Is Reimbursement for Childhood Immunizations Adequate? Evidence from Two Rural Areas in Colorado

Judith E. Glazner, MS[a]
John F. Steiner, MD, MPH[b]
Kathleen J. Haas, RN, MPH[c]
Brenda Renfrew, MSPH[c]
Mark Deutchman, MD[d]
Stephen Berman, MD[c]

SYNOPSIS

Objective. To assess adequacy of reimbursement for childhood vaccinations in two rural regions in Colorado, the authors measured medical practice costs of providing childhood vaccinations and compared them with reimbursement.

Methods. A "time-motion" method was used to measure labor costs of providing vaccinations in 13 private and public practices. Practices reported non-labor costs. The authors determined reimbursement by record review.

Results. The average vaccine delivery cost per dose (excluding vaccine cost) ranged from $4.69 for community health centers to $5.60 for private practices. Average reimbursement exceeded average delivery costs for all vaccines and contributed to overhead in private practices. Average reimbursement was less than total cost (vaccine-delivery costs + overhead) in private practices for most vaccines in one region with significant managed care penetration. Reimbursement to public providers was less than the average vaccine delivery costs.

Conclusions. Current reimbursement may not be adequate to induce private practices to provide childhood vaccinations, particularly in areas with substantial managed care penetration.

[a]Department of Preventive Medicine and Biometrics, University of Colorado School of Medicine, Denver, CO
[b]Department of Medicine, University of Colorado School of Medicine, Denver, CO
[c]Department of Pediatrics, University of Colorado School of Medicine, Denver, CO
[d]Department of Family Medicine, University of Colorado School of Medicine, Denver, CO

Address correspondence to: Judith Glazner, MS, Department of Preventive Medicine, University of Colorado Health Sciences Center, Box C-245, 4200 E. Ninth Ave., Denver, CO 80262; tel. 303-315-7939; fax 303-315-3183; e-mail <judith.glazner@uchsc.edu>.

This research was supported by grant #U66/CCU812972 from the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC. The authors are grateful to the private practices, health departments, nursing services, and community health centers that participate in CRISP. The authors also thank Robert Brayden, MD, Nellie Hester, and Kellyn Pearson, RN, MSN, for assistance in collecting and/or verifying certain cost and reimbursement data used in this study.

INTRODUCTION

Several cost and reimbursement considerations affect physicians' provision of childhood vaccinations, including patients' ability to pay for vaccinations, vaccine cost, and revenue generated by vaccinations, including insurance reimbursement.[1-7] Providing vaccinations in the child's medical home (usual source of medical care) improves childhood vaccination rates and other measurable aspects of primary care.[8,9] Despite this reality, many children are referred by physicians for vaccinations to public health departments, emergency departments, and other sites, including Nutrition Program for Women, Infants, and Children (WIC) clinics, not co-located with health care providers.[1,8,10,11] Concerns about such referrals include whether parents will follow up on the referral, whether continuity of care will be disrupted, and whether opportunities to vaccinate at appropriate ages will be missed.[4]

In response to concerns about childhood vaccination rates, the Colorado Rural Immunization Services Project (CRISP) is testing methods for improving early childhood vaccination rates in rural areas. The principal purpose of CRISP is to demonstrate the use of central immunization registries as tools for improving vaccination rates. Another strategy for increasing childhood vaccination in primary care sites is to demonstrate that providing vaccinations is in the economic interest of the medical practices. A first step in this strategy was to determine whether vaccination services were adequately reimbursed by public and private payers. We therefore sought to determine both the costs of providing vaccinations and the available reimbursements to the providers.

We reasoned that if medical practices are able to cover variable costs (costs that fluctuate with the amount of services provided, i.e., the cost of supplies and personnel required to provide vaccinations) and make any contribution to fixed costs (costs not related to the amount of services provided, e.g., overhead), they should provide the service.[12] We therefore measured the variable costs of providing vaccinations to children under 3 years of age in 13 private and public medical practices and public health departments in rural Colorado.

METHODS

Participants

The rural sites participating in CRISP in 1997 were enrolled in the current cost study; these included six private practices, four health departments or county nursing services, and three federally qualified health centers. These were the only practices serving children in the four study communities. They served between 21 and 628 children younger than age 3; median practice size was 198 children under age 3.

Two study communities were in a sparsely populated region where there was little HMO penetration and where the practices' records indicated that less than 7% of children were insured by HMOs. The other two communities were in a more heavily populated area where practices' insurance records showed that approximately 39% of children were insured by Independent Practice Association (IPA) HMOs. The first region is devoted primarily to raising livestock and wheat farming. Its socio-economic characteristics are similar to those of rural areas in the Midwest. The other region is a farming area similar to rural communities in the Southwest and on the West Coast.

We were interested in whether there were differences in the cost of providing vaccination among the three provider types in the study. Private practices face economic incentives similar to those of other businesses. They must bring in enough revenue to pay salaries, office rent, and other overhead expenses. Community health centers are funded by federal grants, Medicaid, the state's indigent care program, and patient fees based on ability to pay. Local public health departments and county nursing services are funded by state and local governments to provide public and environmental health services and a limited range of health care services, including vaccinations.

Data collection

Estimates of physician practice costs have typically been based on historical charges, which may not reflect actual costs of rendering services.[13,14] Latimer and Becker make a persuasive argument for measuring practice costs using a cost-accounting approach (measuring actual costs, including labor, associated with each service).[13] They demonstrate that other methods result in distorted payments that provide financial incentives to perform services that qualify for high reimbursement in place of services that may be medically more appropriate, but are not as highly reimbursed. The developers of the Resource-Based Relative Value Scale (RBRVS) also acknowledged the desirability of determining practice costs using a cost-accounting approach.[14,15] We therefore took a cost-accounting approach (using "time-motion" methods) to measure practice costs. We included all of the variable costs of delivering vaccinations: vaccines, labor, and supplies.

Forms on which office staff and non-physician providers were to record the time spent on vaccination-related activities were developed in conjunction with

the practices, then pilot-tested and modified. Practice staff kept track of time spent on all vaccination-related activities for one calendar month during 1997 (Table 1).

Physicians did not keep track of time spent on vaccination-related activities. Instead, a CRISP project nurse interviewed each physician once, using a standard interview form, about vaccination activities performed during a typical well-child visit and the time required for each such activity.

The forms completed by practice staff specified the time spent on vaccination-related activities occurring during each patient visit during which a vaccination was provided. For non-physician staff, actual hourly salary and benefits costs were obtained. To determine the cost per dose, time spent by each staff member involved in providing vaccinations was multiplied by applicable salary and benefits; the products of this operation were then summed, and the total was divided by the number of vaccinations provided by the practice during the study month.

To estimate physician cost, we applied average salary and benefits for rural physicians in Colorado to their time estimates. For family practitioners, we assumed a salary of $125,000 and benefits of 12.5% (personal communication, Denise Denton, MS, Director, Colorado Rural Health Center, June 1997). For pediatricians, we assumed a salary of $80,000 and benefits of $10,000 (based on a telephone survey of four practices in rural Colorado that were recruiting pediatricians).

We also estimated practices' non-labor costs, including vaccine and supplies. We assumed August 1997 prices published by the CDC to be the cost of vaccine.[16] We measured the costs of needles, syringes, and other supplies used for immunization by surveying participating sites and calling their medical suppliers. Small-volume purchases of needles and syringes made by private practices were uniformly quoted at $0.20 per dose. Large-volume purchases made by public providers were uniformly quoted at $0.08 per dose. Other supplies were purchased by the practices from several sources; the prices quoted by these sources averaged $0.11 per dose.

Estimating fixed costs

Determination of fixed costs for private practices—rent, medical equipment, professional liability insurance, and other professional expenses—was based on the AMA 1997 Socioeconomic Monitoring System survey, which collected data from physicians on all fixed and variable costs of practice.[17] From survey

Table 1. Vaccination-related activities recorded by practice staff in two rural regions of Colorado, 1997

Routine nursing activities (occur each time vaccination is given)	*Non-routine activities (occur at times other than when vaccination given)*	*Billing activities*	*Reminder/recall activities*[a]
Obtain parental consent.	Order vaccine.	Update information on patient's billing records.	Update reminder/recall system.
Provide vaccine information to parent.	Inventory vaccine.	Receive payment at time of service.	Issue reminders.
Review medical record for vaccination history.	Provide vaccination records to requesters.	Obtain billing information for new patient.	Follow up on non-responders (by telephone or other means).
Complete vaccination log in chart.	Answer telephone questions about vaccinations.	Produce bill for insurer or patient.	
Fill out patient's shot record.	Attend vaccination-related continuing education.	Mail bill.	
Draw and give vaccine.		Post payment.	
Pull and re-file charts.		Make bill adjustments.	

[a]When reminder/recall system is present

data, we estimated that fixed costs represented 24% of gross revenues for family practitioners. We were unable to find a similar data source for public providers and consequently did not estimate average fixed costs for health departments and community health centers.

Measuring insurance reimbursement

From analysis of practice records for the medical practices enrolled in our study, we identified 119 private insurance plans and three public programs—Medicaid, the state Indigent Care Program, and the Colorado Child Health Plan. We recorded actual payments made by insurers and patients for each type of vaccination for a single month in 1997 (not receipts for vaccinations given during the time-keeping month) and calculated an average payment, weighted by the frequency with which each insurer paid for vaccinations, to determine reimbursement per dose. These actual receipts reflected applicable provider discounts.

Statistical analysis

Estimates of the average cost of delivering vaccinations, when based on a small number of observations, may not represent the entire range of costs for each type of practice.[18] To compensate for the small number of practices, we performed stochastic risk analyses using Crystal Ball 2000[19] to estimate the range and probabilities of outcomes resulting from randomly varying the costs about which there was uncertainty. These variables included physician time, nursing time, billing time, reminder/recall time, chart-pulling time, and time for non-routine activities. We modeled these costs as normal distributions based on the distribution of our data by substituting, in a Microsoft Excel[20] spreadsheet, the appropriate normally distributed random variables for corresponding estimates for the CRISP practices, using the Crystal Ball program. To generate the random variables, we used Monte Carlo sampling. In this way, we could simulate values for the probability distributions contained in the spreadsheet. To find the range of all possible outcomes and their probabilities, we recalculated the spreadsheet 1000 times. Separate simulations were performed for the three practice types.

RESULTS

Average variable costs, excluding vaccine, among the three types of practices ranged from $4.69 per dose for community health centers to $5.60 for private practices (Table 2).

Private providers

Reimbursement from private insurance and patients differed according to vaccine and according to region (Table 3). Average reimbursement in Region 1, with little apparent HMO penetration, was higher for nearly all vaccines than in Region 2, which is served by several HMOs. Average reimbursement exceeded our estimates of variable costs for every vaccine, although in some cases in Region 2, the excess was small.

Our estimate of fixed costs was $1.86 per dose. In Region 2, reimbursement exceeded average total (variable + fixed) costs for only three of seven vaccines, while in Region 1, reimbursement was greater than average total costs for all vaccines.

For Medicaid and Colorado Child Health Plan patients, vaccines were provided to practices free of charge. Both Medicaid, at $6.50, and the Child Health Plan, at $10, provided reimbursement exceeding average variable costs, but only the Child Health Plan reimbursement exceeded average total costs.

Public providers

Variable costs for public providers did not include vaccines, which were provided at no cost by the federal government. Reimbursement to public providers varied widely among payers, with only the Child Health Plan payment exceeding variable costs (Table 4).

Table 2. Mean variable cost per vaccine dose (excluding cost of vaccine) for childhood vaccination by activity and type of practice in two rural regions of Colorado, 1997

Type of practice	*Physician time*	*Time of other personnel*	*Cost of supplies*	*Total variable cost/dose*	*Standard deviation*
Private practices	$1.51	$3.78	$0.31	$5.60	$0.99
Public health departments/ County nursing services	0	4.99	0.19	5.18	0.77
Community health centers	1.06	3.44	0.19	4.69	1.75

Table 3. Vaccine-specific variable cost of providing vaccinations and average reimbursement for private practices in two rural regions of Colorado, 1997

Vaccine	Vaccine price	Variable cost of providing vaccination[a]	Average reimbursement Region 1	Difference Region 1	Average reimbursement Region 2	Difference Region 2
DTaP	$16.64	$ 22.24	$26.94	$ 4.70	$23.94	$1.70
MMR	23.58	29.18	39.52	10.34	30.91	1.73
Hib	15.25	20.85	26.85	6.00	20.91	0.06
Hep B	16.92	22.52	26.44	3.92	24.38	1.86
Oral Polio	10.93	16.53	22.45	5.92	17.39	0.86
DTaP-Hib	20.24	25.84	N/A	N/A	38.48	12.64
Varicella	41.73	47.33	50.58	3.25	54.20	6.87

[a]Figures are the sum of the vaccine price (column 2) plus $5.60, the average variable cost of delivering vaccinations for private practices.

Simulation results

The average variable cost per dose, obtained using the simulation model, was $5.55 (SD = $1.16) for private practices, which is similar to the average we computed for the six CRISP practices ($5.60). We compared average private reimbursement for the two regions of the study with the range of simulated costs (Table 5). In Region 1, for three vaccines, average reimbursement exceeded all simulated variable and total costs; for the remaining three vaccines, reimbursement exceeded all simulated variable costs and most total costs. In Region 2, where there is greater managed care penetration, all simulated variable and total costs were defrayed by average reimbursement for only two vaccines. For the other vaccines, average reimbursement usually exceeded simulated variable costs, but it exceeded most of the simulated total costs for only one vaccine.

Among public payers, in most cases the Medicaid payment exceeded the simulated variable costs of private practices; the Colorado Child Health Plan's payment exceeded variable costs in all cases. Neither program covered total costs in all simulated cases.

Medicaid's payment to public providers and the indigent care program's payment to community health centers defrayed very small percentages of simulated variable costs; the Child Health Plan payment, however, exceeded variable costs in nearly 100% of simulated cases.

DISCUSSION

Adequacy of reimbursement

Private practices. The difference between average reimbursement and costs found in Region 2 may not be adequate to induce physicians to deliver all childhood vaccinations. The presence of nearby public health departments as convenient substitutes for providing vaccinations in the medical home may add to the likelihood of referral when vaccination payment is lower than total costs. (Five of the six practices participating in this study referred at least some of their patients to health departments for vaccinations.) As practices begin to participate in immunization registries such as the one developed by CRISP, their costs may increase because of additional labor costs of populating and maintaining a computerized source of immunization information.

Table 4. Cost of providing vaccinations and reimbursement for public health departments and community health centers in two rural regions of Colorado, 1997

Type of practice	Variable cost of providing vaccinations	Reimbursement: Medicaid	Reimbursement: Colorado Child Health Plan	Reimbursement: Colorado Indigent Care Program/ self-pay	Difference: Medicaid	Difference: Colorado Child Health Plan	Difference: Colorado Indigent Care Program/ self -pay
Public health departments/ County nursing services	$5.18	$2.00	$10.00	N/A	($3.18)	$4.82	N/A
Community health centers	$4.69	$2.00	$10.00	$3.00	($2.69)	$5.31	($1.69)

N/A = not applicable; only community health centers are eligible to participate in the Colorado Indigent Care Program.

Table 5. Proportion of simulated practice costs covered by average reimbursement by private and public insurers in two rural regions of Colorado, 1997

Site	Region 1		Region 2	
	Percentage of simulated cases in which variable costs were covered	*Percentage of simulated cases in which total costs were covered*	*Percentage of simulated cases in which variable costs were covered*	*Percentage of simulated cases in which total costs were covered*
Private practices				
Private insurance reimbursement:				
DTaP	100.0	99.8	94.	46.6
MMR	100.0	100.0	94.9	47.1
Hib	100.0	100.0	53.9	7.7
Hep B	100.0	97.4	96.5	51.3
OPV	100.0	100.0	77.7	22.6
DTaP-Hib	N/A	N/A	100.0	100.0
Varicella	100.0	90.2	100.0	100.0
Public reimbursement:				
Medicaid	77.7	23.0	77.7	23.0
Colorado Child Health Plan	100.0	99.5	100.0	99.5
Public clinics				
Health Depts/Nursing Services:				
Medicaid	2.2	N/A	2.2	N/A
Colorado Child Health Plan	100.0	N/A	100.0	N/A
Community health centers:				
Medicaid	6.9	N/A	6.9	N/A
Colorado Child Health Plan	99.8	N/A	99.8	N/A
Colorado Indigent Care Program	17.7	N/A	17.7	N/A

NOTES: Private insurers pay different amounts depending on the vaccine provided; public payers pay the same amount per dose regardless of the vaccine provided because the vaccine is free to the provider.
DTap = diptheria, tetanus, acellular pertussis
MMR = measles, mumps, rubella
Hib = haemophilus influenzae type b
Hep B = hepatitis B
OPV = oral polio vaccine
Varicella = vaccine for chickenpox
N/A = not applicable; we were unable to determine total costs for public providers.

These costs have been estimated to range between $0.24 and $3.24 per vaccination.[21] Providers may therefore experience net losses, even in cases in which current costs are favorable to them.

That Region 2 has experienced substantial market penetration by managed care organizations, likely accompanied by downward pressure on reimbursement, raises concern about the adequacy of reimbursement in other areas of the country facing similar pressures.[22] Since areas with little managed care penetration are becoming rare, the results seen here for Region 1 may apply to few areas.

Public providers. Public providers incurred average variable costs only 8% to 17% lower than those of private providers, but their reimbursement was much lower. The great majority of simulated cases of public providers' costs were not adequately reimbursed by two of the three public programs from which they received reimbursement. The reimbursement amounts shown in Table 4 were Colorado-specific; programs in other states may adequately reimburse public providers for vaccinations.

Study limitations

This study was conducted in a small number of practices in two rural areas of a single state. This may reduce the ability to generalize the results if input costs (e.g., labor and supplies) in other areas are different from those in rural Colorado. In particular, urban practices might be assumed to face different labor prices. For another purpose, however, we measured variable costs in three large urban private pediatric practices for one month in 1997 and found somewhat lower variable costs per vaccination than those described here for rural practices. Both staff composition and salaries paid by the urban practices were similar to those we found in rural practices. We suspect that the difference between average costs borne by urban practices and those of the study practices was related to practice size rather than urban location or other differences. It is possible that large practices are able to achieve economies of scale in vaccination delivery.

CONCLUSIONS

The US health care system uses financial incentives to guide the behavior of health care providers. Because the benefits of immunization have been demonstrated to outweigh its costs, reimbursement of childhood vaccinations should be sufficient to induce clinicians to provide them. To reverse current referral patterns, reimbursement rates may need to exceed not only variable costs, but also total costs. Moreover, as the childhood vaccination schedule lengthens, adequate reimbursement may become more critical because providers may need to spend more time explaining new vaccines. Policy makers concerned about providing incentives for vaccination in the medical home should find the detailed cost information provided here helpful in determining appropriate reimbursement levels.

REFERENCES

1. Schulte JM, Bown GR, Zetzman MR, Schwartz B, Green HG, Haley CE, Anderson RJ. Changing immunization referral patterns among pediatricians and family practice physicians, Dallas County, Texas, 1988. Pediatrics 1991;87:204-7.
2. Ruch-Ross HS, O'Connor KG. Immunization referral practices of pediatricians in the United States. Pediatrics 1994;94:508-13.
3. Hueston WJ, Meade RL, Mainous AG 3rd. Childhood immunization practices of primary care physicians. Arch Fam Med 1992;1:225-8.
4. Zimmerman RK, Medsger AR, Ricci EM, Raymund M, Mieczkowski TA, Grufferman S. Impact of free vaccine and insurance status on physician referral of children to public vaccine clinics. JAMA 1997;278:996-1000.
5. Arnold PJ, Schlenker TL. The impact of health care financing on childhood immunization practices. Am J Dis Child 1992;146:728-32.
6. Wright JA, Marcuse EK. Immunization practices of Washington State pediatricians—1989. Am J Dis Child 1992;146:1033-6.
7. Office of Technology Assessment (US). A review of selected federal vaccine and immunization policies: based on case studies of pneumococcal vaccine. Washington (DC): Office of Technology Assessment; 1979.
8. Bordley WC, Margolis PA, Lannon CM. The delivery of immunizations and other preventive services in private practices. Pediatrics 1996;97:467-72.
9. Rodewald LE, Szilagi PG, Holl J, Shone LR, Zwanziger J, Raubertas RF. Health insurance for low-income working families: effect on the provision of immunizations to preschool-age children. Arch Pediatr Adolesc Med 1997;151:798-803.
10. Lieu TA, Smith MD, Newacheck PW, Langthorn D, Venkatesh P, Herradora R. Health insurance and preventive care sources of children at public immunization clinics. Pediatrics 1994;93:373-8.
11. Rodewald LE, Szilagi PG, Humiston SC, Raubertas RF, Wassilak S, Roghmann KJ, et al. Effect of emergency department immunizations on immunization rates and subsequent primary care visits. Arch Pediatr Adolesc Med 1997;151:798-803.
12. Byrns RT, Stone GW. Economics. New York: Harper Collins College Publishers; 1995.
13. Latimer EA, Becker ER. Incorporating practice costs into the resource-based relative value scale. Med Care 1992;30:NS50-NS60.
14. Becker ER, Dunn D, Hsiao WC. Relative cost differences among physicians' specialty practices. JAMA 1988;260:2397-2402.
15. Hsaio WC, Braun P, Dunn D, Becker ER. Resource-based relative values: an overview. JAMA 1988;260:2347-53.
16. Centers for Disease Control and Prevention (US). CDC vaccine price list, August 21, 1997. Atlanta (GA): Centers for Disease Control and Prevention, 1997.
17. American Medical Association. Physician marketplace statistics, 1997/98. Chicago (IL): American Medical Association; 1998.
18. Deuson RR, Hoekstra EJ, Sedjo R, Bakker G, Melinkovich P, Daeke D, et al. The Denver school-based adolescent hepatitis B vaccination program: a cost analysis with risk simulation. Am J Public Health 1999;89:1722-7.
19. Crystal Ball 2000 Professional, Version 5.0. Denver (CO): Decisioneering, Inc.
20. Microsoft Excel 97. Redmond (WA): Microsoft Corporation.
21. Rask KJ, Wells KJ, Kohler SA, Rust CT, Cangialose CB. The cost to providers of participating in an immunization registry. Am J Prev Med 2000;19:99-103.
22. Hadley J, Mitchell JM. HMO penetration and physicians' earnings. Med Care 1999;37:1116-27.