



HHS Public Access

Author manuscript

JAMA Pediatr. Author manuscript; available in PMC 2022 July 05.

Published in final edited form as:

JAMA Pediatr. 2014 July ; 168(7): 642–648. doi:10.1001/jamapediatrics.2013.5441.

Cost-Benefit Study of School Nursing Services

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Abstract

IMPORTANCE—In recent years, across the United States, many school districts have cut on-site delivery of health services by eliminating or reducing services provided by qualified school nurses. Providing cost-benefit information will help policy makers and decision makers better understand the value of school nursing services.

OBJECTIVE—To conduct a case study of the Massachusetts Essential School Health Services (ESHS) program to demonstrate the cost-benefit of school health services delivered by full-time registered nurses.

DESIGN, SETTING, AND PARTICIPANTS—Standard cost-benefit analysis methods were used to estimate the costs and benefits of the ESHS program compared with a scenario involving

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Ms Wang and Dr Vernon-Smiley had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Wang, Vernon-Smiley, Gapinski, Maughan.

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Statistical analysis: Wang, Vernon-Smiley.

Administrative, technical, or material support: Wang, Gapinski, Desisto, Maughan.

Study supervision: Wang, Sheetz.

Conflict of Interest Disclosures: None reported.

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no school nursing service. Data from the ESHS program report and other published studies were used. A total of 477 163 students in 933 Massachusetts ESHS schools in 78 school districts received school health services during the 2009-2010 school year.

INTERVENTIONS—School health services provided by full-time registered nurses.

MAIN OUTCOMES AND MEASURES—Costs of nurse staffing and medical supplies incurred by 78 ESHS districts during the 2009-2010 school year were measured as program costs. Program benefits were measured as savings in medical procedure costs, teachers' productivity loss costs associated with addressing student health issues, and parents' productivity loss costs associated with student early dismissal and medication administration. Net benefits and benefit-cost ratio were calculated. All costs and benefits were in 2009 US dollars.

RESULTS—During the 2009-2010 school year, at a cost of \$79.0 million, the ESHS program prevented an estimated \$20.0 million in medical care costs, \$28.1 million in parents' productivity loss, and \$129.1 million in teachers' productivity loss. As a result, the program generated a net benefit of \$98.2 million to society. For every dollar invested in the program, society would gain \$2.20. Eighty-nine percent of simulation trials resulted in a net benefit.

CONCLUSIONS AND RELEVANCE—The results of this study demonstrated that school nursing services provided in the Massachusetts ESHS schools were a cost-beneficial investment of public money, warranting careful consideration by policy makers and decision makers when resource allocation decisions are made about school nursing positions.

During the past few decades, several major changes in our society have greatly increased the demand for school nursing services, including a rise in the number of students with chronic health conditions and mental health problems,¹⁻⁵ an increase in the number of students with special care needs, and improved medical technology. As a result, school nursing services have expanded greatly from their original focus of reducing communicable disease-related absenteeism to providing episodic care, managing chronic health conditions, caring for students with disabilities, promoting health behaviors, enrolling children in health insurance and connecting them with health care providers, tracking communicable diseases, and handling medical emergencies.⁶ These services may be provided more promptly if a school nurse is in the school. The National Association of School Nurses⁷ states that every school-aged child deserves a registered nurse, and every school should have a full-time school nurse all day, every day; however, many schools across the United States do not meet this recommendation. Only 45% of the nation's public schools have a full-time on-site nurse; 30% have one who works part-time, often dividing his or her hours between several school buildings; and 25% have no nurse.⁸

School nursing services are typically funded with education dollars. When budget cuts occur, school nurses are often the first to be let go because few states mandate a nurse to be in every school. In recent years, across the country, many districts have cut school nursing services by eliminating nurses, reducing their hours, or replacing them with untrained employees.^{9,10} These cutbacks could have a negative effect on the health of millions of US children, including those who have chronic diseases, have a low socioeconomic status, and depend on medical devices and daily medications.

A growing body of research has examined the effect of school nursing services on students and teachers. On-site school nursing services were effective in improving student health¹¹ and student attendance,^{12,13} reducing early dismissals^{14–16} and reducing teacher time spent on dealing with student illness or injury.^{17,18} However, to our knowledge, no study has assessed the economic impact of school nursing services. The objective of this study was to conduct a case study of the Massachusetts Essential School Health Services (ESHS) program to demonstrate the cost-benefit of school health services delivered by full-time baccalaureate-prepared registered nurses.

Methods

Analytical Framework

A societal perspective and standard cost-benefit analysis methods¹⁹ were used to assess the costs and benefits of school nursing services delivered by full-time registered nurses in the ESHS schools compared with a scenario involving no school nursing services. The “no school nursing services” scenario is hypothetical, in which we projected medical procedure costs, teachers’ productivity loss costs associated with addressing student health issues, and parents’ productivity loss costs associated with student early dismissals and medication administrations when no professional nursing services were provided at schools, given that student needs for health services remain unchanged. We also estimated teachers’ productivity loss costs associated with addressing student health issues and parents’ productivity loss costs related to student early dismissals in the ESHS scenario. The differences in those costs between the 2 scenarios were costs averted or savings resulting from school nursing services and were measured as program benefits. Costs of school nursing services incurred during the 2009-2010 school year were measured as program costs, which included school nurse salary, fringe benefits, and costs of medical supplies. Net benefits and the benefit-cost ratio of school nursing services in the ESHS schools were calculated. All costs and benefits were in 2009 US dollars.

The major data source of this study was the 2009-2010 ESHS program report, which provides a detailed summary of school health services that took place in 78 districts during the school year.²⁰ Between September 1, 2009, and June 30, 2012, a total of 1157 full-time registered nurses in 933 schools reported 4 946 757 student health encounters and 99 903 school staff health encounters. School nurses performed 1 016 140 medical procedures and administered 1 191 060 doses of medication. After assessment and/or treatment by a school nurse, 6.2% of students were dismissed from school early due to illness or injury. In addition to the ESHS data, some published estimates from the existing literature also were used in this study. Institutional review board approval was not required for this study.

Medical Procedure Costs

As shown in Table 1, school nurses performed 22 types of medical procedures during the school year. Many of those procedures are customarily provided in a traditional medical care setting (eg, clinic or hospital). These procedures or treatments refer to activities provided for a preexisting condition, which usually requires a physician order. They are an indicator of skilled nursing care and not activities that are part of a nursing assessment to

determine nursing interventions.²¹ These reported procedures demonstrated the professional services needs that the students had during school hours, and the needs for most of these procedures would not change regardless of whether a school nurse was present. In the scenario involving no school nursing services, we assumed that these procedures would have been performed by physicians or nurses in a medical setting, resulting in medical care costs. Although some procedures or treatments might be addressed by parents outside of school hours when no school nurse is available (eg, nebulizer treatment), most cannot be provided by a nonprofessional during school hours. To estimate medical care costs associated with those procedures, we first identified *Current Procedural Terminology* or *Healthcare Common Procedure Coding* codes for those procedures (see code descriptions in the eTable in the Supplement). We then used these codes to obtain medical cost estimates of both Medicaid and non-Medicaid insurance for those procedures (see details in Table 1). On the basis of student insurance information provided in the ESHS report, we calculated the weighted mean costs of Medicaid and non-Medicaid insurance. We used the weighted mean costs for the base-case analysis and the range of the mean costs $\pm 20\%$ for the sensitivity analysis.

Parents' Productivity Loss Costs Associated With Student Early Dismissal

Several published studies have compared the number or percentage of students sent home by school nurses vs unlicensed personnel. Wyman¹⁵ assessed the number of students in a Midwest urban public school district who were dismissed from school early for illness or injury with or without contact with a school nurse. Data were collected for 3½ weeks from 6 schools with 3132 students in kindergarten through grade 12. The comparison was between the days with and without an on-site school nurse. The study found that 58 students were dismissed with and 167 without a school nurse contact. Pennington and Delaney¹⁴ conducted a similar study in Kentucky, collecting data for 5 months from 2100 students in kindergarten through grade 12. They compared early dismissals between the hours with and without an on-site school nurse and found that of the students sent home, 5% had been seen by a school nurse vs 18% seen by unlicensed school staff. The results of these 2 studies indicate that the dismissal rate without a nurse can be 3 times higher than that with a school nurse. According to the ESHS report, 6.2% of students visiting the nurse office with an illness or injury were dismissed early from school compared with 11.0% of students who were dismissed or stayed in a health or counselor office in 50 non-ESHS schools. The non-ESHS schools had at least 1 part-time school nurse in every school, with a slightly higher student-to-nurse ratio than did the ESHS schools (466:1 vs 412:1). Therefore, the true dismissal rate in the ESHS schools when no school nurse was available should be at least higher than the 11.0% experienced in the non-ESHS schools when a part-time nurse was available. If we apply the 3 times difference from the 2 studies mentioned earlier, the dismissal rate without a school nurse contact may well be 18.6% (3 times the dismissal rate of 6.2%). To be conservative, we used the midpoint of 11.0% and 18.6% for our base-case analysis and a range of 11.0% to 18.6% for the sensitivity analysis.

To estimate productivity costs of parents, we used a published estimate of annual mean earnings of \$36 206¹⁹ to calculate the value of a lost hour of work. The value of a lost hour of work for all adults is \$18. The ESHS program did not collect data on the number of

school hours students missed per early dismissal. The study by Wyman¹⁵ showed that 42.3% of the early dismissals due to illness or injury occurred in the first half of the day and 57.7% were in the second half. For simplicity, we used a mean of 3 hours (half a school day) for our base-case analysis, with a range of 2 to 4 hours for the sensitivity analysis. The costs of parents' productivity loss were calculated as the product of the number of health encounters, early dismissal rate, the number of school hours missed per early dismissal, and the value of a lost hour (Table 2).

Parents' Productivity Loss Costs Associated With Medication Administration

According to the ESHS report, school nurses in the 78 ESHS districts administered a mean of 119 106 doses of medication to students per month, including 59.9% scheduled prescription medications, 14.5% as-needed prescription medications, and 25.6% nonprescription medications written by school physicians.²⁰ The fact that those medications were administered during school hours proved that students had to take those medications during school hours regardless of whether a nurse was present. The Massachusetts regulation requires a school nurse to be on duty in the school system while prescription medications are administered by delegated unlicensed school personnel. Thus, it is reasonable to assume that parents have to go to school to administer medications if there is no school nurse in the school system. However, to generate conservative benefit estimates, in the base-case analysis, we assumed that parents only need to come to school to administer prescription medications, thereby using 74.4% of the total number of doses (both scheduled and as-needed prescription medications) for our base-case analysis, with a range of 59.9% (scheduled prescription medications) to 100% (all medications administered during school hours) of the total number of doses for the sensitivity analysis. For the base-case analysis, we assumed that parents have to spend a mean of 30 minutes for each medication administration at schools, which includes travel time and time spent at school. For the sensitivity analysis, a range of 15 to 60 minutes was used. The annual costs of parents' productivity loss associated with medication administration was calculated as the product of the annual number of doses of medication administered, the number of hours parents incur for medication administration at school, and the value of a lost hour (Table 2).

Teachers' Productivity Loss Costs

Although the ESHS program did not collect information on the time teachers spent on health issues, 2 recent studies provide valuable information on this topic. Baisch et al¹⁸ published the results of a cross-sectional study on the amount of time school staff spent on student health issues before and after a nurse was assigned to their school. Data were collected from 634 school staff members (565 teachers) of 11 schools (elementary, middle, and high schools) in a large urban school district in a major Midwestern city. Teachers reported a mean decrease of 20 minutes per day (26 minutes before and 6 minutes after having a school nurse). Hill and Hollis¹⁷ conducted a cross-sectional study to assess the association between hours of having a school nurse present and hours the teacher spent on managing health issues. Data were collected from a 2-year survey of elementary school teachers in 1 county of western North Carolina, where nearly 50% of students are eligible for free or reduced meals. In year 1, school nurses spent 2 hours per day and teachers spent 80 minutes per day

managing health issues. In year 2, school nurses spent 3.6 hours per day and teachers spent 46 minutes dealing with health issues.

Because our study focused on the difference between having a full-time registered nurse providing health services and having no school nursing services, we used the number of minute estimates from the study by Baisch et al¹⁸ in this analysis. For the sensitivity analysis, we varied the difference of 20 minutes from 0 to 40 minutes. The costs of teachers' productivity loss were calculated as the product of the total number of teachers, the annual number of hours the teachers spent addressing health issues, and the mean hourly pay and fringe benefits per teacher (Table 2).

Sensitivity Analysis

In our base-case analysis, there is uncertainty caused by the assumptions used and parameter estimates derived in the previously published studies. To test how those assumptions and parameter estimates affected the main results, we conducted a multivariate sensitivity analysis on all major parameters as stated earlier. Monte Carlo simulation of 10 000 trials was performed using @RISK (Palisade Corp). Parameter values for each simulation trial were selected randomly from a plausible range identified assuming a uniform distribution of values for teachers' time spent on health issues and a triangular distribution of values for all other parameters.

Results

Table 3 summarizes the base-case results. During the 2009-2010 school year, at a program cost of \$79.0 million, the ESHS program in 78 districts prevented an estimated \$20.0 million in medical care costs, \$28.1 million in parents' productivity costs, and \$129.1 million in teachers' productivity costs. As a result, the program generated a net benefit of \$98.2 million to society. For every dollar invested in the program, society would gain \$2.20.

Table 4 shows the sensitivity analysis results. In 95% of the 10 000 simulation trials of the multivariate sensitivity analysis, total costs averted by the ESHS ranged from \$56.3 to \$302.1 million. The benefit-cost ratio ranged from 0.7 to 3.8. Eighty-nine percent of the simulation trials resulted in a net benefit.

Discussion

The current study fills a void in the current literature by conducting a case study of an ESHS program to examine the cost-benefit of school nursing services delivered by full-time registered nurses. On the basis of the assumptions made and the data used in this study, school nursing services provided in the 933 ESHS schools generated an estimated net benefit of \$98.2 million to society during the 2009-2010 school year. For every dollar invested in the program, society would gain \$2.20. Eighty-nine percent of the 10 000 simulation trials resulted in a net benefit. The results of this study demonstrated that school nursing services provided in the ESHS schools were a cost-beneficial investment of public money, warranting careful consideration by policy makers and decision makers when resource allocation decisions are made about school nursing positions.

The findings of this study suggest that from a societal perspective (not the perspective of the school system or payers), the benefits of school nursing services may well exceed the costs of those services. School nursing services can be a benefit to schools, families, the health care system, and the community at large through increased student attendance, improved teacher and worker productivity, and reduced health care costs. To achieve all those benefits, schools must have a full-time registered nurse. In schools where education budgets are constrained and school nursing services are low priority in education budgets, education agencies can work with partners in the health care system to explore other funding sources for school nursing services. Health care system partners might value their contributions to such partnerships as a part of their community benefit investment.²²

Because every school in the ESHS program had a full-time registered nurse, this study focused on analyzing school nursing services provided by full-time registered nurses, not part-time nurses. Data reflective of school nursing services provided by part-time nurses would be needed to perform such an analysis. Other services provided by the ESHS nurses were not accounted for in this analysis, such as connecting students to health care and insurance providers, identifying undiagnosed conditions, and providing health education and health promotion.²⁰ Including these benefits or services in our analysis could result in higher benefits than we estimated.

This study has several limitations. First, the benefits of the ESHS program were projected, not directly measured. Second, the cost-benefit estimates generated for the Massachusetts program may not be generalizable to other states because of the differences in teacher salaries and other costs. Third, because we derived the estimate of teacher time spent on addressing health issues from a large urban school system, our base-case result might be an overstatement for a rural school system. Fourth, we made some assumptions when no data were available for certain input parameters, such as the mean number of hours parents spent in administering medications at school when no school nurse was present. Fifth, we were not able to quantify the volume and associated costs for any procedures or treatments that might have been addressed by parents outside of school hours when no school nurse was present. Because of these limitations, we have been cautious in our approach and have carefully conducted a multivariate sensitivity analysis by varying those major parameter estimates over a plausible wide range.

Conclusions

To our knowledge, this is the first economic study of school nursing services, providing results that will allow policy makers and decision makers in all sectors to better understand the value of school nursing services. The analytical approach developed in this study can be used by any state or district to assess the cost-benefit of its school nursing programs. School nurses can regularly record their service activities, such as the number of encounters, medications administered, medical procedures, and other types of services provided. The success of data reporting in Massachusetts suggests that school nurses can do this with a minimal burden or negative effect on the delivery of services. They can also work with other school staff members to regularly collect data on school absence, early dismissals, and 911

calls related to illness or injury. As these data are collected, future research could incorporate these variables to strengthen the cost-benefit estimates of school nursing services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

REFERENCES

1. Perrin JM, Bloom SR, Gortmaker SL. The increase of childhood chronic conditions in the United States. *JAMA*. 2007;297(24):2755–2759. [PubMed: 17595277]
2. Branum AM, Lukacs SL. Food allergy among children in the United States. *Pediatrics*. 2009;124(6):1549–1555. [PubMed: 19917585]
3. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980–2007. *Pediatrics*. 2009;123(suppl 3):S131–S145. [PubMed: 19221156]
4. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the US, 2011. http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf. Accessed March 27, 2014.
5. Robison LM, Sclar DA, Skaer TL, Galin RS. National trends in the prevalence of attention-deficit/hyperactivity disorder and the prescribing of methylphenidate among school-age children: 1990–1995. *Clin Pediatr (Phila)*. 1999;38(4):209–217. [PubMed: 10326176]
6. Robert Wood Johnson Foundation. *Unlocking the Potential of School Nursing: Keeping Children Healthy*. In: *School, and Ready to Learn*. Washington, DC: Robert Wood Johnson Foundation; 2010.
7. National Association of School Nurses. School nurses provide back-to-school checklist for parents. http://www.nasn.org/Portals/0/releases/2012_08_07_Parent_Checklist.pdf. Accessed March 27, 2014.
8. Burkhardt Research Services. *School Nursing in the United States: A Quantitative Study*. Silver Spring, MD: National Association of School Nurses; 2007.
9. Delack S. Vision, voice, and visibility: charting the course. *NASN Sch Nurse*. 2009;24(5):176–177. [PubMed: 20440924]
10. Vollinger LJ, Bergren MD, Belmonte-Mann F. Substitutes for school nurses in Illinois. *J Sch Nurs*. 2011;27(2):111–119.
11. Noyes K, Bajorska A, Fisher S, Sauer J, Fagnano M, Halterman JS. Cost-effectiveness of the School-Based Asthma Therapy (SBAT) program. *Pediatrics*. 2013;131(3):e709–e717. [PubMed: 23400614]
12. Weismuller PC, Grasska MA, Alexander M, White CG, Kramer P. Elementary school nurse interventions: attendance and health outcomes. *J Sch Nurs*. 2007;23(2):111–118. [PubMed: 17394381]
13. Telljohann SK, Dake JA, Price JH. Effect of full-time versus part-time school nurses on attendance of elementary students with asthma. *J Sch Nurs*. 2004;20(6):331–334. [PubMed: 15560730]
14. Pennington N, Delaney E. The number of students sent home by school nurses compared to unlicensed personnel. *J Sch Nurs*. 2008;24(5):290–297. [PubMed: 18941153]
15. Wyman LL. Comparing the number of ill or injured students who are released early from school by school nursing and nonnursing personnel. *J Sch Nurs*. 2005;21(6):350–355. [PubMed: 16285845]
16. Allen G. The impact of elementary school nurses on student attendance. *J Sch Nurs*. 2003;19(4):225–231. [PubMed: 12882606]
17. Hill NJ, Hollis M. Teacher time spent on student health issues and school nurse presence. *J Sch Nurs*. 2012;28(3):181–186. [PubMed: 22140140]
18. Baisch MJ, Lundeen SP, Murphy MK. Evidence-based research on the value of school nurses in an urban school system. *J Sch Health*. 2011;81(2):74–80. [PubMed: 21223274]
19. Haddix AC, Teutsch SM, Corso PS. *Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation*. New York, NY: Oxford University Press; 2003.

20. Massachusetts Department of Public Health. The Essential School Health Services Program Data Report, 2009-2010 School Year. 2011. <http://www.mass.gov/eohhs/docs/dph/com-health/school/eshs-report-09-10.pdf>. Accessed March 27, 2014.
21. Massachusetts Department of Public Health. Suggested best practice guidelines to complete the monthly MA DPH report via HealthOffice V5.5 SP1. 2009. <http://www.healthmaster.com/HODL/HO56SP9/904%20Best%20Practice%20Guidelines.pdf>. Accessed March 27, 2014.
22. Young GJ, Chou CH, Alexander J, Lee SY, Raver E. Provision of community benefits by tax-exempt U.S. hospitals. *N Engl J Med*. 2013;368(16):1519–1527. [PubMed: 23594004]

Table 1. Medical Procedure Costs if Performed by Physicians or Nurses in a Medical Setting

Procedure	CPT or HCPC Code	No. of Procedures Performed Monthly		Medicaid Fee or Midpoint of Fee Range ^a	Non-Medicaid Fee or Midpoint of Fee Range ^b	Weighted Mean of Medicaid and Non-Medicaid	Annual Procedure Costs	
		Students	Staff				Students	Staff
Administer immunizations	90471	5141	1288	16.52	29.50	24.84	1 277 064	379 960
Auscultate lungs ^c	T1002/S9123	14 216	261	9.09	15.85	13.42	1 908 240	41 369
Blood glucose testing	82962	31 013	81	2.96	20.00	13.88	4 305 820	16 200
Blood pressure monitoring	99211	2805	1735	10.05	49.50	35.34	991 223	858 825
Carbohydrate insulin calculation ^c	T1002/S9123	11 655	4	9.09	15.85	13.42	1 564 472	634
Catheter care ^c	T1002/S9123	2307	3	9.09	15.85	13.42	309 673	476
Central line care ^c	T1002/S9123	89	1	9.09	15.85	13.42	11 947	159
Check ketones	81000	1408	2	4.01	24.00	16.83	236 901	480
Device adjustment	99002	1571	9	0.00	39.00	25.00	392 734	3510
Insulin pump care ^c	T1002/S9123	11 047	185	9.09	15.85	13.42	1 482 859	29 323
IV infusion care ^c	T1002/S9123	4474	3	9.09	15.85	13.42	600 553	476
Nebulizer treatment	94640	35	3	11.78	60.00	42.69	14 941	1800
Ostomy care	43760	1079	6	164.54	369.50	295.92	3 192 957	22 170
Oxygen administration ^c	T1002/S9123	408	2	9.09	15.85	13.42	54 767	317
Oxygen saturation check	94760	190	3	1.94	40.00	26.34	50 039	1200

Procedure	CPT or HCPC Code	No. of Procedures Performed Monthly			Medicaid Fee or Midpoint of Fee Range ^a	Non-Medicaid Fee or Midpoint of Fee Range ^b	Weighted Mean of Medicaid and Non-Medicaid	Annual Procedure Costs		
		Students	Staff	Staff				Students	Staff	
Peak flow monitoring ^c	T1002/S9123	3993	100	9.09	15.85	13.42	535 988	15 850		
Physical therapy	97110	1279	26	11.82	57.50	41.10	525 671	14 950		
Suctioning ^c	T1002/S9123	786	5	9.09	15.85	13.42	105 506	793		
Tracheostomy care ^c	T1002/S9123	182	0	9.09	15.85	13.42	24 430	0		
Tube care or use ^c	T1002/S9123	88	1	9.09	15.85	13.42	11 812	159		
Weight measurement ^c	T1002/S9123	3484	1	9.09	15.85	13.42	467 664	159		
Wound care	97597	458	187	33.62	104.00	78.73	360 605	194 480		

Abbreviations: CPT, Current Procedural Terminology; HCPC, Healthcare Common Procedure Procedure Coding; IV, intravenous.

^aData were from the Massachusetts Medicaid Fee Schedule.

^bData were from Physicians' Fee and Coding Guide 2009 and the HCPC system.

^cProcedures are not directly transferable to CPT codes or fees unavailable; costs are based on registered nurse services up to 15 minutes.

Table 2.

Parameters Used in Estimating Costs of School Nursing Services and Costs of Lost Productivities^a

Parameter	Value	Source
No. of districts	78	ESHS report, 2009-2010
No. of schools	933	ESHS report, 2009-2010
No. of students	477 163	ESHS report, 2009-2010
No. of nurses	1157	ESHS report, 2009-2010
No. of teachers	34 283	2009-2010 Massachusetts Teacher Salaries Report
Teacher, \$		
Annual salary	70 196	2009-2010 Massachusetts Teacher Salaries Report
Salary and fringe benefits	91 255	Authors' calculation
Hourly salary and fringe benefits	63	Authors' calculation
Nurse, \$		
Annual salary	53 438	ESHS nurse director survey
Salary and fringe benefits	69 469	Authors' calculation
Value, \$		
A day lost per parent	145	Bureau of Labor Statistics ¹⁹
An hour lost per parent	18	Authors' calculation
No. of hours missed per dismissal (range)	3 (2-4)	Authors' assumption
No. of student encounters due to illness or injury	4 289 589	ESHS report, 2009-2010
Students dismissed from school due to illness or injury when a nurse is present, %	6.2	ESHS report, 2009-2010
Students dismissed from school due to illness or injury when a nurse is not present (range), %	14.8 (11.0-18.6)	Assumption (midpoint between 11.0% of non-ESHS schools and 18.6% of published studies)
Parents' time spent on traveling and administering medications at school (range), min	30.0 (15.0-60.0)	Authors' assumption
Teachers' time spent per day on dealing with illness or injury when a nurse is present, min	6.2	Baisch et al ¹⁸
Teachers' time spent per day on dealing with illness or injury when nurse is not present, min	26.2	Baisch et al ¹⁸
Time saved per teacher per day (range), min	20.0 (0.0-40.0)	Baisch et al ¹⁸ and author assumption
No. of medication doses administered	1 191 060	ESHS report, 2009-2010
Medication doses that would have been administered by parents at school if nurse was not present (range), %	0.74 (0.60-1.00)	Authors' assumption based on ESHS report, 2009-2010
Medical equipment and supply costs per student, \$	4.53	ESHS nurse director survey

Abbreviation: ESHS, Essential School Health Services.

^aValues are presented as means unless otherwise indicated.

Table 3.

Base-Case Analysis Results^a

Characteristic	Nurse		Difference
	With	Without	
School nursing services costs, \$			
School nurse salary and fringe benefits	76 902 415	0	76 902 415
Medical equipment and supply costs	2 145 293	0	2 145 293
Parents' productivity loss costs, \$			
Due to early dismissals	14 437 432	34 520 467	20 083 035
Due to giving medications at school	0	8 030 722	8 030 722
Teachers' productivity loss costs due to dealing with students' illness or injury, \$	40 319 125	169 417 864	129 098 738
Procedure costs if performed by physicians and nurses in a medical setting, \$	0	20 009 129	20 009 129
Total costs of school health services, \$			79 047 709
Total benefits, \$			177 221 624
Net benefits, \$			98 173 915
Benefit-cost ratio			2.24

^a All costs were estimated in 2009 US dollars. The difference between the sum of the first two sets of numbers in the last column and the total cost is due to rounding.

Table 4.

Multivariate Sensitivity Analysis Results ^a

Costs and Benefits	Results of 95% of Simulation Trials
School nursing services costs, \$	
School nurse salary and fringe benefits	76 902 415
Medical equipment and supply costs	2 145 293
Reduced parents' productivity loss, \$	
Due to reduced early dismissals	12 081 820 to 29 647 080
Due to reduced medication administration by parents at school	5 190 689 to 15 984 340
Reduced teachers' productivity loss in addressing student health issues, \$	6 438 192 to 251 742 200
Savings in medical procedure costs, \$	19 068 550 to 20 945 790
Total costs of school health services, \$	79 047 709
Total benefits, \$	56 269 360 to 302 059 400
Net benefits, \$	22 778 350 to 223 011 700
Benefit-cost ratio	0.7 to 3.8

^aThe difference between the sum of the first two sets of numbers in the last column and the total cost is due to rounding.