Explaining differences in operating costs among poison control centers: An exploratory study

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Objectives. To explore the effects of population, staffing, location, and funding on cost per human poison exposure call; and organizational characteristics differentiating higher- and lower-cost centers. Methods. Data from 65 poison control centers (2001) were analyzed with linear multiple regression; qualitative data from 10 centers were compared. Results. The most important predictor of expenses per call was 24-hour coverage by Specialists in Poison Information ($15.70 of $40.53/call). Other factors increasing total expenses included northeast location and more health educator FTEs. Qualitative information revealed that more complex organizational forms, including multiple reporting and accountability relationships, characterized higher-cost centers. Surprisingly, having a wider range of reported activities (less specialization) was more common among lower-cost centers. Conclusions. Wide variability in cost per call suggests that inefficiencies exist. While elimination of inefficient poison control centers could reduce costs, the loss of training and collaborative opportunities, and preparedness for public health emergencies and bio-terrorism events, might mitigate against such restructuring. Keywords Poison control centers; Costs and cost analyses; Health resources

Introduction

While poison control centers perform a variety of activities (1), their central mission is to provide guidance, primarily over the telephone, to assist in managing the treatment of suspected and actual poisonings (2–4). Through appropriate referrals to health care providers and proper advice regarding home treatment, poison control centers help to reduce inappropriate health care utilization, such as emergency room visits, while also decreasing the risk of harm from unsuitable or ineffective home management (5,6).

The focus of the published literature on the economics of poison control centers also accords with the fact that treatment management guidance of human exposure calls is the dominant activity of centers in terms of expenditures, representing on average some 70% or more of those expenditures (7,8). Despite recent consolidations and efforts to standardize practices by the American Association of Poison Control Centers, poison control centers display wide variability in virtually all aspects of staffing, operations, and especially costs. For example, 2001 data from American Association of Poison Control Centers indicate that poison control center expenses averaged about $40 per human exposure call with a range of $13-$77 per call (8.2–72 cents per capita; see Table 1). Similarly, in a study of 10 poison control centers, Zuvekas and colleagues (8) found that the costs of treatment management guidance ranged from $24 to $50 per human exposure call (in 2001 dollars). However, evidence of such cost variation (and potential inefficiency) among poison control centers has not motivated studies that would explain why such variation exists. A few studies have analyzed costs in the course of studying changes resulting from a discontinuation of poison control services in specific areas of the U.S. (3,6). The absence of research in this area is particularly problematic given the tenuous financial positions of many centers and the compelling need to develop organizational models that make maximum use of existing resources to manage human exposure calls (9).

The purpose of this study is to develop and test explanations for cost variation among poison control centers. Two research questions are addressed: (1) what are the independent effects of population served, staffing arrangements, regional location, and funding source on cost per human exposure call; and (2) what organizational characteristics of poison control centers best differentiate between centers with higher and lower costs? Improvement of operating efficiency...
represents a compelling issue from the perspective of both the individual center and public policy. For example, center management may use study results to reorganize their centers to make them more efficient and forestall closure. Policy makers may employ study results to ascertain which types of centers should be slated for further consolidation, retention or reorganization, based on economic criteria.

Methods

Study design

The paucity of empirical research, coupled with the absence of comprehensive data, necessitate an exploratory rather than a hypothesis-testing approach to examining poison control center costs. Specifically, we employ a two-pronged analytic strategy that focuses on explaining variation in cost per human exposure call across poison control centers. The first phase applies multivariate modeling to data supplied by the American Association of Poison Control Centers to identify the independent effects of potential cost determinants in poison control centers. The American Association of Poison Control Centers data have the advantage of including all certified and most non-certified centers in the country as well as detailed information on costs (expenses) and operations. However, these data are limited in their coverage of organizational characteristics of poison control centers that potentially account for differences in cost per human exposure call. We therefore supplement the secondary data analysis with a qualitative analysis of primary data collected through interviews with poison control center directors and staff. Although more limited in scope, the poison centers sampled for this second phase of the study were selected to maximize variation on cost per human exposure call, with the goal of identifying organizational features of poison control centers that differentiate higher and lower cost poison control centers. In sum, phase one provides a broad-based picture of poison control center cost and its determinants, while phase two attempts to develop explanations of cost differences based on organizational and strategic characteristics. An institutional review board exempted this study from human subjects review.

Phase one – quantitative analysis

Selection of participants

For the quantitative portion of the analysis (phase 1), we employed data from the 65 poison control centers that reported to the American Association of Poison Control Centers in 2001. The 65 poison control centers were located in 41 states plus the District of Columbia. The number of poison control centers per state ranged from zero (Alaska, Delaware, Idaho, Montana, Nevada, Rhode Island, South Dakota, Vermont, and Wyoming) to six (Texas). In the multivariate models, analytic sample size was limited to 60 poison control centers. The four poison control centers in California are combined into one entity because they operate from a common administrative structure with combined accounting, and two sites had missing data on key variables (North Dakota and New Mexico).

### Table 1. OLS regression results: predictors of expenses per human poison exposure call, parameter estimates, and (standard errors)

<table>
<thead>
<tr>
<th></th>
<th>Total expenses per human exposure call</th>
<th>Personnel expenses per human exposure call</th>
<th>Non-personnel expenses per human exposure call</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercept</strong></td>
<td>15.14 (8.30)</td>
<td>11.68 (6.51)</td>
<td>3.47 (3.56)</td>
</tr>
<tr>
<td>Population (in millions)</td>
<td>−0.75 (0.38)</td>
<td>−0.70 (0.29)</td>
<td>−0.05 (0.16)</td>
</tr>
<tr>
<td>Health educators FTEs</td>
<td>0.88 (0.31)†</td>
<td>0.71 (0.24)†</td>
<td>0.16 (0.13)</td>
</tr>
<tr>
<td>Certified SPIs - %</td>
<td>0.01 (0.07)</td>
<td>0.06 (0.05)</td>
<td>−0.04 (0.03)</td>
</tr>
<tr>
<td>24-hour coverage</td>
<td>15.7 (6.31)†</td>
<td>10.2 (4.95)†</td>
<td>5.49 (2.71)†</td>
</tr>
<tr>
<td>Northeast region</td>
<td>11.2 (3.78)</td>
<td>10.5 (2.96)†</td>
<td>0.70 (1.62)</td>
</tr>
<tr>
<td>HRSA funds - %</td>
<td>0.17 (0.19)†</td>
<td>0.13 (0.15)</td>
<td>0.04 (0.08)</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>32%</td>
<td>38%</td>
<td>11%</td>
</tr>
</tbody>
</table>

* *p < .05.*
Methods of measurement

Outcome measures

Expenses were reported as actual dollars spent on personnel, communication services, communications equipment, and other non-personnel expenses and included actual and subsidized expenses. All expenses were summed as total expenses, which were sub-categorized into two mutually exclusive components: personnel and non-personnel (including telecommunications) costs. To adjust for the call volume variation among the poison control centers, we then divided these values by number of human exposure calls, resulting in three measures of expenses: total cost per human exposure call, personnel costs per human exposure call, and non-personnel costs per human exposure call (see Figures 1 and 2).

Although poison control centers handle four types of calls: human poison exposure, animal poison exposure, poison exposure information, and non-exposure calls, our focus is primarily on the human exposure calls given their centrality to the poison control center mission and contribution to total poison control center expenses.\(^1\)

Independent variables

Population served was the number of persons residing in the poison control centers’ service area.

Census region of Northeast, South, Midwest, or West was represented by dummy variables, each with a value of 1 or 0 (present or absent). Because preliminary analyses indicated no differential effects among poison control centers for regions other than the northeast, this was the only regional indicator included in the final multivariate models. Although we conceptualized region as a proxy for variation in costs of existing services. This raises the issue of how such service (kind support). HRSA funding is particularly germane since it is earmarked for service enhancement rather than support of existing services. This raises the issue of how such service enhancement (or diversification) affects the ability of the poison center to provide core services in an efficient fashion. This source of federal funding was also uniquely common to most centers, with 80% of centers receiving some level HRSA funds, while other sources of funding were applicable only to a few centers.

24-Hour Coverage of telephone call-in lines by a poison control center was assessed by a dichotomous indicator (1=yes, 0=no). It should be noted that in order to provide 24-hour coverage, a minimum staffing level of 5.4 FTE’s is required.

Poison control centers reported the number of full-time equivalents (FTEs) of each of several types of personnel. Personnel who answer calls are termed specialists in poison information (SPIs), certified specialists in poison information (CSPIs), and poison information providers (PIPs). We define PIPs as those personnel whose primary role is answering telephone calls from the public and health care professionals. Because PIPs typically have less advanced training in health care, they are required to work under the on-site supervision of a SPI, CSPI or the managing or medical director of the center. SPIs, by contrast, have health care training as nurses, pharmacists or physicians, and some have advanced certification training in poison prevention and control, entitling them to use the title of CSPI. In addition to their role of answering phone calls from the public, SPIs and CSPIs may also perform administrative or educational functions, and perform research. The total number of specialists in poison information was calculated by summing the FTEs of SPIs and CSPIs. The percentage of certified specialists in poison information was calculated as CSPI FTEs divided by SPI plus CSPI FTEs.

The total number of information provider FTEs was the sum of the FTEs for PIPs, SPIs, and CSPIs. The ratio of health educator FTEs to total information provider FTEs was calculated to represent the level of health education activity in a poison control center and expressed per 100 total FTEs.

Outcome measures

Linear regression analysis was used to assess the independent effects of the predictors described above on the three cost measures – total cost per human exposure call, personnel costs per human exposure call, and non-personnel costs per human exposure call.
Fig. 1. Total personnel expenses per human poison exposure, 2001 (N=61).
Fig. 2. Total non-personnel expenses per human poison exposure, 2001 (N=61).
costs per human exposure call, and non-personnel costs per human exposure call. A subanalysis explored a potential quadratic effect of population served. The analyses were exploratory in nature and sought to explain variation in the cost per human exposure call. The unit of analysis was the poison control center.

Results

The majority of poison control centers studied (43%) were located in the South, with the remainder distributed in roughly equal numbers in the West, Midwest, and Northeast. Number of persons served by a single center ranged from just over a million (HI) to 34.5 million (CA). Among the 60 poison control centers (combining the 4 in California into 1), 92% (n=55) reported providing 24-hour coverage of their phone lines. Poison information personnel averaged 10.8 FTEs (SD=4.7) among centers with 24-hour coverage, 7.0 (SD=4.2) without. About 68% (n=41) of the poison control centers had one or more FTE of a health educator’s time while 4 had no health educator available to them. The ratio of health educator FTEs per 100 poison information provider FTEs averaged 10 ± 5.3 (range 0–28). More poison information specialists were certified than not, with a mean of 61% ± 27% (range 0–100%). On average, about 10% of a poison control center’s revenue came from HRSA stabilization grants, although this measure showed a great deal of variability (SD=10%, range 0–54%).

Total expenses per human exposure call averaged $40.03 (±$13.65), ranging from a low of $13.72 to a high of $76.78. Personnel expenses accounted for the greater portion, averaging $32.15 per call (SD=$11.17; range $11.71-$65.29) while mean non-personnel expenses came to $7.89 per call (SD=$5.10; range $0.66–$23.20).

Multivariate results

Table 1 presents the multiple regression parameter estimates from the three models. Total expenses per human exposure call were negatively associated with a larger population served. Factors positively associated with this dependent variable were location in the northeast region, 24-hour coverage by SPIs, and more health educator FTEs. The addition of the quadratic term for population served improved the model and resulted in a stronger negative effect of population coupled with a modest positive effect of population-squared.

Results for personnel expenses per human exposure call were virtually identical to the results for total expenses per human exposure call, for the models with and without the quadratic term. This dependent variable was negatively associated with a larger population served and positively associated with location in the northeast region, 24-hour coverage by SPIs, and more health educator FTEs. This pattern of results suggests that total expenses are largely driven by factors related to personnel costs. This finding is further supported by the fact that the model for non-personnel cost per human exposure call was not significant overall and none of the predictors beyond 24-hour coverage reached significance at the p < .05 level. The quadratic term was not significant in the exploratory model. Non-personnel expenses per human exposure call, including telecommunications, increased with 24-hour SPI coverage. Compared with personnel expenses, expenses related to non-personnel items (e.g., telecommunications fees and equipment) appear to play a relatively minor role in total center cost differentials.

In sum, the most important predictor of expenses per call was 24-hour coverage, which accounted for an average $16 difference in cost per call. Whereas the vast majority of poison control centers have such 24-hour coverage as a requirement of accreditation by American Association of Poison Control Centers (11), these results reinforce the importance of personnel costs and staffing patterns as key determinants of center costs. Of nearly equal importance in the model was center location in the northeast region of the county. Relative to centers located in the West and Midwest, these poison control centers spent on average $11 more per call, even holding constant other variables such as population served and funding source. Although these differences may reflect higher wage rates in this part of the country, a factor that drives up the cost of providing services, including a cost of living indicator in the model failed to alter the effect of region. Finally, it should be noted that our models account for at best 49% of the total variation in cost per call. This means that a substantial portion of cost differentials across centers is not accounted for by the variables in our model, and that other unmeasured factors may be contributing to such differentials.

Phase two – qualitative analysis

Selection of participants

The regression models described above were limited insofar as they contained only variables available from the American Association of Poison Control Centers survey and, on average, explained less than half the variance in expenses per human exposure call. Notably absent from the set of explanatory variables were organizational characteristics of the poison control centers that might account for differences in costs. Further, poison control centers operate in different administrative contexts, and under different organizational and market conditions. While these conditions may not impact costs directly, they may indirectly influence costs by introducing alternative priorities for the organization, constraints related to the operating environment, and other factors that affect what the center can or cannot do regarding cost control. To present only the “hard data” without this contextual background may lead to inappropriate administrative or policy interventions, especially given that our data strongly support the lack of uniformity in structure, operating processes, and functions across poison control centers.
To describe and compare the organizational characteristics of poison control centers in depth, a stratified non-probability sample of 10 centers was selected for further qualitative study based on semi-structured interviews with key informants at each site (either the managing director or the medical director). The strata separated higher and lower cost centers, defined by being in the highest or lowest quartile for at least one of three categories of expense per exposure call: total, personnel, or non-personnel expense. Five of the 10 centers were in the highest cost quartile; five were in the lowest quartile. Differences and similarities between the lower- and higher-cost centers are described below in detail, and summarized in Table 2.

**Affiliation**

The ten centers surveyed were evenly divided between private not-for-profits (five) and public not-for-profits (five). Public not-for-profit centers are those in which administrative control resides with the state or local government, or whose parent organization operates under such control arrangements. Private not-for-profit centers are those that operate under the administrative control of a non-profit entity that is not affiliated with state or local government. Nine centers identified themselves as part of a hospital (5), university (3), or similar entity (1), and one was independent. Except at the independent center, respondents indicated that major management decisions needed to be approved by the larger entity of which they were a part, and sometimes even minor decisions. Some funding agencies also exercised decision approval over use of funds. Most centers were accountable to a high-level vice-president, CEO, or dean, and sometimes to an outside entity such as the state department of health.

There were few differences in nonprofit status, reporting, and accountability among centers classified as higher- and lower-cost. The one notable exception was that four of five higher cost centers were public not-for-profits, while four of five lower cost centers were private not-for-profits. All of the lower-cost centers served larger populations.

**Staffing**

Staffing was similar across centers. FTEs at lower-cost centers ranged from 14 to 26, while the number at higher-cost centers ranged from about 10 to 29.

Estimates of average annual turnover ranged from “very low” to 20%; the higher turnover was concentrated among SPIs. Reasons for turnover included new hires not successfully completing orientation, personnel moving, and staff receiving better job offers elsewhere. SPI pay was seen as noncompetitive with most other pharmacist and nursing jobs, despite the fact that the long hours and heavy job responsibilities were seen as more taxing. Average annual staff turnover did not differ greatly between higher- and lower-cost centers. Lower-cost centers, however, were much less likely to mention low pay as contributing to turnover rates.

### Table 2. Differences between lower-cost and higher-cost poison control centers

<table>
<thead>
<tr>
<th>Survey variables</th>
<th>Lower cost</th>
<th>Higher cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation</td>
<td>Most are private not-for-profit</td>
<td>Most are public not-for-profit</td>
</tr>
<tr>
<td>Staffing</td>
<td>More staff hours spent weekly on all poison center activities; more staff hours spent on poison prevention</td>
<td>Slightly higher staff turnover rate</td>
</tr>
<tr>
<td></td>
<td>More likely to mention low pay as a contributor to staff turnover</td>
<td></td>
</tr>
<tr>
<td>Services and activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current practices</td>
<td>More FTEs devoted to education and outreach</td>
<td>No differences</td>
</tr>
<tr>
<td>Areas of growth</td>
<td>No differences</td>
<td>Professional education, fellowship training, general call volume</td>
</tr>
<tr>
<td>Areas of decline</td>
<td>Industry contracts, general call volume, resident training</td>
<td>More shared staff and shared information technology</td>
</tr>
<tr>
<td>Inter-organizational relationships</td>
<td>More likely to have partnership or joint venture arrangement with another organization</td>
<td>Higher proportion of calls referred to outside providers</td>
</tr>
<tr>
<td>Quality improvement and assurance</td>
<td>No differences</td>
<td>No differences</td>
</tr>
<tr>
<td>Research and training</td>
<td>No differences</td>
<td>No differences</td>
</tr>
<tr>
<td>Future organizational challenges</td>
<td>More likely to have a strategic plan specific to poison control centers</td>
<td>More likely to cite problems related to complex reporting and accountability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More likely to cite balancing core poison control functions with other activities such as research and bioterrorism response and preparedness</td>
</tr>
</tbody>
</table>


Weekly hours spent by staff on various center activities were self-reported estimates by the respondents to the qualitative interviews. The specific activities included outreach, community collaborations, prevention workshops and other activities that do not constitute direct client response, but that are related to poison control and prevention. With one exception, higher-cost centers estimated fewer hours spent on all poison center activities (370 to 690 versus 670 to 1,000 hours). Higher-cost centers also tended to spend fewer weekly hours on activities other than direct client response (60 to 195 versus 70 to 500 hours). These results are perhaps surprising given that the two types of centers do not differ greatly on FTEs employed.

**Services and activities**

In addition to handling exposure and non-exposure calls, all 10 centers conducted professional and public education. Additional activities included research, grant-writing, guideline development, bilingual services, data collection, and industry contract services.

Professional education and residency training targeted students, residents and fellows in medical toxicology, pediatrics, emergency medicine, and pharmacy. Most centers also provided education for practicing professionals, through grand rounds and lectures at area health care institutions, as well as conferences and seminars.

Public education and outreach activities include workshops, promotional activities (such as health fairs), bilingual training for volunteer peer educators (promotoras), newsletters, and prevention education at schools, adult education programs, and WIC sites. Centers with lower costs employed more FTEs in education and outreach (1.25 to almost 5), while centers with higher costs employed 0.5 to 2.

Respondents mentioned six areas of growth in services and six areas of decline. Growth areas included: public education and outreach, professional education, total call volume, administrative burden due to the Health Insurance Portability and Accountability Act (HIPAA) requirements and funding (e.g., grant writing and administration), research, and bilingual services. The last two areas were mentioned only by higher-cost centers; growth areas did not otherwise vary by cost stratum.

Areas of decline included: professional education, total call volume, human exposure calls as a percent of all calls, drug information calls (service had been discontinued), industry or other contracts for special services, and marketing (due to lack of funding). Declines in service differed somewhat between higher- and lower-cost centers. Three higher-cost centers experienced declines in professional education while one lower-cost center suffered such a decrease. Two lower-cost centers indicated declines in industry or other contracts. Shifting call volume – increases or decreases -- did not vary by center cost level.

**Interorganizational relationships**

Half of the respondents indicated that their center had joined some sort of poison center coalition in the last four years, including formal state and regional consortia. Four respondents mentioned informal collaborations—such as data sharing or call coverage. Six centers had entered into joint ventures with other organizations. These varied from partnerships to provide education and outreach services, to multicenter research or other programs with hospital or university departments. None of the centers indicated involvement in a merger, although several mentioned that they had expanded their service areas in the past 10 years because nearby poison control centers had closed. Two higher-cost centers had entered into an organizational partnership compared with four lower-cost centers.

Higher- and lower-cost centers were equally likely to provide services to other providers. Centers with higher costs had more shared staff and information technology (including databases) than centers with lower costs, but none reported extensive sharing of administrative support or other services. Centers with lower costs tended to have a somewhat lower percentage of referrals out to other healthcare providers.

**Quality improvement and assurance**

All centers, regardless of cost stratum, had written procedures for handling telephone calls including guidelines for triage, evaluation, and treatment of specific exposures. All centers also had a formal written quality assurance plan. Quality assurance focused on two areas, customer service and appropriateness of treatment.

**Future organizational challenges**

Historically, poison control centers have changed in response to economic, political, and technological imperatives and will likely experience further change as these forces shift in direction and magnitude. The nature of these exogenous changes may set the stage for conditions that lead to greater or lower costs in the future. The most frequently mentioned organizational challenge the poison centers faced was staff recruitment and retention, particularly for SPIs. Respondents complained of difficulty in finding qualified staff to hire, not only because of competition from better paying jobs, but also because of problems finding people with the right mix of skills.

Some respondents also described organizational challenges arising from the complex, multidisciplinary nature and structure of poison control centers. Staff often came from diverse departments of the affiliated institution (e.g., hospital or university), and funding was typically derived from multiple sources (hospitals, universities, states, and federal government) (12). Under such conditions, it was difficult for the center to function as an autonomous, cohesive organizational
entity. One respondent noted that delays in addressing important issues could then result.

Related to this, some respondents pointed to the tenuous balance between “core” functions (e.g., answering calls) and other activities that were important but perhaps not central to the poison control center mission (e.g., research). In most cases, these other activities were viewed as tasks that poison centers were well-placed and well-suited to do, encompassing bioterrorism and emergency preparedness. Some respondents expressed the opinion that poison control centers have been overlooked and should be more involved in these “non-core” issues. However, they also recognized the difficulties of coordinating missions, given the realities of multiple funding streams and already fragmented organizational structures.

Several respondents noted problems related to HIPAA and difficulties convincing provider organizations to share patient-level follow-up data with the center. This has hampered toxicosurveillance and research efforts (13).

Finally, one respondent noted that language and cultural barriers need to be addressed as the number of linguistic minority residents in the United States continues to grow. Utilization of poison center services by non-English speakers is low, yet they may be at higher risk than English-speakers because of difficulty reading English-language packaging and the younger average age of some immigrant groups (14).

Some differences by cost stratum were noted among these organizational challenges. Higher-cost centers were much more likely than lower-cost centers to describe organizational challenges arising from the complex, multidisciplinary nature and structure of their organizations. They were also more likely to experience difficulties in balancing “core” poison control functions and other functions, such as research and bioterrorism response and preparedness.

In summary, a more complex organizational form, including problematic reporting and accountability relationships, staffing difficulties, and bilingualism, seems to be more common among higher-cost centers. Having a wider range of reported activities, however, was more common among lower-cost centers. Most notably, while higher and lower-cost centers employed similar numbers of FTEs overall, higher-cost centers estimated spending less time than lower-cost centers on all poison center activities, and on activities other than direct client response in particular.

**Limitations**

As with all administrative data bases, questions can be raised about the validity of self-reported data. While the American Association of Poison Control Centers data have not been audited in the formal sense, we have a reasonable degree of confidence in the integrity of this information. First, the Association has been collecting these data elements for a number of years and has developed an understanding about which items yield “good” information versus those that do not. Over time, less reliable survey items have been modified or eliminated. Second, the Association conducts systematic internal and longitudinal checks on the submitted data to identify outliers, inconsistent values, sharp discontinuities, etc. Further, because the population of poison centers is small, it is relatively easy for the Association to go directly to the individual center to reconcile aberrant values or inconsistencies. Third, the Association survey uses standard definitions of key terms (e.g., PIPs, expense source, etc.) so that there should be reasonable definitional uniformity of responses across responding centers. Finally, although there may be noise in the data, the advantage of having information on virtually the entire population of centers largely outweighs this concern, especially given that most previous studies of cost have been conducted on small convenience samples.

A second limitation concerns our ability to make causal claims from our data. For example, whether costs are driven by poor utilization of poison control services in larger population areas is impossible to determine using cross-sectional and qualitative data. Indeed, one of the qualities that make poison control centers interesting from a cost/efficiency perspective is that demand can only be predicted and/or controlled to a limited extent. There is little theoretical reason to believe that large population/service areas, in and of themselves, are more prone to poor utilization of center services. It may be the case, for example, that a service area was established based on historical utilization patterns, or alternatively, for political or economic reasons. Our study found a curvilinear relationship between population served and cost outcomes.

**Discussion**

Several potentially important findings emerge from our study. First, there is ample evidence of inefficiency among poison control centers in light of the wide variation in cost per human exposure calls among the population of poison control centers. Regardless of its source, this inefficiency suggests that the current configuration of the poison control system contains room for improvement in this area of performance. One possible conclusion is that despite the recent reductions in the number of poison control centers, there still may be too many, given existing resources and demand. All other things being equal, fewer centers serving larger populations (and presumably fielding more calls) should result in lower costs per unit of service. However, this begs the question of how much improvement might be gained through further consolidation and the fact that output or quality, an important consideration for which we currently have no data, was not considered here. In other words, costs or efficiency alone are unlikely to be the sole criteria on which restructuring poison control centers are based. Policy makers must also concern themselves with the value of non-call related contributions such as training sites for pharmacists and medical residents and the maintenance of excess capacity to respond to bioterrorism and public health emergencies.
Regarding the first question, results from our multivariate analyses indicate that population served is indeed independently and significantly associated with greater total cost in poison control centers. The association was relatively modest, however, suggesting that further consolidation may result in only marginal improvements and would not by itself eliminate the variation in operating cost. Further, if higher-cost centers do in fact produce higher quality service or provide services beyond simply fielding human exposure calls, decisions made on the basis of cost alone are inappropriate. In the absence of such data, and in light of the tenuous financial position of many centers and the system as a whole, operating cost is clearly important in its own right. This concern would increase as call volumes decline among poison control centers, a finding noted in our qualitative analysis.

A second key finding is that much of the explained difference in cost among poison control centers is attributable to staffing patterns and regional variation. This raises the question of how much control poison control center directors actually have in terms of increasing efficiency in their centers. For example, are poison control centers staffed to meet peak demand or average demand (e.g., number of calls)? It seems implausible that centers can employ staff registries to meet peak demand periods as hospitals do to address fluctuations in patient census, given that neither demand (number of calls) nor population served is directly controlled by center managers. However, our data suggest that some centers may be overstaffed given that higher-cost centers were found to employ about the same number of FTEs as lower-cost centers, even though the latter tend to serve much larger populations. Specifically, the data indicate that there seems to be large staffing/expense variations given similar levels of one key type of output. By definition, therefore, some centers are not operating as efficiently as others, all else equal. However, because centers engage in activities other than phone call service and because they may provide phone call service of varying quality, we can only say that with respect to the economic efficiency of phone call service, some centers appear to be overstaffed. Just as small area variation studies of health care utilization cannot accurately determine optimal levels of utilization, establishing a gold standard of staffing levels for poison control centers in light of efficiency data is a difficult problem, one requiring very different methods than those employed here.

Clearly, another plausible explanation for differences in poison control center operating cost is that some centers simply perform a wider range of activities (e.g., outreach, training, etc.), and that the costs associated with these added functions contribute to the overall costs of handling human exposure calls. Interestingly, however, our data indicate that the opposite is the case. Poison control centers claiming to perform a wider range of activities actually operate more efficiently than those with a more restricted set of functions. This raises the possibility that organizational and management factors may contribute to inefficiencies in poison control centers. For example, the most frequently mentioned organizational challenge is staff recruitment and retention, particularly for SPIs. Lower-cost centers, all of which serve larger populations, are much less likely to mention low pay as contributing to turnover rates. Higher-cost centers are much more likely than lower-cost centers to describe organizational challenges arising from the complex reporting and conflicting accountabilities of their organizations. Higher-cost centers tend to experience difficulties in balancing “core” poison control functions and other functions, such as research and bioterrorism response and preparedness. These differences suggest that the instability and marginal status of many poison control centers within hospitals or medical centers create considerable management challenges for centers.

In summary, the organizational challenges and complex funding and accountability relationships under which many poison control centers function make it difficult to run these organizations with optimal efficiency. In addition to identifying organizational models of poison control centers that appear to be both efficient and effective, future research should examine funding models that would allow poison control centers the financial stability to manage costs rather than simply cobbling together resources in order to survive.

This article represents an attempt to provide information on one aspect of the operation of poison control centers—relative costs and efficiency—that may contribute to a larger discussion of the direction, form and functions that centers will assume in the future. The findings we provide are intended to be used in conjunction with other approaches that address this issue from different perspectives. For example, although, there is both policy and managerial value to conducting organizational-level analysis on the population of centers, future studies may complement this approach by employing time management methods to determine time spent on tasks (time and motion) and proportion of time spent on various tasks (time sampling) to further clarify how poison control centers might improve efficiency.

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References


