Available online at www.sciencedirect.com
SCIENCE DIRECT®
Vaccine 23 (2005) 915–923
Vaccine
www.elsevier.com/locate/vaccine

Estimating medical practice expenses from administering adult influenza vaccinations☆

Margaret S. Coleman[a,*], John Fontanesi[b], Martin I. Meltzer[c], Abigail Shefer[a], Daniel B. Fishbein[a], Nancy M. Bennett[d], David Stryker[e]

[a] *Health Services Research and Evaluation Branch (HSREB), National Immunization Program (NIP), Centers for Disease Control and Prevention (CDC), 1600 Clifton Road NE, MS-E52, Atlanta, GA 30333, USA*
[b] *University of California at San Diego, San Diego, CA, USA*
[c] *Office of Surveillance, Office of the Director, National Centers for Infectious Diseases, CDC, Atlanta, GA, USA*
[d] *University of Rochester, Rochester, NY, USA*
[e] *Infectious Disease and Internal Medicine Associates, Albuquerque, NM, USA*

Received 22 March 2004; received in revised form 21 July 2004; accepted 26 July 2004
Available online 1 September 2004

Abstract

Potential business losses incurred vaccinating adults against influenza have not been defined because of a lack of estimates for medical practice costs incurred delivering vaccines. We collected data on vaccination labor time and other associated expenses. We modeled estimates of per-vaccination medical practice business costs associated with delivering adult influenza vaccine in different sized practices. Per-shot costs ranged from US$ 13.87 to US$ 46.27 (2001 dollars). When compared with average Medicare payments of US$ 11.71, per-shot losses ranged from US$ 2.16 to US$ 34.56. More research is needed to determine less expensive delivery settings and/or whether third-party payers need to make higher payments for adult vaccinations.
© 2004 Elsevier Ltd. All rights reserved.

Keywords: Adult influenza vaccination; Economic evaluation; Vaccination costs

1. Introduction

Public health advocates are concerned that influenza vaccinations are under-utilized by adults despite their proven effectiveness at preventing influenza and sequellae [1–4]. Many factors affect adult vaccination rates and vaccine delivery [5–11]. But one factor not explored in the literature that has the potential to reduce availability is high delivery costs incurred by medical practices. There is a foundation for this concern; research has shown in the past that vaccination costs may discourage physicians from offering vaccine to children [5].

There is some evidence indicating physician-owned medical practices might be increasing their awareness of non-profitable interventions. For example, growing numbers of physicians are refusing to enroll new Medicare patients because of complaints about declining reimbursement levels [12–14]. This is an indication that fewer medical practices may be providing influenza vaccinations for the elderly.

In trying to determine the impact of adult vaccination costs on medical practice balance sheets, we discovered that vaccination delivery costs have not been estimated separately from the costs of other interventions. We compared well documented third-party payments [12–15] with estimated vaccine and delivery costs to define medical practice losses and profits.

☆ This research is part of a larger project that observed vaccination procedures during 2000–2001. The Centers for Disease Control and Prevention (CDC) in Atlanta, the University of California at San Diego and the New York State University of Rochester approved this research.

* Corresponding author. Tel.: +1 404 639 8801; fax: +1 404 639 8614.
E-mail address: zby5@cdc.gov (M.S. Coleman).

0264-410X/$ – see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.vaccine.2004.07.028

2. Methods

2.1. Model overview

We estimated per-patient vaccination costs during scheduled visits for the purpose of a vaccination and no-appointment visits at walk-in vaccination clinics. No other medical services were included in the basic model so that we could isolate vaccination costs and compare them with Medicare payments. The costs of vaccination delivery during scheduled visits where clinical staff address multiple medical problems per patient are estimated in the sensitivity analysis. We do not compare sensitivity results with Medicare payments because of the infinite variety of billable medical services.

Model inputs came from the two original data sources described in Table 1: the occupational checklist of patient encounters-senior (OCPE-S) [16] and the office managers' survey (OMS, reprinted in the Appendix A). The basic model defined below may be expressed as: the total cost-per-vaccinated-adult = labor + overhead + supplies. We chose to analyze costs in per-vaccinated-adult increments because these could be directly compared with Medicare payments. The model inputs and results are in 2001 dollars, however, the results are also adjusted to 2003 dollars using the medical price index [25]. The rest of the methodology section explains how these model inputs were derived.

2.2. Labor overview

There were two challenges to determining adult vaccination labor costs [17–21]. First, time-motion studies of vaccination-related labor have been performed in either pediatric or hospital settings. Since children frequently receive multiple doses at one time, and since vaccinations are a larger part of pediatric clinic business, we felt pediatric labor costs might no t be the same as labor costs in other medical practices. Therefore, we used OCPE-S results because the study timed most clinical functions associated with adult, rather than pediatric, vaccinations. The other challenge was that there is no published research assigning the portion of non-clinical labor—pulling charts, billing, record keeping, insurance checks—to adult vaccinations. How we estimate this data is described in Section 2.4.

Per-vaccination labor costs were determined in a sequence: (1) clinical and non-clinical labor time needed to complete vaccinations were estimated using OCPE-S results; (2) medical practice staffing patterns were simulated using OMS results (Table 2); (3) clinical and non-clinical vaccination labor time estimates became a percentage of medical practice weekly labor time; (4) labor was valued using weighted wages (Table 3). Occupational titles in the clinical and non-clinical labor categories are listed in Table 3.

Clinical labor includes licensed practical nurses (LPN), registered nurses (RN), and medical assistants (MA). Physician labor was not included since the current Medicare payment schedule does not include physician labor for adult vaccinations. This is because most vaccinations are given by nursing staff. By not including physician labor in the model, we felt more comfortable comparing medical clinic vaccination costs with Medicare payment rates for vaccination. However, there were more difficult methodological issues that led to the final decision not to include physician labor. Most patients get vaccinated on their doctor's advice but once a physician advises a patient to be vaccinated, the patient may keep getting vaccinated annually. We could not think of a way to assign a dollar value to physician advice so that the "price" of advice could be assigned to one vaccination, but not to subsequent vaccinations where advice was not given. In addition, some physicians are employees and some are business owners. Deciding whether to include wages or profits in the model was problematic.

Table 1
Original sources

Office managers' survey (OMS)	Occupational checklist of patient encounters-senior (OCPE-S)[a]
Convenience sample of primary care practices	Workflow data acquisition tool
Spring–Autumn 2002	Convenience sample of patients
20 clinics	November 2001–February 2002
1–18 physicians	Patients > age 50 without influenza vaccinations (n = 666)
Rochester, NY (n = 8)	16 primary care practices
Albuquerque, NM (n = 6)	Same locations as OMS
San Diego, CA (n = 6)	Data collected
Data collected	Presence or absence of key activities
Work hours	Types of personnel
Numbers of employees	Task timing
Employee titles standardized using Occupational	Operational conditions
Employment Series, Bureau of Labor Statistics	
23 different titles identified	
Survey and sample response in Appendix A	

[a] Fontanesi J, DeGuire M, Chiang J, Holcomb K, Sawyer M. Applying workflow analysis tools to assess immunization delivery in outpatient primary care settings. Jt Comm J Qual Improv 2000;26(11):654–60.

Table 2
Model inputs by practice size and type of labor: distribution parameters used in Monte Carlo simulation, simulation results and calculated average weekly work minutes

Practice size	Clinical labor		Non-clinical labor	
	RN	LPN/MA	Staff	Manager
Distribution parameters: minimum, likeliest and maximum numbers of employees				
Solo/partner		1, 1.1, 2	1, 3.3, 5	0.6, 0.6, 1
Small	0.5, 0.5, 2	2, 4.7, 8	2, 8.3, 10	1, 1.7, 3
Medium	0.5, 2.3, 8	6, 9.3, 13	8, 10, 14	1, 2.3, 4
Large	0.5, 3.3, 9	7, 10.3, 14	10, 12.8, 15	1, 3.3, 5
Corporate	1, 3.3, 9.5	15, 21.5, 28	24, 39.5, 55	1, 3.5, 6
Simulation results: average numbers of employees (standard deviations)				
Solo/partner		1.4 (0.2)	3.1 (0.8)	0.7 (0.1)
Small	1.0 (0.4)	4.9 (1.2)	6.8 (1.2)	1.9 (0.4)
Medium	3.6 (1.6)	9.4 (1.5)	10.7 (1.2)	2.4 (0.6)
Large	4.3 (1.8)	10.5 (1.4)	12.6 (1.0)	3.1 (0.8)
Corporate	4.8 (1.8)	21.5 (2.6)	39.2 (6.5)	3.5 (1.0)
Average weekly work minutes of employees[a]				
Solo/partner	0	3273	7458	1770
Small	2412	11831	16205	4605
Medium	8689	22600	25586	5776
Large	10273	25090	30255	7363
Corporate	11399	51504	94199	8404

Solo/partner, 1 or 2 physicians; small, 3 or 4 physicians; medium, 5 or 6 physicians; large, 7–10 physicians and corporate, 11–18 physicians. *Data source*: office managers' survey (Table 1).

[a] Number of employees multiplied by 40 h, then 60 min.

Table 3
Labor categories and weekly compensation[a]

Labor category[b]	1999 hourly wage[a] (US$)	19% adjustment[b] (US$)	Weight[a] (%)	2001 weekly compensation (US$)
Clinical				
Registered Nurse (RN)	22.31	4.24	100	1061.96
Licensed practical nurse (LPN)	14.65	2.78	40.6	
Medical assistant (MA)	11.46	2.18	59.4	607.11
Non-clinical				
Managers				
Medical services manager	29.63	5.63	2.8	
Administrative services manager	25.31	4.81	47.2	
First line supervisor	17.51	3.33	50.0	1024.83
Staff				
Receptionist	9.99	1.90	14.2	
Medical equipment preparer	10.68	2.03	1.0	
Medical records personnel	11.74	2.23	15.9	
Medical transcriptionist	12.37	2.35	8.3	
Medical secretary	11.76	2.23	24.7	
Accountant/auditor	23.12	4.39	3.5	
Billing and account collector	12.82	2.44	5.2	
Billing and posting clerk	12.25	2.33	6.9	
Book keeping clerk	12.96	2.46	1.0	
Office clerk	10.72	2.04	10.0	
File clerk	9.49	1.80	4.8	
Administrative assistant	15.63	2.97	3.8	
Word processor/typist	12.22	2.32	0.4	569.03

[a] The weighted wage is a composite of all the wages in that category. For example, the LPN/MA wage is ((0.406 × US$ 14.65) + (0.594 × US$ 11.46)) + adjustment for inflation and benefits, multiplied by 40 h for a weighted weekly wage. Weights developed from responses to the office manager's survey, Table 1.

[b] Employee titles and wages from the Bureau of Labor Statistics "Occupational Employment Series, 2000." Data for 2000 collected in 1999. 19% Adjustment is broken down by 4% for inflation (Consumer Price Index, Bureau of Labor Statistics) and 15% for benefits by assumption.

2.3. Clinical labor (occupational titles Table 3)

The OCPE-S timing observation instrument included observed times for: check-in, called from the waiting room, medical questioning and vaccine counseling, blood pressure, weigh-in, actual vaccination, and check-out. Clinician labor functions that took place during check-in and check-out were not recorded in the OCPE-S because patients were followed instead of staff. Because these labor functions were unobserved, we assumed that during check-in and check-out clinicians were working on vaccination-related tasks such as filling syringes or charting patient vaccinations. This was feasible in the basic model, since patients were only at the clinic to be vaccinated. During these visits, the clinician would only be doing vaccination-related work while unobserved. We did not include sitting in the waiting room or any time patients were not interacting with staff. Two separate estimates were calculated for clinician labor time; 11 min for scheduled visits and 5 min for walk-in clinics. These times are consistent with other studies that observed clinician vaccination labor times of 2–10 min in emergency rooms and 13.8 min in pediatric offices [22,23].

2.4. Non-clinical labor (occupational titles Table 3)

We use OCPE-S results to model non-clinical labor time because we lacked direct observations. The logic guiding the model is that most non-clinical labor functions take an average time per patient [17–21]. For example, inputting the codes from a super bill, pulling a medical record, and insurance coverage checks take average amounts of time per patient. This is unlike clinical labor function times which change depending on the number and complexity of medical services a patient requires. Therefore, we assumed each patient consumed an average amount of total non-clinical labor time and that enough non-clinicians are employed by each provider to complete the work created by an anticipated number of patients [17–21].

The OCPE-S recorded an average time of 38 min of patient/staff interaction (excluding waiting time) for all scheduled visits, including visits for multiple medical interventions and vaccinations only. We included all types of visits because there was no reason to assume non-clinical labor functions associated with giving a vaccination were any less time consuming than those associated with other types of visits. When 38 min becomes a percentage of work time of all non-clinicians in the practice, it represents the administrative labor time needed to process one patient.

Thirty-eight minutes seems high until one realizes that it represents the work of multiple staff performing many jobs, e.g. record pulling and filing, insurance checks, billing, accounting, patient check-in and check-out, collections, supply ordering, stocking, general clerical work, etc. Thirty-eight minutes was used to estimate non-clinical labor time for both scheduled visits and walk-in clinics because, except for scheduling appointments, the majority of labor functions were the same in both delivery settings. This estimate is supported by other research that found it took an average of 42.3 min to process vaccination patients in pediatric clinics [23].

2.5. Labor composition of medical practices (Table 2)

Once we determined how much time the tasks associated with a vaccination took, there was still the question of what portion of staff labor time would be devoted to vaccination. There was no way to determine which clinical staff person would give a shot and how many non-clinical staff would be associated with other vaccination-related tasks. Therefore, we needed to construct a representative office staff in order to determine the per-shot labor times as a percentage of all the work done in the office.

We used the OMS responses to set the distribution parameters of a Monte Carlo simulation (TreeAge Software DataPro 4.0) that estimated average numbers of employees in each occupational title by medical practice size. Simulations can be described as probabilistic sensitivity analyses that allow all parameters to vary. These models capture interactive effects and avoid the potential of variable selection bias by the researcher. Economics research on simulation modeling shows that even with very few real world parameters, simulation results and confidence intervals are more accurate than simply using the mean or median of a small data set [17,28,29].

The OMS sample was comprised of 20 clinics ranging in size from 1 to 18 physicians (Table 1). The sample was too small to set simulation parameters incrementally (e.g. one physician, two physicians, three physicians, etc.) so we grouped physicians into a range of medical practice sizes that best fit the OMS results: 1–2, solo/partner; 3–4, small; 5–6, medium; 7–10, large and 11–18, corporate. We felt that these groupings represented real medical practice conditions because, according to the American Medical Association, about 76% of all physicians work in groups of nine or less [27]. The estimated average numbers of employees were then multiplied by 2400 min for an average work week expressed in minutes.

2.6. Valuing labor (Table 3)

Weekly work minutes were valued with wage data from the Bureau of Labor Statistics Occupational Employment Series (OES) weighted and adjusted for inflation and benefits (2000–2001) [24,25]. We used the OES rather than ask providers or practices about wages and benefits on the OMS because: (1) salary information is sensitive and (2) the OES was nationally representative.

2.7. Labor cost

The labor cost of one vaccination was calculated as (5 or 11 min clinical labor time/(clinical work week in

Table 4
Labor costs of one influenza vaccination: by type of visit

Practice size	Scheduled visit			Walk-in clinic		
	Clinical labor cost (US$)[a]	Non-clinical labor cost (US$)[a]	Total labor cost (US$)	Clinical labor cost (US$)[a]	Non-clinical labor cost (US$)[a]	Total labor cost (US$)
Solo/partner	2.10	25.47	27.57	0.95	25.47	26.42
Small	6.05	10.32	16.36	2.75	10.32	13.06
Medium	2.00	8.10	10.11	0.91	8.10	9.02
Large	1.68	6.46	8.14	0.76	6.46	7.22
Corporate	1.35	1.55	2.87	0.61	1.55	2.13

For a walk-in clinic, the formula for the cost of clinical labor is (5 min/weekly work minutes) × weighted wages. The formula for the cost of non-clinical labor is (38 min/weekly work minutes) × weighted wages. Weighted wages listed in Table 2.

[a] For a scheduled visit, the formula for the cost of clinical labor is (11 min/weekly work minutes) × weighted wages. The formula for the cost of non-clinical labor is (38 min/weekly work minutes) × weighted wages. Weighted wages listed in Table 2.

minutes × weighted wage)) + (38 min non-clinical labor time/(non-clinical work week in minutes × weighted wage)) (Table 4).

2.8. Overhead (categories and model)

We used the overhead costs of family physician group practices collected by the Medical Group Management Association because this was the only data source we could find [26], Table 5. A literature search produced no methods to assign overhead per physician or per patient. Therefore, we assumed that after the first physician, each additional physician added to an office's marginal overhead costs by decreasing amounts due to savings accrued through shared resources. We also assumed that each additional physician would increase patient flow and decrease per-patient overhead costs because overhead would be averaged out over more patients. Clinical labor time estimates were used as proxies for patient flow (i.e. 5 min of clinical labor equals 12 patients per hour).

2.9. Supplies (Table 4)

Influenza vaccine was priced at US$ 6.50, the national average price of vaccine in 2001, plus US$ 1.63 for shipping, handling and storage [15], plus or minus assumed small purchase surcharges or large purchase discounts. Each syringe cost US$ .06, the average cost of non-safety syringes reported in the OMS.

2.10. Cost summary

Two equations were used to determine total costs. The first was (5, 11, or 38 min spent per-patient as a percentage of RN, LPN, staff, or manager weekly minutes, Table 2) multiplied by weighted wages (Table 3) equals labor cost-per-shot (Table 4). The second equation was (labor cost, Table 4) plus (US$ 6.50 vaccine cost plus (shipping and handling, Table 5)) plus (US$ .06 for syringe, Table 5) plus (overhead, Table 5) equals total cost of a shot (Table 6).

Table 5
Costing overhead[a], vaccine and syringe

Physician number	Per-minute[b] (US$)	Scheduled visit formula[c]	Scheduled visit (US$)	Walk-in clinic formula[c]	Walk-in clinic (US$)
Overhead					
1	0.90	.90 × 11	9.90	.90 × 5	4.50
2	1.78	(1.78 × 11)/2	9.80	(1.78 × 5)/2	4.46
3	2.65	(2.65 × 11)/3	9.71	(2.65 × 5)/3	4.41
4–17	3.49–12.86	(Per-minute overhead × 11)/#physicians	9.61–8.32	(Per-minute overhead × 5)/#physicians	4.37–3.78
18	13.45	(13.45 × 11)/18	8.22	(13.45 × 5)/18	3.74
Practice size	2001–2002 Average market price (US$)	25% Shipping and handling (US$)	Purchase surcharge or discount (US$)	Vaccine cost to provider (US$)	Vaccine plus US$ .06 syringe (US$)
Vaccine and disposable syringes					
Solo/partner	6.50	1.63	0.65	8.78	8.84
Small	6.50	1.63	0.33	8.45	8.51
Medium	6.50	1.63	0.00	8.13	8.19
Large	6.50	1.63	−0.33	7.80	7.86
Corporate	6.50	1.63	−0.65	7.48	7.54

[a] Each additional physician adds 2% less overhead than the previous physician.

[b] This averages out the overhead cost of one patient among all the physicians in an office and assumes that each physician sees the same number of patients.

[c] The Medical Group Management Association Cost Survey 2001 CD shows an average non-labor annual overhead cost of US$ 103,719 for family physicians. Divided by weekly work minutes in a 48 weeks year; 115,200, results in US$ .90 a minute.

Table 6
Results: cost of an influenza shot to a medical practice and expense/payment gaps

Practice size	Scheduled visit				Walk-in clinic			
	Per-shot cost 2001 (US$)	Per-shot cost 2003 (US$)	Expense/payment gap 2001 (US$)	Expense/payment gap 2003 (US$)	Per-shot cost 2001 (US$)	Per-shot cost 2003 (US$)	Expense/payment gap 2001 (US$)	Expense/payment gap 2003 (US$)
Solo/partner	46.27	50.43	−34.56	−32.76	39.79	43.37	−28.08	−25.70
Small	34.56	37.67	−22.85	−20.00	26.00	28.34	−14.29	−10.67
Medium	27.77	30.27	−16.06	−12.60	21.52	23.46	−9.81	−5.79
Large	25.22	27.49	−13.51	−9.82	19.29	21.03	−7.58	−3.36
Corporate	19.58	21.34	−7.87	−3.67	13.87	15.12	−2.16	2.55

Medicare payment rate for an influenza vaccination 2001, US$ 11.71; 2003, US$ 17.67; no reimbursement for physician work when the patient only has a vaccination. 2003 results calculated by inflating 2001 costs using the medical portion of the Consumer Price Index [22].

3. Sensitivity analysis

We do two sensitivity analyses. First, we drop the assumption that the non-clinical labor functions are the same for scheduled visits and walk-in clinics. Effectively, we assume that not only does it take less clinical labor to give a shot during a walk-in clinic, it also takes less time to perform all the other labor functions such as billing, record keeping, etc. In the second, we examine the cost of delivering vaccinations during a scheduled visit in which the patient receives multiple medical services. The basic model only allowed patients to receive influenza vaccinations during the scheduled visit.

1. *Sensitivity to patient volume*. For walk-in clinics, we used 2 min to estimate clinical and non-clinical labor time and overhead, instead of the baseline of 5 min of clinical labor and 38 min of non-clinical labor used in the model. This increased patient flow from 12 to 30 per hour and vastly reduced the estimated time needed for non-clinical labor functions.
2. *Multiple medical problems.* We dropped the assumption that patients only received vaccinations during scheduled visits. The 38 min average time for scheduled visits from the OCPE-S was used to estimate clinical labor, non-clinical labor, and overhead. These total costs were multiplied by fractions to assign a portion of total costs of a scheduled visit for multiple interventions to a vaccination. The fractions were derived from two sources:
   - *OCPE-S*: The 11 min of clinician labor time per vaccination was divided by 38 min resulting in .29.
   - *Albuquerque, New Mexico*: Another way to determine how much time a vaccination takes was to determine how many medical problems a physician addresses. In data acquired from an Albuquerque, New Mexico medical practice, the first 100 adult patients scheduled in a week were treated for an average of 2.7 medical problems, not including influenza vaccinations. If vaccinations are added for all adults the average rises to 3.7. Thirty-eight minutes divided by 2.7 or 3.7 equals 14.07 and 10.27 min, respectively, per problem addressed. Dividing these minutes by 38 results in each problem receiving .37 or .27 of the time allotted to each visit.

4. Results

Results are listed in the order described in the Section 2.

- Simulated staffing levels and hours worked (Table 2)
  Solo/partners employed an average of 1.4 clinicians and 3.8 non-clinicians while practices in the corporate category employed an average of 26.3 clinicians and 42.7 non-clinicians.
- 2001 weighted weekly compensation values (Table 3)
  Average weekly earnings were: US$ 1061.96 registered nurses, US$ 607.11 licensed practical nurses and medical assistants, US$ 1024.83 managers and US$ 569.03 non-clinical staff.
- Labor costs (Table 4)
  Total labor: scheduled visit costs ranged from US$ 2.87 (corporate) to US$ 27.57 (solo/partner). Walk-in clinic costs ranged from US$ 2.13 (corporate) to US$ 26.42 (solo/partner). Non-clinical labor: costs ranged from US$ 25.47 (solo/partner) to US$ 1.52 (corporate). Clinical labor: scheduled visit costs ranged from US$ 2.10 (solo/partner) to US$ 1.35 (corporate); walk-in clinic costs ranged from US$ .95 (solo/partner) to US$ .61 (corporate).
- Overhead costs (Table 5)
  For scheduled visits, overhead costs ranged from US$ 8.22 to US$ 9.90. Walk-in clinics costs ranged from US$ 3.74 to US$ 4.50.
- Total per-vaccination costs and business losses/profits (Table 6)
  In 2001 dollars, the per-shot costs to a medical practice delivering influenza vaccinations during scheduled visits ranged from US$ 19.58 (corporate) to US$ 46.27 (solo/partner). Walk-in clinic per-shot costs ranged from US$ 13.87 (corporate) to US$ 37.03 (solo/partner). When adjusted to 2003 dollars using the medical price index, scheduled visit costs ranged from US$ 21.34 (corporate) to US$ 50.43 (solo/partner). Walk-in clinic costs ranged from US$ 15.12 (corporate) to US$ 40.36 (solo/partner).

When these costs were compared with Medicare payment rates, business losses were almost universal. In 2001 dollars, all estimated costs were higher than the national average Medicare payments of US$ 11.71 for adult influenza vac-

Table 7
Results: sensitivity analysis

Practice size	Walk-in clinic, 30 patients per clinical labor hour		Vaccination as a fraction of a multiple purpose visit					
	Per-shot cost (US$)	Standard deviation (US$)	.29[a]		.27[a]		.37[a]	
			Per-shot cost (US$)	Standard deviation (US$)	Per-shot cost (US$)	Standard deviation (US$)	Per-shot cost (US$)	Standard deviation (US$)
Solo/partner	12.38	0.16	37.41	1.55	35.51	1.45	45.38	1.45
Small	11.94	0.36	27.23	2.00	25.99	1.87	32.46	2.56
Medium	10.72	0.21	22.01	1.15	21.10	1.08	25.87	1.47
Large	10.21	0.18	20.63	1.01	19.79	0.94	24.19	1.29
Corporate	9.75	0.15	18.48	0.65	17.76	0.61	21.53	0.83

[a] Time to give vaccination as a fraction of patient/staff interaction time: 11 min per vaccination divided by 38 min interaction time equals .29. Time per intervention in a multiple purpose visit as a fraction of patient/staff interaction time: in data acquired from an Albuquerque, New Mexico medical practice, the first 100 adult patients scheduled in a week discussed an average of 2.7 medical problems or interventions with their physicians, not including influenza vaccinations. With influenza vaccinations, that average becomes 3.7 medical problems or interventions. Thirty-eight minutes divided by 2.7/3.7 equals 14.07/10.27 min per item discussed. Dividing 14.07/10.27 by 38 equals .37/.27. Formula = ((38 min clinical labor/clinical labor weekly work minutes × weighted wages) × fraction) + ((38 min non-clinical labor/non-clinical labor weekly work minutes × weighted wages) × fraction) + ((per-minute overhead × 38 min/number of physicians) × fraction) + supplies.

cinations. In 2003 dollars with a Medicare payment of US$ 17.67, only corporate practices delivering vaccines to patients during walk-in clinics earned a profit. In 2001 dollars, scheduled visit losses ranged from US$ 7.87 (corporate) to US$ 34.56 (solo/partner). Walk-in clinic losses ranged from US$ 2.16 (corporate) to US$ 25.32 (solo/partner). In 2003 dollars, scheduled visit losses ranged from US$ 3.67 (corporate) to US$ 32.76 (solo/partner) and walk-in clinic losses ranged from US$ 3.36 (large) to US$ 22.69 (solo/partner).

4.1. Sensitivity analyses

- *Patient volume*: Walk-in clinics vaccinating 30 patients per hour, resulted in per-shot costs ranging from US$ 9.75 to US$ 12.38 (Table 7).
- Multiple-intervention scheduled visits per-shot costs:
  - .29 of a scheduled visit resulted in a range of US$ 18.48 to US$ 37.41 (OCPE-S);
  - .27 of a scheduled visit resulted in a range of US$ 17.76 to US$ 35.51 (New Mexico, without vaccination);
  - .37 of a scheduled visit resulted in a range of US$ 21.53 to US$ 45.38 (New Mexico, with vaccination).

5. Discussion

Medicare payment rates for influenza vaccination do not cover the costs incurred by medical practices delivering influenza immunizations in standard settings, even though Medicare payments for vaccination administration costs were almost doubled in 2003. An exception to this finding was observed in one analysis: in 2003 dollars, corporate practices with walk-in vaccination clinics were able to make a profit of US$ 2.55 per shot. Other analyses indicated that while influenza vaccinations were still business losses for large practices, these offices were likely able to recoup their losses via other, more profitable intervention. For smaller practices, however, business losses may serve as a disincentive to vaccinate.

Smaller practices face disproportionately large business losses for a number of reasons. Eleven minutes as a *portion* of clinical weekly work minutes accounts for .34% of labor time in solo/partner practices, but only 0.02% of clinical weekly work minutes in a corporate practice. Likewise, 38 min accounts for 0.41% of non-clinical labor time in solo/partner practices, but only 0.04% of non-clinical labor time in corporate practices.

Employees in small practices are unable to engage in multiple, simultaneous activities in the same way as employees in larger practices. The average solo/partner practice engages 11/2 clinicians, while corporate practices engage an average of almost 43 clinicians. If the solo/partner practice uses their 11/2 clinicians to give shots in a high-volume, walk-in clinic, 100% of its clinical labor time is engaged. If a corporate practice uses 11/2 clinicians for the same task, this only represents 3.3% of the practice's total clinical labor time. The rest of the clinicians can be engaged in other revenue generating activities.

There are no published data about whether or not smaller medical practices offer to vaccinate adults at different rates than larger practices. However, there is some research that shows that self-employed physicians working in medical practices with four to eight physicians earn about 20% more annually than solo practitioners [30]. From this, one could infer that providing vaccinations for which they are not adequately compensated would be more of a disincentive to self-employed physicians in smaller practices than in larger practices.

The only situation that does not result in a financial loss for most practices is the scenario hypothesized in the walk-in clinic sensitivity analysis. This situation assumes 30 patients per clinician per hour and that non-clinician time can

be streamlined. The problem is that the walk-in clinic results only hold if each clinician vaccinates 30 patients per hour—an objective dependent on patients arriving within the time frame allotted and non-clinicians taking advantage of labor saving measures such as batch billing. For small, physician-owned offices, these parameters are probably unrealistic.

The model has several weaknesses.

- Most adults are vaccinated during multiple-intervention visits. We decided to confine multiple-intervention visit vaccination cost estimates to the sensitivity analysis because the wide range of billing possibilities made it impossible to compare results with Medicare payments.
- OCPE-S and OMS results are based on convenience samples and their distributions may not reflect the population at large or regional variations.
- Staff composition, wages, and variability in local real estate charges could significantly change per-shot costs.
- Some variation in supply prices was taken into account with small purchase surcharges and large purchase discounts, but evidence points to a wider spread towards the high end, indicating that model estimates were conservatively skewed to the low side.
- Responses from the OMS indicated that syringe prices varied from US$ .05 to over US$ 3.00 for safety syringes, but the model uses a uniform US$ .06 per syringe.

6. Conclusions

Improving adult immunization rates is a complex public health issue that extends beyond the parameters of this study. The Medicare Physician Fee schedule was revised effective 1 March 2003, resulting in a doubling of the vaccine administration fee [14], but our study results show that more needs to be done. Currently, vaccination-related losses to providers constitute a potential business-based disincentive to immu-

Appendix A

Survey of office managers

1. For the office location where you received this questionnaire, please fill out the following chart. If you manage multiple offices, fill the form out for one office and pro-rate employee time for that office.
   - ☐ **Number of regularly employed, paid staff** in each title.
   - ☐ **Average weekly hours.** If one physician works 28 hours, and the other 40 hours, their combined weekly average is (28+40)/2 = 34 hours per week.

Staff Title	# of Employees	Average Weekly Hours	Staff Title	# of Employees	Average Weekly Hours
Family or General Practitioners			Medical Transcriptionist		
Internists			Medical Secretaries		
Physician's Assistants			Accountants or Auditors		
Registered Nurses			Billing and Accounts Collector		
Licensed Practical Nurses			Billing and Posting Clerks		
Lab Technicians			Bookkeeping Clerks		
Medical Assistant			Office Clerks – General		
Medical Equipment Preparer			File Clerks		
Medical Services Manager			Receptionists		
Administrative Services Manager			Administrative Assistants		
First-Line Supervisors			Word Processor and Typist		
Medical Records & Health Information Personnel					
If there are employees in your office with titles not listed above, describe their types, numbers, and hours below:					

2. The following questions are for both last year's and this year's influenza season. Please **estimate** your answer for the 2001-2002 influenza season if you do not have complete information yet:

		2000-2001	2001-2002
A.	The number of influenza vaccine doses purchased.	_____	_____
B.	The number of influenza vaccine doses used.	_____	_____
C.	Total price your office paid for influenza vaccine.	_____	_____
D.	Cost per syringe if vaccine did not come in pre-filled syringes.	_____	_____
E.	Average monthly rent or mortgage, and utility costs.	_____	_____

3. What **percent of influenza shots** are administered by:
   1. Nurses (or other medical personnel besides physicians) _____
   2. Physicians _____

   TOTAL: 100%

nize. Part of any initiative to improve adult immunization rates should include recommendations that third-party payment structures cover medical practice expenses at a level that avoids business losses. In addition, further research needs to be done to evaluate the cost effectiveness of delivering adult vaccinations in alternative settings.

References

[1] Bridges CB, Fukuda K, Uyeki TM, Cox NJ, et al. Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2002;51(RR03):1–31.

[2] Bridges CB, Thompson WW, Meltzer MI, et al. Effectiveness and cost-benefit of influenza vaccination of healthy working adults: a randomized controlled trial. JAMA 2000;284(13):1655–701.

[3] Nichol K. Cost-benefit analysis of a strategy to vaccinate health working adults against influenza. Arch Intern Med 2001;161:749–59.

[4] MacNeil A, Singleton JA, Moran JS. Influenza and pneumococcal vaccine levels among persons aged ≥65, years—United States, 2001. MMWR Wkly 2002;51(45):1019–24.

[5] Szilagyi PG, Humiston SG, Shone LP, Barth R, Kolasa MS, Rodewald LE. Impact of vaccine financing on vaccinations delivered by health department clinics. Am J Public Health 2000;90(5):739–45.

[6] Buchwald D, Sheffield J, Furman R, et al. Influenza and pneumococcal vaccination among Native American elders in a primary care practice. Arch Intern Med 2000;V160:1443–8.

[7] Etkind P, Simon M, Shannon SDO, et al. The impact of the Medicare influenza demonstration project on influenza vaccination in a county in Massachusetts. J Community Health 1996;V21(3):199–209.

[8] Kouides RW, Bennett NM, Lewis B, Cappuccio JD, et al. Performance-based physician reimbursement and influenza immunization rates in the elderly. Am J Prev Med 1998;14(2):89–95.

[9] Krieger JW, Castorina JS, Walls ML, et al. Increasing influenza and pneumococcal immunization rates: a randomized controlled study of a senior center-based intervention. Am J Prev Med 2000;18(2):123–31.

[10] Schneider EC, Cleary PD, Zaslavsky AM, et al. Racial disparity in influenza vaccination: does managed care narrow the gap between African Americans and Whites? JAMA 2001;286(12):1455–60.

[11] Smith DM, Shou X, Weinberger M, et al. Mailed reminders for area-wide influenza immunization: a randomized controlled trial. J Am Geriatr Soc 1999;47(1):1–10.

[12] American College of Physicians (ACP)—American Society of Internal Medicine, College: Medicare must reverse 'severe' reimbursement cuts. Observer 2002, http://www.acponline.org/journals/news/oct02/policybriefs.htm [accessed October 2002].

[13] The American Medical Association, Member Connect Medicare Physician Payment Cut Survey, http://www.ama-assn.org/ama/pub/article/1751-6680.html [accessed October 2002].

[14] American College of Physicians, Medicare reimbursement, Int Med: Doct Adults 2002, http://www.acponline.org/aii/immuno_news.htm#top.

[15] Physicians fee & coding guide, 12th ed. The Health Care Consultants of America Inc.; 2001, www.hccainc.com.

[16] Fontanesi J, DeGuire M, Chiang J, et al. Applying workflow analysis tools to assess immunization delivery in outpatient primary care methods. Jt Comm J Qual Improv 2000;26(11):654–60.

[17] Glick ND, Blackmore CC, Zelman WN. Extending simulation modeling to activity-based costing for clinical procedures. J Med Sys 2000;V24(2):77–89.

[18] Waters H, Abdallah H, Santillan D. Application of activity-based costing (ABC) for a Peruvian NGO healthcare provider. Int J Health Plan Manage 2001;16:3–18.

[19] Zeller TL, Senagore AJ, Siegel G. Manage indirect practice expense the way you practice medicine: with information. Dis Colon Rectum 1999;V42(5):579–89.

[20] Hawkins H, Langer J, Padua E, et al. Activity-based costing via an information system: an application created for a breast imaging center. J Digit Imaging 2001;V14(2):194.

[21] Mabry CD. The use of a resource-based relative value scale (RBRVS) to determine practice expense costs: a novel technique of practice management for the vascular surgeon. Semin Vasc Surg 2001;V14(1):29–38.

[22] Slobodkin D, Zielske PG, Kitlas JL, et al. Demonstration of the feasibility of emergency department immunization against influenza and pneumococcus. Ann Emerg Med 1998;V32(5):537–43.

[23] Pellissier JM, Coplan PM, Jackson LA, May JE. The effect of additional shots on the vaccine administration process: results of a time-motion study in 2 settings. Am J Manage Care 2000;6(9):1038–44.

[24] The occupational employment statistics. U.S. Department of Labor, Bureau of Labor Statistics; 2000, http://www.bls.gov/oes/home.htm.

[25] Consumer price index, Medical price index. U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/news.release/cpi.toc.htm.

[26] The 2001 Medical Group Management Association Cost Survey on CD, http://www.mgma.com/.

[27] Physician Market Place Report. American Medical Association, Center for Health Policy Research, http://www.ama-assn.org/ama1/pub/upload/mm/363/pmr-022004.pdf [in Fig. 4; accessed 12 July 2004].

[28] Kennedy P. A guide to econometrics. 3rd ed. Cambridge, MA: The MIT Press; 1992.

[29] Drummond MF, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd ed. Oxford: Oxford University Press; 2000.

[30] Compensation monitor, Compensation, patient-care time vary widely by practice size, http://www.managedcaremag.com/archives/0104/0104.compmon.html [accessed 14 July 2004].