

School-Based Health Centers: Cost–Benefit Analysis and Impact on Health Care Disparities

Jeff J. Guo, PhD, Terrance J. Wade, PhD, Wei Pan, PhD, and Kathryn N. Keller, MPA

Racial or ethnic health care disparities are a social phenomenon that reveals differences in utilization and quality of health care because of accessibility, operation of health care systems, cultural or socioeconomic status, and discrimination at the individual and patient–provider level.^{1–5} Recent literature has documented ethnic and racial disparities in the health care system across a wide range of diseases. According to the Centers for Disease Control and Prevention,⁶ African Americans had higher prevalence rates across many chronic diseases, including perinatal diseases, diabetes mellitus, hypertension, and obesity. Health care disparities can lead to decreased quality of life, loss of economic opportunities, and perceptions of injustice.⁷ Twenty-two percent of African American children and adolescents were classified as overweight or obese and 68% were fully vaccinated, compared with White children and adolescents, who were less likely to be overweight or obese (12%) and more likely to be fully vaccinated (78%).^{6,8}

For some illnesses, health care disparities are manifested through the underuse of treatments and procedures.^{9–11} School-aged children and adolescents have high prevalence rates of some chronic diseases, including asthma (estimated at 7%) and attention deficit/hyperactivity disorder (estimated at between 3% and 6%).^{7,12,13} However, African American children and adolescents with asthma had more hospitalizations, disability, and a higher mortality rate compared with that of White children and adolescents with asthma.^{14,15} Moreover, African American children and adolescents were also less likely to access mental health services.^{16–19}

School-based health centers (SBHCs) are thought to be 1 solution to reduce these health status and health care disparities across groups. SBHCs provide essential primary care (e.g., mental health treatment, dental care, well-child checkups) for students. SBHCs, by their location in schools, are designed to overcome many health care access barriers, including transportation, lack of providers, lack of insurance coverage,

Objectives. We evaluated the impact of school-based health centers—which provide essential health care for students by aiming to eliminate many access barriers—on health care access disparities and conducted a cost–benefit analysis.

Methods. We employed a longitudinal quasi-experimental repeated-measures design. Primary data sources included the Ohio Medicaid claims, enrollment file with race/ethnicity, and survey reports from parents. We used hierarchical linear modeling to control unbalanced data because of student attrition. We assessed quarterly total Medicaid reimbursement costs for 5056 students in the SBHC and non-SBHC groups from 1997 to 2003. We calculated net social benefit to compare the cost of the SBHC programs with the value that SBHCs might save or create.

Results. With SBHCs, the gap of lower health care cost for African Americans was closed. The net social benefits of the SBHC program in 4 school districts were estimated as \$1352087 over 3 years. We estimated that the SBHCs could have saved Medicaid about \$35 per student per year.

Conclusions. SBHCs are cost beneficial to both the Medicaid system and society, and may close health care disparity gaps. (*Am J Public Health.* 2010;100:1617–1623. doi:10.2105/AJPH.2009.185181)

and inconvenient appointment times because of parents working. By 2008, more than 1980 SBHCs nationwide had been established with partial support from the federal government, foundations, Medicaid, health insurance companies, and other programs such as “Healthy Schools Healthy Communities.”^{20–22} In many SBHCs, the majority of enrolled students are uninsured or low income, ranging from 50% to 90% of the patient load.

Numerous studies have documented that SBHCs can effectively reduce health care access barriers and emergency room visits in children and adolescents.^{23–31} These in-school services can also alleviate barriers such as non-adherence and inadequate access to mental health services for youths.^{23,32–34} With the SBHC, students received more mental health care services,²³ less hospitalization,^{24,26} fewer urgent or emergency visits,^{25–28} and fewer transportation and pharmacy costs.²⁶

Although SBHCs have demonstrated their value to school-aged children and adolescents, their impact on addressing health care disparities has not been evaluated. Moreover, it is unclear whether the SBHC is cost-beneficial. With these considerations in mind, we sought

to measure the impact of SBHCs on addressing health care disparities among students in schools with SBHCs compared with students in comparable schools without SBHCs. The central hypotheses were that increased accessibility to primary care services with SBHCs would reduce the gaps of health care disparities over time by increasing needed primary care. Second, by providing timely and essential primary care, the SBHC program would have a positive net social benefit to the population.

METHODS

We used a longitudinal quasi-experimental repeated-measures design. Four school districts (7 schools in total) with newly implemented SBHCs were matched with 2 other school districts (6 schools in total), based on urban or rural status, percentage of non-White students, and percentage of students in the free or reduced-price school lunch program. The target population was school-aged students (kindergarten through 12th grade) enrolled in schools in the Greater Cincinnati, Ohio, area who were also enrolled in Ohio Medicaid or the State Children’s Health Insurance Program (SCHIP) from

academic years 1997 through 2003. All students in the SBHC had parental approval to participate. The written consents for evaluation were documented in each SBHC. Because of the nature of retrospective data analysis, researchers did not modify or alter any medical treatment or services for student participants. There was little risk to study participants.

The SBHCs were established in September 2000 and provided for students in kindergarten through eighth grade. All enrolled students were eligible to use the SBHC. The SBHCs were open on weekdays during the school academic quarters and closed in the summer quarter. Each SBHC was equipped with basic medical instruments (examination bed, blood pressure meter, weight and height scale, urgent medications) and the Welligent version 5.0 Web-based computerized medical record system (Welligent Inc, Norfolk, VA) to track SBHC encounters. The SBHC was managed by a medical partner (e.g., nurse practitioner and health worker) related to primary care and specialist physicians (e.g., pediatrician). Each SBHC was typically staffed by 1 nurse practitioner and 1 nurse technician. A part-time pediatrician was present in some schools for 3 hours per week. A licensed mental health therapist was in service in some schools 1 or more days per week. Among these school districts, a large number of students (ranging from 50% to 88%) was enrolled in the free or reduced-price school lunch program because of their low family incomes.³⁵

Data Sources

Four primary data sources were used for this study: school enrollment files, Ohio Medicaid claims, SBHC encounter records, and parents' and SBHC coordinators' survey data. First, schools provided student enrollment databases identifying student names and demographics for each school year from the 2000–2001 school year to the 2002–2003 school year. There were 9240 unique students.

Second, school enrollment data were linked with the Ohio Medicaid claim database, which is an automated database that includes Medicaid enrollment records, as well as patients' pharmacy, medical, hospital inpatient, and outpatient institutional claims from September 1997 to February 2003. This totaled 5069 unique students based on matched name, sex, race, date of birth, and county code. Thirteen

students who switched between an SBHC and non-SBHC comparison school were excluded. Because of the implementation of the Health Insurance Portability and Accountability Act and other regulation changes, we were unable to collect and use the completed Medicaid claims data from March 2003 to August 2003.

Third, SBHC encounter data from the 4 intervention schools that documented students' visits in SBHCs were retrieved from the Welligent database. During the study period, 4136 students were enrolled in the SBHC program, of which 2314 students used the service, generating a total of 7572 SBHC encounters.

Fourth, surveys of both parents and SBHC coordinators were conducted to collect data regarding cost and benefit information (such as travel distance from home to the hospital or clinic), hours spent for students' physician visits, facility utility and space cost, and health care grants received as a result of local SBHC programs.

Outcome Measures and Covariates

The primary outcome measure for our study was quarterly total health care cost per student, as a proxy for health care utilization, which was defined as the total dollar amount that Medicaid paid for inpatient and outpatient care, physician encounters, mental health services, pharmacy, procedures, and diagnoses. For each claim reimbursement, total health care reimbursement was adjusted by using the medical component of the Consumer Price Index (MCPI) as the dollar value in 2002. The annual MCPI rates of change were 4.6% in 2002, 4.7% in 2001, 4.2% in 2000, 3.7% in 1999, 3.4% in 1998, and 2.8% in 1997.^{36–38}

The covariates included the student's age as of September 30, 2000. Sex and race were dichotomous variables. The number of enrollment months was defined for each child enrolled in the Medicaid program during the study period. Enrollment categories included aid for disabled or blind, Temporary Assistance for Needy Families (TANF), SCHIP, and managed care organizations (MCOs).

Cost–Benefit Analysis

Cost–benefit analysis (CBA) is a method to compare the value of resources consumed (costs) in providing a program or intervention

to the value of the consequence (benefit) from that program or intervention.³⁶ Two major components for CBA are costs and consequences. This view of CBA assumes that the SBHC is being compared with a non-SBHC alternative. A CBA requires health outcomes of the SBHC to be valued in monetary units, thus enabling us to compare the program's incremental cost with its incremental outcomes.

We looked at the costs of (or resources consumed by) the SBHCs from 3 sectors: (1) the health care sector (e.g., SBHC operation costs, such as prescription drugs, medical equipment, and physician and nurse hours), (2) the patient and family sector (e.g., out-of-pocket expenses in traveling to get medical care, copayments, and lost work time), and (3) other sectors (e.g., essential start-up funds [not including SBHC operational costs] and costs for school facility use).

We considered certain activities that would not have occurred without a SBHC to be incremental benefits from the program, including (1) the students' health status change, which can be measured in terms of equivalent value of clinical effects; (2) other sector savings, including other value or grants created by the SBHCs; (3) resources saved by the SBHCs or costs not spent on an alternative, which mirror the costs and were measured according to the 3 cost sectors: health care savings, patient and family savings, and other sector savings such as the community multiplier effect (R. Greenbaum, PhD and A. Desai, PhD, Ohio State University, written communication, April 30, 2003); and (4) unquantifiable benefits, such as healthy students having better attendance and better learning performance, and increased access to care for racial/ethnic minorities.

The net social benefit³⁶ from implementing the SBHC was calculated as total benefits minus the total costs based on the previously defined components. To measure and estimate the cost–benefit variables, we constructed 2 sets of questionnaires. The first was administered to a random sample of parents through phone interviews,²³ including the frequency of child sick visits and hospitalizations, distance from home to physician offices and hospitals, and number of days off for child sick leave. Study samples were randomly selected from SBHC and non-SBHC schools and, as such, we assume the results from questionnaires to be representative of all parents in the specific schools. The second survey was

administered through self-report to the SBHC administrative staff or coordinators in each SBHC about their working hours, facility and equipment costs, and other operational costs.

Data Analysis

To test equivalency between SBHC and non-SBHC comparison schools on demographic characteristics, we used the *t* test for continuous data including age, months enrolled, and percentages of enrollment categories; we used the χ^2 test for dichotomous variables.

We employed hierarchical linear modeling using HLM version 5.05 (Scientific Software International Inc, Lincolnwood, IL)³⁹ on a repeated-measures basis, allowing for the control of unbalanced observations with time-series quarterly data because of student attrition in different schools or different enrollment periods in Medicaid programs. The multiple observations are properly originated as nested within students. The quarterly total Medicaid costs (adjusted 2002 dollar value) per student were measured as time-related variables for all eligible students to analyze growth trends, including linear, quadratic, and cubic growth trends.³⁹ The nested-structure growth analysis allows for examination of students' health care utilization changes over time. Unlike other repeated measures analyses, HLM can examine the fit of data with an unequal number of repeated observations for each individual student. Two levels of HLM models were involved in the analysis: a level-1 polynomial model of the repeated observations for the effect of time including 22 quarters from fall 1997 to winter 2003 on the outcome variable of the quarterly health care cost, and level-2 linear models of the individual student-level measures for the effects of the individual differences (such as sex, race, age, SBHC intervention, SCHIP, aid for disabled or blind, and MCO) on the linear, quadratic, and cubic growth trends.

RESULTS

Of 5056 students (45% African American and 49% female), there were 3673 students enrolled in SBHC schools and 1383 students enrolled in schools without SBHCs (Table 1). The students in the non-SBHC comparison group were younger, had fewer enrollment months, were enrolled in the SCHIP program at greater proportions, and were enrolled in

TABLE 1—Demographics and Characteristics for Students Enrolled in Both Medicaid and Schools With School-Based Health Centers (SBHCs) and for Students Enrolled in Schools Without SBHCs: Greater Cincinnati, OH, 1997–2003

	Students Enrolled in Schools With SBHCs (n = 3673)	Students Enrolled in Schools Without SBHCs (n = 1383)	<i>P</i> ^a
Male, no. (%)	1906 (51.9)	697 (50.4)	.315
Age ^b , y, mean (range)	8.41 (3–15)	8.04 (3–15)	<.001
Race, no. (%)			
White	1947 (53)	732 (52.9)	.917
Black	1664 (45.3)	613 (44.3)	.508
Hispanic	18 (0.5)	4 (0.3)	
Asian	4 (0.1)	0	
American Indians	4 (0.1)	0	
Other	37 (1.0)	35 (2.5)	
No. of months enrolled in Medicaid program, ^c mean (SD)	40.3 (18.1)	38.4 (18.0)	<.001
Enrollment ^c , % (SD)			
SCHIP	32.5 (0.35)	37.3 (0.37)	<.001
Aid to disabled or blind	4.2 (0.18)	4.5 (0.18)	.613
MCO	24.8 (0.27)	14.6 (0.27)	<.001
TANF	94.5 (0.20)	93.5 (0.21)	.144
Quarterly total cost 1997–1998 academic year, mean \$			
Black	173.9	208.9	
Non-Black	158.8	230.3	
Quarterly total cost 1998–1999 academic year, mean \$			
Black	198.6	250.7	
Non-Black	152.1	245.0	
Quarterly total cost 1999–2000 academic year, mean \$			
Black	210.5	289.9	
Non-Black	214.5	321.2	
Quarterly total cost 2000–2001 academic year, mean \$			
Black	293.7	364.2	
Non-Black	276.7	340.3	
Quarterly total cost 2001–2002 academic year, mean \$			
Black	401.8	343.6	
Non-Black	348.3	423.0	
Quarterly total cost 2002–2003 academic year, mean \$			
Black	394.5	341.6	
Non-Black	374.2	334.2	

Note. MCO = managed care organization; SCHIP = State Children Health Insurance Plan; TANF = Temporary Assistance for Needy Families. The total sample size was n = 5056.

^aStudents in schools with SBHCs compared with students in schools without SBHCs, by the *t* test for age and months enrolled, and by the χ^2 test for other variables.

^bAge was calculated as (September 30, 2000 minus the student's date of birth) divided by 365.25.

^cEnrollment category is not mutually exclusive. As recipients could have been in multiple enrollment categories during the study period, the recipient's aid category was defined by the percentage of enrollment months for which the recipient was enrolled in each program.

an MCO in smaller proportions compared with that of students in the SBHC group. Medicaid spent a total of \$30 million dollars on all 5056 students during the 5.5 years. The

major cost components included mental health services (\$8.9 million, 29.7%), outpatient care (\$7.3 million, 24.3%), hospitalization and emergency room visits (\$5.7 million, 19%),

physician encounters (\$3.3 million, 11%), and prescription drugs (\$2.8 million, 9.3%).

Health Care Disparities

Table 2 summarizes the final least-squares estimates of fixed effects with robust standard errors for quarterly total Medicaid costs under the HLM analysis. African American students had lower health care costs than did other students ($P=.061$) in Fall 2000, indicating some health care disparities at the beginning of the SBHC program. The gap was closed after the implementation of the SBHC according to the growth curves displayed in Figure 1.

Cost-Benefit Analysis

Figure 2 summarizes both costs and benefits that were estimated based on 3 years of SBHC operation. The CBA was based on all students enrolled in each SBHC school, regardless of different medical insurance or noninsurance. There were a total of 7608 students enrolled in 4 schools or districts with SBHCs.

Costs. For health care sector costs, we used total funding of \$1 382 260 for the first 3 years of operation as a proxy for the costs of SBHC operation because the funding enabled SBHCs to initiate and maintain personnel, equipment, and space for SBHC activities. We estimated the 7572 SBHC encounters as \$479 929 by using Medicaid reimbursement value. For patient and family sector costs, we estimated a copayment total of \$75 720 with \$10 per SBHC encounter. Also, although each school donated space to the SBHCs, we estimated \$60 750 for the market value of the space over the 3 years in the schools with SBHCs.

Benefits. We estimated total value of health state changes to be \$954 387 on the basis of Medicaid claims, including (1) the total value of the additional mental health care for students was \$771 840 over 3 years, (2) the increased dental care benefit was \$38 568 over the first 3 years, and (3) that nurse practitioners spent 30% to 50% of their time on nonbillable activities such as services for teachers and staff, student smoking cessation programs, student health status consultations, and staff meetings. The value of nonbillable health care activities was estimated as 30% of SBHC office visits with a total cost of \$143 979. Other created value was estimated to be \$457 598 from the additional funding attracted by SBHCs from

TABLE 2—Final Estimation of Effects of the School-Based Health Center (SBHC) Program on the Growth Trends of the Quarterly Total Medical Costs: Greater Cincinnati, OH, 1997–2003

Fixed Effect ^a	Growth Trend Variable ^b	b (SE)	t	P
Initial status ^c	B ₀			
Intercept ²	G ₀₀	193.270 (50.31)	3.842	<.001
Sex	G ₀₁	48.979 (32.81)	1.493	.135
Race	G ₀₂	-86.095 (46.01)	-1.871	.061
Age	G ₀₃	13.190 (5.97)	2.210	.027
SBHC	G ₀₄	-48.477 (37.82)	-1.282	.200
MCO	G ₀₅	-12.987 (47.55)	-0.273	.785
SCHIP	G ₀₆	10.520 (38.26)	0.275	.783
Disabled	G ₀₇	1825.471 (290.68)	6.280	<.001
Linear growth ^d	B ₁			
Intercept ²	G ₁₀	-9.859 (9.69)	-1.018	.309
Sex	G ₁₁	5.373 (5.24)	1.025	.306
Race	G ₁₂	-0.148 (6.71)	-0.022	.983
Age	G ₁₃	2.482 (1.05)	2.363	.018
SBHC	G ₁₄	8.338 (5.96)	1.398	.162
MCO	G ₁₅	-8.412 (8.16)	-1.030	.303
SCHIP	G ₁₆	-3.020 (6.04)	-0.500	.616
Disabled	G ₁₇	-9.771 (34.61)	-0.282	.778
Quadratic growth ^d	B ₂			
Intercept ²	G ₂₀	-0.615 (0.66)	-0.931	.352
Sex	G ₂₁	-0.084 (0.40)	-0.208	.835
Race	G ₂₂	0.732 (0.55)	1.325	.185
Age	G ₂₃	0.044 (0.08)	0.521	.602
SBHC	G ₂₄	0.711 (0.50)	1.411	.158
MCO	G ₂₅	-0.553 (0.77)	-0.720	.471
SCHIP	G ₂₆	-0.127 (0.57)	-0.222	.824
Disabled	G ₂₇	-7.969 (2.28)	-3.500	.001
Cubic growth ^d	B ₃			
Intercept ²	G ₃₀	-0.004 (0.10)	-0.042	.967
Sex	G ₃₁	-0.010 (0.06)	-0.174	.863
Race	G ₃₂	0.057 (0.08)	0.755	.450
Age	G ₃₃	-0.008 (0.01)	-0.620	.535
SBHC	G ₃₄	-0.010 (0.07)	-0.140	.889
MCO	G ₃₅	-0.004 (0.10)	-0.035	.972
SCHIP	G ₃₆	-0.089 (0.08)	-1.159	.247
Disabled	G ₃₇	-0.067 (0.30)	-0.224	.823

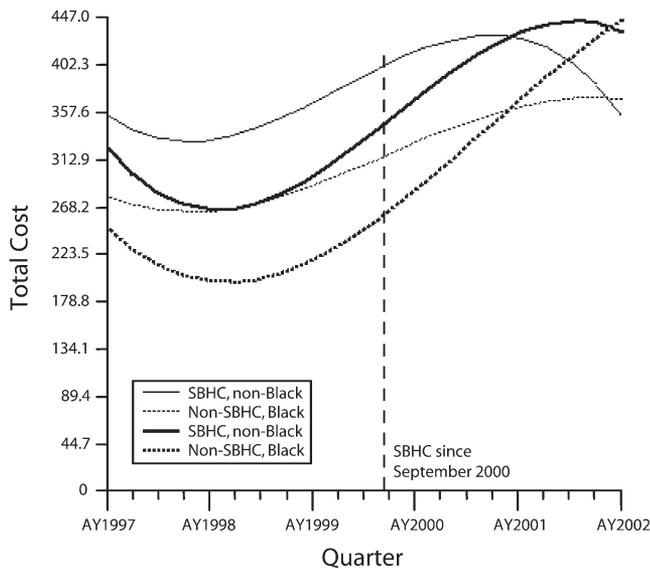
Note. MCO = managed care organization; SCHIP = State Children Health Insurance Plan. Final estimation of variance component: level 1 = 1 537 702.88; degrees of freedom = 5048; $\chi^2 = 33 762$; $P < .001$. The total sample size of eligible students was $n = 5056$.

^aLinear model of quarterly Medicaid cost was regressed on race, sex, age, SBHC, SCHIP, aid for disabled or blind, and MCO for their growth trends.

^bG₀₀, G₁₀, G₂₀, and G₃₀ are for the intercepts; G₀₁, G₁₁, G₂₁, and G₃₁ are for the effects of gender (male = 1 and female = 0) on the growth trends; G₀₂, G₁₂, G₂₂, and G₃₂ are for the effects of race (Black = 1 and others = 0) on the growth trends; G₀₃, G₁₃, G₂₃, and G₃₃ are for the effects of age (years in September 2000) on the growth trends; G₀₄, G₁₄, G₂₄, and G₃₄ are for the effects of SBHC (SBHC = 1 and non-SBHC = 0) on the growth trends; G₀₅, G₁₅, G₂₅, and G₃₅ are for the effects of MCO enrollment on the growth trends; G₀₆, G₁₆, G₂₆, and G₃₆ are for the effects of SCHIP enrollment on the growth trends; and G₀₇, G₁₇, G₂₇, and G₃₇ are for the effects of disabled enrollment on the growth trends.

^cDegrees of freedom for initial status are 5048.

^dDegrees of freedom for linear growth, quadratic growth, and cubic growth are 74565.



Note. AY = academic year. The sample size for eligible students enrolled in a participating school and enrolled in Medicaid was n = 5056. Total cost equals the quarterly total Medicaid reimbursement amount per student.

FIGURE 1—Growth trends of quarterly total Medicaid costs by school-based health center (SBHC) and race: Greater Cincinnati, OH, 1997–2003.

local children’s hospitals and Healthy School Healthy Community grants.

Resources saved from the health care sector included potential cost-savings for hospitalization, estimated as \$228 144 or \$970 per student with asthma,²⁴ and, according to Medicaid claims, potential savings for prescription drugs were estimated to be \$443 532. From the patient and family sector, SBHCs prevented productivity losses of \$542 761 by parents who would otherwise have had to take their children to other sources of care. We estimated the value of the parent’s time in the Cincinnati metropolitan region as equal to the blue- and white-collar combined average hourly rate of \$17.92. Over the 7572 SBHC encounters, the SBHCs saved parents between \$542 761 (4 hours work time per parent) and \$1 085 522 (8 hours work time per parent). Also, because students received care in the SBHCs their parents saved a substantial amount of travel expenses. From parent survey data, the average time to a physician’s office was 28 minutes round trip in an urban area and 46 minutes round trip in a rural area. With the rate of \$0.35 per mile, we estimated total travel expenses to be \$42 956.

Regarding resources saved from other sectors, SBHC staff identified and referred

students to additional primary care. With a Medicaid reimbursement rate of \$69 per visit, we estimated Medicaid spent \$42 642 for the 618 documented referrals. We also estimated the community multiplier effect as \$638 726 from a societal perspective, which was related to \$1.00 Medicaid spent for a \$3.15 multiplier effect in Ohio (written communication with Professors R. Greenbaum, PhD and A. Desai, PhD, Ohio State University, written communication, April 30, 2003). For the 42.25% of students with Medicaid, the community multiplier effect was estimated as:

$$(1) \$479\,929 \times 42.25\% \times 3.15 = \$638\,726.$$

Finally, the unquantifiable benefits included at least 5 aspects. First, SBHCs helped African American children and adolescents from low-income families get health care they may not have otherwise received, closing the gap in potential health care disparities (Figure 1). Second, about 80% of students in schools with SBHCs returned to class after SBHC encounters. We believe that students with better attendance are more successful at school. However, because this was beyond our study scope, we were unable to quantify this benefit. Third, increased early mental health services

received by students in SBHC schools may reduce costly future treatment of those students. Because of the limited time frame of this study, we were unable to quantify this impact. Fourth, increased dental care received by students in SBHC schools might prevent or reduce costly future dental treatment. Fifth, we found that students with asthma in schools with SBHCs had a lower risk of hospitalization and emergency room visits compared with that of students with asthma in schools without SBHCs. It is possible that students with asthma in schools with SBHCs had better asthma management. However, we were unable to quantify the benefit related to quality of life and future health care savings.

Net Social Benefit Estimation

On the basis of the assumptions made and the calculations performed, as described previously, we estimated the net social benefit of the SBHCs over the 3 years to be \$1.35 million. This is a low-end estimation that is based on total costs of \$1 998 659 and total benefits of \$3 350 746.

DISCUSSION

In the urban areas within Cincinnati, increased attention has been paid to racial and ethnic health disparities in an effort to increase the accessibility to health care services for African Americans and low-income families. When one considers that nearly 50% of the population in urban areas within Cincinnati is African American, it is very meaningful that SBHCs provide essential health care for these students and aim at eliminating barriers to health care.

SBHCs appear to have a significant ability to reduce health care access disparities among African Americans and disabled students because these groups received more primary care since SBHCs opened in September 2000. This suggests that having access to an SBHC can help reduce or eliminate access barriers to care and reduce health care disparities for these vulnerable populations—a matter of equity in utilization and not excess utilization. This finding should be robust because the time-series HLM analysis was employed to control for some variations in students’ ages and Medicaid enrollments.

The cost–benefit analysis showed that a net social benefit of the SBHC program in the 4 Ohio school districts was about \$1.35 million

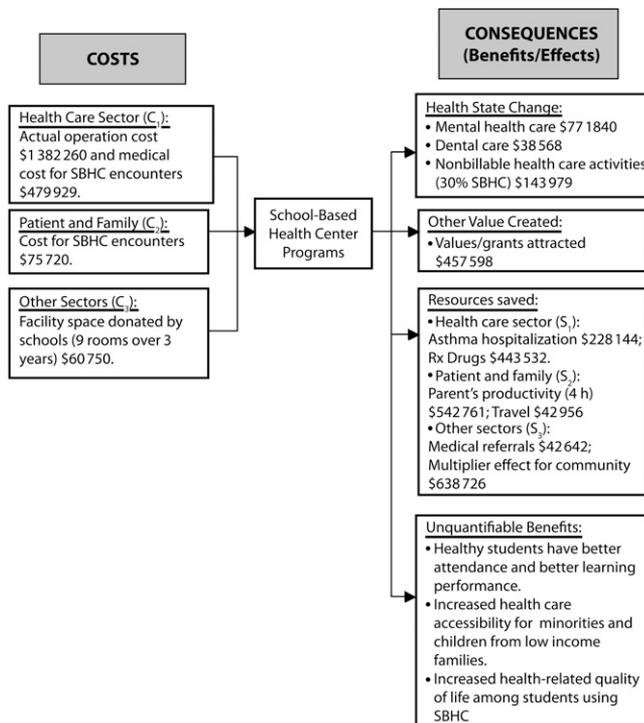


FIGURE 2—Estimated net social benefits of school-based health centers (SBHCs), with components of costs and benefits over the 3-year period: Greater Cincinnati, OH, 2001–2003.

over 3 years. Because Medicaid was the primary payer of services to children and adolescents, we also looked at the cost benefits to Ohio Medicaid. In our previously published studies and final report,^{24,25,40} students in SBHC schools benefited from more dental services, less prescription drug use, more mental health services, and fewer hospitalizations. Increased Medicaid costs of \$1179264 (increased dental care of \$121344 plus increased mental health services of \$1057920) were offset by the total savings of \$1713228 (savings of \$1395456 from prescription drugs and savings of \$317772 from hospitalization for students with asthma). Net 3-year Medicaid savings was \$533964, which equals roughly \$35.20 savings per child per year.

Our study does not account for the reported increase in health-related quality of life among students participating in SBHCs as compared with students in schools without SBHCs.⁴¹ These unquantifiable benefits of SBHCs may also exceed any extra costs to the Medicaid program. Although we can only speculate as to how much benefit there is to Medicaid, we still believe it is important for Medicaid to

foster improved access to health care for minorities and children from low-income families and to increase access to children's mental health services, dental care, and other health care.

Our study also has relevance to broader health policy issues. SBHCs provide important primary care for children and adolescents, indicating benefits to federal and state governments for improving coordination between the SBHCs and state Medicaid and managed care organizations.^{42–44} The SBHC schools in Greater Cincinnati have a large proportion of children and adolescents who are African American students from lower-income families. If one considers concerns about racial disparities and acknowledged barriers to care for the poor and uninsured, the SBHC program is particularly well suited to address these disparities, especially among students with chronic disease such as mental health conditions and asthma.

The SBHC is a model for providing quality health care services for children and adolescents that eliminates most barriers students face when they are trying to access health care. SBHCs address problems regarding

transportation, lack of nearby providers, lack of providers accepting public insurance, and parental difficulties getting time away from work to take a child to the doctor, which in turn helps parents retain employment and helps employers increase worker productivity. Moreover, they are in a unique position to reduce financial, language, familial, and cultural barriers in providing care for children and adolescents in the community in which they live. By providing services on-site, SBHCs help return students to the classroom more quickly, meaning they miss less instruction time.

Our study was limited to school-aged children and adolescents in the Greater Cincinnati area. We were unable to assess students with other insurance plans or no insurance because the primary data source used was retrospective Medicaid claims database. We also did not differentiate between students who were treated by the SBHCs and students in the SBHC schools who were not treated. Finally, during the 5.5-year study period, the natural history of disease epidemics among school-age children and adolescents varies along with maturation of students, which may influence the time trends.

In conclusion, SBHCs were cost beneficial to the society. The health care utilization for African American and disabled students increased after the SBHC program and closed the gaps of health care disparities. SBHCs should be seen as a health service delivery model to help address a lack of accessing timely care for disadvantaged students. ■

About the Authors

Jeff J. Guo is with the University of Cincinnati College of Pharmacy, Cincinnati, Ohio. At the time of the study, Terrance J. Wade was with University of Cincinnati Medical Center. Wei Pan is with College of Education, Criminal Justice and Human Services, University of Cincinnati. Kathryn N. Keller is with the Health Foundation of Greater Cincinnati, Cincinnati, Ohio.

Correspondence should be sent to Jeff J. Guo, PhD, Associate Professor, University of Cincinnati Medical Center College of Pharmacy, 3225 Eden Ave, Cincinnati, OH 45267-0004 (e-mail: jeff.guo@uc.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints/Eprints" link.

This article was accepted February 1, 2010.

Contributors

J.J. Guo and T.J. Wade originated the study and were responsible for research design, data collection, and article writing. W. Pan performed statistical analyses and contributed to writing pertinent sections. K.N. Keller was involved in research coordination and

contributed to writing pertinent sections. All authors conceptualized some ideas, interpreted findings, and reviewed drafts of the article.

Human Participant Protection

The research protocol was approved by the University of Cincinnati institutional review board.

Acknowledgments

This research was funded by a grant from The Health Foundation of Greater Cincinnati.

We are grateful to Patricia O'Connor and Ann McCracken from the Health Foundation of Greater Cincinnati and the Ohio Department of Jobs and Family Services. We are indebted to Tracy Huentelman and Kristin Line for their project coordination. We would like to thank Raymond Jang, Robert Cluxton, Thomas Young, Kathleen E. Adams, Arthur Kendall, Linda Juszcak, Daniel Mullins, John Schlitt, Melvin Mark, and Anand Desai for their expert consultations and comments on our research design and data analyses. We appreciate data programming and statistical support from Mona Ho, Gregory Roth, Mark Carrozza, and Beth-Ann Witherow.

Note. The opinions and conclusions expressed in this article are solely those of the authors.

References

1. Institute of Medicine. *Unequal Treatment. Confronting Racial and Ethnic Disparities: View Health Care*. Washington, DC: The National Academies Press; 2003.
2. Cook BL. Effect of Medicaid managed care on racial disparities in health care access. *Health Serv Res*. 2007; 42(1 pt 1):124–145.
3. Smedley BD, Stith AY, Nelson AR, eds. *Board on Health Sciences Policy. Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. Executive Summary*. Washington, DC: Institute of Medicine, National Academy Press; 2002.
4. Lillie-Blanton M, Parsons P, Gayle H, Dievler A. Racial differences in health: not just black and white but shades of gray. *Annu Rev Public Health*. 1996;17:411–448.
5. Weinick RM, Zuvekas SH, Cohen JW. Racial and ethnic differences in access to and use of health services, 1977–1996. *Med Care Res Rev*. 2000;57(suppl 1):36–54.
6. Centers for Disease Control and Prevention, Office of Minority Health. Health disparities experienced by Black or African Americans—United States. *MMWR Morb Mortal Wkly Rep*. 2005;54(1)1–3.
7. Centers for Disease Control and Prevention. *Health, United States, 2004; With Chartbook on Trends in the Health of Americans*. Table 30. Hyattsville, MD: National Center for Health Statistics; 2004. Available at: <http://www.cdc.gov/nchs/data/hsr/hsr04trend.pdf#03>. Accessed June 30, 2006.
8. McKinnon J. The Black population 2000. Census 2000 brief. Washington, DC: US Dept of Commerce, US Census Bureau; 2001. Available at: <http://www.census.gov/prod/2001pubs/c2kbr01-5.pdf>. Accessed June 30, 2006.
9. Cooper GS, Koroukian SM. Geographic variation among Medicare beneficiaries in the use of colorectal carcinoma screening procedures. *Am J Gastroenterol*. 2004;99(8):1544–1550.
10. Cooper GS, Yuan Z, Landefeld CS, Rimm AA. Surgery for colorectal cancer: race-related differences in

- rates and survival among Medicare beneficiaries. *Am J Public Health*. 1996;86(4):582–586.
11. Bernabei R, Gambassi G, Lapane K, et al. Management of pain in elderly patients with cancer. Systematic assessment of geriatric drug use via epidemiology. *JAMA*. 1998;279(23):1877–1882.
12. Richters JE, Arnold LE, Jensen PS, et al. NIMH collaborative multisite multimodal treatment study of children with ADHD: I. Background and rationale. *J Am Acad Child Adolesc Psychiatry*. 1995;34(8):987–1000.
13. Goldman LS, Genel M, Bezman RJ, Slanetz PJ. Diagnosis and treatment of attention-deficit/hyperactivity disorder in children and adolescents. Council on Scientific Affairs, American Medical Association. *JAMA*. 1998;279(14):1100–1107.
14. Akinbami LJ, LaFleur BJ, Schoendorf KC. Racial and income disparities in childhood asthma in the United States. *Ambul Pediatr*. 2002;2(5):382–387.
15. Newacheck PW, Halfon N. Prevalence, impact, and trends in childhood disability due to asthma. *Arch Pediatr Adolesc Med*. 2000;154(3):287–293.
16. Wells R, Hillemeier MM, Bai Y, Belue R. Health service access across racial/ethnic groups of children in the child welfare system. *Child Abuse Negl*. 2009;33(5):282–292.
17. Coker TR, Elliott MN, Kataoka S, et al. Racial/ethnic disparities in the mental health care utilization of fifth grade children. *Acad Pediatr*. 2009;9(2):89–96.
18. Howell E, McFeeters J. Children's mental health care: differences by race/ethnicity in urban/rural areas. *J Health Care Poor Underserved*. 2008;19(1):237–247.
19. US Surgeon General. Mental health: a report of the surgeon general. Washington, DC: US Dept of Health and Human Services; 1999. Available at: <http://www.surgeongeneral.gov/library/index.html>. Accessed June 30, 2006.
20. Schlitt J, Santelli J, Juszcak L, et al. Creating access to care: school-based health center census 1998–1999. Washington, DC: National Assembly on School-Based Health Care; 2000. Available at: <http://www.nasbhc.org/site>. Accessed June 30, 2006.
21. Dryfoos JG. School-based health centers in the context of education reform. *J Sch Health*. 1998;68(10):404–408.
22. Lear JG. Health at school: a hidden health care system emerges from the shadows. *Health Aff (Millwood)*. 2007;26(2):409–419.
23. Guo JJ, Wade TJ, Keller KN. Impact of school-based health centers on students with mental health problems. *Public Health Rep*. 2008;123(6):768–780.
24. Guo JJ, Jang R, Keller KK, McCracken A, Pan W, Cluxton RJ. Impact of school-based health centers on children with asthma. *J Adolesc Health*. 2005;37(4):266–274.
25. Young TL, D'angelo SL, Davis J. Impact of a school-based health center on emergency department use by elementary school student. *J Sch Health*. 2001;71(5):196–198.
26. Adams EK, Johnson V. An elementary school-based health clinic: can it reduce Medicaid costs? *Pediatrics*. 2000;105(4 pt 1):780–788.
27. Kaplan DW, Brindis CD, Phibbs SL, Melinkovich P, Naylor K, Ahlstrand K. A comparison study of an elementary school-based health center: effects on health care access and use. *Arch Pediatr Adolesc Med*. 1999; 153(3):235–243.
28. Kaplan DW, Calonge BN, Guernsey BP, Hanrahan MB. Managed care and school-based health centers. Use of health services. *Arch Pediatr Adolesc Med*. 1998;152(1):25–33.
29. Meeker RJ, DeAngelis C, Berman B, Freeman HE, Oda D. A comprehensive school health initiative. *Image J Nurs Sch*. 1986;18(3):86–91.
30. Fisher M, Juszcak L, Friedman SB, Schneider M, Chapar G. School-based adolescent health care. Review of a clinical service. *Am J Dis Child*. 1992;146(5):615–621.
31. Balassone ML, Bell M, Peterfreund N. A comparison of users and nonusers of a school-based health and mental health clinic. *J Adolesc Health*. 1991;12(3):240–246.
32. Walter HJ, Vaughan RD, Armstrong B, Krakoff RY, Tiezzi L, McCarthy JF. School-based health care for urban minority junior high school students. *Arch Pediatr Adolesc Med*. 1995;149(11):1221–1225.
33. Weist MD, Paskewitz DA, Warner BS, Flaherty LT. Treatment outcome of school-based mental health services for urban teenagers. *Community Ment Health J*. 1996;32(2):149–157.
34. Anglin TM, Naylor KE, Kaplan DW. Comprehensive school-based health care: high school students' use of medical, mental health, and substance abuse services. *Pediatrics*. 1996;97(3):318–330.
35. Wade TJ, Keller KN, Guo JJ, Huentelman T, Line K, Mansour ME. Access and utilization patterns across the first three years of implementation of elementary and middle school school-based health centers. *Public Health Rep*. 2008;123(6):739–750.
36. Drummond MF, O'Brien B, Stoddart GL, et al. *Methods for the Economic Evaluation of Health Care Programs*. New York, NY: Oxford University Press; 1999:52–96.
37. Bureau of Labor Statistics. Consumer Price Index for all urban consumers 1997, 1998, 1999, 2000, 2001, 2002. Washington DC: US Dept of Labor. Available at: <http://www.bls.gov>. Accessed June 1, 2003.
38. Bureau of Labor Statistics. Medical care inflation continues to rise. Washington DC: US Dept of Labor; 2001. Available at: <http://www.bls.gov/opub/med>. Accessed June 1, 2003.
39. Raudenbush SW, Bryk AS. *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2nd ed. Thousand Oaks, CA: Sage; 2002.
40. Guo JJ, Jang R, Cluxton RJ. Evaluation of health outcomes and costs among Medicaid recipients enrolled in school-based health centers. A prescription for success. Cincinnati, OH: Health Foundation for Greater Cincinnati; 2004. Available at <http://www.healthfoundation.org/publications.html>. Accessed June 30, 2006.
41. Wade TJ, Mansour M, Line K, Huentelman T, Keller KE. Improvements in health-related quality of life among school-based health center users in elementary and middle school. *Ambul Pediatr*. 2008;8(4):241–249.
42. Health care: school-based health centers can expand access for children. Washington DC: US Government Accounting Office; 1994. GAO publication GAO/HEHS 95–35.
43. Leonard M. GAO: Health reform could help school-based health centers. *Nations Health*. 1994;24(6):3–4.
44. Waxman HA. Juvenile detention centers: warehousing children with mental illness? The House Committee on Government Reform. Washington, DC: US Congress; 2004. Available at: <http://oversight.house.gov>. Accessed June 30, 2006.