontinuity in admissions at one year for publicly insured patients is much greater than in Table 3. The coefficient on "Less than one" rises 50% from .077 for the publicly insured with known asthma to .123. As before, the coefficients for "all asthma" are smaller, but show a similar pattern. The coefficient on "Less than one" rises from .034 in Table 3 to .078 in Table 4. Thus, in times of scarce resources, patient protocols are even more protective of disadvantaged patients.

b) Effects of the discontinuity on patient outcomes

Beyond showing that protocols narrow disparities in treatment, we can ask whether more equal treatment improves the health outcomes of the disadvantaged.   To this end, we use a fuzzy regression discontinuity framework to look at the impact of admission on the probability a child returns to the ER for asthma within 30 days, as well as the number of days spent in the hospital on return visits and total charges.

We view change in probability of returning to the ER within 30 days as a measure of whether being admitted actually improves patient outcomes. The thinking is that children who are turned away when they need treatment are more likely to return to either the first ER or another in their area (recall that we can track children wherever they go in New Jersey).

Figures 4 and 5 show time patterns in readmission rates for public and private patients with known asthma and all asthma. Figure 4 shows readmissions for asthma, while Figure 5 shows readmissions for any reason. The first part of each figure focuses on our main outcome of interest—whether the child returned within 30 days. Since these trends are somewhat noisy given the small numbers of children returning within this window, the second part of each figure shows similar estimates for the probability of returning within 180 days. None of these cuts of the data show evidence of a discontinuity at one year in this outcome.

Table 5 shows reduced form estimates of the effect of being less than one on the probability that a child returned to the ER within 30 days. The first panel shows the probability of returning for any reason, while the second show the probability of returning with an asthma diagnosis. These regressions are based on equation (5) above. The estimates confirm what is shown in Figures 4 and 5 – there does not seem to be any evidence of a discontinuity in the probability of returning to the ER.

Table 6 shows estimates based on equation (4) above, which treat the discontinuity as an instrumental variable for admission. Not surprisingly, these estimates also fail to disclose any discontinuity in the probability of returning to the ER within 30 days.

Table 7 presents the fuzzy regression discontinuity estimates of the effect of admission on the number of days the child spends in the hospital in the next 14 days. These results are presented two ways: Excluding the index visit provides an estimate of whether being admitted reduces the number of days of hospitalization resulting from future visits. This estimate provides insight into whether the children who are being turned away deteriorate enough that they must be hospitalized when they return. Including the index visit recognizes that if the child is hospitalized on the initial visit, some days of hospitalization will be incurred, which may or may not be offset by decreased hospitalization days in future.

The results excluding the index visit are shown in Table 7. For the sake of brevity, we show results only for publicly insured patients, since only the admission of publicly insured patients was affected by the discontinuity at one year. The estimates suggest that for marginal patients, admission to hospital does not reduce future days in hospital, list charges, billing charges, or ER billing charges either among patients with known asthma, or among all asthma patients.

Results for the same outcomes including the index visit are shown in Table 8. Here we see, not surprisingly, that if a patient is admitted, there are more days in the hospital, higher list charges, and higher billing charges. Thus, it appears that admitting the marginal patient incurs a resource cost for the index admission without averting any future days in hospital or costs.

c) Robustness

As is always the cases with regression discontinuity designs, we arrived at the window of 200-days for all our main results in an attempt to balance a larger sample with being true to the design – using data only close to the cutoff to estimate our coefficients. Our results, though, are robust to using different windows around one year. In our case, the danger of using a very wide window is that we want to exclude infants in the first few months, as they have health problems different from those of older babies. The appendix shows estimates similar to those in Table 3, but using a 275 day window. The table demonstrates that publicly insured patients see a drop in admissions just after the first birthday and the point estimates are very similar to those in Table 3.

6. Discussion and Conclusions:

There is continuing controversy about the extent to which publicly insured children are treated differently than privately insured children. This paper focuses on a single (albeit common) condition and a single treatment margin, whether a child who presents at the ER with asthma is admitted to hospital. We use a regression discontinuity design to deal with possible unobserved differences between the publicly and privately insured, such as the fact that the publicly insured may be needier, or may be more likely to use the ER as a usual source of care.

We show that hospitals are less likely to admit publicly insured children once they turn one year old compared to privately insured children, and that this differential increases in times when hospital beds are at a premium. However, we find little effect of differential admission on measurable outcomes including whether the child ends up returning to the ER, the number of subsequent days in the hospital, or hospital charges (exclusive of the index visit). Thus, there is little evidence that there is a health benefit to hospitalization in the marginal cases. This result does not of course tell us that hospitalization is unnecessary or not useful in the inframarginal cases.

Hence, the results are somewhat ambiguous for the utility of strong treatment protocols. Professional norms dictate that infants be treated with more care than children over a year old, and these norms result in smaller treatment gaps among infants than among children over a year old. While the Institute of Medicine (Smedley et al., 2003) has flagged the use of evidence-based protocols as a way to reduce disparities in care, there is little previous empirical evidence that use of a protocol does indeed equalize care.[10] One exception is Weissman et al. (2013) who

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[10] Recommendation 5-6 of this report is that "To the extent possible, medical care allocative decisions should be driven by evidence-based clinical guidelines to insure consistency of care. These guidelines should be published along with their supporting evidence base to allow public and professional scrutiny." In the Executive Summary the authors argue that "The application of

compare the quality of hospital care received by nonelderly adults covered by Medicaid and by private insurance, respectively, for three major conditions: heart attack, congestive heart failure, and pneumonia. The authors argue that because the recommended processes of care for all these conditions are supported by strong scientific evidence, the quality of hospital care is very similar for the privately and publicly insured patients. However, given that the study did not examine any "control" conditions without strong protocols, there is no direct proof of this assertion.

Smedley et al. (2003) recognize that there may also be costs associated with the adoption of rigid protocols. They argue that "in actual practice, however, a pragmatic balance must be sought between the advantages and limitations of guidelines, such as the tension between the goal of standardization versus the need for clinical flexibility. Disclosing health plans' clinical protocols offers one means of achieving this balance, as it would aid both private sector and public efforts in balancing the virtues of rules and discretion."

In our case, protocols equalized care, but did not confer a health benefit suggesting that the cost may have outweighed the benefits. A possible reason is that hospitalization is not necessarily the best option for asthmatic children in any absolute sense. If children with known asthma received appropriate care on an outpatient basis, or from visiting nurses, then they might be diverted from appearing in the ER at all. Thus, differential treatment upon arrival at the ER is only one of the issues facing the publicly insured.

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evidence to healthcare delivery, such as through the use of evidence-based guidelines, can help to address the problem of potential underuse of services resulting from capitation or per case payment methods.

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Appendix:

New Jersey Medicaid and CHIP Rules for Children

From state of NJ website and "Holding Steady, Looking Ahead: Annual Findings of a 50 State Survey of Eligibility Rules, Enrollment and Renewal Procedures, and Cost Sharing Practices in Medicaid and CHIP 2010-2011"

Eligibility

- The upper income limit of New Jersey's combined Medicaid/SCHIP program is 350% of the FPL.
- Income eligibility limits for Medicaid are 200% FPL for children 0-1, 133% FPL for children 1-19. Income eligibility limit for CHIP is 350% FPL for children ages 0-19. The separate CHIP program is for children not eligible for Medicaid
    - Infants born to Mothers enrolled in Medicaid are covered up to 200% FPL; infants born to non-Medicaid covered mothers are covered up to 185% FPL
    - Families above the 350% cut off for CHIP can buy into the program for a monthly premium of $144. The child must have been uninsured for 6 months prior to enrolling
- Pregnant women eligible for Medicaid at 185% FPL and CHIP at 200% FPL. An asset test is not required, and the program operates under presumptive eligibility. Pregnant immigrants are covered regardless of immigration status.
- There is the same eligibility system for Medicaid and CHIP

Application

- Streamlined application: there is a joint Medicaid/CHIP application, which requires no face-to-face interview or asset test. Applications are available online, and can be submitted electronically.

Enrollment

- Before enrollment in CHIP, a child must be uninsured for 3 months
- Streamlined enrollment: Medicaid and CHIP both operate on presumptive eligibility and use express lane eligibility for Medicaid and CHIP.
    - New Jersey implemented Express Lane Eligibility for Medicaid 5/1/09, and for CHIP 9/2012: "In an effort to avoid requiring families to provide the same information to multiple programs and to achieve administrative efficiencies, ELE allows states to use income and other eligibility findings from another assistance program as evidence of eligibility for Medicaid and CHIP. New Jersey uses data

from NJ 1040 tax form."

Renewal

- Frequency of renewal for Medicaid/CHIP: 12 mo, no face to face interview required
  - There is a joint Medicaid/CHIP renewal form; Medicaid renewal uses the express lane since 5/1/09; CHIP in 2012
- Both Medicaid and CHIP also have 12-month continuous eligibility
- Disenrollment policies: grace period for non-payment is 60 days, with no lock-out period. To reenroll, must reapply for coverage and repay outstanding premiums.

Premiums and Copays

- Premiums in CHIP start at 201% FPL; copays start at 151% FLP
  - At 201% FPL premiums are about $40/mo, at 250% FPL $79/mo, at 301% FPL $133/mo
- Copays for services: At 151% FPL there is a $5 copay for non-preventive physician visits, $10 copay for ER visit, 0$ copay for inpatient. At 201% FPL the physician visit and inpatient visit copays stay the same, and ER goes up to $35
- Copays for drugs: At 151% $1 for generic, $5 for brand name; at 201% $5 for all.

Information on Coding Medicaid/NJ FamilyCare HMOs:

We categorize the payer information into two groups based on the primary payer: Medicaid, NJ FamilyCare, indigent, and other government (Medicaid, Medicaid HMOs, FamilyCare HMOs, Title XIX Medicaid, other government, and indigent which comes from the "other" category), and private (Commercial, Blue Cross, non Medicaid/FamilyCare HMOs, Champus, and New Jersey State Health Benefits).

The HMO category is broken into Medicaid/FamilyCare and non-Medicaid/FamilyCare HMOs based on information about product lines from New Jersey HMO contracts. Six HMOs with Medicaid/NJ FamilyCare product lines were identified to be in operation during the time period. Four of these HMOs had no commercial product lines, and were easily classified as Medicaid/FamilyCare HMOs. The other two have both Medicaid/FamilyCare and Commercial product lines, and in the data there is no way to distinguish which patients are Medicaid/FamilyCare and which are not. All patients with these HMOs as primary payers were coded as Medicaid/FamilyCare, though some are likely private. The results are robust to whether these patients are coded as Medicaid/FamilyCare or private.

HMO Contracts with Medicaid Product Lines	2006	2007	2008	2009	2010	2011	2012	Commercial Product Line
AmeriChoice of New Jersey/UnitedHealthcare	X	X	X	X	X	X	X	
AMERIGROUP New Jersey/Americaid	X	X	X	X	X	X	X	
Healthfirst Health Plan of New Jersey, Inc				X	X	X	X	
Health Net of New Jersey, Inc.	X	X	X	X				X
Horizon Healthcare of New Jersey/ HMO Blue	X	X	X	X	X	X	X	X
University Health Plans, Inc.	X	X	X	X				

Information on HMO contracts and product lines from the 2006-2012 New Jersey HMO Performance Reports (Report Cards)

http://www.state.nj.us/dobi/lifehealthactuarial/hmo2007/index.html

Information on the String Matching Algorithm

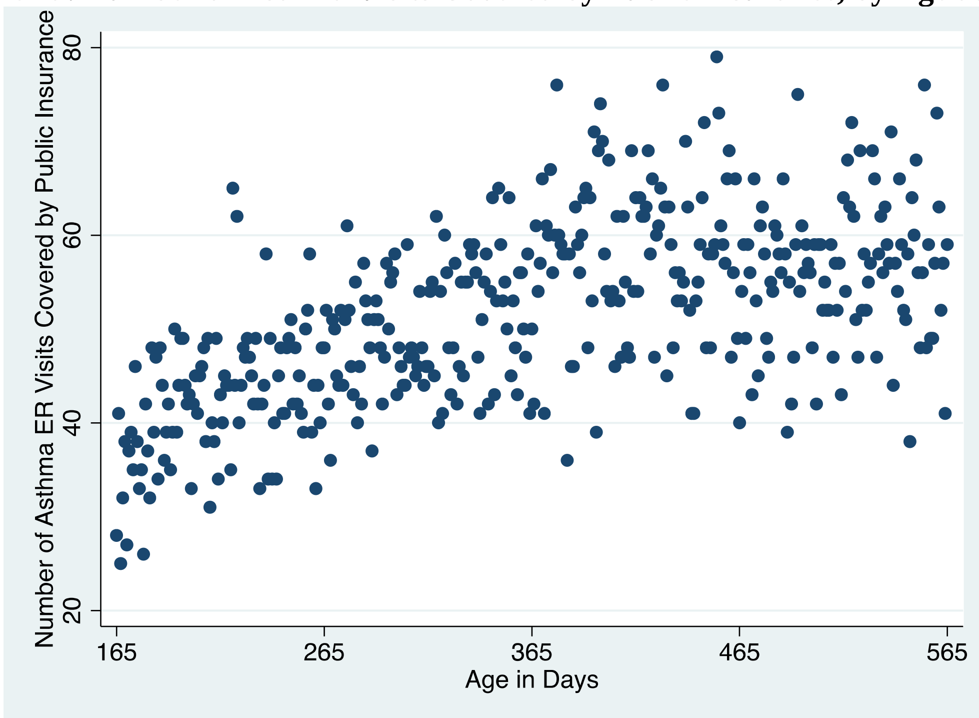
The matching algorithm creates a patient identifier by finding records with the same date of birth and the same or very similar first and last names. Specifically, the Levenshtein edit distance is used to match names, because of problems with typos and misspellings (stata command strgroup). While it is possible that we are picking up a few cases of different people with the same name and birthday, it does not seem to be a large problem. To examine the quality of the matching algorithm, we looked all visits of children included in the main sample, during the age window of 275 days around the first birthday.

The main worry is that there may be many children with similar names and the same birthday, who are being aggregated by the algorithm. In order to assess whether this was a concern, we looked at people with the most common first and last name combinations. We took first and last name combinations that the algorithm assigned to at least eight children, and called this the sample of “common names”.

In order to assess the match quality, we looked at the three-digit zip code of residence reported for each visit. Of this sample of children with extremely common names, those with more than ten visits reported all visits in the same three-digit zip code. This suggests that the algorithm did not mistakenly aggregate people with common first and last name combinations – otherwise we would expect the people with common name combinations and many visits to report multiple zip codes. Of all people with these common names, 92.49% reported just one three digit zip, 6.94% reported two, and 0.58% reported three.

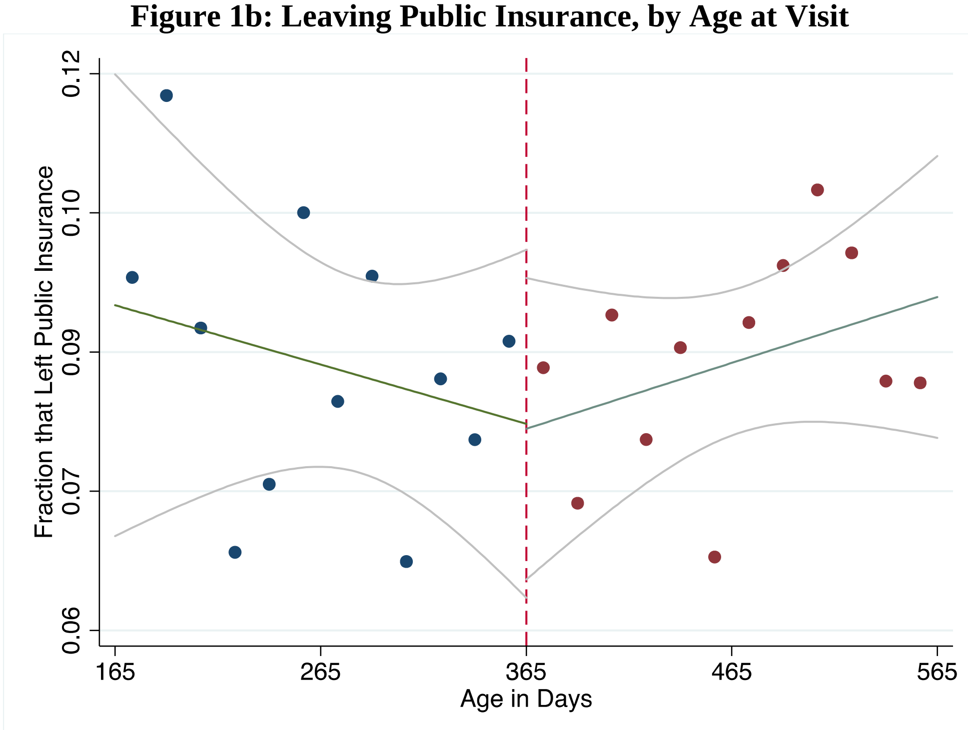
Furthermore, we manually inspected all patients in the top 1% of number of visits. None of these children had “common names”, as defined above, and almost all reported either just one three digit zip code, or a combination of neighboring three digit zip codes.

Figure 1a: Number of Asthma Visits Covered by Public Insurance, by Age at Visit



Notes: Figure 1a plots the number of asthma visits covered by public insurance by age of patient. The sample is asthma patients who went through the ER.

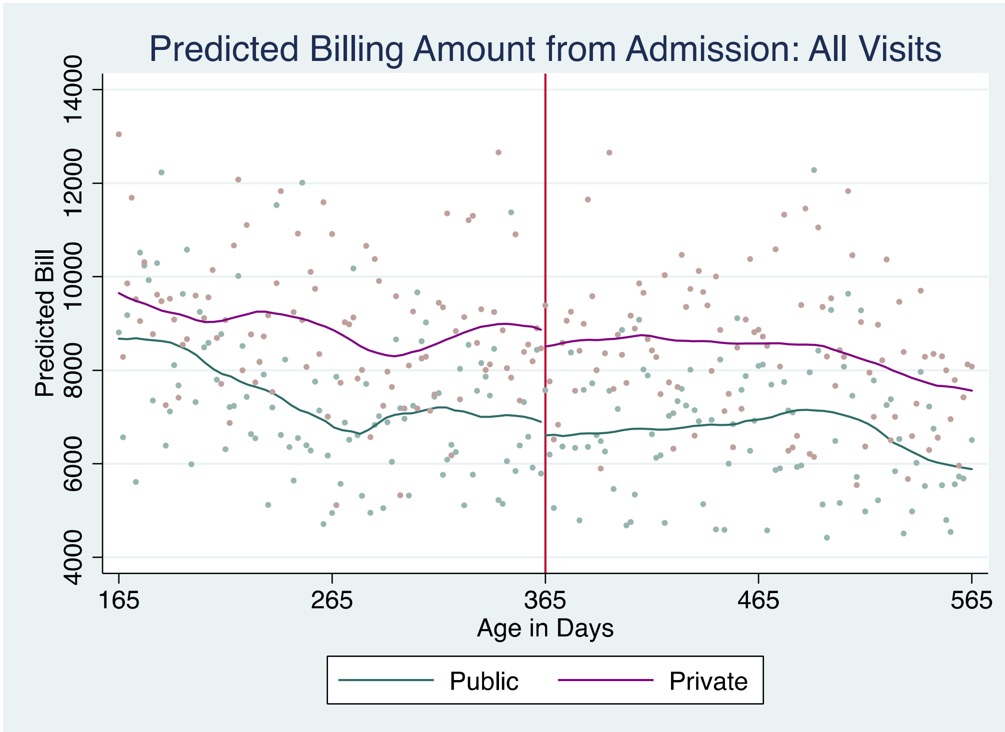
Figure 1b: Leaving Public Insurance, by Age at Visit



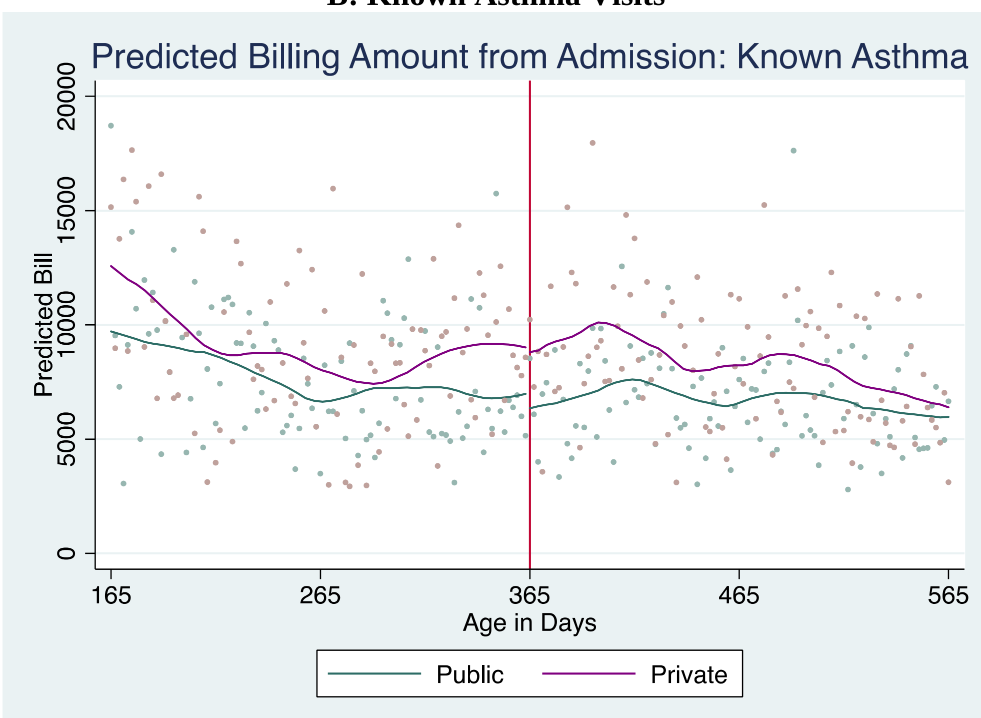
Notes: The sample is all visits by asthma patients to the ER in which a child was covered by public insurance on their previous visit. The first visit by each patient was dropped.

Figure 2: Changes in Billing with Age within Insurance Category

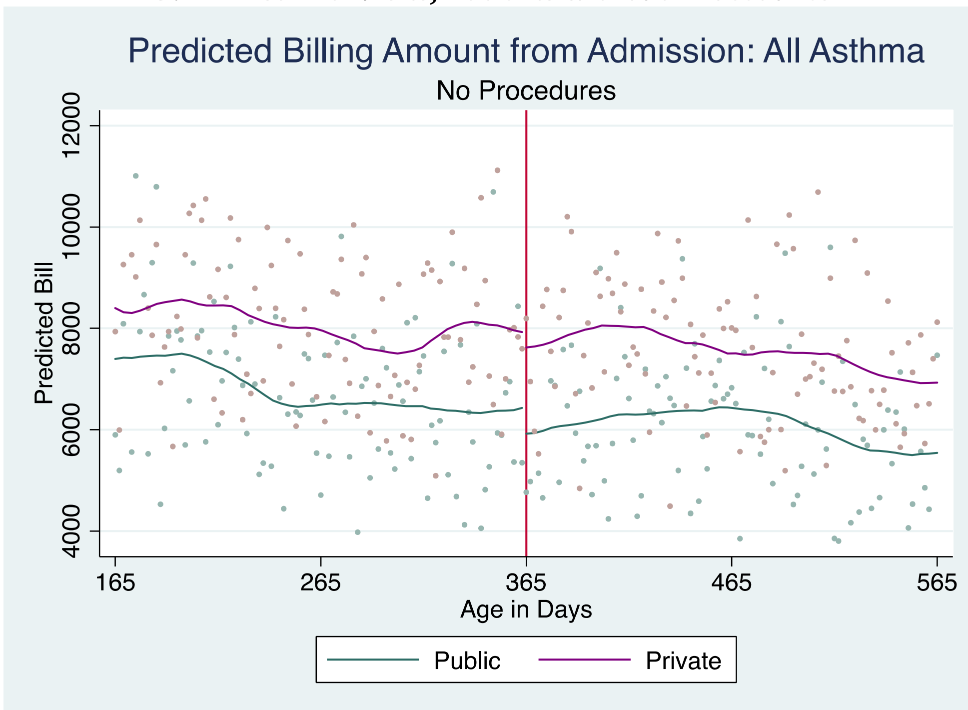
A: All Asthma Visits



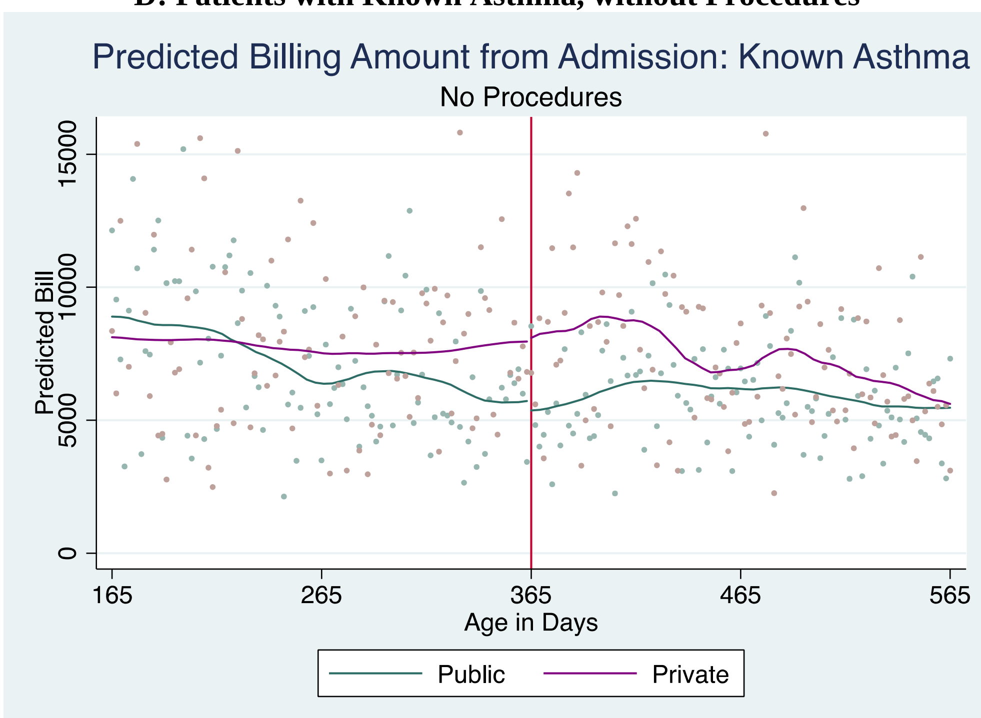
B: Known Asthma Visits



C: All Asthma Visits, Patients without Procedures

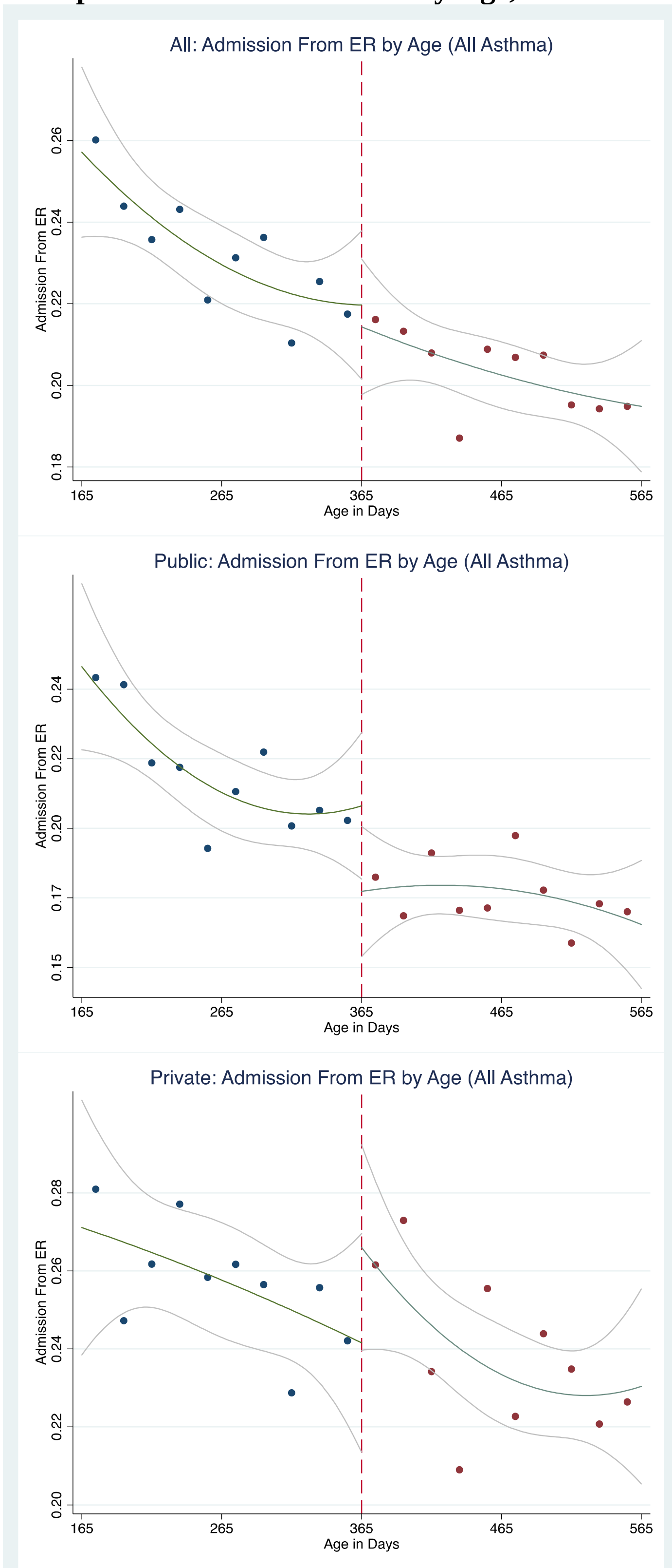


D: Patients with Known Asthma, without Procedures



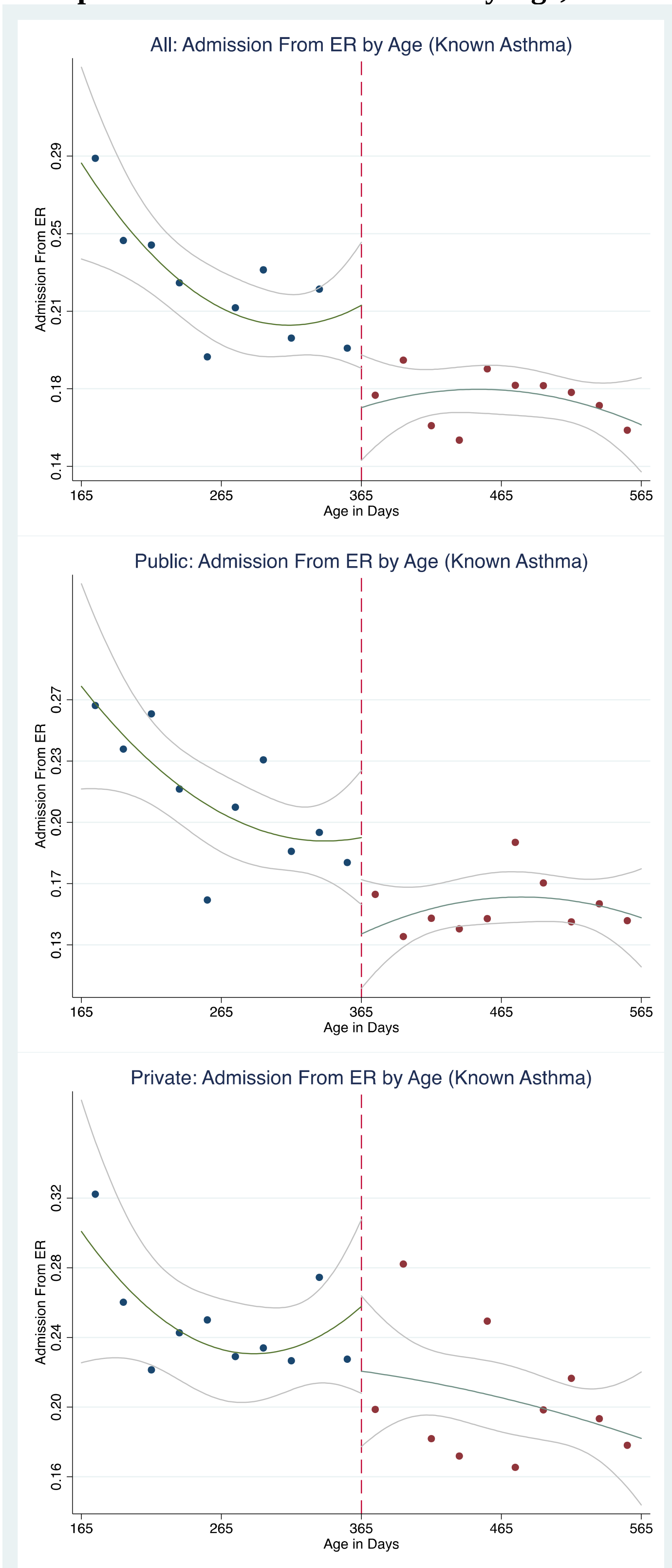
Notes: The predicted billing charges are estimated from the list charges as described in the text. Known asthma refers to patients with a previous admission for asthma. Patients without procedures are being billed only for the admission. Top and bottom 2% are trimmed to make the graphs easier to read.

Figure 3a: Probability of Hospital Admission from ER by Age, All Asthma



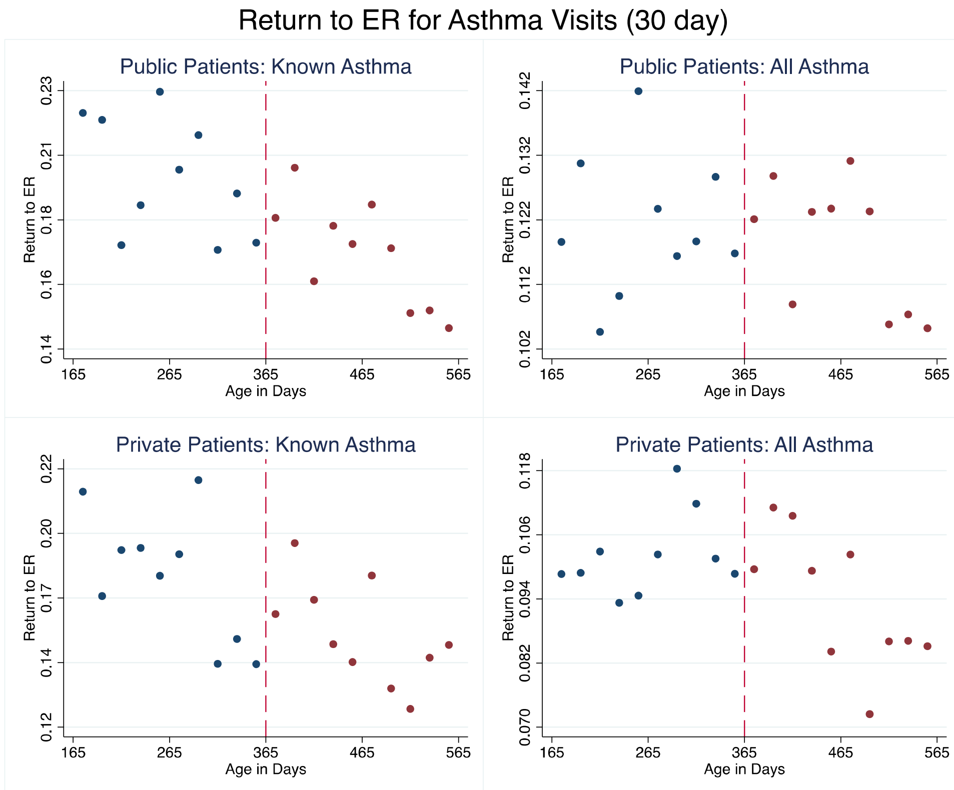
Notes: Figure 3a plots the fraction of emergency room asthma visits where the patient was admitted, by age in days. This figure includes all visits with a diagnosis of asthma, whether or not the patient was known to have asthma.

Figure 3b: Probability of Hospital Admission from the ER by Age, Known Asthma



Notes: Figure 3b plots the fraction of emergency room asthma visits where the patient was admitted, by age in days. This figure includes only visits where the child was previously diagnosed with asthma.

Figure 4: Return to ER for Asthma by Age



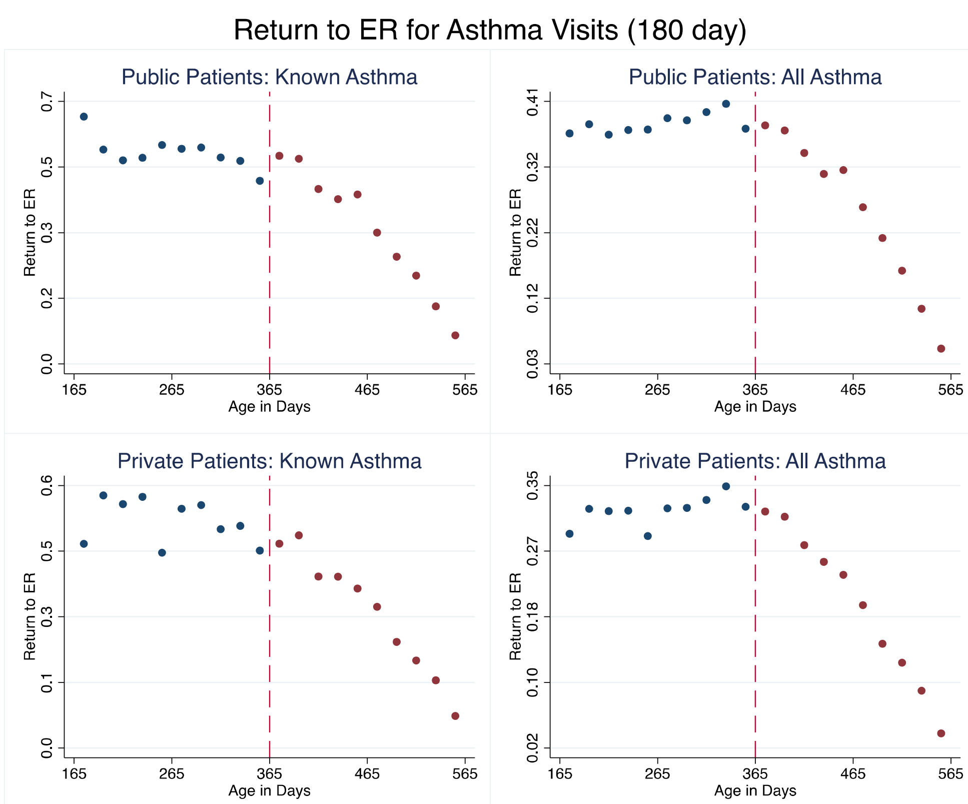


Figure 5: Return to ER for Any Reason by Age

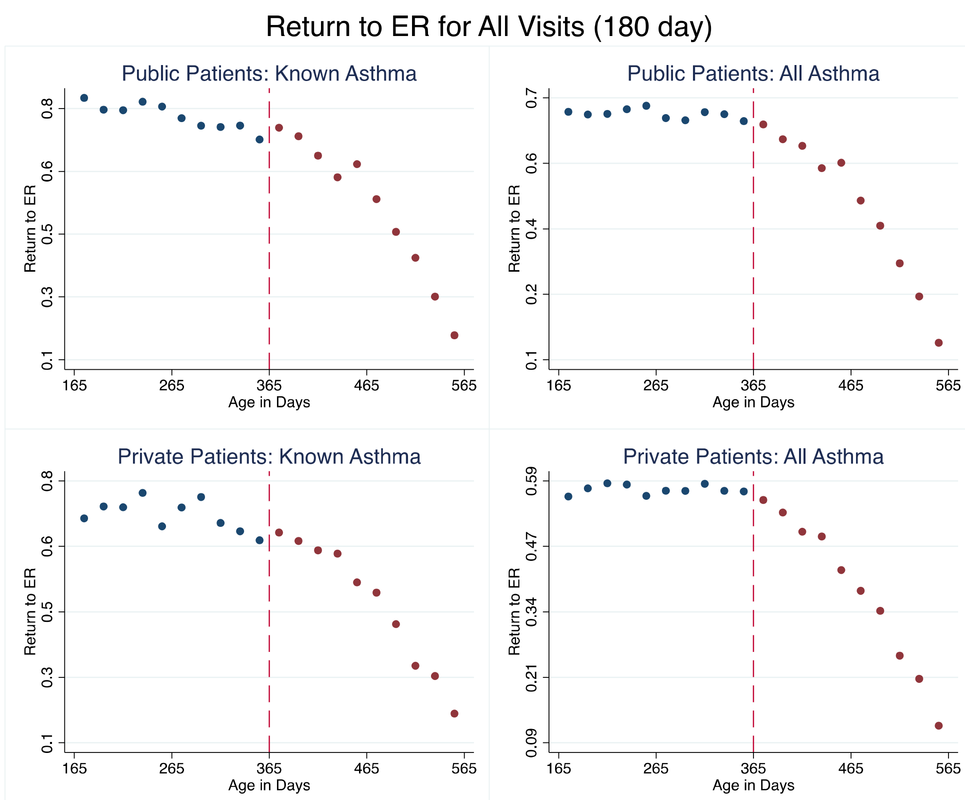


Table 1a: Patient Characteristics by Insurance Type

ER Asthma Visits (+/-200 Days of 1 Year)	**All**	**Public Insurance**	**Private Insurance**
Public Insurance	54.5	100.0	0.0
Private Insurance	45.5	0.0	100.0
% Black	40.2	42.6	37.3
% Hispanic	29.5	34.0	24.0
% Boy	65.1	64.2	66.3
% w/o Procedure (not admitted)	83.7	82.2	85.6
% w/o Procedure (admitted)	84.1	85.3	82.9
Admission Rate	21.6	19.1	24.6
Days of stay (not admitted)	1.1	1.1	1.1
Days of stay (admitted)	3.7	3.7	3.6
Return to ER for asthma in 30 days	10.9	11.9	9.8
Known asthma	35.8	39.1	31.8
Mean Number of ER visits in last 90 days			
Median Number of ER visits in last 90 days			
Number of co-morbidities	1.5	1.5	1.5
% admitted during high flu	23.4	20.3	27.5
Average list charges	$6589	$6390	$6827
Med. income of zip code of residence	$54,737	$50,329	$60,025
Number of children	25,619	13,878	12,681
Number of visits	**37,557**	**20,482**	**17,075**

Notes: Table 1a shows averages for the full sample (pediatric asthma hospital visits that went through the ER, where the child was within 200 days of their first birthday), by insurance type. All variables except for income are from the New Jersey hospital discharge data, 2006-2012. Median household income is from the American Community Survey, 2006-2010. http://www.psc.isr.umich.edu/dis/census/Features/tract2zip/index.html

Table 1b: Hospital Characteristics by Insurance Type: Asthma Visits

	All General Hospitals	Above Median Public Ins.	Below Median Public Ins.
From Discharge Data (Asthma Sample)			
% Public	48.4	68.0	28.3
% Private	51.6	32.0	71.7
% Black	32.2	30.1	34.3
% Hispanic	28.4	32.2	24.4
% Boy	66.3	65.6	67.1
% without Procedure (not admitted)	86.1	84.9	87.3
% without Procedure (admitted)	88.4	88.4	88.4
Admission rate for asthma	17.6	17.2	18.0
Days of stay (not admitted)	1.1	1.1	1.1
Days of stay (admitted)	3.3	3.3	3.3
Return to ER for asthma in 30 days	8.2	8.9	7.7
Known asthma	27.8	28.9	26.6
Avg. # of ER visits in last 90 days			
Total comorbidities	1.3	1.4	1.2
% admitted during high flu	18.3	17.4	19.2
List charges	$4591	$4,415	$4,773
Med. income of zip code of residence	$61,258	$57,316	$65,310
Avg. # of asthma ER visits at hospital over sample period	519.6	648.89	386.8
American Hospital Assoc. Survey			
Avg. Total ER Patients Per Year	48,216	48,193	48,240
Avg. Number of Pediatric Beds	13.6	14.0	13.2
Number of Hospitals	**73**	**37**	**36**

Notes: Excluding the last three rows, the underlying data are the same as in Table 1a (pediatric asthma hospital visits that went through the ER, where the child was within 200 days of their first birthday); the data are collapsed to the hospital level and then averaged across hospitals. The variables in the last two rows come from the American Hospital Association's annual survey, and are averaged across the sample time period. Low and high public insurance hospitals are defined as hospitals below or above the median of hospitals in the fraction of pediatric (<14) ER visits covered by public insurance. Common asthma co-morbidities include: Respiratory infections, ill-defined symptoms, ear conditions, other lower respiratory disease, and viral infection.

Table 2: List and Billing Charges for ER and Admitted Patients

Panel a: List and Billing charges for all hospitals (imputed for hospitals with missing data)

	Public		**Private**	
	List Chgs	Billing Chgs	List Chgs	Billing Chgs
ER Charges – Not Admitted	$1,732	$655	$1,639	$850
N (visits)	16,640	16,640	12,803	12,803
ER Charges -- Admitted	$26,174	$7070	$22,753	$8,765
N (visits)	3,906	3,906	4,197	4,197

Panel b: List and Billing Charges for ER and Admitted Patients
Nine hospitals with both list and billing charges

ER Charges – Not Admitted	$1,631	$438	$1,635	$555
N (visits)	1,096	1, 096	1,602	1,602
ER Charges -- Admitted	$ 18,351	5,630	$ 19,588	7,237
N (visits)	392	392	618	618

Panel c: List and Billing Charges for ER and Admitted Patients with no Procedures
Missing data on billing charges are imputed using hospitals with billing charges.

ER Charges – Not Admitted	$1,603	$613	$1,571	$821
N (visits)	13,573	13,573	10,974	10,974
ER Charges -- Admitted	$ 22,302	$6,381	$19,360	$7,905
N (visits)	3,332	3,332	3,479	3,479

Panel d: List and Billing Charges for ER and Admitted Patients with no Procedures
Includes only nine hospitals with billing charge data

ER Charges – Not Admitted	$1,625	$436	$1,635	$555
N (visits)	1059	1059	1,588	1,588
ER Charges -- Admitted	$15,760	$4,822	$17,485	$6,450
N (visits)	351	351	549	549

Notes: The data in Table 2 come from the New Jersey hospital discharge data, 2006-2012. In hospitals that only give list charges, the billing charges are predicted using the data from the nine hospitals with reliable billing data, and then averaged across the same sample as the list charges, see text.

Table 3: First Stage: Admission

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.077***	-0.034**	-0.041	0.010
	(0.024)	(0.016)	(0.033)	(0.019)
Age in days	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Age in days*After 1	0.000	-0.000	-0.000	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Age in days sq.	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age in days sq. * After1	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.038***	-0.046***	-0.055***	-0.062***
	(0.012)	(0.007)	(0.015)	(0.009)
Hispanic	0.000	-0.015**	-0.041**	-0.030***
	(0.013)	(0.008)	(0.017)	(0.009)
Woman	0.007	0.007	0.004	0.010
	(0.009)	(0.006)	(0.012)	(0.007)
Constant	0.102**	0.094***	0.094*	0.017
	(0.046)	(0.028)	(0.054)	(0.031)
N	8007	20482	5437	17075

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

Table 4: First Stage: Admission by Flu

Panel A: High Flu

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.123**	-0.078**	-0.095	0.011
	(0.056)	(0.036)	(0.083)	(0.047)
Age in days	0.001	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.002)	(0.001)
Age in days*After 1	0.000	0.001	0.002	-0.000
	(0.001)	(0.001)	(0.002)	(0.001)
Age in days sq.	0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age in days sq, * After1	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.041	-0.067***	-0.040	-0.058***
	(0.030)	(0.017)	(0.038)	(0.021)
Hispanic	-0.015	-0.048***	-0.055	-0.031
	(0.031)	(0.018)	(0.042)	(0.023)
Woman	0.025	0.025**	-0.015	-0.009
	(0.021)	(0.013)	(0.030)	(0.016)
Constant	0.177	0.257***	0.249*	0.021
	(0.140)	(0.084)	(0.139)	(0.079)
N	1613	4155	1021	3248

Panel B: Low Flu

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.063**	-0.022	-0.033	0.005
	(0.027)	(0.018)	(0.036)	(0.021)
Age in days	0.000	0.000	0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Age in days*After 1	-0.000	-0.000	-0.001	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Age in days sq.	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age in days sq, * After1	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.038***	-0.042***	-0.058***	-0.063***
	(0.013)	(0.008)	(0.017)	(0.010)
Hispanic	0.003	-0.008	-0.039**	-0.029***
	(0.014)	(0.008)	(0.018)	(0.010)
Woman	0.003	0.002	0.006	0.014*
	(0.010)	(0.006)	(0.013)	(0.007)
Constant	0.092*	0.054*	0.052	0.009
	(0.050)	(0.031)	(0.059)	(0.034)
N	6394	16327	4416	13827

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

Table 5: Reduced Form: Return to the ER within 30 Days

Panel A: Return to ER for Any Reason

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.021	-0.026	0.033	-0.012
	(0.030)	(0.017)	(0.035)	(0.018)
ageday	-0.000	-0.000	-0.001	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Ageday*after1	0.002**	0.001**	0.001	0.001
	(0.001)	(0.000)	(0.001)	(0.000)
Ageday Sq	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Ageday Sq*after1	-0.000**	-0.000***	-0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Black	0.029**	0.029***	0.023	0.038***
	(0.015)	(0.008)	(0.017)	(0.008)
hispanic	0.042***	0.047***	0.047**	0.057***
	(0.016)	(0.008)	(0.018)	(0.009)
woman	0.007	-0.011*	0.004	-0.007
	(0.011)	(0.006)	(0.013)	(0.006)
_cons	0.204***	0.175***	0.245***	0.213***
	(0.056)	(0.031)	(0.058)	(0.029)
N	8007	20482	5437	17075

Panel B: Return to ER for Asthma

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.006	-0.019	0.047	0.006
	(0.025)	(0.013)	(0.029)	(0.013)
ageday	-0.001	0.000	-0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Ageday*after1	0.001**	0.001**	0.001*	0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Ageday Sq	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Ageday Sq*after1	-0.000	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
black	0.036***	0.031***	0.041***	0.033***
	(0.012)	(0.006)	(0.014)	(0.006)
hispanic	0.027**	0.018***	0.043***	0.025***
	(0.013)	(0.006)	(0.015)	(0.007)
woman	0.007	-0.012***	-0.007	-0.008*
	(0.009)	(0.005)	(0.011)	(0.005)
_cons	0.047	0.073***	0.141***	0.132***
	(0.047)	(0.024)	(0.049)	(0.022)
N	8007	20482	5437	17075

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

Table 6: RD: Return to the ER within 30 days for Any Reason

Panel A: Return to ER for Any Reason

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
admission	0.065	0.032	-0.990	-2.124
	(0.364)	(0.485)	(1.057)	(2.289)
black	0.031	0.030	-0.030	-0.095
	(0.020)	(0.024)	(0.063)	(0.144)
ageday	-0.000***	-0.000***	-0.001*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Ageday sq	-0.000***	-0.000***	-0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
hispanic	0.041***	0.048***	0.007	-0.007
	(0.015)	(0.011)	(0.050)	(0.072)
woman	0.007	-0.011	0.009	0.014
	(0.011)	(0.007)	(0.017)	(0.027)
_cons	0.223***	0.180***	0.357***	0.254***
	(0.057)	(0.046)	(0.098)	(0.075)
N	8007	20482	5437	17075

Panel B: Return to ER for Asthma

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
admission	-0.000	0.050	-1.286	-0.900
	(0.304)	(0.369)	(1.131)	(1.123)
black	0.036**	0.033*	-0.029	-0.023
	(0.017)	(0.018)	(0.067)	(0.071)
ageday	-0.000**	-0.000	-0.001*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Ageday sq.	-0.000**	-0.000***	-0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
hispanic	0.027**	0.019**	-0.009	-0.002
	(0.013)	(0.009)	(0.053)	(0.035)
woman	0.007	-0.013**	-0.001	0.001
	(0.009)	(0.005)	(0.018)	(0.013)
_cons	0.074	0.075**	0.275***	0.157***
	(0.048)	(0.035)	(0.105)	(0.037)
N	8007	20482	5437	17075

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

Table 7: Other RD Outcomes (30 Day Return Window, Asthma Visits)
Excluding the Index Visit

Panel A: Known Asthma

	Publicly Insured			
	Days in Hospital	Total List Charges	Total Pred. Billing Charges	Total ER Billing Charges
admission	-0.752	-1264.795	856.816	-270.074
	(0.748)	(5968.119)	(1702.863)	(187.370)
black	0.077*	669.043**	187.766**	-2.441
	(0.041)	(327.775)	(93.355)	(10.272)
Ageday	-0.000**	-2.244	-0.287	-0.095*
	(0.000)	(1.714)	(0.488)	(0.054)
Ageday sq.	0.000	0.001	-0.002	0.000
	(0.000)	(0.010)	(0.003)	(0.000)
hispanic	0.103***	771.615***	142.422**	4.528
	(0.032)	(253.930)	(72.231)	(7.948)
woman	0.004	-58.947	-68.084	2.236
	(0.023)	(181.403)	(51.611)	(5.679)
_cons	0.065	497.919	344.490	40.622
	(0.117)	(936.821)	(266.661)	(29.341)
N	8007	8007	8004	8004

Panel B: All Asthma

	Publicly Insured			
	Days in Hospital	Total List Charges	Total Pred. Billing Charges	Total ER Billing Charges
admission	0.402	8677.863	2062.421	-238.668
	(0.902)	(9165.381)	(2048.515)	(222.208)
black	0.060	455.797	151.713	0.015
	(0.044)	(448.101)	(100.253)	(10.875)
ageday	-0.000	0.606	0.177	-0.033
	(0.000)	(1.574)	(0.352)	(0.038)
Ageday sq	-0.000	-0.007	-0.002	0.000
	(0.000)	(0.006)	(0.001)	(0.000)
hispanic	0.041**	289.985	71.660	2.113
	(0.021)	(211.984)	(47.342)	(5.135)
woman	-0.029**	-191.572	-82.427***	-1.499
	(0.013)	(131.506)	(29.312)	(3.180)
_cons	0.013	-423.282	73.356	43.792**
	(0.085)	(865.218)	(193.182)	(20.955)
N	20482	20482	20476	20476

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

Table 8: Other RD Outcomes (30 Day Return Window, Asthma Visits)

Including the Index Visit

Panel A: Known Asthma

	Publicly Insured		
	Days in Hospital	Total List Charges	Total Pred. Billing Charges
admission	2.326**	35316.067***	8611.461***
	(1.143)	(12355.084)	(3075.846)
black	0.042	365.692	85.286
	(0.063)	(678.554)	(168.779)
ageday	-0.001**	-2.765	-0.920
	(0.000)	(3.548)	(0.884)
Ageday sq	0.000	-0.013	0.003
	(0.000)	(0.020)	(0.005)
hispanic	0.114**	672.976	209.054
	(0.049)	(525.680)	(130.740)
woman	0.046	267.433	-140.138
	(0.035)	(375.536)	(93.370)
_cons	1.371***	1546.530	3265.402***
	(0.179)	(1939.389)	(481.866)
N	8007	8007	7981

Panel B: All Asthma

	Publicly Insured		
	Days in Hospital	Total List Charges	Total Pred. Billing Charges
admission	3.252*	25730.019	12481.795***
	(1.725)	(19728.093)	(4837.318)
black	0.077	215.704	148.074
	(0.084)	(964.518)	(238.163)
Ageday	-0.000	-4.454	0.081
	(0.000)	(3.387)	(0.836)
Ageday sq.	0.000	0.016	0.000
	(0.000)	(0.012)	(0.003)
hispanic	0.078**	365.261	105.904
	(0.040)	(456.286)	(112.620)
woman	0.012	237.840	-169.958**
	(0.025)	(283.062)	(69.539)
_cons	1.190***	-447.703	2234.383***
	(0.163)	(1862.345)	(455.659)
N	20482	20482	20362

All regressions include median income, as well as FE for day of week, month of year, year, and hospital

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Appendix Table 1: First Stage: Admission (275 Day Window)

	Publicly Insured		Privately Insured	
	Known Asthma	All Asthma	Known Asthma	All Asthma
After 1	-0.071***	-0.033**	-0.037	-0.010
	(0.021)	(0.014)	(0.028)	(0.016)
Age in days	0.000	0.000	0.001	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Age in days*After 1	0.000	-0.000	-0.001	-0.001**
	(0.000)	(0.000)	(0.001)	(0.000)
Age in days sq.	0.000*	0.000***	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Age in days sq. * After1	-0.000**	-0.000***	-0.000*	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.034***	-0.045***	-0.046***	-0.060***
	(0.010)	(0.007)	(0.013)	(0.008)
Hispanic	0.008	-0.011	-0.036**	-0.036***
	(0.011)	(0.007)	(0.015)	(0.008)
Woman	0.008	0.006	0.009	0.006
	(0.008)	(0.005)	(0.010)	(0.006)
Constant	0.112***	0.079***	0.108**	0.050*
	(0.040)	(0.025)	(0.047)	(0.028)
N	10371	26241	7130	22002

All regressions include median income, as well as FE for day of week, month of year, year, and hospital